When Emotion Reports Reflect Beliefs Rather than Experience: Top-Down and Bottom-Up Processes

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Abstract

Fundamental cognitive processes can be broken into top-down and bottom-up processes. Cognitive performance, for example, often involves both the retrieval of prior knowledge and new learning. Similarly, impression formation may involve the use of both categorical (e.g., stereotypes) and individuated information. The current dissertation project focused on the Accessibility Model of Emotion Report (Robinson & Clore, 2002a; 2002b), which distinguishes the contributions of top down and bottom up processes in self-reports of feelings and emotion. A review of research suggested that an over-emphasis on top down processes (beliefs about self and emotions) might interfere with bottom-up processes (awareness of actual changes in emotional experience), which in clinical settings might hinder perceptions of actual therapeutic change. To further assess this model, three studies, consisting of analyses of two existing data sets and one lab experiment, were conducted. These three studies tested how different measures of cognitive capacity influence individuals' reliance on top-down processes in reports of emotion.

The hypothesis was that limited cognitive capacity makes people less efficient bottom-up processors so that top-down processes tend to fill in when reporting recent feelings. Therefore, people who are less efficient when engaging in bottom-up processing are more likely to rely on their general expectations and beliefs about emotions when reporting emotion. Results from these three studies were consistent with previous findings concerning the influence of cognitive capacity on state-level judgments of individuals. I found that under some conditions, measured, manipulated, and temporal variables (e.g., processing speed, cognitive load, and time frame) all influenced whether

emotion reports reflected feelings or beliefs. Consistent with the accessibility model, beliefs about emotions (e.g., trait affect) dominated emotion reports when relevant episodic memories were less accessible due to such factors as having low cognitive capacity generally, being temporarily under high cognitive load, or trying to retrieve distant memories.

When Emotion Reports Reflect Beliefs Rather than Experience: Top-Down and Bottom-Up Processes

Top-down and Bottom-up Processing

Everyday perception and cognition involves both top-down and bottom-up processing (e.g., Neisser, 1984). Top-down and bottom-up processing have been discussed and distinguished from each other by investigators studying education, interpersonal perception, emotional perception, and among other areas of human development.

Language

The concepts of top-down and bottom-up processing are frequently used in the literature on human development and language (Freberg, 2015). An illustration of the processes at work can be seen in the following example demonstrating that people's comprehension of text is effortless despite the fact that most of the key words involve letter inversions so that they are badly misspelled.

"All you hvae to do to mkae a snetnece raedalbe is to mkae srue taht the fisrt and lsat letrtes of ecah word saty the smae. Wtih prcatcie, tihs porcses becoems mcuh fsater and esaeir."

This demonstration is perhaps surprising if one assumes that reading is solely a bottom-up process. In fact, there are two processes of perception functioning at the same time: our brains do receive the visual sensations from the letters and use them to construct words and meanings, which is referred as bottom-up processing, but in addition, based on our knowledge of the English language and our expectations from the context provided by other words in the passage, we are able to recognize easily the target words despite their being misspelled, a process that involves top-down processing (Freberg, 2015).

Education

Cognitive psychologists also distinguish top-down from bottom-up cognitive processing in learning experiences. During top-down processing, prior knowledge is used to interpret incoming information, and in bottom-up processing, new interpretations are generated from raw data. For example, when Piaget (1954) discussed cognitive development in the child, he distinguished whether the child processed new information by assimilating it to existing schemas or by accommodating existing schemas to the new information. Incoming information is interpreted using existing knowledge, but knowledge can also be changed by incoming information. The American philosopher of education, John Dewey (1911), emphasized that learning requires exposure to problems that cannot be solved with existing knowledge. Good educational lessons and materials therefore allow students not only to use what they know (top-down processing) but also require them to learn something new (bottom-up processing). In the domain of education, children's over-reliance on existing knowledge should therefore undermine learning.

Interpersonal Perception

Another domain in which psychologists have studied top-down versus bottom-up processing concerns the use of stereotypes in forming impressions of others. People can form quick impressions of strangers based on the general categories to which they belong. Thus, perceivers have different expectations and beliefs based on a person's gender, age, attractiveness, racial or ethnic group, occupation, social class, and so on. On the other hand, for acquaintances, episodic memories of specific experiences with them may play a bigger role in our impressions than the expectations from stereotypes. Much research has focused on the conditions in which people categorize versus individuate others. Brewer (1988) and others have reviewed social psychological research concerning when people rely on stereotypes and when people use information about the individual to make an interpersonal judgment.

Self-reported Emotion

The examples from education and social psychology illustrate that both top-down and bottom-up processes are fundamental operations of the mind, and that over reliance on top-down processing can have negative consequences. My emphasis, however, was less on how these two processes affect learning and attitudes, but more on their role in self-judgments, especially reports of feelings and emotions.

When we are in a situation that provokes anxiety, bottom-up processing might help us construct our emotional experiences from physical sensations. People might note that they feel tense and that their heart is beating fast, and conclude that they are anxious. On the other hand, top-down processing may aid in this categorization by relying on general semantic and personal knowledge about emotions. For example, I am giving a lecture, which is supposed to be an anxious moment, and I always have trouble speaking in public. Hence, I think I am anxious (Robinson & Clore, 2002a, 2002b; Tulving, 1984).

However, when individuals make judgments about their own physical or psychological reactions, including their feelings and symptoms, the quality of the judgments depends on the information they use. For example, relying on semantic memory or beliefs about their usual experience (top-down process) rather than actual experience from episodic memory (bottom-up process), may result in poor judgments (Pennebaker, 1982; Skelton & Strohmetz, 1990).

This dissertation project focuses on emotion self-report and examines the conditions under which people rely on accessible beliefs about emotion when asked to report their recent or past feelings. These issues are the subject of the Accessibility Model of Emotion Report (Robinson & Clore, 2002a; 2002b). The dissertation reviews the accessibility model and reports empirical evidence for the application of the model to understanding the tradeoffs between top-down and bottom-up cognitive processing or between reliance on semantic and episodic knowledge. Specifically, the dissertation explores how cognitive capacity influences people's tendency to rely on their general beliefs about emotions when reporting their feelings.

The Accessibility Model of Emotion Self-Report

Robinson and Clore (2002a, 2002b) reviewed previous research on emotion reporting and proposed the Accessibility Model of Emotion Self-report. According to this model, individuals have two routes to process information and make judgments about their emotions. One route is a bottom-up, on-line computation process in which individuals refer to current internal and situational cues and make judgments from scratch. Under this process, people are more likely to report their genuine feelings. In contrast to this process, individuals could also report their emotion through a top-down process by retrieving similar experiences from memory. Such judgments are thus based on beliefs about their emotion, rather than actual feelings of emotion.

The model can be illustrated through this example: someone may describe himself as "depressed" based on current or recent symptoms characterized by depression, or he might do so based on general self-beliefs about being a depressed person. These two alternative processing routes could result in distinct mental health outcomes. If the state-related description is applied, this generally depressed person could find himself to be less depressed in some moments due to contextual changes. However, if the belief-based description gains the dominant position, this person might identify "being depressed" as one of his unchangeable characteristics and be more resistant to positive changes. Then the question becomes: when are individuals more likely to utilize the bottom-up or the top-down process? To answer this question, Robinson and Clore (2002a) characterized their accessibility model in terms of three principles:

The first one was called the "relative accessibility" principle. According to this principle, different sources of information have different contributions to emotional self-repots. Therefore, when people make a judgment on their emotions, they access the resource with a higher relative accessibility.

The second one was referred as the "dominance" principle. When multiple sources of information are equally accessible for emotional self-reports, the more specific source will be relied on for emotional judgment. For example, if experiential knowledge, episodic memory, and semantic memory are all accessible when a person reports his/ her emotion, "experiential knowledge dominates episodic memory and episodic memory dominates semantic memory" (Robinson & Clore, 2002a, p. 937).

The last principle was named as "evanescence" principle. When time passes by, some sources of information (e.g., feelings, episodic memory) disappear or and become less accessible.

During the following sections, I explained each principle in details and reviewed relevant empirical evidence supporting these principles.

Principle I: Relative Accessibility

This principle indicates that the contribution of different sources of information to self-reports of emotion "depends on their relative accessibility with respect to the judgment at hand" (Robinson & Clore, 2002a, p. 937). The principle is consistent with the "race model" of dual processing (Logan & Cowan, 1984), which states that people process information relatively automatically in more than one way at the same time. The information actually used then depends on which one wins the race. During reading, for example, some words may have multiple meanings, but in the context of other words in a passage only the intended meaning is likely to win the race, and other meanings, although also activated, have no impact on comprehension or reading speed if they lose the race. When reporting emotion, information is processed from both episodic and semantic memory, and the most accessible information is likely to win the race and guide responses. That is, self-reports of emotion should then reflect whichever process provides an answer first.

Then the question is, what factors could affect the relative accessibility of information for judgment from various sources? One identified factor is variation in cognitive capacity (Robinson & Clore, 2007). Three approaches to measuring and manipulating cognitive capacity were examined in the current dissertation project. These included natural processing speed (measured by reaction times), working memory capacity (measured by Stroop performance), and the manipulation of cognitive load.

A prior study manipulated cognitive load to assess whether increased load would increase people's tendency to rely on gender stereotypes for reporting their emotions (van Boven & Robinson, 2012). In this study, after watching an emotion-provoking movie (either sad or angry), research participants were asked to remember an easy or difficult string of letters, e.g., ABCDE vs. EHNSU). When holding such letter strings in mind, the participants reported their current feelings. When the mental task was more difficult (causing high cognitive load), females reported more intense sad emotions in response to sad movies and less intense angry emotions in response to angry movies than males, a pattern that is consistent with gender stereotypes. Thus, when high cognitive loads made on-line computation difficult, identity-related beliefs in the form of gender stereotypes provided a ready-made answer. In contrast, under low cognitive loads, there was no gender difference in reports of emotions. The results indicated that having more cognitive capacity allows more opportunity for on-line computation, leading to a more accurate emotional description than one based on gender stereotypes.

This study indicated that high cognitive load reduced cognitive capacity, which made people take longer to retrieve episodic information. Therefore, general, belief-based information was more likely to win the race and become the information on which people relied for emotional self-reports.

Principle II: Dominance

Sometimes, both bottom-up and top-down processes are equally accessible and both have similar opportunities to win the race and become dominant. In such situations, the "more specific" source of information, such as episodic memory, is more likely to become dominant. For example, in a typical situation, emotion might be triggered by unconscious stimuli and accessed through momentary subjective experiences (Clore, 1994). Under this circumstance, these on-line emotional experiences might be more informative than identity-related beliefs and hence become dominant.

