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The Influence of Mood on the Process and Content of Encoding Future Intentions

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Abstract

Remembering to perform an intention in the future when some environmental cue is encountered is referred to as event-based prospective memory. The influence of mood on this future-oriented memory is unclear. By experimentally manipulating mood, the current set of experiments sought to examine the influence that differing mood states have on encoding future intentions. Participants were induced into a neutral, positive, or negative mood state at intention formation and returned to their baseline mood before beginning the prospective memory task. Relative to the neutral mood, positive mood facilitated and negative mood impaired intention encoding when neutrally-toned cues were used, as evidenced by the proportion of cues subsequently detected. The use of negatively-toned cues ameliorated the benefit of the positive mood but not the impairment of the negative mood. Further, reinstatement of the encoding mood during retrieval equated performance for all three mood conditions. Results suggest that encoded mood influences the future accessibility and completion of intended behaviors, perhaps through modulation of associative processing. The current study demonstrates that mood plays a determining role in encoding future intentions.

Keywords: Prospective Memory, Affect, Future Intentions, Valence, Emotion Processing

The Influence of Mood on the Process and Content of Encoding Future Intentions

Prospective remembering involves the formation or encoding of a future intention (e.g., delivering a message to one's colleague) that may be associated to some environmental cue (e.g., the colleague) which when later encountered is meant to remind one of the planned intention. Such cue-dependent declarative memories have been labeled event-based prospective memories. Though empirical interest in prospective remembering has developed only recently (i.e., relative to the long research tradition of retrospective memory; Ebbinghaus, 1885; Harris, 1984; Einstein & McDaniel, 1990), reliance on prospective memory (PM) is ubiquitous in everyday life (McDaniel & Einstein, 2007). Intended behaviors can range from pleasant, anticipated actions (e.g., attending a party) to unpleasant, dreaded actions (e.g., attending court to contend a traffic violation) and so too can the cues associated with such future behavior (e.g., positive: the gift; negative: the speeding ticket on the counter). Additionally, intentions can be formed and retrieved in a variety of moods or emotional states, considering the propensity with which mood states fluctuate (Russell, 2003).[1] The investigation of how different mood states influence event-based PM has been largely neglected (but see Rummel, Hepp, Klein, & Silberleitner; 2012), besides correlational studies on intrinsic affective tendencies which have produced mixed results (see Kliegel & Jager, 2006 for a review). The current goal was to systematically investigate how differing moods modulate encoding of intentions for the future, and examine how this is influenced by negatively-toned cues and one's mood when the intention is to be fulfilled.

Encoding of Future Intentions

The importance of understanding the encoding of intentions is both intuitive and evident in the empirical demonstrations that PM performance can be significantly improved by optimizing encoding through such strategies as implementation intentions and imagery

(Chasteen, Park, & Schwarz, 2001; Gollwitzer, 1999, McDaniel, Howard, & Butler, 2008; Meeks & Marsh, 2010; Brewer & Marsh, 2010; Brewer, Knight, Meeks, & Marsh, 2011). Encoding of prospective memories overlaps to some extent with that of retrospective memories in that qualitative features (e.g. perceptual, contextual, and emotional) must be associated together to form a declarative representation (Bower, 1967; Johnson, Hashtroudi, & Lindsay, 1993; Marsh, Hicks, & Cook, 2006). Unlike retrospective memory, an action and the future context in which the prospective action is to be fulfilled must be associated with the declarative representation during encoding in order for the intention to be eventually fulfilled (Marsh, Hicks, & Cook, 2008; Brewer & Marsh, 2010). Thus, successful PM encoding is highly dependent on associative processing and can be a dynamic process which relies on executive control processes including episodic future simulation and planning (Brewer & Marsh, 2010; Martin, Kliegel, McDaniel, & 2003; Poppenk, Moscovitch, McIntosh, Ozcelik, & Craik, 2010).

Mood and Information Processing

Theoretical proposals of mood effects on information processing offer a framework for developing predictions about the influence of mood on prospective memory encoding. The affective-regulation-of-information-processing view (ARIP) suggests that people in a positive mood approach tasks with an integrative and relational processing style, whereas those in a negative mood are thought to engage tasks with a local and item-level processing style (Clore & Huntsinger, 2007; 2009). That is, associative processing is enhanced in a positive mood and hindered in a negative mood (Clore & Huntsinger, 2007). Consequently, individuals experiencing a positive mood, relative to a neutral or negative mood, have been found to engage in more global processing (Gasper & Clore, 2002; but see Huntsinger, Clore, & Bar-Anan, 2010), more easily form connections between words with weak associations (Bolte, Goschke, &

Kuhl, 2003), and have increased activation of associative memory networks evidenced by an elimination of intentional forgetting (Bauml & Kuhbandner, 2009). In contrast, those in a negative mood, relative to a neutral or positive mood, tend to engage in more local processing (Gasper & Clore, 2002), to process information in relation to accessible concepts less often (Storbeck & Clore, 2008), and to be less likely to associate the critical lure (in the DRM false memory paradigm) to the semantically-related encoded words (i.e., false lure memory is reduced as a result of item-level processing at encoding; Storbeck & Clore, 2005).

To the extent that positive mood promotes associative processing as predicted by the ARIP view, one would expect PM encoding to be facilitated by a positive mood induction. This notion is consistent with findings that future simulations are facilitated, in terms of vividness and amount of contextual details, for positive, relative to negative, events (D'Argembeau & Van der Linden, 2004). Additionally, PM encoding may be impaired by the tendency to engage in item-level processing when in a negative mood, as the needed associations may be insufficiently formed. Other mood (primarily positive) and information processing views make similar predictions about the influence of mood in the current study (Isen, 2008; Fredrickson, 2001).

Alternatively, successful intention formation is also reliant on planning processes to establish the appropriate strategy for fulfilling the intention, and planning has been found to be impaired by an induced positive mood and unaffected by an induced negative mood state, relative to a neutral mood (Oaksford, Morris, Grainger, & Williams, 1996; Phillips, Smith, & Gilhooly, 2002; Mitchell & Phillips, 2007). Thus, positive mood may have detrimental effects on future intention encoding, and negative mood may have no effect, which would be generally consistent with Rummel and colleagues (2012) finding that positive relative to negative and neutral moods during the retrieval phase of a PM task impaired performance. Some researchers have proposed the deleterious effects on planning result from positive mood engendering superficial, nonrigorous processing that would not be beneficial for such executive control processes (Mitchell & Phillips, 2007; Phillips et al., 2002). Others have suggested these impairments may have arisen because the task or materials were dull and unpleasant and participants saw no benefit in attending to the task (Isen, 2008). Research investigating social goal pursuit has demonstrated that associating negatively-valenced material with goal representations can reduce the goal's activation level and accessibility, evidenced by slower response times and diminished goal completion relative to neutral goals (Aarts, Custers, & Holland, 2007; see Dijkstterhuis & Aarts, 2010 for review). Thus, cognitive processing may only benefit from positive affect when the task and materials used are non-aversive. Considering these competing predictions, in Experiment 1 we first sought to examine the influence that varying mood states have on forming intentions associated to non-aversive cues. Then in Experiment 2, we investigated the effects of mood on intention encoding when undesirable (i.e., negatively-toned) cues were associated to the intention.

