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Emotion and cognition : exploring the "perceptual pop-out"

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EMOTION AND COGNITION: EXPLORING THE "PERCEPTUAL POP-OUT"

A Thesis

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the Faculty of the Department of Psychology

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In Partial Fulfillment

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by

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Abstract

EMOTION AND COGNITION: EXPLORING THE "PERCEPTUAL POP-OUT"

by Tuan Quoc Tran

Studies on mood congruence effects have been inconsistent. One possible reason may have been the accidental priming caused by the mood scale. Ninety-six participants were randomly assigned to four conditions, happy, sad, neutral, and none. The mood induction technique was watching a happy, sad, or neutral videotape. The mood was assessed by using a modified Brief Mood Introspective Scale. Within each condition, half of the participants completed the mood scale prior to the critical experiment; the other half did not. Participants were asked to search and find affective words embedded in a crossword puzzle format. It was hypothesized that participants would find more mood-congruent words than mood-incongruent words. More importantly, participants in the prime group were hypothesized to find more words than participants in the non-prime group. Results failed to support both perceptual pop-out and mood incongruent inhibition hypotheses. Possible explanations for the null findings and future directions are discussed.

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Abstract

Studies on mood congruence effects have been inconsistent. One possible reason may have been the accidental priming caused by the mood scale. Ninety-six participants were randomly assigned to four conditions, happy, sad, neutral, and none. The mood induction technique was watching a happy, sad, or neutral videotape. The mood was assessed by using a modified Brief Mood Introspective Scale. Within each condition, half of the participants completed the mood scale prior to the critical experiment; the other half did not. Participants were asked to search and find affective words embedded in a crossword puzzle format. It was hypothesized that participants would find more mood-congruent words than mood-incongruent words. More importantly, participants in the prime group were hypothesized to find more words than participants in the non-prime group. Results failed to support both perceptual pop-out and mood incongruent inhibition hypotheses. Possible explanations for the null findings and future directions are discussed.

Emotion and Cognition: Exploring the "Perceptual Pop-Out"

Word recognition has been the primary focus in reading research for cognitive psychologists in the last decade (Seidenberg & McClelland, 1989). Understanding how words are recognized is very important in understanding the fundamental architecture of the brain; especially, how information of an input pattern is stored and retrieved from memory. Word recognition can be defined as a basic process of computing a physical signal (a word), matching it with abstract representations stored in long-term memory, and selecting a (best) candidate for identification (Grainger & Jacobs, 1996).

Prior studies have found several significant effects in facilitating and inhibiting word recognition. One of the most robust facilitating effects is the word frequency effect. Another effect is neighborhood frequency. A word neighborhood can be defined as the number of words that can be created by changing only one letter in a given letter string while presevering letter positions (Coltheart, Davelaar, Jonasson, & Besner, 1977). Neighborhood frequency refers to the frequency of occurrence of those words (word neighborhood) similar to a target word. Studies have found an inhibitory effect when looking at neighborhood frequency. Words that are near or at the bottom of its neighbors in frequency are found to have slower reaction times and more error rates than words that are near or at the top of its neighborhood (Grainger, 1990; Huntsman & Lima, 1996). And finally, neighborhood density was found to facilitate word recognition. That is, words that

have many neighbors were found to have faster reaction times and lower error rates than words that have fewer neighbors, while holding neighborhood frequency constant (Andrews, 1989).

In recent years, the notion that emotion may influence visual word recognition has received an immense amount of attention in cognitive psychology. One of the major catalysts of such attention was the publication of Bower's (1981) associative network model of mood and memory. In his model, Bower outlined several predictions, one of which is the facilitation of word recognition by mood state. Therefore, the central question raised in this thesis is "Does emotion mediate visual word recognition?" And if it does, does it facilitate or inhibit recognition?

Bower's Associative Network Model of Mood and Memory

Bower's (1981) associative network model of mood and memory proposed that human memory consists of a network of nodes responsible for the transformation and storage of information from an event into the basic unit of thought, a proposition. An event is represented in memory by a cluster of descriptive propositions. The basic process of thought is activation of a proposition and its concepts. Activation is believed to spread from one concept to another, from one proposition to another, or by the associative linkages between them. For example, to illustrate a simple event in a tree diagram such as, "In the park, Sara kicked me and I felt sad," represent two events (Please refer to Figure 1). Event 19 described the idea of a whole proposition in its tree diagram. The tree is

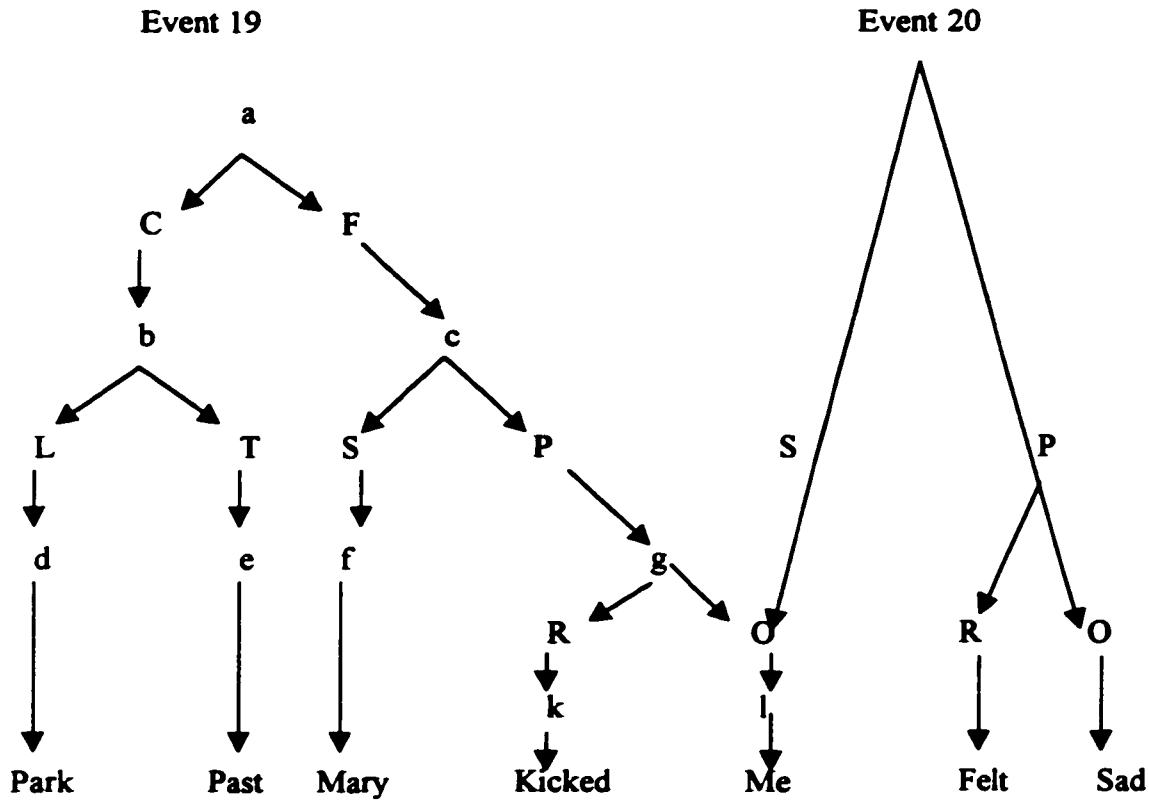

Figure 1. Diagram of a prototypical organization of propositions in Bower's associative Network model of mood and memory (adapted from Bower, 1981).

a = idea of whole proposition
C= context subtree
F = Fact subtree
b = represent idea of the context
c = represent idea of the fact
O = object node l
L = represent location of node d
T = represent time of node e
S = suject of node f
P = predicate of node g
R = relation node k

(nodes):

d = a particular park
e = a particular past time
f = a particular Mary
k = a particular kicked
l = a particular Me

divided into two subtrees, context (C) and fact (F) describing a proposition. The context subtree is further divided into two branches, location (L) and time (T). The fact subtree is also divided into two branches, subject (S) and predicate (P). The predicate branch is further divided into smaller branches, relation (R) and object (O). Hence, in our example of a basic proposition, the park represents the location, the past represents the time, Sarah represents the subject, kicked represents the relation, and me represents the object. In event 20, me represents the subject, feel represents the relation, and sad represents the object.