To follow up on this principle, one project (Robinson & Clore, 2007) assessed the hypothesis that when cognitive processing capacity is limited, more specific emotional memories may be relatively inaccessible, so that "less specific" beliefs may play a dominant role. In this project, one measure of cognitive capacity, processing speed, was measured through a series of simple two-choice tasks. Responses to multiple tasks provided a highly reliable measure of individual differences in reaction time. The researchers hypothesized that fast participants should have good encoding skills and hence be able to engage in on-line computation, including retrieval of episodic memories, whereas slow participants should have somewhat more difficulty making such on-line choices. As a result, individuals with slow general reaction times should base their answers more on beliefs, semantic level information than on current feelings or specific episodic memories.

To test this hypothesis, participants filled out a neuroticism scale (as a measure of negative identity-related self-beliefs) and a standard measure of physical complaints (as a measure of somatic symptoms over the previous week) (Pennebaker, 1982). The results supported the proposed hypothesis and showed that negative beliefs (e.g., neuroticism) predicted negative emotional self-reports (e.g., somatic symptoms) among individuals with low cognitive capacity (e.g., slow reaction times) rather than those with fast reaction times (Robinson & Clore, 2007). For example, in two studies, negative self-beliefs (neuroticism) and physical symptoms were not significantly related (β's = .11, .16) for fast individuals (+1 SD), but were highly related (β's = .48, .63) for slow individuals (-1 SD).

A conceptual replication of this study was conducted focusing on positive rather than negative emotion. Specifically, cognitive capacity was again measured by choice reaction times, but this time, the role of positive identity-related self-beliefs were used to predict positive emotional self-reports under different levels of cognitive capacity (Robinson & Oishi, 2006). In this study, the extraversion personality trait was the measure of positive identity-related self-beliefs, and ratings of current life satisfaction were the example of emotion self-report. The results indicated a similar pattern as the previous finding in that positive self-beliefs (extraversion) predicted positive emotional reports (life satisfaction) only among slow people but not among fast people. In multiple studies, for fast individuals (+1 SD), positive self-beliefs (extraversion) and life satisfaction were not significantly related (β's = .08, .03, .22), but for slow individuals (-1 SD), they were highly related (β's = .48, .63).

These results have provided preliminary support for the hypothesis that slow individuals, who are assumed to be less efficient processors than individuals with fast reaction times, tend to encounter difficulties encoding or computing answers to questions about both symptoms and life satisfaction, which makes the answers based on bottom-up processing less accessible. For these individuals, their top-down, semantic level beliefs about themselves won the race and filled in to dominate the answers before retrieval of relevant episodic memories could take place (Robinson & Clore, 2007). The use of reaction times in simple 2-choice tasks as a measure of cognitive processing capacity provided a pattern of results that is consistent with the idea that there are two cognitive process routes, and that which predominates depends on the available cognitive capacity. People with low cognitive capacity (e.g., slow categorization processing speed) are more likely to rely on their general beliefs about themselves (e.g., as measured by questions on standard personality tests) to report their positive and negative emotions.

Principle III: Evanescence

The Evanescence Principle is that experiential information cannot be stored in memory and episodic memory declines quickly with the passage of time (Robinson & Clore, 2002, p. 937). Empirically, episodic memories of specific details have been found to decline over time, such that a steep loss is followed by a more gradual loss (Rubin & Wetzel, 1996). This is the phenomenon to which Robinson and Clore's (2002a) third principle refers. Episodic information tends to become less accessible as time goes by, whereas personal beliefs (e.g., as assessed by a personality test) are not ephemeral and therefore are likely to remain accessible to provide a basis for emotion self-reports when episodic or experiential information is no longer accessible (Robinson & Clore, 2002a; 2002b).

Robinson and Clore (2002b) conducted several studies to explore the pattern of self-reported emotion over time. At first, reaction times for reporting emotion increased in a linear pattern within certain time frames (e.g., last few weeks), because people needed longer time to retrieve episodic memories as time went by. However, the judgment latencies reached a peak at a certain period of time, and dropped and flattened afterwards. This finding is consistent with the idea that on-line information and episodic memory are inaccessible at a later time frame. After episodic memory fades, individuals begin drawing information from their beliefs, and this process takes less time than retrieving relatively inaccessible episodic memories. Generalized beliefs then "fill in" the gaps in information left by the inaccessible information from episodic memory, providing a basis for reports of emotion for longer time frames (Robinson & Clore, 2002b). And, of course, when individuals are asked to report their trait emotions (e.g., “emotions in general”) or to predict their future or hypothetical emotions, their reports must rely on semantic memory (Horan et al., 2008).

Indeed, comparisons between daily emotional experiences and retrospective emotional experiences demonstrate the bias that characterizes retrospective judgments. In retrospective reports, since no currently accessible feelings are present, relevant beliefs about emotion may fill in. Self-report personality measures (e.g., extraversion, neuroticism, trait anxiety, self-esteem) are essentially measures of beliefs about one’s usual affect and emotions. Thus, for example, research has found that participants high in neuroticism or trait-anxiety report more experiences of negative affect when asked for memories of past emotions than when asked for ratings of current emotion in daily diary studies (Barrett, 1997; Culter et al., 1996). That results suggests that they were relying on their beliefs when rating past emotions. Similarly, extraverts and individuals with high self-esteem tended to retrieve more instances of positive affect in such retrospective, belief-based reports than in reports of current emotion (e.g., Conner, Wood, & Barrett, 2003; Schimmack, 1996).

Other research makes a similar point. For example, in a study at the University of Michigan, people were asked to rate the pleasant feelings of driving luxury cars. The feelings were found to increase with (beliefs about) the value of cars when individuals reported their general or usual feelings when driving. But such reports of feelings about driving were independent of beliefs about the value of their car when people reported on their actual current day's driving experiences (Schwarz & Xu, 2011). For questions about the current day's driving, the experiential data were still accessible, but for questions about general or usual feelings when driving, experiential data were no longer accessible so that beliefs were relied upon instead.

Finally, some related research asked schizophrenic patients to rate their emotional experiences. The results showed that individuals with schizophrenia showed normal emotional experiences when reporting on their current feelings. However, their answers were different when asked for retrospective reports about past emotions. Since information from actual feelings was no longer accessible when reporting on past emotions, they relied on their general beliefs that they suffered from alexithymia (Strauss & Gold, 2012), and reported very different emotional experiences than most people.

From these studies, one common pattern was that when people recall emotions from long ago, the information from episodic memory was inaccessible. Under those conditions, people are more likely to rely on their general beliefs and semantic memory to make a judgment of their feelings. Moreover, that likelihood should be increased when cognitive capacity is reduced.

Current Project

Although several studies have examined aspects of the accessibility model, there is still a limited amount of empirical support for the three principles of the model. Therefore, I conducted three studies for the current dissertation. Study 1 and study 2 were both based on secondary analyses of existing datasets. A general search was made for datasets that included all of the measures needed to test the hypothesis, including a measure of general reaction time, a measure of general beliefs about emotion (e.g., PANAS-Usual, or neuroticism scale), and a measure of self-reported emotions (e.g., PANAS-Now, or somatic symptoms within two weeks). Two such datasets were located (MIDUS II, Ryff et al., 2004-2006; Pathways to Desistance study, Mulvey, 2013), and they explored the relationship between beliefs about the negative emotions usually experienced and reports of emotions currently or recently experienced under different levels of cognitive capacity. These two studies provided evidence especially for the relative accessibility and dominance principles. Then, a third study was conducted, to test assumptions of the accessibility model experimentally. To determine whether cognitive capacity is the important variable, I varied cognitive capacity by introducing a cognitive load. To assess the role of semantic and episodic memory in the reporting process, I varied instructions to think about semantic or episodic level information when making emotion self-reports. Study 3 found evidence that, as hypothesized, long time frames, instructions to rely on semantic memory, and cognitive load combined to increase the role of general beliefs in current emotion reports.

In some studies I refer to "working memory capacity," in others to "cognitive capacity." The theory does not define precisely what kind of cognitive limitation should lead to reliance on beliefs over experiences. In the current dissertation, therefore, I refer simply to "cognitive capacity" without being more specific, and I referred working memory capacity as one form of cognitive capacity.

Study 1

Method

Participants

Data were analyzed from an existing data set called MIDUS (Midlife in the United States). MIDUS is a national survey of 7108 Americans aged 25 to 74 carried out from 1995 to 1996 (MIDUS I; Brim et al., 1995-1996). The goal was to investigate the role of behavioral, psychological, and social factors in understanding age-related differences in physical and mental health. A longitudinal follow-up of the original sample (MIDUS II) was conducted from 2004 to 2006 with a range of ages from 35 to 84 (Ryff et al., 2004-2006).

In the current study, a dataset from a subsample of the MIDUS II was used. This dataset included data from 331 participants (148 or 44.7% men, 183 or 55.3% women, aged from 36 to 84, M_{age}=55.41, SD_{age}=11.12) recruited at University of Wisconsin-Madison. An example of the procedure is shown in Appendix A.

Measures

A number of standard personality and other measures were administered as part of the MIDUS project. Those relevant to the current research include the following:

General Beliefs about Emotions. The general beliefs about negative affects were measured through the trait STAI and general PANAS scales. Spielberger State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983; Appendix D & E) is a measure of state and trait anxiety that has been widely used in research and clinical practice. The trait scale contains 20 items rated on a 4-point Likert scale (1 = Not at all; 4 = Very much so). The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988; Appendix B & C) consists of one 10-item scale measuring positive affect (PA) and another 10-item scale measuring negative affect (NA) on a 5-point Likert scale (1 = Very slightly or not at all; 5 = Very much). These items were derived from Zevon and

Tellegen's (1982) mood checklist. There are several timeframes in PANAS scales and the reliability across time frames ranged from .86 to .90 for the PA trait scales and .84 to .87 for the NA trait scale (Watson et al., 1988). In the current study, PANAS scale adopting "generally/ on average" time frame was used to measure individuals' general beliefs about negative affect.

Emotional Self-reports. The self-reported current emotions were measured through the state STAI scale (20 items) and the state PANAS scale (10 items). STAI state-trait scales have demonstrated good internal consistency (average $\alpha > .89$), test-retest reliability (average $r = .88$; Barnes, Harp, & Jung, 2002), and validity (Spielberger et al., 1983). The STAI state measure was reported to have low temporal stability (Barnes, et al., 2002), which does not seem inappropriate for a state measure, but also a low ability to discriminate between anxiety and more general negative affect (e.g., Bieling, Antony, & Swinson, 1998). The state PANAS scale includes the same items as the trait form, but asks about emotions "right now/ at this very moment".