Mood as a Representation

In addition to the influence mood has on how information is processed, mood can also impact the *content* of information that is attended to and encoded (Elliott, Rubinsztein, Sahakian, & Dolan, 2002; Innes-Ker & Niedenthal, 2002). Bower's (1981) network theory of affect proposes that when an event is experienced in a certain mood, emotion-specific features are bound to the memory trace (e.g., Bower, 1967). In line with this idea, neuroimaging studies of retrospective memory have shown that emotion-related brain activity in the prefrontal cortex and amygdala was elicited at encoding (Erk et al., 2003) and retrieval (Maratos, Dolan, Morris, Henson, & Rugg, 2001) of neutral information that was learned in either a positive or negative context. Thus, the emotional context is thought to affect the features of an event's mnemonic representation. This may impact the future accessibility of intentions encoded in varying mood states, such that the intended action may be less easily retrieved when the mood at retrieval does not sufficiently overlap the mood present at encoding, as is the case in mood-dependent effects found in retrospective memory (Bower, Monteiro, & Gilligan, 1978; Blaney, 1986; Smith, 1995; Forgas, 2008; Lewis & Critchley, 2003; see Bower & Mayer, 1985; Eich & Macauley, 2006 for limitations and constraints of mood-dependent views). These ideas derive from Tulving and Thompson's (1973) encoding-specificity principle and the classic finding that previously inaccessible memories were able to be retrieved when a category cue was provided that reinstated sufficient features from the encoding context (Tulving & Pearlstone, 1966). When considering the possible detriments of mood on intention encoding, it is important to determine whether the intention representation is available—effectively encoded and stored in memory—but not accessible during the retrieval (i.e., intention execution) interval, due to insufficient retrieval cues. Accordingly, in all of the present Experiments we tested participants' retrospective memory for the intention following the PM task. Further, in Experiment 3 we matched the encoding and retrieval mood states to better understand the impact of the intention encoding mood on availability versus accessibility and elucidate its susceptibility to mood-dependent effects.

Experiment 1

The goal of this experiment was to systematically investigate the effects of differing mood states on encoding prospective memories. Participants were induced into either a positive, negative, or neutral mood state directly before they encoded the same prospective intention. We used a standard prospective memory paradigm in which participants were informed of the

Lexical Decision Task that they would complete later in the experiment; then all participants were given a list of neutrally-toned words to learn and were told to make a special key press if they encountered them later during the task. We wanted the mood states across the three groups of participants to only differ when the intention was encoded, so we engaged participants in a distractor task and allowed time for them to return to their baseline mood state before beginning the task in which they were to complete the intention (Van Dillen & Koole, 2007). Thus, to the extent that differences in PM performance are found between conditions, they would be attributable to differences in mood at encoding because that was the only manipulated difference between the conditions.

Method

Participants

Undergraduate students from the University of Georgia (UGA) student population participated for credit towards a research appreciation requirement. Participants were randomly assigned to three conditions: neutral mood induction (n=29), positive mood induction (n=29), and negative mood induction (n=31). All participants gave informed consent; and all experiments in this study were approved by the UGA Institutional Review Board.

Procedure

Mood Induction. The mood induction procedure was adapted from Velten (1968). Statements meant to elicit either a positive, negative, or neutral mood state were obtained from published reports using a similar procedure (Velten, 1968; Seibert & Ellis, 1991; Jennings, McGinnnis, Lovejoy, & Stirling, 2000). A total of 50 statements for each mood condition were selected and 25 of those were randomly presented during the induction procedure (e.g., Neutral: "An orange is a citrus fruit"; Positive: "I have got some good friends"; Negative: "I do not think that anyone likes me." Each statement was presented on the screen for ten seconds. Standard instructions used in previous studies were implemented (Seibert & Ellis, 1991; Colibazzi et al., 2010). Participants were told to read the sentence and focus on it for the entirety of the time that it was on the screen. They were instructed to try to think about the emotion expressed in the statement and to imagine themselves being in the situation described by the current statement (Jennings et al., 2000).[3]

Mood Assessment. At multiple stages during the experiment, each participants' current mood state was assessed with the Brief Mood Introspection Scale (BMIS; Mayer, & Gaschke, 1988). On a likert scale ranging from 1 to 4 (1: definitely do not feel, 2: do not feel, 3: slightly feel, 4: definitely feel), participants rated how well each of 16 adjectives described their current mood state. The adjectives were *lively, happy, sad, tired, caring, content, gloomy, jittery, drowsy, grouchy, peppy, nervous, calm, loving, fed up,* and *active*. Participants completed this scale at the outset of the experiment to provide a baseline mood measurement when they began the experiment. This scale was also completed after the mood induction procedure as well as before beginning the lexical decision task. The brief nature of the scale makes it optimal for multiple administrations within an experiment (Mayer & Gaschke, 1988). The pleasantness/unpleasantness of the participants' subjective experience of their current mood state was assessed using the BMIS. Mood ratings were obtained for each participant by adding the scores given for the adjectives *active, calm, caring, content, happy, lively, loving,* and *peppy* and subtracting the scores given for the adjectives *drowsy, fed up, gloomy, grouchy, jittery, nervous, sad,* and *tired* (Mayer & Gaschke, 1988). Mood ratings from the baseline BMIS were subtracted from each of the ratings given for the other two BMIS administrations to have assessments of how each participant's mood at encoding and commencement of the task differed from baseline.

For example, if a participant's mood rating on the initial BMIS was 10 and her rating on the second BMIS after the positive mood manipulation was a 17, then her mood at encoding would be coded as a 7. Thus, the participant would be considered to be in a more positive mood than when she began the experiment.

Task and Materials. Participants completed 210 trials of a lexical decision task (LDT) in which they decided whether a presented string of letters constituted a valid English word or a nonword. Words, of which 105 were presented, were obtained from the Kucera and Francis compendium (1969). There were 105 pronounceable nonwords (e.g., *spange*) presented which were formed by changing one or two of the letters of words from the same collection. These words and nonwords were used for all experiments presented herein. Words and nonwords were presented randomly and each trial was separated by an intertrial interval during which the word "waiting" appeared on the screen. Participants pressed the space bar to begin the next trial.