In addition, according to associative network model of mood and memory, emotional states are represented in memory as central nodes in a semantic network (Please refer to Figure 2). Connected to these emotion nodes are related ideas, autonomic reaction, expressive behaviors, verbal labels, and events, which are connected to its associated nodes when the material was first learned. Emotion nodes can be activated by either internal or external stimuli. When activated above the threshold, the emotion node transmits excitation to the nodes that produce an autonomic reaction or expressive behavior commonly assigned to that emotion. Activation of an emotion node also spreads selective activation to memory structures connected to it, creating a subthreshold among the related structures. Therefore, emotional arousal should prime or activate memory structures relating to that emotion. According to Bower (1981), a mood congruent effect should be found in several areas of cognitive functioning such as selective attention,

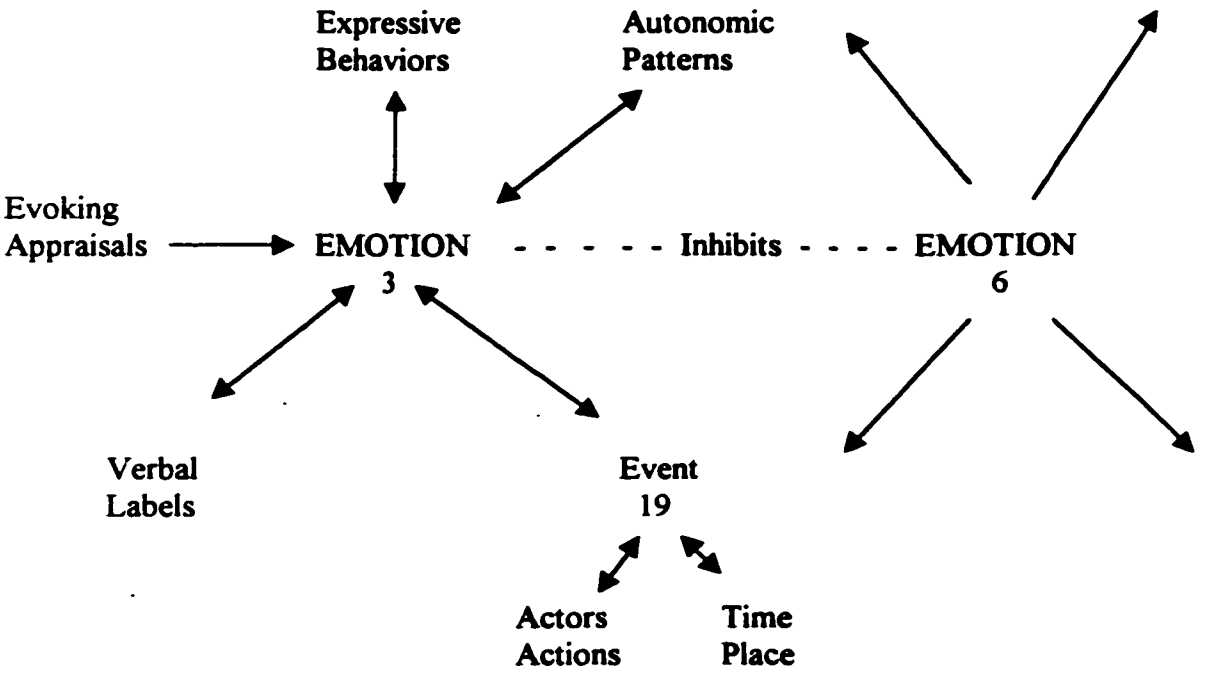

Figure 2. Diagram of a prototypical organization of emotion nodes in Bower's associative network model of mood and memory (adapted from Bower, 1981).

recognition threshold, and perceptual pop-out. In selective attention, Bower's theory predicts that emotion should enhance the salience of mood-congruent materials for selective attention and learning. Hence, participants should listen to more mood-congruent messages or music in a dichotic listening situation. However, for the purpose of this paper, the focus on Bower's theory will concentrate on recognition threshold and perceptual pop-out. Regarding recognition threshold, Bower's theory predicts that mood-congruent words should have a lower threshold than neutral words. The assumption is as follows; when an emotion is activated, it spreads partial activation among word nodes labeling that emotion. Presentation of an emotion-congruent word also causes activation among the word nodes. The summation from these sources of activation results in a perceptual response. Accordingly, this priming should make detection, identification, and classification of mood congruent words faster and more accurate than other words. Therefore, happy participants should be faster and more accurate at detecting a happy word than sad participants; sad participants on the other hand, should be faster and more accurate at detecting a sad word than happy participants. And finally, following the same logic, Bower's theory predicts that an emotion should cause mood-congruent words to "pop-out" at the perceiver. When presented with emotional words, words that are congruent to the perceiver's emotion will have a lower activation level causing the words to pop-out.

If Bower's theory is correct, then it will increase our understanding of how emotions interact with cognition and how memory of an emotional event or category is stored and connected to semantic memory. However, results of investigative studies have shown inconsistencies in Bower's mood congruent theory.

Review of Literature

Gerrig and Bower (1982) failed to demonstrate a significant effect for mood congruence in both Experiments 1 and 2. Participant's mood (happy or angry) was induced by hypnosis using an eye-closure technique in both experiments. In Experiment 1, the participant's task was to identify a target word (pleasant, unpleasant, or neutral) from a word pair which consisted of both a target word (pleasant, unpleasant, or neutral) and a distractor word (pleasant, unpleasant, or neutral). In Experiment 2, participants were given a word recognition task in which the stimulus word (pleasant, unpleasant, or neutral) was presented for a brief duration that lengthened progressively until the word was identified. In conclusion, the authors attributed the null findings as a possible indication that mood may not influence "lower-level" pattern identification processes that reflect overlearned automated skills.

In exploring Gerring and Bower's (1982) conclusion, Weaver and McNeill (1992) attempted to obtain a mood congruent effect by using a semantic memory task, in both Experiments 1 and 2, participants were asked to read a sentence and decide quickly if the context of the sentence was happy or sad. The importance of this task was that it required

controlled processing from participants. The only difference between Experiment 1 and 2 was the instructions. In Experiment 1, participants were asked to identify the sentence as quickly as possible. The computer screen went blank as soon as participants made their response. While in Experiment 2, participants were instructed to read the sentence and then make their response. Participants' mood was induced through a combination of techniques: music, facial feedback, and memory elicitation. The result failed to find a significant interaction between mood (happy, sad) and sentence affect (happy, sad). The authors reasoned that the failure to reject the null was a possible indication of the distinction between episodic and semantic memory retrieval. According to the authors, episodic memory is theoretically believed to store personal episodes and mood states. Hence, mood states should prime past personal experiences. However, semantic memory contains "factual knowledge and information in the broadest sense" (Tulving, 1989, p. 362). To facilitate this distinction, the authors gave the following example, "knowing a circus is a place where one has a good time is not stored in the same memory system as one's memory of attending the circus" (Weaver & McNeill, 1992, p. 300).