Cognitive Capacity. In the current study, cognitive capacity was measured through individual reaction time on simple 2-choice categorization tasks. Thirty negative ($M = 2.89$, $SD = 0.61$), 30 neutral ($M = 5.14$, $SD=0.52$), and 30 positive ($M = 7.24$, $SD = 0.44$) pictures were selected from the International Affective Picture Series (IAPS) on the basis of established norms (Lang et al., 2005). Each picture was surrounded by a colored border (either purple or yellow, see Appendix A). The border appeared for 500ms, but the image remained on the screen for 3500ms after the border offset. Participants were asked to press the left key when the border color was purple and the right key when the color was yellow (Ryff & Davidson, 2011). Reaction times for identifying the color of the border were recorded separately for negative, neutral, and positive pictures. The average reaction time across all 90 pictures was used as an overall measure of an individual's reaction time.

Procedure

Participants filled out both trait STAI and trait PANAS scales, right after they gave their informed consent. Then, after the reaction time data had been collected, they filled out STAI and PANAS state scales, along with some other self-report questionnaires.

Results

The question to be answered is whether limited processing capacity increases people's reliance on beliefs about emotion when reporting current or recent emotional experience. The measure of processing capacity was the average reaction time on a two-choice reaction time task (indicating the color of the border of an image seen a moment earlier). The measure of personal emotional beliefs was their reports of negative emotions on the PANAS-General, and the measure of current emotion was the report of current negative emotions on the PANAS-Now.

The hypothesis was tested by regression predicting state negative affect from trait negative affect (beliefs), general reaction time, and their interaction. The first step was to average reaction times for all 90 negative, neutral, and positive pictures, and to log transform the data because they were positively skewed ($M_{RT} = 2.90$, $SD_{RT} = .12$; Tabachnick & Fidell, 2007; Howell, 2007). Similarly, PANAS negative affect scale scores were also log transformed to normalize the distribution before analysis.

Correlational analyses indicated no correlation between reaction time and trait or state affect measures, which is an important prerequisite for an unbiased test of the hypothesis.

The regression analysis showed a marginally significant interaction effect between processing speed and trait negative affect in predicting state negative affect. Slow people were more likely than fast people to show a relationship between emotion reports (PANAS state scores) and general beliefs about emotion, β = 2.50, t (313) = 1.88, p = .061, R^2 = .13 (PANAS trait scores). A similar analysis predicting state negative affect on the PANAS from negative emotion beliefs as measured by trait anxiety scores on the STAI produced a similar interaction; β = 2.55, t (311) = 1.91, p = .057, R^2 = .11 (STAI trait scores) (see Figure 1 and Table 1).

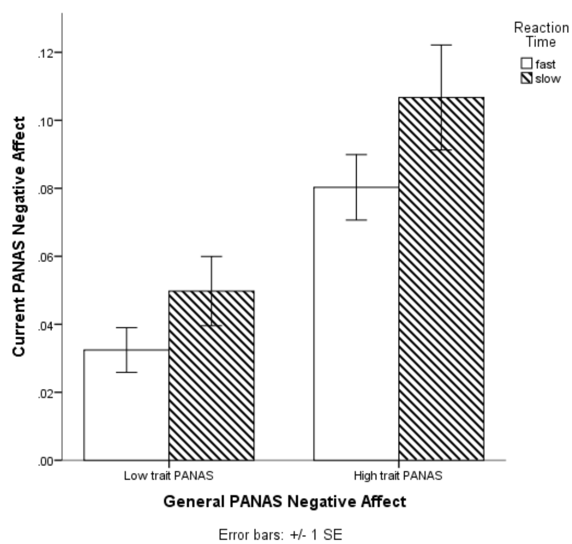

Figure 1. The interaction effects of reaction time and trait affect on state affect in the whole MIDUS sample (n = 313). Fast group included people with reaction time lower than the mean, and slow group included people with reaction higher than the mean.

Table 1. Interaction effects between general beliefs about emotion and emotion report in study 1 (n = 313).

	β	t	p
Predict State PANAS negative affect			
PANAS general negative affect	-2.17	-1.63	.103
Average reaction time	.03	.32	.753
Interaction	2.50	1.88	**.061**
STAI trait anxiety	-2.23	-1.68	.094
Average reaction time	-.33	-1.34	.182
Interaction	2.55	1.91	**.057**
Predict State Anxiety (STAI)			
PANAS general negative affect	-.43	-.23	.818
Average reaction time	.04	.35	.725
Interaction	.82	.44	.659
STAI trait anxiety	1.20	.67	.505
Average reaction time	.24	.89	.372
Interaction	-.70	-.40	.691

However, a similar analysis produced no interaction showing greater reliance on beliefs for reports of state anxiety, regardless of whether personal emotional beliefs were measured by the PANAS or STAI measures. The fact that reaction time did not moderate the relationship between stated and trait anxiety may reflect the sizable correlation between state and trait anxiety for both fast ($r = .68$, $p < .0005$) and slow people ($r = .56$, $p < 0.0005$). It appears that most participants relied on their beliefs about their anxiety when reporting state anxiety, regardless of capacity, so that the level of individual variation in state-trait anxiety relationship needed to test the hypothesis may not have existed in these data.

In order to make the pattern of the significant PANAS interaction clearer, people with reaction times that were one standard deviation below the mean were categorized as the fast group ($n = 48$), and those with one standard deviation above mean reaction time were categorized as the slow group ($n = 63$). The results show that state negative affect correlates with trait negative affect ($r = .48$, $p < .0005$) among slow people, but not significantly among fast people ($r =.23$, $p = .120$). Moreover, if we only keep slow and fast groups of participants (1SD away from mean) in the dataset, the regression analysis indicated that the slow group are significantly more likely than fast people to rely on their general beliefs about negative emotion (PANAS trait scores) for reporting negative emotion (PANAS state scores), $\beta = 3.15$, $t\ (108) = 2.13$, $p = .036$, $R^2 = .22$ (see Figure 2).

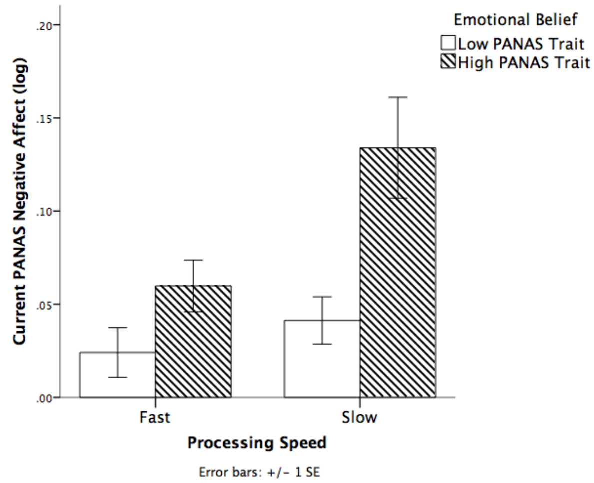

Figure 2. The interaction effects of reaction time and trait affect on state affect for individuals with reaction time scores 1 SD above the mean and 1SD below the mean reaction time scores (n = 108).

In general, the relatively consistent difference in these patterns of correlations between people who are relatively fast and relatively slow in reaction times is consistent with the findings of Robinson and Clore (2007). I interpret the result as supportive of the hypothesis that reduced cognitive capacity, which is evidenced by low processing speed, may result in reliance on pre-existing negative beliefs (trait scores) when reporting momentary negative affect.

Study 2

Method

Participants

The participants in study 2 are from the Pathways to Desistance study (Mulvey, 2013). This is a multi-site study that followed 1354 serious juvenile offenders from adolescence to young adulthood in two locations, Maricopa County (Phoenix), Arizona (N=654) and Philadelphia County, Pennsylvania (N=700), between the years 2000 and 2010. The baseline interview was conducted about three months after the participants' adjudication hearing from 2000 to 2003, with follow-up interviews at 6, 12, 18, 24, 30, 36, 48, 60, 72 and 84 months after their baseline interviews. For the purpose of this current study, only individuals with no reported history of head injuries from the baseline interview were included (N = 943), including 794 men (84.2%) and 149 women (15.8%), $M_{age} = 16$, $SD_{age} = 1.14$.

Measures

A number of standard personality, intelligence, cognitive, and other self-reported measures were administered as part of the Pathways to Desistance project. Those relevant to the current research include the following:

General Beliefs about Emotions. The Neuroticism personality scale from the NEO-PI-SF (Costa & McCrae, 1989; McCrae & Costa, 2004) was used to measure individuals' general beliefs about their negative affect. The neuroticism scale is especially appropriate for this research because the items are essentially belief statements about the person's usual negative affect, and because it was used previously by Robinson and Clore (2007). The NEO-PI-SF is a widely used personality inventory. It taps the "Big 5" dimensions of personality (i.e., neuroticism, extraversion, openness, agreeableness, and conscientiousness) and provides an assessment of emotional, interpersonal, experiential, attitudinal and motivational personality styles. It is a self-report measure in which participants rate the degree to which they think the statement is true about themselves (e.g., I shy away from crowds of people) on a 5 point Likert scale (1=disagree strongly to 5=agree strongly). The neuroticism scale was administered in a 24-month follow-up interview rather than in the baseline interview with other variables.

Emotional Self-reports. The Brief Symptom Inventory (BSI; Derogatis & Melisara, 1983) is a 53-item self-report inventory in which participants rate the extent to which they have been bothered (0="not at all" to 4="extremely") in the past week by various symptoms. The BSI has nine subscales designed to assess individual symptom groups: somatization (e.g., "Faintness or dizziness"), obsessive-compulsive (e.g., "Having to check and double-check what you do"), interpersonal sensitivity (e.g., "Feeling inferior to others"), depression (e.g., "Feeling no interest in things"), anxiety (e.g., "Feeling tense or keyed up"), hostility (e.g., "Having urges to break or smash things"), phobic anxiety (e.g., "Feeling uneasy in crowds, such as shopping or at a movie"), paranoid ideation (e.g., "Others not giving you proper credit for your achievements"), and psychoticism (e.g., "The idea that something is wrong with your mind"). These items measured the emotional and physical symptoms that participants had experienced within the previous week. The somatization, anxiety, and depression subscales were included as measures of individuals' recent emotional experiences.

Cognitive Capacity. In the current study, cognitive capacity was measured through performance on the Stroop test (Stroop, 1935), Trails Making Test (Reitan, 1979), and a screening intelligence test (Vocabulary and Matrix Reasoning subtests in WASI-III; Wechsler, 1999).

Stroop Test. Performance on the Stroop Color-Word Test has been interpreted in various ways. In this dissertation, to be most consistent with the Accessibility model, I interpret it as reflecting working memory capacity, as is commonly done in cognitive psychology. People with higher capacity are found to be less susceptible to Stroop interference (Hutchison, 2007; Kane & Engle, 2003; Long & Prat, 2002; Miyake et al., 2000; Unsworth & Spillers, 2010). Consistent with that interpretation, performance on the Stroop test has been associated with cognitive flexibility, resistance to interference from outside stimuli, creativity, psychopathology and cognitive complexity (Golden & Freshwater, 2002).