After participants completed the initial BMIS, they were engaged in the mood induction procedure which lasted about four minutes. The only difference across the groups was whether the Velten-like statements were neutral, positive, or negative. Subsequently, the second BMIS was administered to assess each participant's mood after the mood induction procedure. Participants then received instructions about the LDT that they would complete later in the experiment. If they were presented with a word, they were to press the key on the keyboard labeled "word" (i.e., the "J" key); however, if a nonword was presented, they were to press the key labeled "nonword" (i.e., the "F" key). Additionally, they were given a list of eight neutrally-toned words and told if they encountered any of those words during the LDT they were to press the "word" key as usual then press the "/" key during the "waiting" message. The eight words constituted the intention-related cues, and pressing the "/" key served as the intended action.

Pressing the "/" key would cause the next trial to begin. All eight cues were words chosen from the Affective Norms for English Words database (ANEW; Bradley & Lang, 1999), and they were all from the animal category (*fish*, *lamb*, *horse*, *lion*, *cat*, *frog*, *hawk,* and *pig*). Words in the ANEW database are rated according to their valence and arousal characteristics, separately. The rating scale for both characteristics ranges from 1 to 9. Valence ratings below 4 are typically considered negatively-toned, between 4 to 6 are neutrally-toned, and above 6 are positively toned. For arousal, ratings below 4 are low, between 4 to 6 are moderate, and above 6 are high. The cues used in the present experiment were neutrally-toned in valence (M = 5.72, SE = .11) and moderately arousing (M = 4.37, SE = .29). Participants learned the eight words to criterion such that the next part of the experiment did not commence until they were able to recite all of the words back to the experimenter. Criterion learning was achieved in one or two attempts for the majority of participants (M=96%), and after this point the intended action or intention-related cues were not mentioned again. Participants then completed a five minute distractor task (i.e., a number find task in which participants must find a string of numbers in a matrix of digits). The purpose of this procedure was two-fold: to ensure that the prospective intention was not in the focus of attention when the LDT began and to allow ample time for participants to return to their baseline mood state. Considering the effects of mood induction procedures are typically transient (Kenealy, 1986), this task should have allowed sufficient time for the induced mood to have dissipated. A recent study demonstrated that the effects of an induced mood had subsided five minutes after the induction procedure had ended (Kliegel et al., 2005). Additionally, tasks consuming working memory processing have been found to reduce effects of negative mood induction, possibly by interfering and reducing rumination that might have otherwise maintained the mood state (Van Dillen & Koole, 2007). Thus, this delay period and distractor task served to ensure the effects of the mood induction procedures were not present when the LDT began. Upon completion of the five minute distractor task, participants completed the final BMIS to assess their mood and to further confirm the expectation that mood induction effects had in fact dissipated.

Participants were then engaged in the lexical decision task. During the task, four of the eight intention-related cues (*fish*, *lamb*, *horse,* and *lion*; $M_{\text{valence}} = 5.85$, $SE = .1$; $M_{\text{arousal}} = 4.4$, $SE = .63$) were presented once on four randomly selected trials from this set: 25, 50, 75, 100, 125, 150, 175, or 200. Participants were asked to learn eight cues to place greater demands on encoding, in aims of increasing its susceptibility to influences of mood state across participants. After finishing the LDT, participants completed a recognition memory test that assessed the participants' retrospective memory for the eight cues using the exact same information to query memory—the cue words themselves. A sheet of paper containing 16 words (the eight cues and eight new words from the animal category) was given to them, and they were to circle the eight words that they learned at the beginning of the task. If participants could accurately recognize the cues on the final memory test, then it is unlikely that failures to respond to the cues during the LDT could be attributed to failures of retrospective memory and would suggest that the individual contents of the intention were available.

Results and Discussion

Mood Manipulation Check

For all analyses in the present 3 Experiments, statistical significance was set at the traditional alpha level of $p <= .05$, and results obtained in the $.05 < p <= .08$ range were considered and discussed as marginally significant. The one-way ANOVA with the factor of condition (neutral, positive, negative) examining the success of the mood induction procedure revealed that the baseline-adjusted subjective mood ratings significantly differed across the three groups at encoding (Negative: *M* = -4.9, *SE* = 1.02; Neutral: *M* = -1.1, *SE* = .82; Positive: *M* = 4.28, *SE* = .82), $F(2,86) = 26.58$, $p < .001$, $\eta^2_p = .38$. Planned comparisons, computed with separate one-way ANOVAs including two groups (e.g., neutral vs. positive), revealed that relative to the neutral condition mood ratings were significantly higher for the positive condition, $F(1,56) = 21.43$, $MSE = 19.58$, $p < .001$, $\eta^2_p = .28$, and significantly lower for the negative condition, $F(1,58) = 8.31$, $MSE = 26.02$, $p = .006$, $\eta^2_p = .13$. Critically, participant's baseline-adjusted ratings of their mood state did not differ across conditions at the beginning of the LDT during (Negative: *M* = -1.23, *SE* = .62; Neutral: *M* = -1.55, *SE* = .72; Positive: *M* = .45, *SE* = .82), $F(2,86) = 2.16$, $MSE = 23.90$, $p = .121$, $\eta^2_p = .05$. Planned comparisons indicated that mood ratings for the negative and neutral condition did not significantly differ, $F < 1$, and there was a marginal difference between the positive or neutral condition, $F(1,56) = 3.33$, $MSE = 17.44$, $p = .074$, $\eta^2_p = .06$; however, this difference was driven by the neutral condition ratings becoming slightly, but not significantly, more negative over the distractor interval, *M diff* = -.45; $F < 1$. Importantly, average mood ratings in the positive condition were nearly identical to baseline, evidenced in the near zero mean listed above. Therefore, the induction procedure successfully led to different mood states across the three conditions at encoding, and the induced moods had dissipated before the onset of the LDT.

Prospective Memory Performance

Cue detection was operationalized as the proportion of the cues that received a "/" key response (i.e., cues that elicited the intended action) and was calculated separately for each condition. Late responses were not included because of their infrequency (1.2 % of responses) and because late PM responses could technically be considered a PM failure, due to the time-sensitive nature of PM (i.e., showing up an hour late to a meeting constitutes a failure to complete one's intended action). Averaged word (nonword) accuracy represents the mean proportion of correct responses to words (nonwords) for each condition. Averaged word (nonword) latency reflects the mean response times to words (nonwords) across participants for each condition. Individuals' word and nonword response times that exceeded 2.5 standard deviations were excluded from analyses. This resulted in a total loss of 3.4 % of the data, and including these trials did not change any of the results reported here. Cue interference was calculated by subtracting each individual's mean word latency from his/her mean latency to indicate successfully detected cues were words. This measure provided an assessment of the degree to which successfully detecting and responding to intention-related cues interfered with word processing (Marsh et al., 2003).