These studies are in conflict with two studies that did find a mood congruent effect. Powell and Hemsley (1984) using depressed inpatients and normal controls found a mood congruent effect, in a word recognition task. The word recognition task was set individually for each participant at his or her 50% recognition threshold level; in other words, the level in which 50% of words could be recognized. To determine each

participants 50% recognition threshold level, thirty neutral words were presented for a brief duration and lengthened progressively until a response was made. Participants' task in the critical experiment was to recognize a word (bad or neutral) through a tachistoscope as quickly as possible. Their findings showed a marginally significant mood congruent effect between groups (depressed, normal) and words (neutral, unpleasant). The authors concluded that clinically depressed participants have greater access to unpleasant words than normal participants in the control group.

Small (1985) also found a significant mood congruent effect using a recognition task. Participants were divided into two groups, depressed or neutral, and moods were induced by using a technique developed by Velten (1968). Participants in the depressed group read a series of 50 depressed self-referent statements (e.g. "I feel rather sluggish now") that progressively increased in severity in order to induce a depressed mood. Participants in the neutral group read a series of 50 neutral non self-referent statements (e.g. "99.1% of Alaska is owned by the federal government"). The participant's task was to recognize depressed and neutral words as quickly as possible. Each word was briefly exposed starting at 100 ms and progressed in increments of 10 ms. The results revealed a significant interaction between mood (depressed, neutral) and word category (depressed, neutral). Depressed participants were able to recognize depressive words faster than neutral words; hence, supporting Bower's theory of mood congruence.

Mood Congruence in a Lexical Decision Task Paradigm

The lexical decision task (LDT) has been used in a number of studies testing Bower's notion of lower perceptual threshold for mood congruent words (Challis & Krane, 1988; Clark, Teasdale, Broadbent, & Martin, 1983; MacLeod, Tata, & Mathews, 1987; Niedenthal, Halberstadt & Setterlund, 1997; Niedenthal & Setterlund, 1994). In a LDT paradigm, the participant's task is to respond as quickly and accurately as possible, "YES" if the presented stimulus is a word or "NO" if the stimulus is a nonword.

The LDT paradigm was utilized by MaeLeod et al. (1987) to further investigate Powell and Hemsly's (1984) conclusion that clinically depressed participants have greater access to unpleasant words than normal participants in the control group. Using introductory psychology students as controls and hospital in-patients meeting DSM-III criteria for depressive neurosis, the authors failed to find a significant interaction between mood (depressed, neutral) and word (good, neutral, bad). Interestingly and contrary to Powell and Hemsly (1984) findings, depressed participants in this study were slightly faster in recognizing positive and neutral words as words than in recognizing bad words as words. The authors concluded that the Powell and Hemsly's (1984) study may have found a possible effect of mood influencing participants' guessing strategy rather than affecting lexical access directly.

In Clark et al.'s (1983) study, participants' mood (happy and depressed) was manipulated by using a music technique. Using a LDT, the authors found happy

participants to be faster than depressed participants in recognizing positive words as words; however, sad participants were slower than happy participants in recognizing negative and neutral words as words. No significant interaction between mood (happy, depressed) and word type (positive, neutral, negative) was revealed. Immediately following a LDT, participants were given a surprise recall task on the words that were presented during the LDT. The results of the surprise recall task approached significance; with happy participants recalling more negative words than positive words. Contrarily, depressed participants recalled more positive words than negative words. Thus, the results seem to support the notion that mood congruence may actually interfere with word recognition and not facilitate it as Bower's theory has predicted.

Challis and Krane (1988), also using a LDT paradigm, induced their participants' moods (elated, depressed, or neutral) using a Velten (1968) technique, mention earlier, found elated participants to be faster than depressed and neutral participants in recognizing both positive and negative words as words. Furthermore, depressed participants were faster at recognizing both neutral and elated words as words than depressed words as words. In addition, and similar to the Clark et al. (1983) study, immediately following the LDT, participants were given a surprise recall task on words that were present in the LDT. Contrary to Clark et al.'s (1983) results, elated participants recalled more elated words than depressed and neutral participants did. Neutral participants recalled more depressed words than depressed or elated participants did;

however, depressed participants recalled more depressed words than elated participants did. The authors concluded that the failure to support Bower's prediction may have been due to the insufficient strength between mood and its related words.

Niedenthal and Settterlund (1994) in Experiments 1 and 2, manipulated their participants' mood with classical music. Using a LDT, the authors found happy participants were faster than sad participants in recognizing both positive and negative words as words. Again in Experiment 2, the authors found happy participants were faster than sad participants in recognizing both positive and negative words as words. However, in both Experiments 1 and 2, happy participants were faster than sad participants in recognizing happy words as words, and sad participants were faster than happy participants in recognizing sad words as words. More importantly, a significant interaction between mood (happy, sad) and word category (happy, sad) was found. Thus, the authors concluded that for a mood-congruence effect to occur, stimulus words need to be closely matched to their related mood.

Hence, the major conclusion from these studies was that the associative relationship between mood and its related words may have been too weak for a facilitation effect to be observed. This called into question the experimental word stimulus that has been utilized in past studies and the nature of valence. The valence hypothesis views all emotions as located on a single dimension. Emotions can be represented as positive or negative, whereas, the word-category hypothesis maintains that each emotion is

structurally unique (Niedenthal & Setterlund, 1994). For example, both sad and angry emotions represent the negative valence dimensions but they are two distinct word-categories. Most of the early studies on mood congruence used words of valence as their experimental stimuli, which may explain their inability to reject the null hypothesis (Challis & Krane, 1988; Clark et al., 1983; Gerrig & Bower, 1982; MacLeod et al., 1987).

Mood Congruence: Valence versus Word Category Hypotheses

In investigating valence and word category hypotheses, Niedenthal et al. (1997) compared the valence hypothesis with the word-category hypothesis using a lexical decision task in both Experiments 1 and 2. Their participants' mood was induced by classical music. In both Experiments 1 and 2, a significant interaction was revealed between mood (happy, sad) and word category (happy, sad). Happy participants were found to recognize happy words faster than sad words, and sad participants were found to recognize sad words faster than happy words. However, for both experiments, a significant interaction between mood (happy, sad) and word category (love, anger) was not found. In Experiment 1, happy participants were found to recognize both love and anger words faster than sad participants. In Experiment 2, happy participants were somewhat faster than sad participants to recognize anger words as words, and sad participants were somewhat faster than happy participants to recognize love words as words. In Experiment 3, using a naming task, a marginally significant interaction was found between mood (happy, sad) and word category (happy, sad). Happy participants

were found to recognize happy words faster than sad participants; and sad participants were found to recognize sad words faster than happy participants. Interestingly, a marginally significant interaction was also found between mood (happy, sad) and word category (love, anger). Happy participants were faster than sad participants in pronouncing sad words and sad participants were faster than happy participants in pronouncing happy words. Thus, in all three experiments, the word-category hypothesis was supported and the word valence hypothesis was rejected.

The authors concluded that the main reason for the null effect in mood-congruence experiments using valence is that almost all information in memory carries some information about valence. A mood congruence effect could be obtained if the stimulus words were more closely matched with a specific emotion than with its valence in general (Niedenthal et al., 1997).