The Stroop can be used on both children and adults (Grade 2 through adult) and contains three parts: word page (the names of colors printed in black ink), color page (rows of X's printed in colored ink) and word-color page (the words from the first page are printed in the colors from the second page; however, the word meanings and ink colors are mismatched), each with 5 columns containing 20 items. The subject's task is to look at each sheet and move down the columns, reading words or naming the ink colors as quickly as possible, within a given time limit (45 seconds). There are several methods to calculate Stroop color-word interference score. The calculation method used in the current study involves the number of colors named in a fixed time span. Specifically, the score involves subtracting predicted color-word reading scores from actual color-word reading scores to measure the relative delay in naming colors from the word-color page (where colors mismatch with words) (Golden & Freshwater, 2002). Therefore, smaller color-word interference scores relative to control color-word scores indicates lower working memory capacity (Unsworth & Spillers, 2010) and executive functioning (Golden & Freshwater, 2002).

Trails Making Test. The trails making test is a measure of general brain function, and the required skills are indicative of the presence of brain damage (Reitan, 1979). The test has two parts: Part A involves a series of numbers and the participant is required to connect the numbers in sequential order (similar to a dot-to-dot). Part B involves a series of numbers and letters and the participant is requiredto alternately connect letters and numbers in sequential order. The test generally requires ability to sequence (Parts A and

B), ability to shift cognitive set (Part B), and motor processing speed (Parts A and B). Part A and Part B are scored separately and expressed in terms of the number of seconds it takes the participant to complete each section. Longer completion times (Adult: Part A, greater than 39 seconds / Part B, greater than 85 seconds) are indicative of neurological deficit. In this study, the average reaction time of part A and part B was calculated and was interpreted as a representation of processing speed, which is also one form of processing capacity.

Intelligence Test. The Wechsler Abbreviated Scale of Intelligence (WASI-III; Wechsler, 1999) produces an estimate of general intellectual ability based on two subtests, Vocabulary (42 total items that require the subject to orally define 4 images and 37 words presented both orally and visually) and Matrix Reasoning (35 incomplete grid patterns that require the participant to select the correct response from five possible choices). Administered in approximately 15 minutes, the WASI is a quick estimate of an individual's level of intellectual functioning, with higher scores indicating greater intellectual ability. The WASI is linked to both the Wechsler Intelligence Scale for Children (WISC-III) and the Wechsler Adult Intelligence Scale (WAIS-III), and has been normed for individuals who age 6 to 89 years. In the current study, FSIQ score from the two subtests were used in analysis.

Results

As in Study 1, the question was whether cognitive capacity affects reliance on personal beliefs about emotion when reporting current feelings. The measure of cognitive capacity was individuals’ performance on an intelligence test, motor speed tasks, and a Stroop task. The measure of personal emotional beliefs was the report of negative emotions on the Neuroticism scale of the NEO-PI-SF (Costa & McCrae, 1989; McCrae & Costa, 2004), and the measure of current emotion was the report of current negative symptoms on the Brief Symptom Inventory (Derogatis & Melisara, 1983). The hypothesis was again tested by regression, predicting current experiences of symptoms from beliefs about personal negative emotion (neuroticism scores), current processing capacity (e.g., Stroop performance, intelligence scores, and motor processing speed), and their interactions.

BSI Somatization scores were log transformed before analysis. The Stroop interference score indicated individual working memory capacity, which served as a measure of cognitive capacity. Motor speed on the Trails Making Tests (A and B) served as another measure of cognitive capacity, and the intelligence score was also used to represent cognitive capacity. The correlation matrix indicated medium correlations between intelligence and motor speed scores, r = -.37, as would be expected. However, the correlation between the Stroop interference score and intelligence score (r = .00), and motor speed score (r = .02) were very small. This suggests that the Stroop interference score represents a different cognitive capacity than what motor speed and intelligence represented. Between these cognitive capacity measures, neuroticism, and other emotional self-report measures, low correlations were found (r = -.08 to .05), which were important for an unbiased test of the hypothesis.

The data analysis showed small correlations between neuroticism (self-beliefs about negative affect) and self-reported negative symptoms regardless of motor processing speed and intelligence scores. Regression analysis indicated significant interaction effects between personal emotional beliefs (neuroticism scores) and working memory capacity (Stroop interference scores) on self-reports of recent somatic symptoms, β = -.527, t (411) = -2.38, p = .018, R^2 = .04 (see Figure 3); and on self-reported anxiety symptoms, β = -.598, t (411) = -2.72, p = .007, R^2 = .06 (see Figure 4), but not on self-reported depression symptoms.

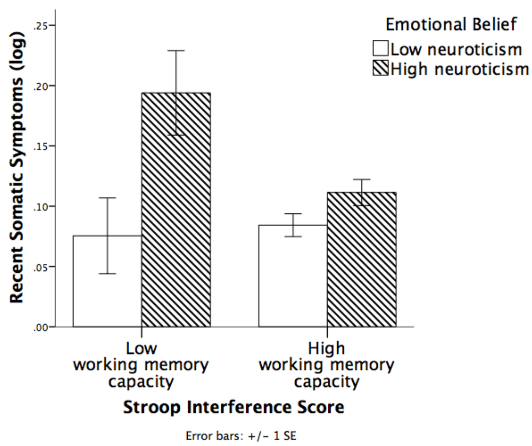

Figure 3. Somatic symptoms as a function of neuroticism and *working memory capacity*

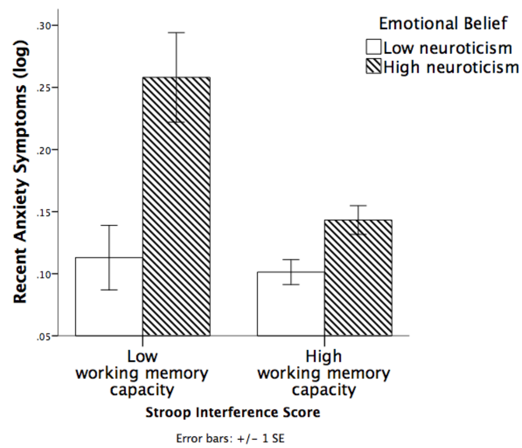

Figure 4. Anxiety symptoms as a function of neuroticism and *working memory capacity*

Thus, the results indicate that individual differences in working memory capacity, as measured by Stroop performance, influence the relationship between self-beliefs (neuroticism) and self-reported emotional experiences (somatic and anxiety symptoms). However, such interactions were not found when processing capacity was replaced by motor speed or intelligence scores. Consistent with the difference in correlations between Stroop and the other two measures of processing capacity, it is possible that people's reliance on emotional beliefs for momentary emotional reports differ across conditions only for working memory capacity, but not for other types of abilities such as motor speed or intelligence levels.

This result has to be interpreted with caution considering the small effect size of the major result. In addition, the participants were juvenile offenders with limited education and cognitive ability levels (M_{FSIQ} = 87.84, SD_{FSIQ} = 10.19). Also, this dataset was collected right after their adjudication hearing, which was a stressful event for them. Attitude toward tests and paying attention during tests among these participants could both influence their performance in the various tasks. With all these in mind, I interpret the result as generally consistent with the idea that people with low cognitive capacity are less efficient in retrieving episodic information and are more likely to rely on pre-existing negative self-beliefs when reporting their recent emotional experiences.

Study 3

The results from the first two studies indicated an influence of cognitive capacity on the relationship between general beliefs about emotions and self-reported feelings. Low cognitive capacity was indicated by slow responses on a simple two-choice task (Study 1) and on a Stroop color-word interference task (Study 2). These individuals showed stronger relationships between beliefs about their usual negative emotions and current or recent self-reports of negative emotions and symptom in comparison to people with high cognitive capacity.

Following the “Dominance” and the “Relative Accessibility” principles in the Accessibility model (Robinson & Clore, 2002a), these results provided evidence that people with low cognitive capacity are more likely to rely on their beliefs about their affect to judge their momentary affect. The accessibility model of emotion self-report (Robinson & Clore, 2002a; 2002b; 2007) says that top-down processing (e.g., information from semantic memory, beliefs, or personality traits) tends to fill in when bottom-up processing (e.g., information from current experience or episodic memory) is less efficient. However, more evidence is required to test this explanation since previous research, including Studies 1 and 2, has not directly tested the assumptions of the model.

Study 3 tested several hypotheses, including whether reliance on emotion beliefs for reporting recent emotions would increase when people focus on semantic-level information, when their cognitive capacity is limited, either generally or temporarily, and when episodic memories of emotion become less accessible over time.

Consistent with the "Evanescence" principle, Robinson and Clore (2002b) found that reaction times for reporting emotions increased for longer time frames (e.g., yesterday as opposed to an hour ago). The increased reaction times indicate increased difficulty retrieving episodic memories as time frames get longer. But, as indicated above, they also found that after the response latency reaches a peak, it flattens out and even decreases, indicating a steady reliance on semantic memory during long time frames. Study 3 aimed not only to replicate such findings, but to extend the accessibility model by testing how the three principles in this model interact with each other to influence the relationship between general beliefs about affect and self-reported momentary affect.

The current design involved both natural variations in processing speed and manipulations of two key variables: belief accessibility and cognitive ability to retrieve recent emotional memories. I hypothesized that each would influence the tendency to rely on emotion beliefs when answering questions about emotion experience. The specific hypotheses were as follows:

Hypotheses

1) People should take longer to report their emotions within a longer time frame, than within a shorter time frame, a finding that would be consistent with the "Evanescence" principle (Robinson & Clore, 2002b).
2) In general, people should be more likely to rely on their general beliefs when reporting emotions within longer time frames (e.g., one week ago, two weeks ago, and one month ago) than within more recent time frames (e.g., yesterday), due to the increasing inaccessibility of specific episodic memories as time goes by.
3) People with chronic low cognitive capacity or slow processing speed should be more likely to rely on their general beliefs about emotions to report emotions than do fast people, a finding that would be consistent with both "Dominance" and "Relative Accessibility" principles;
4) People with momentarily low cognitive capacity, such as those under high cognitive load, should be more likely to rely on their general beliefs when reporting emotions than those under low cognitive load, which would be consistent with both "Dominance" and "Relative Accessibility" principles;
5) People who were instructed to report their emotions using their semantic memory should be more likely to rely on their general beliefs about emotions than those who were instructed to use episodic memory, and this tendency should occur across all time frames.

Method

Participants

Participants were recruited from a public university participant pool, including 153 female and 64 male (N = 217). Due to computer problems, one female participant answered the wrong questionnaires and therefore her data were excluded from the data analysis. The mean age of the participants was 18.47 years old (SD = .98), and the average time they had been in the U.S. was 17.04 years (SD = 3.94).