For all three experiments, means and standard errors for examined accuracies and latencies can be found in Table 1, except cue detection which is plotted in Figure 1. Results from a one-way ANOVA revealed that cue detection was significantly affected by the mood induced at encoding, $F(2,86) = 8.06$, $MSE = .09$, $p = .001$, $\eta^2_p = .16$. Planned comparisons indicated that the positive mood encoding condition subsequently detected significantly more cues relative to the neutral condition, $F(1,56) = 4.64$, $MSE = .059$, $p = .036$, $\eta^2_p = .08$, whereas the negative condition detected marginally fewer cues than the neutral condition, $F(1,58) = 3.61$, $MSE = .11$, $p = .063$, $\eta^2_p = .06$. Average word and nonword accuracy did not significantly differ across conditions, $Fs < 1$. Conditions also did not differ in average latencies for words, $F(2,86) = 2.04$, $MSE = 18794.71$, $p = .137$, $\eta^2_p = .05$, or nonwords, $F < 1$. An absence of differences in response accuracies and latencies suggest the conditions did not differ in the level of motivation or attention to complete the task or in the amount of processing devoted towards noticing the intention-related cues. Cue interference did not differ across conditions, $F < 1$, suggesting the processes engaged when a cue was noticed were similar across conditions. Additionally, results from the post-experimental recognition test revealed that across the three mood induction conditions participants did not differ in how well they retrospectively remembered the eight intention-related cues, $F(2,86) = 2.42$, $MSE = .005$, $p = .095$, $\eta^2_p = .05$, indicating that the differences in cue detection likely cannot be attributed to a failure to remember which cues were to receive a prospective response. False alarm rates on the recognition test were very low (< 1%) and statistically equivalent across conditions in each of the present experiments, Fs < 1, and thus will not be considered further. Hence, for all mood conditions the intention representation was available in memory and accessible when retrieval was explicitly probed in the recognition task. In contrast, when the same word (i.e., identical memory cue) occurred during the PM task it differentially elicited the intended action for varying encoding moods, suggesting a mechanistic dissociation between prospective and retrospective memory retrieval and their interaction with affective states present during encoding.

Data from Experiment 1 demonstrated, for the first time to our knowledge, that when forming an intention to execute some behavior in the future one's mood state substantially influenced how that intention was encoded which subsequently affected the likelihood of that planned behavior being fulfilled. Positive mood, relative to a neutral mood, benefited prospective memory encoding, perhaps by facilitating associative connections between the cues, intended action, and future retrieval context (Clore & Huntsinger, 2007; 2009). Negative mood appeared to impair intention encoding, relative to neutral mood. Although this difference was marginal, it does reveal that negative mood did not promote processing beneficial for encoding prospective memories. The presence of a negative mood may have engendered item-level, non-associative processing that could raise difficulties in encoding future intentions (Clore & Huntsinger, 2007; 2009).

Experiment 2

The goal of Experiment 2 was to examine how negatively-toned cues would affect PM encoding when one is in a neutral, negative, or positive mood. This manipulation matches the affective tone of the cues with the existing mood in the negative condition and leads to a mismatch in the positive condition. A number of studies have demonstrated that one's current mood can engender an emotional context that facilitates encoding of congruently-valenced material (Bower, Gilligan, & Monteiro, 1981; Gray, Braver, & Raichle, 2002; for reviews see Blaney, 1986; Rusting, 1998). Thus, the negatively toned cues in this experiment could facilitate formation of the intention in the negative condition and result in improved PM performance relative to the neutral condition. Positive mood has been found to impair goal planning (Oaksdale et al., 1996), and this may result from the task materials being relatively unpleasant (Isen, 2008). This notion is consistent with findings that goals associated with negatively-toned materials are reduced below the normally heightened accessibility of goals and are less likely to be completed (Aarts et al., 2007). Ergo, the positive condition's PM performance may be at or below the neutral condition's level because the positive condition exhibited better performance when neutral cues were used in Experiment 1. The current experiment was aimed at providing evidence as to whether the benefits of positive mood to intention encoding are robust in the presence of incongruent (negative) intention-related cues, and whether the detriments of negative mood to encoding are offset by the presence of congruent cues.

Method

Participants

Undergraduate students from the University of Georgia (UGA) student population participated for credit towards a research appreciation requirement. Participants were randomly assigned to three conditions: neutral mood induction (n=31), positive mood induction (n=29), and negative mood induction (n=31). All participants gave informed consent.

Procedure

The same materials and procedure from Experiment 1 were implemented in this experiment with one exception. The intention-related cues in this experiment were negatively-toned words (*cancer*, *failure*, *morgue*, *killer*, *gloom*, *grief*, *torture*, and *upset*) rather than neutral words. During the intention encoding phase, participants across all conditions learned eight negatively-toned words which served as the intention-related cues (Valence M = 1.77, SE = .06; Arousal M = 5.58, SE = .44). During the LDT, four of those cues (*cancer*, *failure*, *morgue*, and *killer* M_{valence} = 1.75, SE = .1; M_{arousal} = 6.02, SE = .71) appeared randomly on four of the eight trials previously mentioned for Experiment 1.

Results and Discussion

Mood Manipulation Check

The one-way ANOVA with factors of condition (neutral, positive, negative) examining whether baseline-adjusted mood ratings (see Exp. 1 Method) were affected by the mood induction procedure revealed that the subjective mood ratings significantly differed across the three conditions at encoding (Negative: M = -3.84, SE = .84; Neutral: M = -.19, SE = .63; Positive: M = 2.38, SE = .61), $F(2,88) = 19.47$, $p < .001$, $\eta^2_p = .31$. Relative to the neutral condition mood ratings were significantly higher for the positive condition, $F(1,58) = 8.57$, $MSE = 11.58$, $p = .005$, $\eta^2_p = .13$, and significantly lower for the negative condition, $F(1,60) = 12.08$, $MSE = 17.05$, $p = .001$, $\eta^2_p = .17$. Critically, participant's subjective ratings of their mood state did not differ across conditions when the LDT commenced (Negative: M = -.77, SE = .60; Neutral: M = -1.55, SE = .85; Positive: M = .72, SE = .71), $F(2,88) = 2.47$, $MSE = 18.65$, $p = .09$. Planned comparisons indicated mood ratings did not significantly differ between the neutral and negative conditions, $F < 1$; mood ratings for the neutral condition were significantly lower than the positive condition, $F(1,58) = 4.15$, $MSE = 18.65$, $p = .046$, $\eta^2_p = .07$; however, positive condition mood ratings did not significantly differ from the negative condition, $F(1,58) = 2.61$, $MSE = 12.88$, $p = .112$, $\eta^2_p = .04$.