Possible Explanations for Mood Incongruent Results

There are several other possible explanations for these mood incongruent results. One possible explanation could be the activation of one emotion by another due to their inhibitory effects. As Bower (1981) maintains, "Each emotion may reciprocally inhibit an emotion of opposing quality, as fear inhibits joy and sexual arousal" (p. 135). This reciprocal inhibitory relationship between emotions might have spontaneously activated semantic nodes of other emotions (Small & Robins, 1988). Another explanation is the utilization of a LDT paradigm in searching for a mood congruence effect. It is of this

author's opinion that by using a LDT, an automatic priming effect might have occurred in accordance with Bower's (1981) associative network. In other words, by presenting a word (JOY), a spreading activation occurs throughout the semantic network. Although, the word (JOY) will be identified faster by a happy participant than a sad participant, it may also prime other words that are closely connected to it, which then primes other words, and so forth (Bower, 1981).

And finally, a third possible explanation is the completion of a mood scale by participants prior to the critical experiment. Studies that have followed this procedure have found both mood congruent and incongruent results (Challis & Krane, 1988; Niedenthal et al.,1997; Niedenthal & Setterlund, 1994; Clark et al., 1983). Having participants complete a mood scale prior to the experiment may have inadvertently sensitized participants to their feelings and their mental lexicon in the experiment (Niedenthal et al.,1997; Small & Robins, 1988).

Perceptual Pop-Out a Review of Literature

There has been very limited research in this area utilizing a perceptual paradigm to examine mood congruence theory. According to Bower (1981), if tested with a perceptual paradigm in which the target affective word is surrounded by other words, a "perceptual pop-out" would occur if the target word is congruent with the perceiver's mood.

Only two experiments that this author is currently aware of tested "perceptual pop-out" (as cited in Bower, 1981). Clore's (1980) unpublished preliminary study placed happy and angry participants in front of a tachistoscope. They were asked to rapidly classify target words as pleasant or unpleasant in quality. The target words (mood congruent) were surrounded with distractors (mood incongruent). Clore hypothesized that if these distractor words were congruent with the participant mood and the target word was not, there would be interference and the reaction time would be slower and more error prone. Clore's preliminary results found that participants in the pleasant mood group made more errors in the "unpleasant-target, pleasant distractors" condition and participants in the angry mood group made more errors in the "pleasant-target, unpleasant distractors" condition. However, the effects obtained in the study were small.

In a second experiment, (as cited in Bower, 1981), Clore (1980) re-examined the "perceptual pop-out" hypothesis by utilizing the Stroop color-naming task. Clore hypothesized that the affective phrase which is congruent to a perceiver's mood would suffer greater interference and the perceiver would be slower in naming the ink color of that phrase. Therefore, happy participants should be slower at naming the ink color of a happy phrase then a sad or neutral phrase. Preliminary results revealed no mood and specific types of phrase interaction. A possible confound in both Clore's experiments was the utilization of words of different valence (positive and negative) as his experimental stimuli.

Purposes and Hypotheses

The purpose of this study is twofolds. First to investigate the "perceptual pop-out" more closely by using a different paradigm, namely a word search task. The word search task was selected to provide an opportunity to embed three words from different emotions (happy, sad, neutral) in close proximity. If Bower's "Perceptual pop-out' hypothesis is correct, then mood-congruent words, having lower threshold levels, will be detected faster than other words causing the mood-congruent words to pop-out to the perceiver as the perceiver scans for words. Therefore, it is hypothesized that participants will find more words that are congruent to their emotional state. Hence, a "perceptual pop-out" would have occurred. Accordingly, Bower's mood incongruent inhibition hypothesis can then be eliminated. However, if the results show participants finding more words that are incongruent to their emotional state, Bower's "Perceptual pop-out" hypothesis could then be eliminated.

The second purpose of this study is to investigate whether mood scales taken prior to the critical experiment would sensitize participants' performance. Niedenthal et al. (1997) hypothesized that participants may have been inadvertently primed by the mood scale taken prior to the critical experiment. Participants completing the mood scale prior to the experimental task will have been exposed to adjectives related to that particular mood. Hence, these adjectives will spread activation to related concepts throughout the network, thus priming either or both happy and sad emotional words in memory. To

directly test this hypothesis, half of the participants in each conditions will be asked to complete the mood scale prior to the experiment (prime group), while the other half will not be asked to complete the mood scale (non-prime group). It is hypothesized that participants in the prime group will find significantly more words than participants in the non-prime group. Accordingly, Niedenthal et al.'s (1997) hypothesis will be verified. However, if the participants in the prime group do not find significantly more words than participants in the non-prime group, then Niedenthal et al.'s (1997) hypothesis can be discarded.

In summary, two hypotheses are proposed: 1) participants will find more words that are congruent to their emotional state and 2) participants in the prime group will find significantly more words than participants in the non-prime group.

Method

Participants

Ninety-six undergraduate students randomly selected from introductory psychology classes at San Jose State University participated in the study for course credit. All participants were native or very fluent speakers of English.

Materials

The procedure used for inducing happiness and sadness was a videotaped technique. Participants in the sad condition watched a short documentary from "Ronald McDonald" camp for children with cancer (adapted from Asuncion & Lam, 1995).

Participants in the happy condition watched a segment from "Comic Relief." Participants in the neutral condition watched a segment on the "Proper grooming of a horse" (adapted from Asuncion & Lam, 1995). Participants in the none condition (no mood induction) were not shown any videotaped programs.

A mood scale adapted from the Brief Mood Introspection Scale (BMIS) was used to measure mood. It should be noted that the BMIS has been used in prior studies (Niedenthal & Setterlund, 1994; Niedenthal et al., 1997). The mood scale lists 16 affect adjectives embedded in sentences, with the following stem: "I presently feel _____. " Participants indicated the degree they are feeling toward each statement on a 7-point scale: with "1" indicating definitely do not feel, "4" indicating neutral, and "7" indicating definitely do feel (A copy of the modified scale can be found in Appendix B).

Three 13 X 12 letter puzzles were constructed with each puzzle containing nine words (3 happy, 3 sad, and 3 neutral). Each puzzle was constructed to control for word locations and orientations (A copy of the word puzzles can be found in Appendixes C, D, and E).

In addition, the twenty-seven stimulus words chosen were closely matched for frequency and word length. The frequency of a given word is operationally defined by Kucera and Francis (1967) as the number of times a given word occurs in written English per one million words. The mean frequencies of occurrence and mean word lengths for each stimulus word in Puzzle A, B, and C, can be found in Table 1.

Pilot participants (N=10) rated semantic relatedness (sad, happy, neutral) to the stimulus words by responding to the following format: 1 = definitely sad, 2 = somewhat sad, 3 = neutral, 4 = somewhat happy, 5 = definitely happy. The mean ratings for each word can also be found in Table 1. An analysis of variance (ANOVA) revealed affective word condition (sad, happy, neutral) were statistically significant, $F(2,35)=658.73$, $MSE=27.46$, $p<.001$.