Measures

General Beliefs about Emotions. The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was administered to students at the beginning of the semester during the pretest phase, and these pretest scores served as the measure of trait negative affect or beliefs held by participants about their negative affect. The 20-item Trait Anxiety Inventory (STAI; Spielberger et al., 1983) was also administered during the pretest phase (see study 1 for more details). The Big Five Inventory is a self-report inventory designed to measure the Big Five dimensions of personality (Goldberg, 1993), including 44 items (BFI; John & Srivastava, 1999). In the current study, only the 8-item Neuroticism scale was administered (see Appendix G). It served as a measure of beliefs about the person's usual negative affect.

Self-reported Negative Affect. Participants reported on the extent to which they have experienced ten emotions[1] over four distinct time frames: "yesterday"; "one week ago"; "two weeks ago"; "one month ago" (adapted from Robinson & Clore, 2002b). Ratings were made on a 5-point intensity scale (1 = none; 2 = a small amount; 3 = a moderate amount; 4 = a large amount; 5 = an extreme amount). Each emotion was crossed with each time frame, such that each participant made 40 judgments (10 emotions

[1] Emotions from the ten in PANAS negative affect scale, including *distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid.*

X 4 time frames). Trials were presented on a computer and randomized for each participant.

Cognitive Capacity. 1) Categorization processing speed was measured through the simple 2-choice tasks consisting of 16 trials of words from Robinson and Clore's (2007) task list. For example, when the word "lamp" was presented on the screen, participants were asked to press key "9" if the word represented an animal, and key "1" if not. This was administered as the first task in the lab. 2) A cognitive load manipulation used by van Boven and Robinson (2012) was used to vary cognitive capacity. Participants were asked to remember a 7-letter non-word string of consonants. Those who were randomly assigned to the high cognitive load group received a complex 7-letter string (e.g., DNZQLBP), whereas those in the low cognitive load group received an easy, less demanding letter string to remember (e.g., ABCDEFG). The letter string appeared on the screen for only 5 seconds, and participants were asked to remember it and immediately recall it on the next page. Then the string was presented for another 5 seconds, and participants were asked to expect a memory test for the letter string at the end of the study). 3) Two different sets of instructions were randomly assigned to the participants with an intention to influence people's accessibility to episodic or semantic memories for emotional reports (see Appendix F). The episodic memory instruction asked them to recall "specific occasions" when reporting the intensity of their emotions. However, the semantic memory instruction encouraged them to recall their "typical feelings" based on their general knowledge about themselves.

Judgment Latency. Within each of the 40 trials, the length of time needed to judge emotions was measured following the procedures in Robinson and Clore (2002b).

Participants were instructed to determine the extent to which they had experienced a given emotion during the given time frame. Each trial began with a time frame (e.g., yesterday). After reading this time frame, participants clicked the page to enter the next page, where a specific emotion appeared on the page. When they were ready to give their answer, they would hit the space bar to enter the next page to make a choice in the 5-point scale. To ensure that participants had actually determined their answer prior to hitting the space bar, we removed all information about the trial (i.e., time frame and emotion) once the space bar was pressed (Robinson & Clore, 2002b). We started timing the judgment latency when the emotion word appeared, and stopped the timing when they clicked to enter the next page to make a choice. This reaction time was considered their judgment latency. Before starting these 40 test trials, two practice trials were administered to help the participants understand the format and content of these tasks.

Previous research revealed that these procedures were successful, as rating time—that is, time to make a rating after pressing the space bar—did not vary by emotion, time frame, or their interaction in any of the samples (all ps > .15). In addition, these rating times were quite short (.5 – .7s), consistent with the amount of time that would be required to find and hit the intended rating key (1–5). Therefore, it is reasonable to consider each space bar press as the time required to make a particular judgment of current affect (Robinson & Clore, 2002b).

Procedure

During the pre-test phase at the beginning of the semester, participants had filled out many psychological measures, including the general PANAS negative affect scale, and the trait STAI scale. During the lab experiment, after offering their informed consent, participants completed a series of categorization speed tasks, and were then randomly assigned to a cognitive load condition (high vs. low) and received instructions on whether to rely on semantic or episodic memory (semantic instruction vs. episodic instruction). Then, all the participants completed the 40 emotion judgment latency trials in a random order and filled out the neuroticism scale.

Results

This study was a 2 (Cognitive load: high vs. low) X 2 (Instruction: semantic vs. episodic memory) X 2 (Categorization speed: slow vs. fast) X 4 (Time frame: yesterday, one week ago, two weeks ago, and one month ago) mixed design. Good internal reliabilities were achieved among all the self-report scales in the current study: general PANAS scale ($\alpha = .88$), trait STAI scale ($\alpha = .91$), neuroticism scale ($\alpha = .83$), PANAS scale yesterday ($\alpha = .86$), PANAS scale one week ago ($\alpha = .82$), PANAS scale two weeks ago ($\alpha = .84$), and PANAS scale one month ago ($\alpha = .83$).

The procedure from Robinson and Clore (2007) was followed to process the reaction time data. Across 40 trials, judgment latencies for self-reported negative emotions were log-transformed to reduce positive skew, which is typical of reaction time data. Then, outliers were replaced with the cut-off values if they were 2.5 standard deviations below or above the grand latency mean. In sum, 7.08% of trials in yesterday, 6.71% in 1 week ago, 6.48% in 2 weeks ago, and 7.92% in 1 month ago time frames were replaced. Judgment latency within each time frame was calculated by averaging reaction times across all 10 trials within that time frame. A similar procedure was applied to the categorization speed trials. After dropping inaccurate trials (accuracy rate was 98.81%), the remaining trials were log transferred to reduce the positive skew. Then, outliers were replaced with the cut-off values if they were 2.5 standard deviations below or above the grand latency mean (10.13% trials were replaced). Individuals' processing speed was then calculated by averaging reaction times across all 16 trials, $\alpha = .95$, which indicated the reliability of categorization speed as an individual difference measure.

Also, following Robinson and Clore (2007), categorization speed was considered an index of an individual's general cognitive capacity, rather than as a response bias (e.g., sacrificing accuracy for speed). Therefore, the correlation between the average speed and average accuracy was calculated $r = -.17$, $p = .013$. This result indicated a response bias in the current dataset; that is, slow people were more accurate, which was the opposite from the previous studies in which they found no such correlation ($|r|$s $< .04$ except study 1; Robinson & Clore, 2007). In order to reduce the influence of such response bias on the current study, the final data analysis was conducted among participants who had 100% accuracy rate in this categorization task ($n = 180$).

No correlation between the reaction time scores and any of other self-report measures were found in the current dataset, which eliminated a potential source of confounds between the measurements. There were three trait measures in the current design, including the trait PANAS negative affect scores, the neuroticism scores, and the trait STAI scores. To determine the shared aspects of these three trait scores, an exploratory factor analysis was conducted. The results revealed one common component out of these three traits with factor loadings of .84, .90, and .84 respectively. Therefore, the sum of the three standardized trait scores that had been multiplied by their loadings was created as a ***latent trait negative affect score***, representing individuals' general beliefs about their emotions, and was used in the rest of the analyses[2]. Trait-state correlations were then calculated and compared across conditions, between the self-reported emotions within each time frame and the general beliefs about emotions.

Test for Hypothesis 1: Time Frame

"People were expected to take longer to report their emotions within a longer time frame, than they spent reporting emotions within a shorter time frame, a finding that would be consistent with the 'Evanescence' principle."

Judgment latencies for reporting emotions within the "yesterday" frame were significantly lower than those in the other three time frames, $t = -.47$, $p < .00025$, Cohen's $d = -.698$, $t = -3.85$, $p < .00025$, Cohen's $d = -.575$, $t = -3.79$, $p < .00025$, Cohen's $d = -.566$, separately (Cohen & Cohen, 1983). There were no differences in judgment latency among the "one week ago," "two weeks ago," and "one month ago" time frames (see Figure 5). This pattern of judgment latencies is consistent with the "evanescence" principle, which is that as the time frame expanded, people tend to take longer to make an emotion judgment because it takes longer to retrieve distant episodic memories. In previous research, such a result was explained by the reduced accessibility of episodic memory during longer time frames, which led people to rely on semantic memory to report emotions further back in time. If the time frame was long enough, such as longer than two weeks ago, the judgment latencies began to flatten out, reflecting reliance on the same trait-level beliefs about emotion.

[2] Analyses of the individual scales generally mirrored the analyses of the latent trait of negative affect, although they were sometimes less reliable.

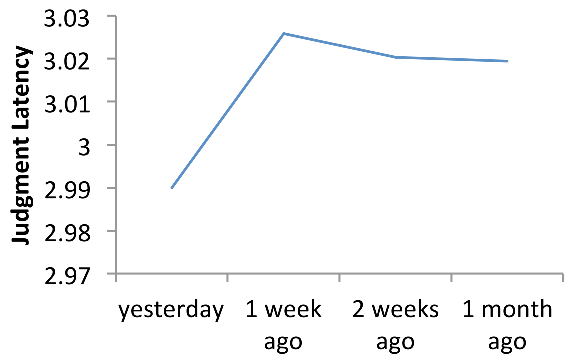

Figure 5. People took longer time to report their emotions as time frame extended, but the judgment latency flatten out when time was longer than "1 week ago."

Test for Hypothesis 2: Interaction between Time frame and Trait

The second hypothesis was that "people would be more likely to rely on their general beliefs when reporting emotions within longer time frames (e.g., one week ago, two weeks ago, and one month ago) than within more recent time frames (e.g., yesterday), due to the increasing inaccessibility of specific episodic memories as time goes by."

An interaction effect between time frames and different trait scores when predicting emotion reports was found, $F(2, 151) = 6.04$, $p = .003$, $\eta^2 = .074$ (see Figure 6). This finding was consistent with the hypothesized effects especially among people with higher trait scores. That is, higher general beliefs about emotion (trait scores) were more likely to predict higher state emotion reports as time goes by.