Prospective Memory Performance

Cue detection, average word and nonword accuracies and latencies, cue interference, and recognition memory accuracy were all calculated the same as in Experiment 1 (See Table 1 for means). Results from a one-way ANOVA revealed that cue detection differed significantly across conditions, $F(2,88) = 3.22$, $p = .045$, $\eta^2_p = .07$ (Figure 1). Planned comparisons demonstrated that the positive and neutral mood conditions did not differ in the proportion of cues detected, $F < 1$, whereas the negative mood condition detected significantly fewer cues compared with the neutral condition, $F(1,60) = 6.23$, $MSE = .15$, $p = .015$, $\eta^2_p = .09$. Across conditions no differences in accuracy occurred for either words, $F < 1$, or nonwords, $F(2,88) = 1.7$, $MSE = .01$, $p = .189$, $\eta^2_p = .04$. No differences across conditions were found in either average word or nonword latency, $Fs < 1$, suggesting participants across conditions devoted similar levels of processing and motivation towards the task and fulfilling the intention. Cue interference levels did not significantly differ across conditions, $F < 1$, indicating that processing of detected cues was similar across conditions. Post-experimental recognition memory accuracy for the cues marginally differed across the three mood conditions, $F(2,88) = 2.92$, $MSE = .003$, $p = .059$, $\eta^2_p = .04$; follow up one-way ANOVAs, contrasting recognition accuracy for the neutral condition with the positive and negative conditions separately, were conducted to examine the nature of this marginal effect. These analyses revealed that recognition accuracy for the cues was significantly lower in the positive condition relative to the neutral condition, $F(1,58) = 5.28$, $MSE = .003$, $p = .025$, $\eta^2_p = .08$, whereas the negative and neutral condition did not differ in recognition memory performance, $F < 1$. Thus, the poorer PM performance in the negative condition was likely not due to a failure to remember the cues associated with the intention, providing further evidence of differential prospective and retrospective retrieval accessibility of intention-related representations learned in a negative mood.[4]

In spite of the congruence between existing mood state and the affective tone of the cues, negative mood induction at encoding still impaired the formation of the future intention as evidenced by the significantly lower cue detection relative to the neutral condition. Any benefit that may have resulted from the congruence was not enough to counteract the deleterious influences of the induction of a negative mood. Additionally, in this experiment the positive condition did not exhibit higher cue detection than the neutral condition, despite having a larger sample size than in Experiment 1. Rather, the two conditions displayed statistically equivalent performance and if anything the positive condition performed quantitatively worse relative to the neutral condition. The incongruence in the existing mood and the affective tone of the intention-related cues may have disrupted the benefits of a positive mood that was observed in Experiment 1, consistent with mood-incongruent impairments of future-oriented thinking found in future simulation studies (Hepburn, Barnhofer, & Williams, 2006). A somewhat different interpretation is that positive mood may not have benefited encoding here because it involved negatively-toned content that was either deemed uninteresting (Isen, 2008) or was prohibitive to goal activation (Aarts et al., 2007). This notion is more in line with findings that planning was hindered by a positive mood; however, a significant decrement resulting from positive mood was not observed here (Oaksdale et al., 1996; Phillips et al., 2002). Experiment 2 demonstrated that, relative to a neutral mood state, positive mood does not facilitate and negative mood impedes PM encoding when the intention is associated with negatively-toned cues.

Experiment 3

The goal of Experiment 3 was to examine if reinstating the encoding mood during the LDT would benefit performance in the positive and negative mood conditions when the valence of the intention-related cues was negative, because these cues resulted in the lowest performance previously. Mood-dependent effects in retrospective memory entail that retrieval of information is facilitated when one encodes information in a certain mood and subsequently is in the same mood when retrieval is attempted (Bower, 1981; Eich, 1995; but see Bower & Mayer, 1985). Mood-dependency is more prevalent when encoding of information involves elaborative and constructive processing, like in the prospective memory encoding here (Forgas, 1995). When such moods are reinstated (e.g., by mood induction), the emotion-related activation is thought to spread to associated features thereby creating above-baseline excitation of those representations (Bower, 1981; Lewis & Critchley, 2003). In the present experiment, this spreading activation may lead to a heightened accessibility of the intention representation, and thus increase the likelihood that in the presence of the cues the intention is retrieved and ultimately fulfilled. Here we reinstated the encoding mood by presenting an additional mood induction directly prior to the LDT and playing mood-congruent music throughout the LDT. Our aim was to examine if negative mood states and cues were generally maladaptive, or if performance levels comparable to neutral and/or positive moods and neutral cues can be obtained with a greater overlap in the encoding and retrieval mood.

Method

Participants

Undergraduate students from the University of Georgia (UGA) student population participated for credit towards a research appreciation requirement. Participants were randomly assigned to three conditions: neutral mood induction (n=28), positive mood induction (n=28), and negative mood induction (n=28). All participants gave informed consent.

Procedure

The same materials and procedures from Experiment 2 were implemented here with a few exceptions. After participants learned the list of intention-related cues to criterion, they completed the number find distractor task for one minute rather than five minutes. This distractor time change served to maintain the same amount of elapsed time between coding and LDT onset that was used in Experiments 1 and 2, as the second mood induction procedure last 4 minutes. Hence for all three experiments herein, the total delay period between encoding and LDT onset was 5 minutes. After the number find task, participants completed a second mood induction procedure (Velten, 1968). The valence of this mood induction procedure matched the initial induction procedure for each respective condition. The same 50 self-referent statements for each condition from the previous two experiments were used; 25 of those were randomly presented for the first induction procedure, and the other 25 statements were randomly presented for the second induction procedure. At the conclusion of the second induction, participants completed the BMIS to check that the mood induction procedure was effective in inducing the appropriate mood state. As participants completed this form mood congruent music (e.g., the positive condition heard positive music) began playing and continued playing in the background for the remainder of the experiment. The second mood induction and the mood congruent music throughout were implemented in order to induce and sustain a similar mood during the LDT that was induced during the intention encoding phase. The musical pieces used for all three conditions were classical songs that have been used as mood induction supplements previously (see Gerrards-Hesse, Spies, & Hesse, 1994 for a review). The songs were chosen to be congruent with the mood induction procedure for each condition. The neutral condition heard Chopin Waltzes no. 11 in G-flat and no. 12 in F minor (Wood, Saltzberg, & Goldsamt, 1990), the positive condition heard Mozart's "Eine kleine Nachtmusik" (Eich & Metcalfe, 1989), and the negative condition heard "Moonlight Sonata" by Beethoven (Gerrards-Hesse, Spies, & Hesse, 1994). After the LDT, participants completed the final BMIS to assess whether the induced mood had been sustained throughout the task. Each of the BMIS mood ratings had the baseline BMIS ratings subtracted from them, as in the previous experiments. To ensure that those in the negative condition did not leave the experiment in a negative mood, they were shown a comedy video (i.e., a musical video about the TV comedy show *The Office*) before the experimenter debriefed them and ensured that their negative mood state had dissipated.