Design and Procedure

Twenty-four participants were randomly assigned to one of four conditions; sad, happy, neutral, or none (no mood induction). Participants were tested in groups of one, two, or three. Depending on their mood condition, participants watched a sad, happy, or neutral videotaped program. Within each condition, half of the participants were asked to complete the mood scale prior to the critical experiment (prime group). The other half of the participants were not asked to complete the mood scale (none-prime group) prior to the experiment. It was stressed that the participants be honest in rating their mood. After completing the mood scale, participants were asked to solve a word search task, in which several target words (happy, sad, and neutral) were embedded in a crossword format surrounded by letters (noise). The participants' task was to find and circle any letter strings that form an English word. There were a total of three puzzles (A, B, and C) arranged in the following order: A, B, C; B, C, A; and C, A, B. Participants were given 60 seconds to complete each puzzle. At the beginning and depending on each puzzle,

Table 1

Important Characteristics of Stimulus Words

	Frequency	Word Length	Mean Ratings
Puzzle A			
Sad			
grief	10	5	1.20
mourn	2	5	1.80
remorse	1	7	1.40
Mean Freq. 4.33			
Happy			
cheer	8	5	4.90
glee	3	4	4.30
jubilant	2	8	4.60
Mean Freq. 4.33			
Neutral			
chord	7	5	3.00
foyer	3	5	3.00
pedal	4	5	3.00
Mean Freq. 4.67			

Table 1 (Continue)

Important Characteristics of Stimulus Words

	Frequency	Word Length	Mean Ratings
Puzzle C			
Sad			
regret	9	6	1.90
lousy	12	5	1.80
despair	29	7	1.30
Mean Freq. 16.67			
Happy			
joy	40	3	4.80
merry	8	5	4.60
elated	3	6	4.80
Mean Freq. 17.00			
Neutral			
manual	9	6	3.00
globe	13	5	3.00
mirror	27	6	3.00
Mean Freq. 16.33			

Table 1 (Continue)

Important Characteristics of Stimulus Words

	Frequency	Word Length	Mean Ratings
Puzzle B			
Sad			
weep	14	4	1.40
gloom	14	5	1.40
misery	15	6	1.10
Mean Freq. 14.33			
Happy			
jolly	4	5	4.60
glad	38	4	4.30
bliss	4	5	4.50
Mean Freq. 15.33			
Neutral			
clock	20	5	3.00
sector	15	6	3.00
paste	10	5	3.00
Mean Freq. 14.33			

participants were verbally instructed to search and find any words which were at least 3 or 4 letters in length. Only completely circled words were rated correct. Partially circled words were discarded. Upon completion of the puzzles, participants were asked to complete the mood scale again to verify the stability of the mood manipulation. At the end of the session, participants were debriefed, thanked, and dismissed.

Results

Mood Induction Assessment.

After the mood induction procedure, half of the participants (BMIS) in each condition completed the BMIS. The BMIS scores were calculated with the sad participants' scores being subjected to reverse scoring. Following the critical experiment, all 96 participants (48 BMIS and 48 noBMIS) completed the BMIS. The mean BMIS scores for the 48 (BMIS) and 96 participants (48 BMIS and 48 noBMIS) are presented in Tables 2 and 3. The means for both the 48 (BMIS) and 96 participants (48 BMIS and 48 noBMIS) followed the predicted directions; sad participants had the lowest mean scores, neutral participants had a higher mean scores, and happy participants had the highest mean scores. To test whether this difference was significant, the scores for these 48 participants (BMIS) and 96 participants (48 BMIS and 48 noBMIS) were analyzed using two separate one-way analysis of variances (ANOVA), with independent variables for both of these analyses being mood induction (sad, happy, neutral). The effect of mood induction for the 48 (BMIS) participants was statistically significant, $F(3, 47)=2.987$, $MSE=2.69$, $p<.05$.

Table 2

Means and Standard Deviations Score Ratings on BMIS Sad Adjectives.

(Scale: 1= Definitely do not feel, 4= neutral, 7= Definitely do feel)

Mood Condition Experiment	Pre Experiment	Post
Prime Condition (BMIS)		
Sad	4.08 (1.32)	4.60 (1.36)
Neutral	4.17 (.74)	4.56 (1.27)
Happy	5.73 (.87)	5.89 (1.00)
None	5.40 (1.11)	5.46 (1.04)
Non-Prime Condition (BMIS)		
Sad		4.00 (1.43)
Neutral		4.56 (.89)
Happy		5.90 (.86)
None		4.44 (.92)

Table 3

Means and Standard Deviations Score Ratings on BMIS Happy Adjectives.

(Scale: 1= Definitely do not feel, 4= neutral, 7= Definitely do feel)

Mood Condition	Pre Experiment	Post Experiment
Prime Condition		
Sad	3.08 (1.14)	3.08 (1.17)
Neutral	4.23 (1.13)	4.03 (1.32)
Happy	4.65 (.68)	4.35 (1.00)
None	4.55 (.92)	4.27 (.85)
Non-Prime Condition		
Sad		3.72 (.99)
Neutral		4.58 (.56)
Happy		4.67 (.99)
None		3.63 (1.15)

The effect of the mood induction for all 96 participants (BMIS and noBMIS) was also statistically significant, $F(3,95)=6.86$, MSE=9.37, $p<001$. Clearly, these significant mood effects reveal that the participants' moods were successfully manipulated and were stable across the critical experiment.

To investigate whether taking the BMIS prior to the experiment will influence the latter BMIS scores taken post experiment, the data set was submitted to a 2 BMIS (yes,no) X 2 BMIS score (pre, post) mixed design analysis of variance (ANOVA), with BMIS score category being a within-subject comparison. There was no main effect of BMIS nor an interaction between BMIS score by BMIS conditions. There was a main effect of BMIS score, $F(1,47)=17.38$, MSE=14.53, $p<.001$, suggesting that taking the BMIS prior to the experiment affected participants' score ratings on the post BMIS; participants rated themselves to be happier in the post BMIS then the pre BMIS.

Mood Congruence Effect on Word Search

To investigate whether participants' mood facilitates or inhibits word recognition and whether taking the BMIS prior to the critical experiment would sensitize participants' performance; the data set was submitted to a 4 (mood type: sad, happy, neutral, none) X 3 (word type: sad, happy, neutral) X 3 (repetitions: rep1, rep2, rep3) X 2 (BMIS: no, yes) mixed-design analysis of variance (ANOVA), with mood and BMIS categories being between-subject comparisons. The means and standard deviations for word types found by mood conditions and prime conditions (BMIS and noBMIS) are presented in Table 4. In

Table 4

Means and Standard Deviations of Words Found by Word and Repetition Categories.

Word Category	Number of Word Found
Sad	1.88 (1.32)
Neutral	1.75 (1.31)
Happy	1.08 (1.05)
Repetition Category	
Repetition 1	1.64 (1.29)
Repetition 2	1.56 (1.19)
Repetition 3	1.51 (1.07)

addition, the mean and standard deviations for word found by both word and repetition categories are presented in Table 5.

The primary phenomenon of interest in the present experiment was the mood congruence effect. After the mood induction procedure, all participants completed a word search task. Embedded in each word search puzzle were sad, happy, and neutral words. It should be noted that to better facilitate comparisons between word type and mood type, the mood conditions were collapsed across the BMIS and no BMIS conditions for the analyses. The main effect of word type was statistically significant, $F(1,88)=16.69$, $MSE=7.11$, $p<.001$. This suggests that sad words were more salient to participants than happy or neutral words. There was no main effect of repetition, $F(1,88)=.689$, $MSE=.250$, p=n.s. There was no main effect of mood condition, $F(3,88)=.678$, $MSE=.515$, p=n.s.