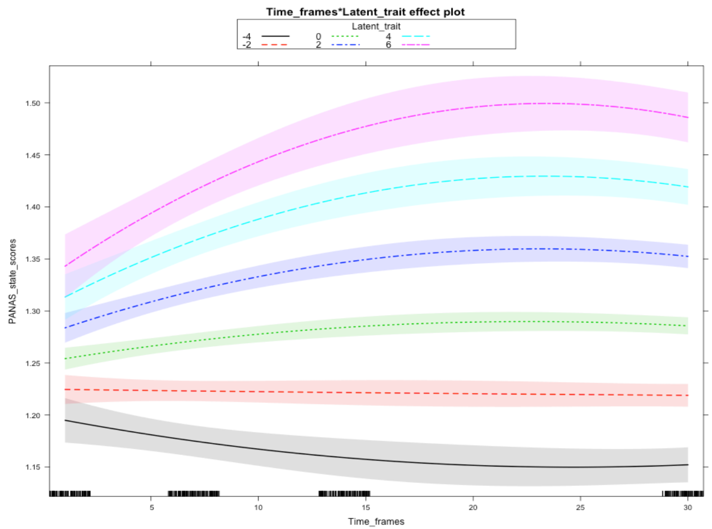

Figure 6. As time frame extended, higher trait scores predicted higher state PANAS scores. *Note.* The shade represented one standard error. X-axis represents the number of days in the time frame, yesterday was 1 day ago, one week ago was 7 days ago, two weeks ago was 14 days ago, and one month ago was 30 days ago. The Y-axis represents momentary self-reported negative affect. The different colors of lines represent levels of latent trait scores, the pink line represents people with high latent trait scores, and black line referred to people with low latent trait scores.

Test for Hypothesis 3: Slow Processing Speed vs. Fast Processing Speed

"People with low cognitive capacity, such as slow processing speed, should be more likely to rely on their general beliefs about emotions to report emotions than do fast people, which would be consistent with both 'Dominance' and 'Relative Accessibility' principles."

In order to test hypothesis 3, the trait-state correlations were compared within each time frame. As shown in Figure 7, slow people showed a consistent pattern of higher trait-state correlations than fast people within time frames of "one week ago", "two weeks ago", and "one month ago," but not within the "yesterday" frame. Although differences are small and none of the correlations within single time frames differ significantly from each other, they are in the predicted direction at each of the longer time frames.

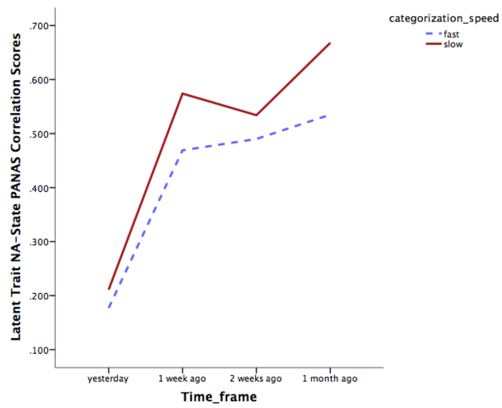

Figure 7. The difference of the State-Trait correlations between fast and slow people across time frames.

In order to test this hypothesis further and more clearly, a mixed model analysis was conducted in R.3.1.2 (Judd, Westfall, & Kenny, 2012; R Development Core Team, 2008). First, a linear model was compared to a quadric model, based on AIC (−1122.7 for the linear model vs. -1188.2 for the quadric model) and BIC (−1086.5 for the linear model vs. -1129.4 for the quadric model) values (Akaike, 1981), the quadric model fit the data better than a linear model, which is also consistent with the patterns of trait-state correlations. Therefore, a quadric model was used in the remainder of the mixed model analyses. However, there was no evidence of the predicted interaction effect, $F(1, 150) = .04$, $p = .850$.

Trait affect did not predict state affect differently across processing speed levels, despite a consistent tendency for trait-state correlations to be somewhat higher among slow than among fast individuals. Hypothesis 3 was, therefore, not supported in these data.

Test for Hypothesis 4: High Cognitive Load vs. Low Cognitive Load

"People with low cognitive capacity, such as those under high cognitive load, should be more likely to rely on their general beliefs about emotions to report emotions than

those under low cognitive load, which would be consistent with both 'Dominance' and 'Relative Accessibility' principles."

People under high cognitive load generally had higher trait-state correlations than people under low cognitive load. These differences were observed among longer time frames, but not for the short "yesterday" frame. The differences in trait-state correlations under different cognitive load conditions were significant within the "one month ago" time frame, z = - 2.72, p = .007 (see Figure 8).

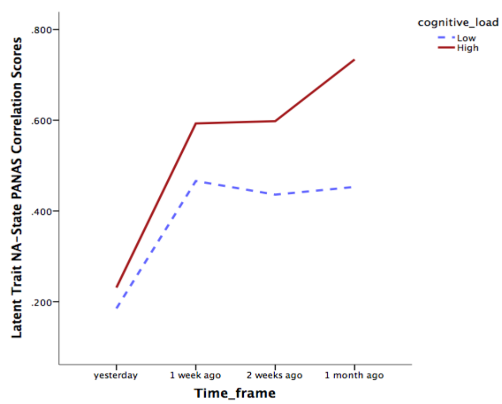

Figure 8. The difference of the State-Trait correlations between high and low cognitive load across time frames.

The results from the mixed model analysis also indicated a marginally significant interaction effects between latent trait score and cognitive load, F (1, 150) = 3.15, p = .078, η^2 = .021 (see Figure 9).

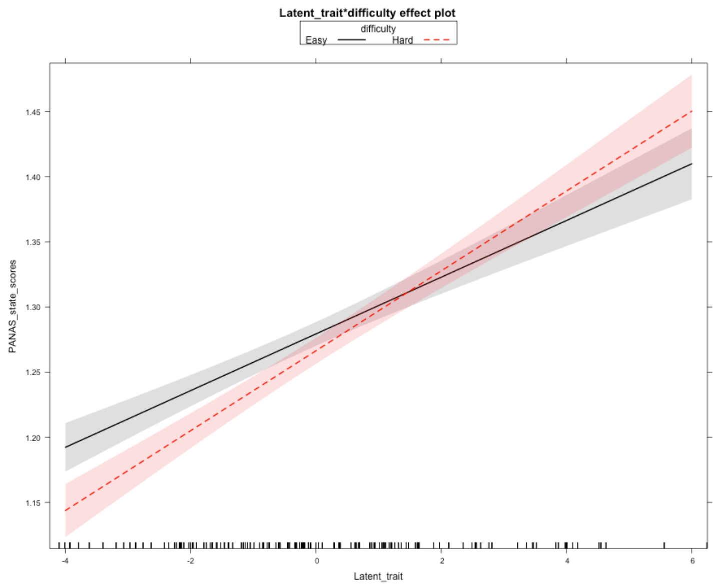

Figure 9. Under high cognitive load, people are more likely to rely on their general beliefs about emotions than those under low cognitive load. *Note.* The shaded area represents one standard error; the x-axis represents the levels of general beliefs about emotions (latent trait scores); the pink line represents the trait-state relationship among people under high cognitive load, and the black line represents people under low cognitive load.

These findings were consistent with the hypothesis that people under high cognitive load should be more likely to rely on their general beliefs to report their momentary emotions. This pattern was found especially when people were asked to recall feelings from a long time period ago, such as more than one or two weeks ago, but trends in the differences between correlations were not significant during each of the other time frames considered separately.

Test for Hypothesis 5: Semantic Memory vs. Episodic Memory

"People who were instructed to report their emotions using their semantic memory should be more likely to rely on their general beliefs about emotions than those who were instructed to use episodic memory, and this tendency should occur across all time frames."

In order to directly examine the relationship between semantic memory and people's tendency to rely on their beliefs when reporting emotions, participants received instructions to guide them to rely on either semantic or episodic memory when they report their emotions across time frames. The results showed that people who were instructed to use semantic memory had higher trait-state correlations than those using episodic memory within one week ago, but not for shorter or longer time frames (see Figure 10). However, none of these correlations were different across conditions. Also, the mixed model analysis did not find an interaction effect between trait scores and instructions on emotion reports, F (1, 150) = .42, p = .518.

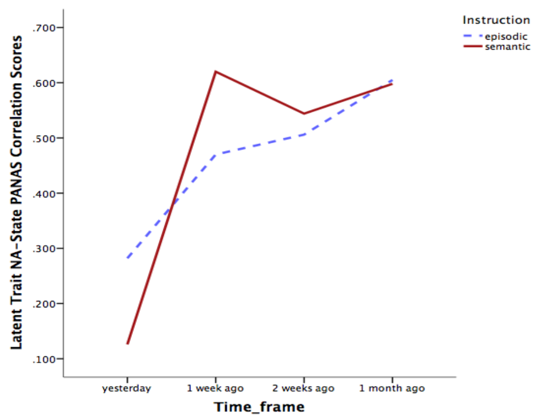

Figure 10. The differences between State-Trait correlations under semantic memory and episodic memory instructions across time frames.

Despite a consistent tendency for trait-state correlations to be somewhat higher among individuals receiving semantic than among episodic instructions within "one week ago" time frame, trait affect did not predict state affect differently across instructions. This hypothesis was, therefore, not supported by the data.

Trait-State Interactions across conditions

Since one purpose of this research was to explore how the trait scores interact with all the conditions across time frames to predict reported emotion, the interactions of the various factors within each time frame were of special interest. Regression results found a three-way interaction between latent trait scores, cognitive load conditions, and instruction conditions, but only within "one week ago" time frame, $F\ (1, 138) = 8.70$, $p = .004$, $\eta_p^2 = .059$ (see Figure 11). For yesterday, there were no such interaction, and among longer time frames, such as two weeks ago and one month ago, similar interactions showed up but only marginally significant.

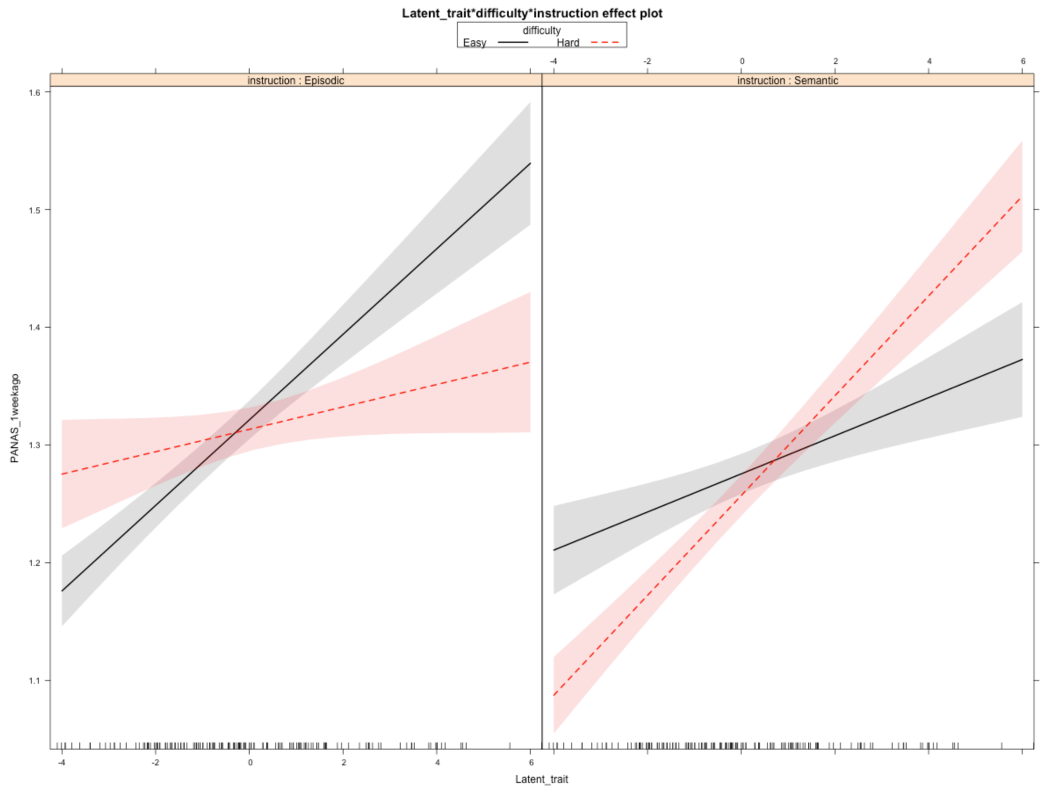

Figure 11. An interaction between latent trait, instructions, and cognitive load (p=.059) showing that when people who are under high cognitive load received semantic instructions, they relies on their beliefs to report emotions.