Results and Discussion

Mood Manipulation Check

A one-way ANOVA with factors of condition (neutral, positive, negative) was conducted to examine participants' mood state at encoding, at the beginning of the LDT, and after completion of the LDT. Analysis was conducted using baseline adjusted mood ratings for each stage of the task. Participants' subjective ratings of their mood significantly differed across conditions at encoding (Negative: M = -6.79, SE = 1.03; Neutral: M = -1.54, SE = .84; Positive: M = 3.0, SE = .74), $F(2,81) = 31.23$, $MSE = 21.50$, $p < .001$, $\eta^2_p = .44$, at the onset of the LDT (Negative: M = -9.17, SE = 1.2; Neutral: M = -3.75, SE = 1.01; Positive: M = 2.46, SE = .94),

F(2,81) = 30.42, MSE = 31.24, p < .001, η^2_p = .43, and after completion of the LDT (Negative: M = -6.61, SE = 1.12; Neutral: M = -3.93, SE = 1.28; Positive: M = .71, SE = .84), F(2,81) = 11.41, MSE = 33.68, p < .001, η^2_p = .22. Planned comparisons revealed that mood ratings were significantly greater for the positive than the neutral mood condition at encoding, F(1,54) = 16.42, MSE = 17.54, p < .001, η^2_p = .23, LDT onset, F(1,54) = 20.22, MSE = 26.75, p < .001, η^2_p = .27, and LDT completion, F(1,54) = 9.13, MSE = 33.07, p = .004, η^2_p = .15. The negative condition mood ratings were significantly lower than the neutral condition at encoding, F(1,54) = 15.65, MSE = 24.66, p < .001, η^2_p = .23, and LDT onset, F(1,54) = 12.10, MSE = 34.40, p = .001, η^2_p = .18; though numerically lower the difference did not reach conventional levels of significance after the LDT, F(1,54) = 2.48, MSE = 40.57, p = .12, η^2_p = .04. However, after the LDT mood ratings were significantly lower for the negative than positive condition, F(1,54) = 27.37, MSE = 27.42, p < .001, η^2_p = .34. Generally, the induction procedures successfully induced and maintained differential mood states for the three conditions.

Prospective Memory Performance

The same dependent variables from Experiments 1 and 2 were examined as to how they would be influenced by matching the mood from encoding with the mood present during the retrieval (i.e., LDT). ANOVA results revealed that there were no differences in cue detection across the three conditions F < 1 (Figure 1). Planned comparisons demonstrated that, relative to the neutral condition, the proportion of cues detected did not differ for either the positive, F(1,54) = 1.31, MSE = .12, p = .26, η^2_p = .02, or negative condition, F < 1. As in the previous two experiments, the three conditions did not significantly differ in their word and nonword accuracies and latencies or cue interference, Fs < 1. Additionally, recognition memory accuracy for the intention-related cues did not significantly vary across conditions, F < 1.

These data indicate that the presence of negative mood or cues when encoding a delayed intention does not entirely impair the associations that must be formed to subsequently fulfill the intention. Rather, when mood was reinstated during the context when the intention was to be executed, the negative condition exhibited cue detection levels that were statistically equivalent to the other two conditions. Though numerically greater, the positive condition did not exhibit significantly greater cue detection than the neutral condition, suggesting the incongruency of the negative cues and the positive mood may still have had some impairing influence.

General Discussion

These three Experiments demonstrated that one's mood state when encoding a prospective memory influences the formation of the future intention and the likelihood that it will be subsequently fulfilled. In the first two experiments mood was systematically manipulated at encoding to isolate the effects that different mood states have on the formation of future intentions. Relative to a neutral mood, positive mood facilitated and negative mood impaired (marginally) intention formation when it was associated with neutrally-toned cues (Exp. 1). When negatively-toned cues were encoded with the intention, the negative mood condition exhibited the same pattern, whereas positive mood induction no longer benefited encoding relative to neutral (Exp. 2). Reinstatement of the encoding mood state during retrieval resulted in both the positive and negative mood induction conditions exhibiting PM performance that was statistically equivalent to the neutral condition.

Intriguingly, these effects of varying mood states on the efficacy of PM encoding and subsequent intention fulfillment were accompanied by nearly identical levels of retrospective memory regardless of encoding mood. Across each of the three experiments, statistically equivalent, high recognition memory accuracy for intention-related cues was observed for each mood condition. The only exception was the positive mood condition in Experiment 2, but this group exhibited similar patterns of PM performance after equalizing the conditions' recognition memory accuracies. Hence, the current findings offer novel demonstrations that varying mood states present during encoding have dissociable impacts on declarative representations depending on whether access to that information is required via prospective or retrospective memory retrieval. We propose that there are, at least, two possible loci of such accessibility differences, namely 1) accessibility of the associative links binding the components of the intention and/or 2) activation level of the intention goal representation, both of which are theorized as necessary to support self-initiation of the intended action at the appropriate opportunity in the prospective retrieval context. Both of these possible mechanisms and their relative merit for explaining the current interactions of mood and prospective encoding found will be considered below.

PM encoding is a highly associative process reliant on cognitive control mechanisms (Marsh et al., 2006). Multiple studies have reported facilitated versus impaired PM performance when the association between the cue, intended action, and/or future context was strong versus weak (Gollwitzer, 1999; Chasteen, Park, & Schwarz, 2001; Marsh et al., 2003; Loft & Yeo, 2007; Brewer & Marsh, 2010; Neroni, Gamboz, & Brandimonte, 2014; see Marsh et al., 2006 for review). As the affective-regulation-of-information-processing view proposes (Clore & Huntsinger, 2007; 2009; see also Isen, 2008; Fredrickson, 2001), the positive mood induction at encoding potentially facilitated associative processing needed to form readily accessible links between the cue, the intended action, and the prospective retrieval context which led to the observed benefits in performance when neutrally-toned cues were used. Beneficial effects of positive mood coincide with improvements in PM performance, so called PM positivity effects, for positively-toned relative to neutrally-toned cues (Clark-foos et al, 2010; Rendell et al., 2011;

Schnitzspahn et al, 2012). The deleterious effects that negative mood had on encoding future intentions (Exp. 1 & 2) are also consistent with the ARIP view and may have resulted from a bias toward item-level processing (e.g., Clore & Huntsinger, 2007; 2009). Thus, the presence of a negative mood could have resulted in weakening of the needed associations at intention formation, rendering the associative links less accessible. These findings correspond with research indicating participants in a negative mood are impaired at retrieving remote associates (Spence, 1958). Finding this detriment when the cues were congruent with the negative mood suggests congruence of cue content and mood does not benefit PM encoding processes, at least when negative cues are used. Cue incongruence was more impactful, however. Any benefit to associative processing from the positive mood induction was ameliorated by the incongruent, aversive intention-related cues (Exp. 2).

Although cross-experimental comparisons should be interpreted with caution, some interesting patterns emerge when Experiment 1 and 2 results are considered together. Visual inspection of cue detection for Experiments 1 and 2 (see Figure 1) reveals that PM performance for each respective condition was lower when the cues were negatively valenced. These data provide further evidence that the affective tone of the intention-related cues influences the likelihood with which an intention will be fulfilled (Clark-Foos et al., 2009; Altgassen, Phillips, Henry, Rendell, & Kliegel, 2010; Rendell et al., 2011; Schnitzspahn, Horn, Bayen, & Kliegel, 2012). Lower performance for negative cues could result from the valence of these items activating competing, task-irrelevant thoughts (Clark-Foos et al., 2009; Mackay et al., 2004) and/or decreasing intention goal activation (Aarts et al., 2007), both of which would reduce their relative accessibility.