The interaction between repetition (rep1, rep2, rep3) X mood (sad, neutral, happy, none) was not statistically significant, $F(3,88)=.574$, $MSE=.208$, p=n.s. This finding suggests that mood states were stable across the three repetitions. Most importantly, the interaction between word type (sad, happy, neutral) X mood (sad, neutral, happy, none) was not statistically significant, $F(3,88)=.467$, $MSE=.199$, p=n.s. This finding suggests that mood state did not influence the processing of affective and neutral words. Thus, this finding fails to replicate previous findings (Niedenthal et al., 1997; Niedenthal & Setterlund, 1994) which found a facilitory effect of mood state in processing affective words (please see Figure 3). Finally, the interaction of repetition (rep1, rep2, rep3) X

Table 5

Means and Standard Deviations of Words Found by Mood Conditions and Prime Conditions.

	Word Category		
	Sad	Neutral	Happy
Mood Condition			
Sad	2.29 (1.30)	1.54 (1.28)	1.21 (1.14)
Neutral	1.54 (1.28)	1.75 (1.57)	.96 (1.00)
Happy	1.58 (1.28)	1.79 (1.14)	1.04 (1.04)
None	2.08 (1.32)	1.92 (1.25)	1.08 (1.08)
Prime Condition			
Prime	2.02 (1.41)	1.60 (1.23)	1.17 (1.21)
Non-Prime	1.73 (1.22)	1.90 (1.37)	1.00 (.88)

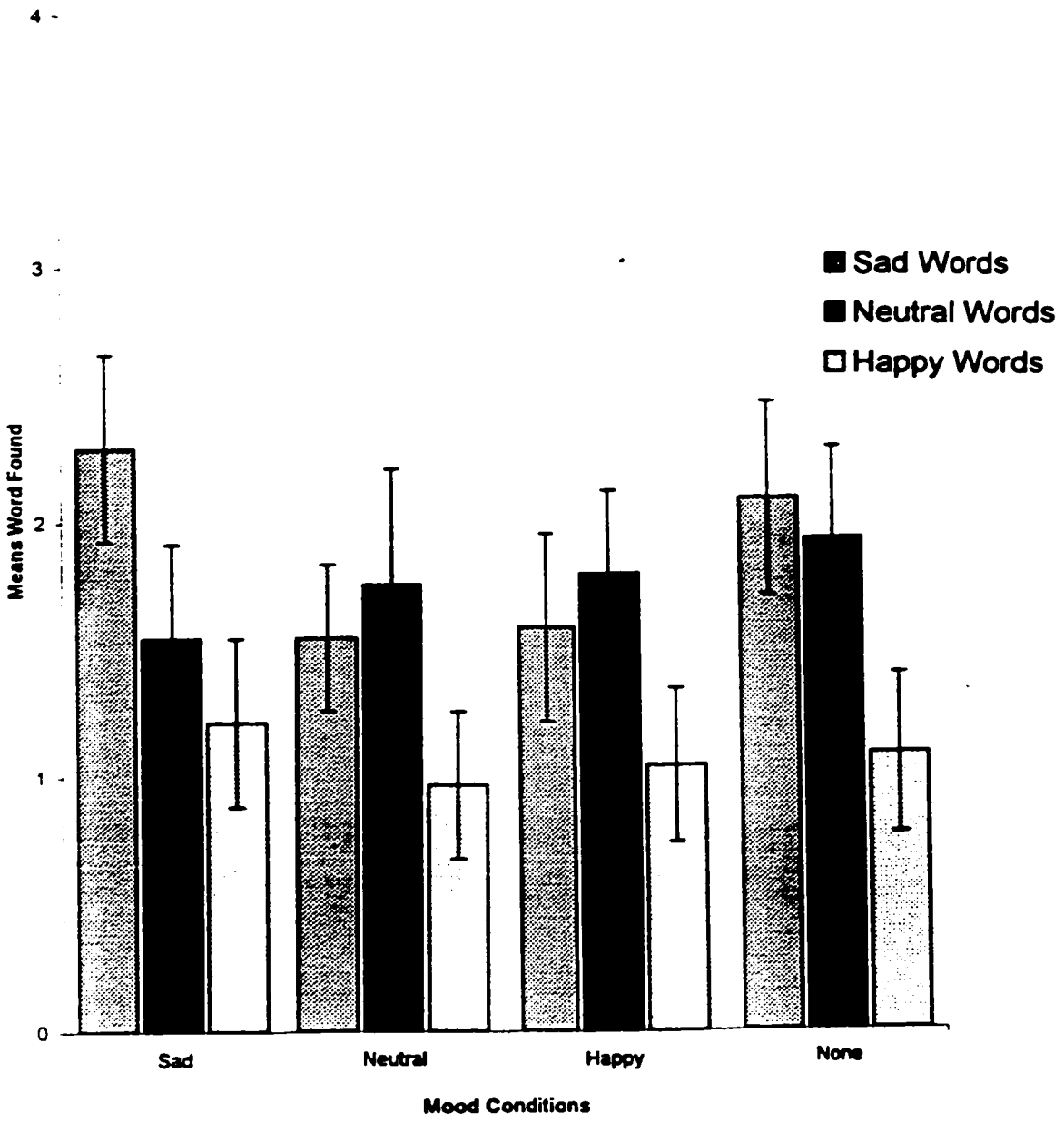

Figure 3. Means and standard error bars of words found by mood conditions and prime conditions.

word (sad, neutral, happy) X mood (sad, neutral, happy, none) was not statistically significant, $F(3,88)=.079$, MSE=.003, p=n.s. This finding further suggests that stability of mood was constant across the experimental repetitions.

Effect of Prior Administration of BMIS on Word Search

Another interest in the present experiment was a priming effect that may have occurred from the mood scale, sensitizing participants to their mental lexicon. In the omnibus ANOVA described above, the main effect of BMIS conditions was not statistically significant, $F(3,88)=.097$, MSE=.007, p=n.s. This finding suggests that there was no advantageous effect to taking the mood assessment scale prior to the critical experiment. The interaction between BMIS (yes, no) X word (sad, happy, neutral, none) was not statistically significant, $F(1,88)=1.97$, MSE=.840, p=n.s. This finding indicates that there was no priming effect for words caused by taking the mood assessment scale prior to the critical experiment. This finding is inconsistent with Niedenthal et al.'s (1997) suggestion that participants may be inadvertently primed by the mood scale (please see Figure 4). In addition, the interaction of BMIS (yes, no) X mood (sad, neutral, happy, none) X word (sad, neutral, happy) was not statistically significant, $F(3,88)=.744$, MSE=.317, p=n.s. This further supports the lack of a mood congruence effect in the present experiment. Finally, the overall interaction of BMIS (yes, no) X mood (sad, neutral, happy, none) X word (sad, neutral, happy) X repetition (rep1, rep2, rep3) was not statistically significant, $F(3,88)=.079$, MSE=.003, p=n.s.