The interaction indicated that under high cognitive load, semantic instructions increased reliance on general beliefs (trait affect) when reporting emotions (state affect) within longer time frames. By contrast, under low cognitive load, episodic instructions also tended to increase reliance on beliefs, which was not expected.[3] To better understand this interaction, the correlations between latent trait scores and the emotion reports were

[3] Within "yesterday," "two weeks ago," and "one month ago," when people received episodic instructions, their reliance on general beliefs was not different across cognitive load conditions any more. However, when receiving semantic instructions, people under high cognitive load were more likely to rely on their general beliefs within longer time frames.

calculated and compared within conditions. Among individuals under high cognitive load, those who received semantic instructions showed higher correlations than those receiving episodic memory instructions within each of the three longer time frames (one week ago, two weeks ago, and one month ago). This difference was significant within the "one week ago" time frame (z = 2.93, p = .003, see Table 2), during which it was expected that semantic and episodic level information would both be accessible.

Table 2. Comparisons of trait-state affect correlations for the two instruction conditions as a function of cognitive load and time frame

	High Cognitive Load r (n)			
	Yesterday	One week ago	Two weeks ago	One month ago
Semantic Instruction	.09 (38)	.78 (38)	.68 (38)	.77 (38)
Episodic Instruction	.38 (32)	.30 (32)	.46 (32)	.66 (32)
Z Value (p)	-1.23 (.219)	**2.93 (.003)**	1.32 (.187)	.91 (.363)

	Low Cognitive Load r (n)			
	Yesterday	One week ago	Two weeks ago	One month ago
Semantic Instruction	.17 (37)	.37 (37)	.32 (37)	.32 (37)
Episodic Instruction	.22 (47)	.56 (47)	.53 (47)	.57 (47)
Z Value (p)	-.23 (.818)	-1.07 (.285)	-1.13 (.259)	-1.38 (.168)

In addition to comparing trait-state correlations for the semantic vs. the episodic, instruction conditions for each load condition, I also compared them for the high vs. the low cognitive load conditions for each instruction condition. That comparison showed that high cognitive load led to higher trait-state correlations than low load under semantic instructions. These differences were significant at each of the three longer time frames, z = 2.73, p = .006 (one week ago); z = 2.07, p = .039 (two weeks ago); and z = 2.86, p = .004 (one month ago) (see Table 3).

Consistent with the logic of the model, therefore, semantic instructions and high cognitive load in combination increased reliance on emotion beliefs (see Table 3). In addition, people tended to have higher trait-state correlations when low cognitive load was combined with episodic instructions, but those puzzling and unpredicted trends were not significant. Only the combination of semantic instructions and high cognitive load significantly increased reliance on emotion beliefs when people reported their emotions, especially for longer time frames. Overall, the results from both regression and correlational analyses indicated that multiple factors work together to increase the likelihood of people relying on their general beliefs about emotions when reporting their emotions.

Table 3. Comparisons of trait-state affect correlations for the two cognitive load conditions as a function of instructions and time frame

	Semantic Instruction r (n)			
	Yesterday	One week ago	Two weeks ago	One month ago
High Cognitive Load	.09 (38)	.78 (38)	.68 (38)	.77 (38)
Low Cognitive Load	.17 (37)	.37 (37)	.32 (37)	.32 (37)
Z Value (p)	-.34 (.734)	**2.73 (.006)**	**2.07 (.039)**	**2.86 (.004)**

	Episodic Instruction r (n)			
	Yesterday	One week ago	Two weeks ago	One month ago
High Cognitive Load	.38 (32)	.30 (32)	.46 (32)	.66 (32)
Low Cognitive Load	.22 (47)	.56 (47)	.53 (47)	.57 (47)
Z Value (p)	.74 (.459)	-1.35 (.177)	-.39 (.697)	.61 (.542)

Discussion

The Accessibility Model of Emotion Self-report (Robinson & Clore, 2002a; 2002b) concerns the conditions under which people's reports of emotions rely on prior beliefs rather than on the retrieval of actual emotional experiences. Previous research on the model has identified three factors that may influence people's ability to retrieve episodic memories of emotion: 1) general reaction times: when people have slow reaction times on cognitive tasks, they are assumed to be less efficient at bottom-up processing, and therefore general beliefs about emotions start filling in; 2) cognitive load: when people are under high cognitive load, they are less efficient at retrieving information from episodic memory, therefore beliefs and semantic memory start filling in; 3) time frame: when people report their general feelings or emotions from a past time period, episodic memory is less accessible so that again, general semantic memory fills in.

There have been only a limited number of studies testing aspects of the proposed framework (e.g., Robinson & Clore, 2002a, 2002b, 2007; Robinson & Oishi, 2006). Hence, this dissertation project was designed to test the assumptions of this model further and to explore the interaction among relevant variables. Three studies were conducted assessing how three different measures of cognitive capacity affect the role of emotion-relevant beliefs vs. recent emotional experiences in emotion reports. Some evidence was found in support of all of the hypotheses, although a number of comparisons were not significant and effects were generally small. In particular:

1) Evidence was mixed for the role of general processing speed that had been found in previous studies (e.g., Robinson & Clore, 2007). The model predicts higher correlations between self-beliefs about emotion and emotional

experiences among people with slow reaction times on the assumption that cognitive reaction times are sensitive to general cognitive capacity. Such correlational patterns were found in Study1 and weakly in Study3. Statistically significant results in regression models were found in Study 1 but not in Study 3.

2) Other evidence indicated that people with low working memory capacity (Study 2) or under high cognitive load (Study 3) were less efficient in bottom-up processing under some conditions and more likely to rely on their emotion-relevant beliefs.
3) Evidence was also found for the prediction that people would increase their reliance on emotion beliefs when their episodic emotion memories were relatively inaccessible. As time frames called for more distant memories, people were more likely to rely on their general beliefs about emotions to report their negative feelings. Such a pattern showed up in both correlational analyses and in the regression models in Study 3.
4) Evidence was mixed for the role of semantic instructions. The model predicts higher correlations between self-beliefs about emotion and emotional experiences among people receiving semantic instructions. Such correlational patterns were found but weakly in Study 3. The expected pattern of generally higher predictability of state negative affect from trait negative affect under semantic instructions was not significant in the regression models of Study 3.
5) In Study 3, there was evidence for interactive effects among several factors. People under high cognitive load were more likely to rely on their general

beliefs when retrieving their momentary feelings in longer time frames. Also, when people were instructed to report their feelings by retrieving their general beliefs about emotion, and they were under high cognitive load at the same time, they were more likely to rely on their general beliefs about emotions for self-reports of their momentary feelings. Moreover, this pattern was found only among time frames longer than “one week ago,” but not within short ones such as “yesterday.”

Implication

Across these three studies, a general pattern revealed that people with low cognitive capacity were more likely than people with high cognitive capacity to rely on general beliefs about their emotions as opposed to their actual experience to report past feelings. In addition, such differences were more likely to be observed among longer time periods, e.g., “one week ago,” but not among more recent time frames such as “yesterday.” Correlational results also indicated a big change in trait-state correlations from the “yesterday” to the “one week ago” time frame, but not much change in correlations for time frames longer than “one week ago”. In general, people started relying on their beliefs about emotion when recalling emotions they had experienced about one week ago, which is consistent with the findings of Robinson and Clore (2002b).

For many emotion reports, such as how one feels generally, how one would feel under different circumstances, or how one felt on in the past, feelings or episodic memories of emotion are simply inaccessible, so responses must reflect emotion beliefs. In addition, according to the accessibility model, as events recede into the past or when people do not have enough capacity or motivation, retrieving specific episodic memories may become difficult. As a result, top-down process and general emotion-relevant beliefs fill in.

In retrospect, the failure of the instruction manipulation is not surprising. The model is based on real world constraints on episodic memory, which should not be subject to change through intention and instruction. For example, the evanescence principle says that under some conditions, episodic-level information is simply inaccessible. Thus for one month ago, memories that might support reports of having or not having a specific emotion can no longer be retrieved. Participants are therefore probably unable to comply with instructions to base emotions reports for these times on episodic memories.

Even when both episodic and semantic-level information are accessible, the dominance principle says that people automatically use the most relevant, episodic level information. As a result, instructions to answer using semantic-level information may be relatively ineffective, since, at least according to the race model, episodic–level information should already have won the race or be most accessible.

The accessibility model assumes that beliefs are more or less constantly accessible, and these study results emphasized variation in people's ability to retrieve memories of experienced emotions. An alternative possibility, however, is that the accessibility of beliefs also varies. This possibility comes from research on working memory capacity and inhibitory control. In that research, a reduction in working memory capacity was found after cognitive demands were induced (Schmeichel, 2007). But such low working memory capacity can lead to increased emotionally intrusive thoughts, increased affective dysregulation in life (e.g., Brewin & Smart, 2005), and reduced inhibitory control, a moderator of the relationship between threat interference biases (measured by emotional Stroop) and social anxiety (Gorlin & Teachman, 2014). Such findings suggest that for some individuals, particular emotion-relevant beliefs may be especially accessible and even intrusive. Therefore, cognitive load manipulations not only reduce the ability to retrieve emotional experiences, but may also reduce inhibitory control of hyper-accessible emotional beliefs, which should also result in top-down, belief-based processes filling in. Viewing Stroop color-word interference scores as a measure of executive control (Golden & Freshwater, 2002) would be consistent with this interpretation of belief-based emotion reports.