Similar to social goals (Dijkstterhuis & Aarts, 2010 for review), prospective intention-related information is thought to be held at heightened levels of activation, supported by findings of faster processing times of uncompleted intention-related material as compared with learned material for a retrospective memory test (Marsh, Hicks & Bink, 1998; Goschke & Kuhl, 1993). Such intention-superiority accounts reveal dissociations between prospective and retrospective memory, in that prospective memories are more readily accessible and are, ostensibly, rendered more likely to be completed. Research investigating social goal pursuit has demonstrated that coactivating negative affect with goal representations, by pairing negatively-toned stimuli with goal-related stimuli, can reduce the goal's activation level and accessibility, evidenced by slower task response times, lower completion rates, and reduced goal pursuit motivation relative to neutral goals (Aarts, Custers, & Holland, 2007). Conversely, the operation of the social goal is facilitated when paired with positively-toned stimuli (Custers & Aarts, 2007; Dijksterhuis & Aarts, 2010 for review). Importantly, the impairing behavioral outcomes of negative affect are typically evident in reduced motivation and attention devoted to the goal. Of note these studies have focused primarily on stimulus valence, not mood; accordingly, they most directly account for the absence of positive mood facilitation and the poorer overall PM performance with negative intention-related cues (Experiment 2), based on decreases in goal activation. Although stimulus valence and emotional mood cannot be equated, co-dependencies of the two are observed in future-oriented thinking (MacLeod, Byrne, & Valentine, 1996). Extrapolating from the goal activation work, the presence of a negative mood during PM encoding could result in an implicit reduced activation of the intention goal, which would account for the impaired intention completion for the negative mood conditions in Experiments 1 and 2. Nevertheless, the absence of differences in ongoing task latencies between mood conditions in each of the current

Experiments suggest groups did not differ in attention devoted towards completing the intention, which presents challenges for intention activation account. Admittedly, it remains possible that the impact of mood on intention-goal activation could have operated at an unconscious level (Aarts et al., 2007).

Moreover, Experiment 3 findings provide evidence that intentions encoded in a negative mood are not universally defective or demotivated, as PM performance for the negative condition was at the level of the other two conditions when the encoding mood was reinstated at retrieval. Comparison of the positive condition's prospective performance with identical materials when the encoding mood was (Exp. 2) and was not (Exp. 3) present at retrieval reveals that the overlap in encoding and retrieval mood state quantitatively improved performance. When mood was reinstated during the LDT, perhaps it potentiated associative links to the cue and intended action, thereby increasing the likelihood that the intention would be fulfilled (e.g., Lewis & Critchley, 2003). The fact that the negative condition, which resulted in the poorest prospective performance in the first two experiments, performed at levels equivalent to the other two conditions when encoding and retrieval mood matched, argues against the notion that negative valence/mood generally deactivates (or demotivates) prospective intention pursuit. These results exemplify a powerful influence of mood as a feature of the intention representation (e.g., Smith, 1995; Eich, 1995; Blaney, 1986) and suggest that encoding mood impacts PM via associative modulations.

Finding the presence and absence of PM performance impairments when in a negative mood state can inform the previous mixed findings in studies correlating intrinsic negative mood characteristics with PM (Meacham & Kushner, 1980; Harris, 1999; Cockburn & Smith, 1994). Prior findings demonstrating impairments of negative mood may have resulted from a greater disparity in the presence of negative affect at encoding and retrieval, whereas in the reports of no influence the participants' negative affective symptoms may have been more stable across encoding and retrieval of the intention. Detriments of a negative mood state at PM encoding reported here and the benefits of a negative mood during the retrieval phase in Rummel et al., (2011) may seem contradictory at first. However, we argue that the type of processing required at intention encoding versus intention fulfillment are distinct. As mentioned, encoding requires associative processing (Brewer & Marsh, 2010), whereas strategic monitoring processes typically engaged during phases of intention fulfillment (e.g., the LDT here) likely rely on item-level, detail-oriented processing to notice PM cues occurrences (see Rummel et al., 2010 for a similar argument). Thus, the influence of the item-level processing promoted by a negative mood would be detrimental at intention encoding and beneficial during intention fulfillment, as is predicted by ARIP and was evidenced in these two studies.

Here, we report on the impact of mood, ranging from negative to positive, on prospective memory encoding and demonstrate fairly consistent findings across three experiments, offering some clarification of previous mixed results on mood and PM (Kliegel & Jager, 2006). Further, the current results are in agreement with both theories of mood's influence on information processing and theories of the cognitive mechanisms of PM. We intend for the current paper to be generative and acknowledge there are limitations with this study. Replication in future research implementing a variety of mood-induction techniques would be valuable. The use of positively-toned cues is needed in future encoding mood-manipulation studies, and, based on the PM positivity benefits (e.g., Rendell et al, 2011) and the harmful influences of mood-cue incongruence found here, we would predict a pattern of results similar to Experiment 1. Although we favor the interpretation that the lower overall PM performance found in Experiment

2 (*M* = .48; *SE* = .04) versus 1 (*M* = .69; *SE* = .03) resulted from the use of negatively-valenced cues in Experiment 2, it is possible that the reduced categorical relatedness of those cues (death-related items) versus Experiment 1 cues (animals) could have had some influence. However, the difference in cue detection here is over 2 fold larger than the same difference found in previous reports from our laboratory comparing PM for related versus unrelated cues (Marsh et al., 2003), suggesting the cue valence may have also contributed some meaningful variance to the performance decrement. Nevertheless, a definitive answer awaits future empirical manipulation within the same study.

To fully consider implications of the current study, we verbally address how mood effects varied across experiments. We acknowledge that direct cause-and-effect relationships cannot be drawn across experiments, but we support their potential value according to the observation of statistically equivalent baseline BMIS mood ratings, $F < 1$, and methodological commonalities across these Experiments (e.g., random sampling and assignment, temporally proximal collections, and identical data analyses). Whereas caution of interpretation is encouraged, such observations offer valuable guidance for future research endeavors in this oft neglected domain. Future work could further examine the ARIP interpretation of these results by specifically testing the extent that relational versus item-specific processing is evident on another task sensitive to these processes (e.g., remote associates task) completed after encoding intentions in each of these moods. Mood-manipulation studies tracking processing latencies of intention-related information (that does not require a prospective response) would offer invaluable evidence regarding the role that intention/goal accessibility plays in the interaction of mood and PM.

In conclusion, through systematic manipulation of participants' mood state, the current study demonstrates that mood state during the formation of a future intention modulates its future accessibility, potentially by impacting associative binding. Processing elicited by a positive mood is more beneficial to intention encoding, whereas the processing evoked by a negative mood is more detrimental to such encoding. Mood affects prospective memory encoding both by influencing *how* the future-oriented thinking is carried out (i.e., the processing promoted) and *what* is bound to the intention representation (i.e., the content). The present study shows that one's mood state when forming a future intention plays a determining role in whether that intended behavior will be ultimately fulfilled.