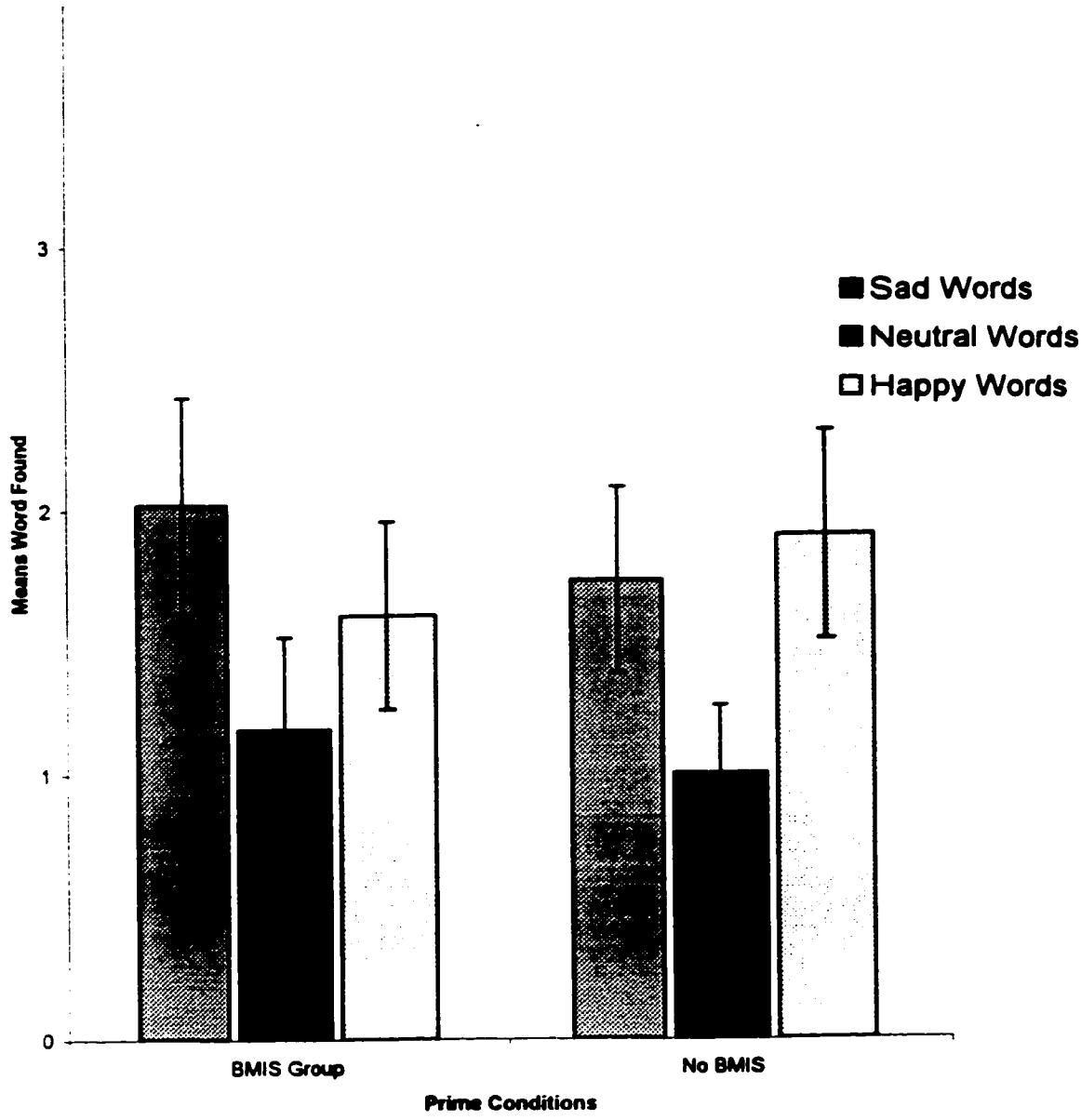

Figure 4. Mean and standard error bars of word found by prime conditions.

Discussion

Overall, the present study failed to support or discard both Bower's perceptual "pop-out" hypothesis and Bower's mood incongruent inhibition hypothesis. In addition, the present study also failed to find a priming effect caused by the preadministered mood scale as hypothesized by Niedenthal et al. (1997). Hence, this study was unable to support or eliminate either the perceptual "pop-out" hypothesis or the mood incongruent inhibition hypothesis

BMIS Administration

Similar to Asuncion and Lam's (1995) study, the present experiment was successful in inducing the desired mood states of happy, sad, and neutral utilizing a videotape technique. In addition, the present experiment was also successful in maintaining a desired mood state stable across repetitions as was shown by the mean scores on the BMIS scale taken pre and post experiment.

Effect of Prior Administration of BMIS on Word Search and Post BMIS Ratings

Importantly, the present experiment failed to find a priming effect that had been reported by several studies (Niedenthal et al., 1997; Small & Robin, 1988). Hence, this study failed to support Niedenthal et al.'s (1997) hypothesis that having participants complete a mood scale prior to the experiment may have sensitized participants to their mental lexicon. It should be noted, nevertheless, that analyses of mean number of words found revealed that both sad and happy participants in the BMIS group did find more

words than their counterparts in the noBMIS group. However, such differences in words found did not reach significance.

One possible reason for the null finding was that the neutral group in the noBMIS group found more words than their counterpart in the BMIS group. A reason for the unexpected group means may lie in the nature of the mood scale itself. The BMIS mood assessment scale consisted of 16 adjectives, five of which assess a sense of happiness and four assessed a sense of sadness. The BMIS, however, does not list any adjectives that are classified as neutral. Following this assumption, both sad and happy participants in the BMIS group may have been primed to a small degree by the mood scale, thus, found more words than their counterparts in the noBMIS group. Neutral participants in the BMIS group on the other hand, were not primed by the mood scale, thus, found fewer words than their counterparts in the noBMIS group.

Despite the BMIS null findings, the present experiment found that participants' score ratings on the BMIS were affected by prior administration, leading to a main effect of BMIS score. Participants tend to rate themselves as being happier on the post administration. Again, the nature of the mood scale can give us some insight about this result. The BMIS contains more happy adjectives than sad adjectives and this may have inadvertenly induced participants to be happier. The greater number of happy adjectives may have primed participants to their mental lexicon relating to happy words, which are connected to and activate the emotional node, happy. Hence, recognizing happy words

will prime a person to feel happy. As Bower (1981) mentioned earlier, this connection between emotion and its related concepts is bi-directional. Therefore, since emotion tends to activate its related concepts (memories, themes, perceptual categories, and thoughts), these related concepts would also tend to activate an emotion node and arouse some associated feelings (Bower, 1981; 1987).

Evaluation of the Perceptual "Pop-Out" Effects

Contrary to Clore's (1980) study (as cited in Bower, 1981), the present experiment failed to find a perceptual "pop-out" effect that had been hypothesized by Bower (1981). Accordingly, if utilizing a perceptual paradigm in which the target affective word is surrounded by other words, a "perceptual pop-out" should occur if the target word is congruent with the perceiver's mood.

There are several possible rationale for this null findings. One possible explanation may be the moderate mood manipulation. Although the mood manipulation was successful in the present study, it may not have been sufficiently strong to induce a mood congruence effect. As Challis and Krane's (1988) concluded, one possible reason for the failure to find the mood congruence effect may have been that the relationship between mood and its related words was not sufficiently strong. The present experiment used words that were semantically related according to the ratings by pilot participants. However, the mood strength in the present experiment may have been questionable. The mean rating for sadness by sad participants was only 4.08 on a seven-point scale. The mean rating for

happiness by happy participants was only 4.65 on a seven-point scale. Hence, the manipulation may have been only moderately successful in changing moods.

Another possible explanation for the failure to observe a perceptual "pop-out" was the task demand of the experiment. Participants were given 60 s to search for and circle as many words as they could find. This time limit may have inadvertently induced stress in the participants, thus making the task a difficult one.