Overall, one might assume that current feelings, by contrast, are always highly accessible. In fact, people with high levels of anxiety find their anxious feelings too accessible. But under ordinary circumstances, sometimes the nature and meaning of one's feelings may not be obvious, as when one feels ambivalent or has more than one feeling at the same time. People in psychological distress may often be awash in feelings that are disabling. Despite their accessibility, their meaning may be unclear solely on the basis of bottom-up processes, and their interpretation is likely to require the use of context and prior beliefs about emotion and about themselves.

The Accessibility model emphasizes that when reporting current emotions, episodic memory and bottom-up processes dominate, and semantic memory and top-down processes fill in only under certain conditions. However, the constructivist interpretation of emotion (Barrett, 2006) argues that feelings are not self-identifying and require context to make sense even when feelings are accessible. People may know from raw experience that they feel good or bad and excited or not, but beyond that, feelings require an interpretation supplied by belief or context or both. According to this theory, therefore, top-down processes are necessary across all kinds of emotional self-reports. For example, one knows that one is sad when one's pet has died, but without that context, the raw feelings appear to be much less obvious in their meaning. Within the current dissertation studies, people were asked to report their emotions without context, a task in which strictly bottom-up processing may be insufficient.

Limitations

Although Study 1 and Study 3 provided some evidence about how general processing speed influences the reliance on general beliefs about emotions when reporting feelings, in Study 2, motor speed on the Trails Making Test did not influence the relationship between negative self-beliefs (e.g., neuroticism) and emotion reports (e.g., self-reported depression and anxiety). One possibility is that only processing speed involving some kind of cognitive judgment, such as involved in categorization tasks, rather than simple word recognition times or times to connect dots should be expected to reflect the cognitive efficiency required to retrieve episodic memories of emotion.

Also, in Study 2, intelligence level (from two subtests explaining words and working on puzzles) did not influence the relationship between negative self-beliefs and emotion reports. This is possibly due to the involvement of a verbal task in this test, which made this intelligence score a less desirable representation of cognitive capacity.

Another limitation of the current study is the low effect size and non-significant effects from some regression models, especially for processing speed and the semantic instruction. One possibility is that the number of conditions led to relatively small sample sizes for particular comparisons, which led to lower power.

Conclusion

Despite mixed findings, such as the weak influence of categorization speed and semantic instruction on emotion reports, I found considerable evidence supporting the Accessibility model. The influences of cognitive load and time frame on the relationship between general beliefs about emotions and self-reported emotions were relatively clear, which is consistent with previous findings (e.g., Clore, 2002b; Robinson & Clore, 2007). Similarly, Studies 1 and 2 each found evidence that limited cognitive capacity increases the tendency for beliefs to trump memories of actual feelings in emotion reports. In sum, results from this dissertation project indicated that cognitive capacity has some influence on the accessibility of episodic memories for emotional experiences. When episodic information about emotional experiences becomes less accessible, top-down, belief-based processes start filling in to provide information for people to make emotion reports.

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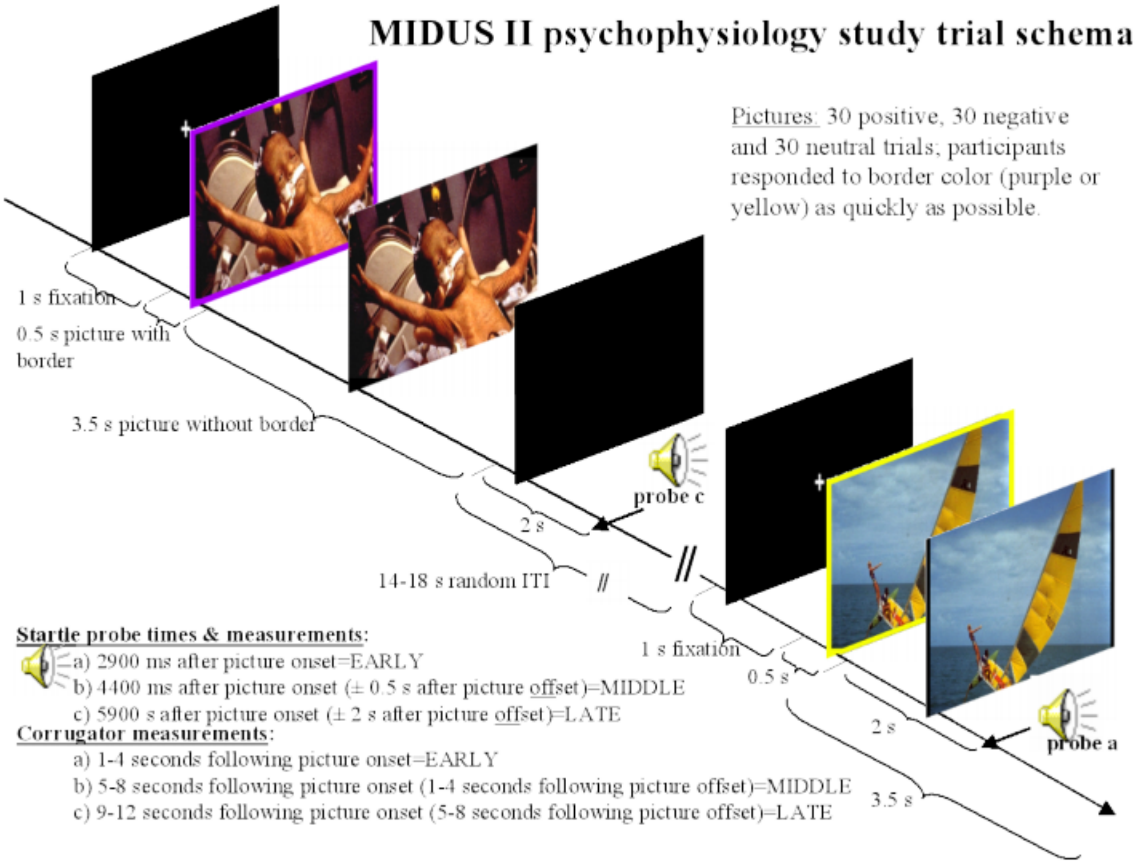
Appendix A

Study design in Study 1



Experimental design in Study 1.

Appendix B

PANAS State Affect Scale

This scale consists of a number of words that describe different feelings and emotions.

Read each item and then mark the appropriate answer in the space next to that word.

Indicate to what extent you feel this way RIGHT NOW, that is, AT THIS VERY MOMENT. Use the following scale to record your answers.

____distressed

____upset

____guilty

____scared

____hostile

____irritable

____ashamed

____nervous

____jittery

____afraid

Coding:

1 (very slightly or not at all)

2 (a little)

3 (moderately)

4 (quite a bit)

5 (extremely)

Appendix C

PANAS General Affect Scale

This scale consists of a number of words that describe different feelings and emotions.

Read each item and then mark the appropriate answer in the space next to that word.

Indicate to what extent you GENERALLY feel this way, that is how you feel ON AVERAGE.

____distressed

____upset

____guilty

____scared

____hostile

____irritable

____ashamed

____nervous

____jittery

____afraid

Coding:

1 (very slightly or not at all)

2 (a little)

3 (moderately)

4 (quite a bit)

5 (extremely)

Appendix D

STAI – Trait

A number of statements which people have used to describe themselves are given below. Read each statement and then write the appropriate number next to the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer that seems to describe how you generally feel.

1- Almost never

2- Sometimes

3- Often

4- Almost always

___ 1. I feel pleasant.

___ 2. I feel nervous and restless.

___ 3. I feel satisfied with myself.

___ 4. I wish I could be as happy as others seem to be.

___ 5. I feel like a failure.

___ 6. I feel rested.

___ 7. I am "calm, cool, and collected".

___ 8. I feel that difficulties are piling up so that I cannot overcome them.

___ 9. I worry too much over something that really doesn't matter.

___ 10. I am happy.

___ 11. I have disturbing thoughts.

___ 12. I lack self-confidence.

___ 13. I feel secure.

___ 14. I make decisions easily.

___ 15. I feel inadequate.

___ 16. I am content.

___ 17. Some unimportant thought runs through my mind and bothers me.

___ 18. I take disappointments so keenly that I can't put them out of my mind.

___ 19. I am a steady person.

___ 20. I get in a state of tension or turmoil as I think over my recent concerns and interests.

Appendix E

STAI - State

A number of statements which people have used to describe themselves are given below. Read each statement and then write the appropriate number next to the statement to indicate how you feel *right* now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1- Not at all
2- Somewhat
3- Moderately so
4- Very much so

___ 1. I feel calm.
___ 2. I feel secure.
___ 3. I am tense.
___ 4. I feel strained.
___ 5. I feel at ease.
___ 6. I feel upset.
___ 7. I am presently worrying over possible misfortunes.
___ 8. I feel satisfied.
___ 9. I feel frightened.
___ 10. I feel comfortable.
___ 11. I feel self-confident.
___ 12. I feel nervous.
___ 13. I am jittery.
___ 14. I feel indecisive.
___ 15. I am relaxed.
___ 16. I feel content.
___ 17. I am worried.
___ 18. I feel confused.
___ 19. I feel steady.
___ 20. I feel pleasant.

Appendix F

Instruction

Episodic Memory Instruction:

This study involves answering questions about specific instances of feelings and emotional experiences. We want you to answer the questions as quickly as possible by thinking about the time referred to in the question and recalling **specifically** how you felt.

For example, when you are asked how angry you felt yesterday, we want you to recall any applicable instances of anger, the physical symptoms or feelings you experienced during the instances, and then rate how angry you felt yesterday. Similarly, when asked how happy you felt a week ago, again we want you to review instances of feeling happy a week ago and answer how happy you remember feeling then. And when you are asked how anxious you felt two weeks ago, we want you to answer by reviewing specific occasions and indicating how intensely you recall feeling anxious. And when you are asked how sad you felt one month ago, answer again by recalling specific sad instances one month ago, and indicate how intensely you recall feeling sad.

Semantic Memory Instruction:

This study involves answering questions about feelings and emotions. We want you to answer the questions as quickly as possible by thinking about yourself generally and about the kinds of emotions you **typically** feel in various situations.

When you are asked how sad you felt one month ago, for example, we want you to answer (as quickly as you can) by considering how much you typically feel sad. Similarly, when asked how anxious you felt two weeks ago, we want you to answer on the basis of the extent to which you are usually an anxious person or not. And when asked how happy you felt a week ago, we want you to answer on the basis of what you know generally about yourself. And when asked how angry you felt yesterday, we want you to think about how angry you generally are, and then rate the likely degree of anger for yesterday.

Appendix G

Neuroticism Scale

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement.

Disagree Strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree Strongly
1	2	3	4	5

____1. Is depressed, blue

____2. Is relaxed, handles stress well

____3. Can be tense

____4. Worries a lot

____5. Is emotionally stable, not easily upset

____6. Can be moody

____7. Remains calm in tense situations

____8. Gets nervous easily