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Footnotes

[1]By mood, affective state, or emotional state we simply mean a diffuse state likely resulting from cognitive and neurophysiological responses. That is, we are referring to consciously accessible feelings that vary in their relative goodness or badness and that are likely a blend of hedonic tone and activation (Russell, 2003). In this initial examination of manipulated mood and prospective memory encoding, we are taking a broad approach and comparing effects of moods that vary in their relative positivity or negativity (e.g., Huntsinger, Clore, & Yoav Bar-Anan, 2010).

[2]It is currently debated whether mood states are specifically linked to a given processing style or whether mood states confer (positive or negative) value on the currently most accessible information processing tendencies (Clore & Huntsinger, 2007; Clore & Huntsinger, 2009). The second proposal suggests positive mood may provide a "yes" signal and negative mood may provide a "no" signal to the dominant, accessible processing tendencies for a given task (e.g., Huntsinger, Clore, & Bar-Anan, 2010). Thus, positive (negative) mood would promote (inhibit) the typical processing style. Given that relational or associative processing is typical for prospective memory encoding, the two proposals would make identical predictions for the influence of mood on forming intentions in the current task.

[3]Though some may contend mood inductions based on Velten statements are driven totally by demand characteristics, meta-analytic work examining an array of studies that used such statements concluded that the "Velten mood induction procedure has a genuine effect on mood that is independent of demand characteristics" (Westermann, Spies, Stahl, & Hesse, 1996, p. 577).

[4]Because the positive condition exhibited poorer recognition memory accuracy for the

cues associated with the intention relative to the neutral condition, we sought to examine if this lowered recognition memory may have prevented a benefit to prospective memory performance for the positive mood induction, like was found in Experiment 1. We compared cue detection between these two conditions only for those participants that recognized 100 % of the cues on the final recognition memory test. This restricted analysis revealed no differences between the positive (*M* = .58; *SE* = .09) and neutral (*M* = .58; *SE* = .07) conditions in the proportion of cues that were detected, $F(1,43) < 1$. It appears safe to conclude that when negatively-toned cues were associated to the intention no benefit in encoding or subsequent prospective memory performance was observed with a positive mood induction.

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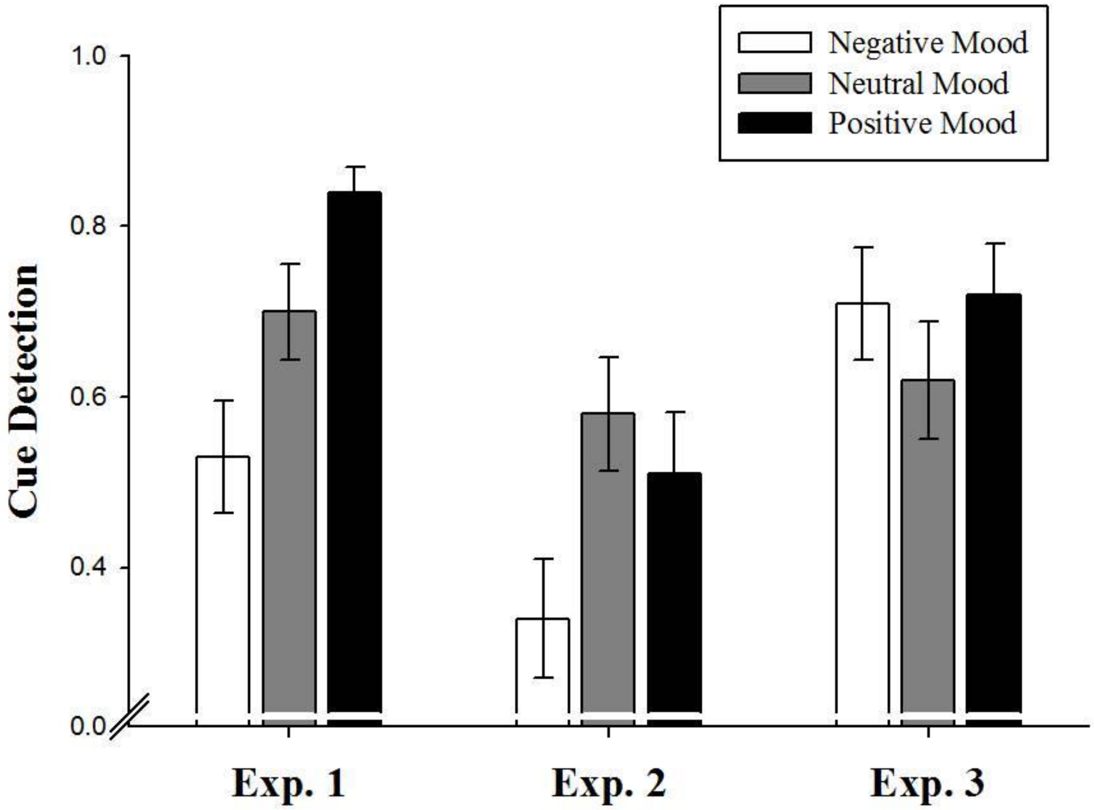

***Figure 1*: Prospective Memory Performance for All Three Experiments.** Exp. = Experiment. Bars depict mean proportion of intention-related cues detected as a function of mood condition. Error bars reflect standard error of the mean.

Table 1

Mean LDT Accuracy (SE), Latency (SE), and Cue Recognition Accuracy (SE) for All Three Experiments

	Word Accuracy	Nonword Accuracy	Word Latency	Nonword Latency	Cue Interference	Recognition Memory
Experiment 1						
Negative	.95 (.01)	.94 (.01)	772 (26)	993 (42)	515 (95)	.95 (.02)
Neutral	.93 (.03)	.91 (.03)	834 (25)	923 (47)	466 (97)	.98 (.01)
Positive	.91 (.03)	.91 (.03)	833 (25)	924 (33)	367 (48)	.98 (.01)
Experiment 2						
Negative	.96 (.01)	.93 (.02)	815 (26)	988 (46)	871 (187)	.98 (.01)
Neutral	.96 (.01)	.96 (.01)	804 (27)	943 (58)	603 (144)	.98 (.01)
Positive	.97 (.01)	.94 (.01)	781 (26)	975 (57)	719 (181)	.95 (.01)
Experiment 3						
Negative	.96 (.01)	.95 (.01)	827 (27)	948 (21)	444 (73)	.98 (.01)
Neutral	.96 (.01)	.96 (.01)	880 (23)	954 (34)	617 (94)	.96 (.01)
Positive	.96 (.01)	.96 (.01)	857 (31)	972 (37)	612 (121)	.96 (.02)

Note: Cue Interference = Detected Cue mean latency – Word mean latency