Finally, the construction of the word search puzzles themselves may also produce the null findings. The following benefits were considered in the adoption of the word search paradigm. First, the word search paradigm allowed an avenue for testing mood congruence given a simultaneous presentation of multiple affective stimuli. Predominately, past studies on mood congruence have been on a single presentation of an affective stimulus. Very little research has focused on the perceptual "pop-out" phenomenon using multiple simultaneous presentations of affective stimuli. Based on the current findings, the mood congruence effect for the presentation of multiple stimuli was still unclear. Second, the word search paradigm, which asked participants to search for words embedded in a series of random letters, was thought to slow down the processing of high frequency words. Such words reflect overlearned skills and as such they may be immune to mood congruence influences. As Gerring and Bower (1982) concluded, mood may not influence "lower-lever" pattern identification processes that reflect overlearned automated skills.

Despite the benefits of utilizing a word search paradigm, its limitation in testing the perceptual "pop-out" may have been overlooked. In each word puzzle, words were embedded in an evenly spread apart 13 letters by 12 letters format. This may have had an impact on participants' search strategy. Instead of searching for words as a whole, participants were searching for words letter by letter. By searching for words letter by letter, the affective nature of each word may have been lost. Hence, searching for an affective word was no different than searching for a neutral word.

Evaluation of Mood Incongruent Inhibitions Effects

The present experiments also failed to find the mood incongruent inhibition effect proposed by Gerring and Bower (1982), that has been reported in previous experiments (Clark et al., 1983; Niedenthal et al., 1997; Niedenthal & Setterlund, 1994). Participants were previously found to be fster at recognizing mood incongruent words than mood congruent words. One previous explanation for a mood incongruent inhibition effect was the preadministration of the mood scale prior to the critical experiment. This procedure may have sensitized participants to their feelings and mental lexicon (Niedenthal et al., 1997; Niedenthal & Setterlund, 1994). The present experiment has empirically tested this hypothesis and found no priming effect, suggesting that taking a mood scale prior to the critical experiment does not significantly affect participants' performance. Consequently, Niedenthal et al.'s (1997) assertion can now be discarded.

Conclusion

In conclusion, the present study failed to support or discard both the perceptual pop-out hypothesis and the mood incongruent inhibition hypothesis. However, the present experiment was successful in discarding Niedenthal et al.'s (1997) assertion that a priming effect was created by preadministration of a mood scale.

Future studies may consider utilizing an eye-tracking device for more precise measurements of perceptual "pop-out" phenomenon, as discussed by Niedenthal and Setterlund (1994). Hence, multiple affective stimuli can be presented within the visual space and participants' attention can be precisely tracked. If Bower's perceptual pop-out hypothesis holds true, then participants should pay more attention to mood congruent stimuli than to mood incongruent stimuli. Consequently, Bower's mood incongruent inhibition hypothesis can then be eliminated. However, if the results show that participants paid more attention to mood incongruent stimuli then Bower's perceptual "pop-out" hypothesis could then be eliminated. Studies may also want to investigate the possible gender effect in mood congruence studies. Many past studies have utilized predominately female participants in their studies (Clark et al., 1983; Niedenthal & Setterlund, 1994). It has long been a cultural belief that women are more susceptible to mood induction than men. Future studies should consider these issues as they seek to understand what role, if any, emotion plays in memory.

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Appendix A

Human Subjects-Institutional Review Board Approval Form

San José State
UNIVERSITY

Office of the Academic
Vice President
Associate Vice President
Graduate Studies and Research
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TO: Tuan Quoc Tran
1244 Clayburn Lane
San Jose, CA 95116

FROM: Nabil Ibrahim, N. Dat
AVP, Graduate Studies & Research

DATE: September 21, 1999

The Human Subjects-Institutional Review Board has approved your request to use human subjects in the study entitled:

"Emotion and Cognition: Exploring the Perceptual Pop-Out"

This approval is contingent upon the subjects participating in your research project being appropriately protected from risk. This includes the protection of the anonymity of the subjects' identity when they participate in your research project, and with regard to any and all data that may be collected from the subjects. The Board's approval includes continued monitoring of your research by the Board to assure that the subjects are being adequately and properly protected from such risks. If at any time a subject becomes injured or complains of injury, you must notify Nabil Ibrahim, Ph.D., immediately. Injury includes but is not limited to bodily harm, psychological trauma and release of potentially damaging personal information.

Please also be advised that all subjects need to be fully informed and aware that their participation in your research project is voluntary, and that he or she may withdraw from the project at any time. Further, a subject's participation, refusal to participate, or withdrawal will not affect any services the subject is receiving or will receive at the institution in which the research is being conducted.

If you have any questions, please contact me at (408) 924-2480.

Appendix B

	1	2	3	4	5	6	7
	Definitely do feel			Neutral			Definitely do not feel
1. I presently feel lively	1	2	3	4	5	6	7
2. I presently feel happy	1	2	3	4	5	6	7
3. I presently feel sad	1	2	3	4	5	6	7
4. I presently feel tired	1	2	3	4	5	6	7
5. I presently feel caring	1	2	3	4	5	6	7
6. I presently feel content	1	2	3	4	5	6	7
7. I presently feel gloomy	1	2	3	4	5	6	7
8. I presently feel jittery	1	2	3	4	5	6	7
9. I presently feel drowsy	1	2	3	4	5	6	7
10. I presently feel grouchy	1	2	3	4	5	6	7
11. I presently feel peppy	1	2	3	4	5	6	7
12. I presently feel nervous	1	2	3	4	5	6	7
13. I presently feel calm	1	2	3	4	5	6	7
14. I presently feel loving	1	2	3	4	5	6	7
15. I presently feel fed up	1	2	3	4	5	6	7
16. I presently feel active	1	2	3	4	5	6	7

Appendix C

Word Puzzle A

a	y	z	q	r	r	e	m	o	r	s	e
f	v	q	e	l	z	d	q	q	z	i	u
y	d	e	m	d	g	m	c	x	r	o	j
c	h	f	o	v	l	p	j	h	d	p	c
c	c	h	u	y	e	x	b	r	q	e	o
a	g	f	r	c	e	q	o	g	q	d	l
k	f	k	n	j	x	h	v	s	z	a	l
k	b	x	u	j	c	i	e	w	x	l	v
f	o	y	e	r	e	f	c	m	r	y	g
v	u	x	c	d	e	h	n	h	j	k	p
r	v	u	k	i	y	z	d	l	x	v	c
k	f	d	r	j	u	b	i	l	a	n	t
j	h	g	l	u	l	y	u	h	g	r	e

Appendix D

Word Puzzle B

j	r	k	p	x	k	p	f	g	u	j	x
h	q	e	v	m	i	s	e	r	y	o	d
q	e	v	m	c	d	q	t	x	s	l	k
w	y	k	u	a	c	e	z	b	c	l	q
c	c	h	l	y	i	u	j	j	i	y	j
p	d	g	y	r	m	t	u	q	u	d	i
a	n	q	e	n	u	s	e	c	t	o	r
s	m	b	l	i	s	s	c	t	w	v	z
t	g	c	l	q	k	x	g	k	h	n	p
e	a	t	q	c	o	k	l	t	l	u	k
b	o	q	o	o	i	r	o	u	h	z	u
v	k	l	x	e	c	u	o	p	w	x	k
h	c	r	z	p	v	z	m	t	l	b	d

Appendix E

Word Puzzle C

y f m a n u a l n e l d

k c g u v j o l l y o q

f m b x q q e j i h u r

g e d u v b z k m q s v

q r j l o p b q o p y l

c r h l q t g s j e s m

d y g l e k a g p x z u

p z d r m d e s p a i r

h x g x i z w t q z k h

g e z v r v k y z n y f

r x j p r n t f e o i v

i r h w o q l r j a j q

q x p v r y p v u u f l