The Effect of Acute Mood on Inhibition:
Decrease with Sad Mood and Increase with Positive Mood

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ABSTRACT

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The present studies examined the hypothesis that sad mood is associated with decreased inhibition and positive mood is associated with increased inhibition. Inhibition occurs in negative priming which is itself reflected in slowing in response time observed when a previously ignored item on a visual selective attention task becomes a target for selection. Degree of negative priming was assessed before and after mood induction. In Experiment 1, induced sad mood resulted in the expected decreased negative priming, whereas induced positive mood was associated with maintenance of negative priming. In a replication, a neutral mood control condition was also included. Sad mood again resulted in decreased inhibition, and positive mood resulted in increased inhibition. No change in inhibition was observed for neutral mood. The results support models of performance deficits in depression which posit a reduction in available attentional resources.

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This thesis is dedicated to the memory of my mother,

Shirley Eileen Holm.

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Introduction

In a complex world the ability to selectively attend to stimuli is crucial. Selective attention has been proposed to be a dual process whereby representations of target stimuli are activated and distracting stimuli are inhibited (Neill, 1977; Neumann & DeSchepper, 1991). Inhibition has been conceptualized as deactivation of a memory representation (Anderson and Spellman, 1995), perhaps involving the active suppression of to-be-inhibited information (Anderson & Bjork, 1994). Inhibitory mechanisms have been posited to be of importance to basic cognitive functions (Neill & Westbury, 1987), including the selection of material for working memory (Anderson & Spellman, 1995), retrieval from memory (Anderson, Bjork, & Bjork, 1994), and visual selective attention (Neill, 1977; Neill & Westbury, 1987; Tipper & Cranston, 1985). The importance of the inhibition of extraneous information is emphasized if one imagines the consequences of losing this ability. Consider what would happen if, as one were reading this sentence, one's attention were drawn to not only grasping the meaning of the words, but to the shapes of the letters, the white spaces in between each letter, the sounds of the words, and so on. The goal of comprehending the ideas in the text would be greatly compromised, if not entirely precluded.

Inhibition is thought to be resource demanding (Neumann & DeSchepper, 1991) and will occur to the extent an individual has sufficient available resources (A. Conway & Engle, 1994). Attentional resources have been construed as a nonspecific resource for cognitive processing (Hasher & Zacks, 1979). The amount of resources individuals have at their disposable to direct towards a task are finite, as illustrated in a person's limited ability to carry out multiple tasks (Kahneman, 1973). If an individual's attentional resources are diminished, inhibition will be less effective. People with reduced inhibition will experience more off-goal information entering working memory (Hasher & Zacks, 1988).

Poor inhibition is implicated by the results of two studies which demonstrate greater Stroop interference for depressed individuals (Benoit, Fortin, Lemelin, Laplante, Thomas, & Everett, 1992; Laplante, Everett, & Thomas, 1992). Deficits in performance across various cognitive tasks in depressed individuals have been explained in terms of limited attentional resources (Ellis & Ashbrook, 1988; Hartlage, Alloy, Vazquez, & Dykman, 1993; Hasher & Zacks, 1977) and such limitation may be related to poor inhibition. The resource allocation model (Ellis & Ashbrook, 1988) suggests that sad mood reduces quantitatively (by some unspecified mechanism) the amount of attentional resources, and in addition a portion of remaining resources is diverted elsewhere. This model proposes that when depressed individuals complete tasks, they are more likely than non-depressed individuals to focus on task-irrelevant features, or even on extra-task thoughts. For example, in an experimental reading session, a depressed individual may be distracted by the ink colour of words, or by thoughts of their plans for after the session. The implication is that depressed individuals have more difficulty inhibiting task-irrelevant stimuli, as a consequence or cause of depleted resources. Reduced resources may lead to less inhibition, and less inhibition, by allowing intrusions, may effectively reduce what available resources remain. In a related vein, the cognitive capacity reduction hypothesis (Hasher & Zacks, 1979; Hasher, Rose, Zacks, Sanft, & Doren, 1985) posits that depression reduces the total amount of resources available (by some unspecified mechanism), with the result that less resources are available to direct toward effortful processes. This capacity model has been reformulated in the area of aging (Hasher & Zacks, 1988), giving precedence to poor inhibition as a cause for the deficits in cognitive performance observed with older adults. This revised model may be extended to account for deficits in other populations, such as depressed individuals. Furthermore, in regards to depression, several theorists propose that depressed individuals focus on depressive cognitions, thus limiting resources available for the task at hand (e.g., Ellis & Ashbrook, 1988; Ingram & Wisnicki, 1991; Ingram, 1990). This negative ideation is also suggestive of poor inhibition.

Proposing reduced inhibition with depression allows for greater specificity in attentional resource models of depression. Further, because performance deficits observed in a depressed population are also observed in dysphoric individuals (i.e., those individuals with elevated scores on self-report depression inventories such as the Beck Depression Inventory, (Beck, 1972)) and those with acute sad mood, sad mood in and of itself may be linked to poor inhibition. Sad mood is the common denominator for individuals with clinical depression, dysphoria, and individuals in whom a sad mood has been experimentally induced (Compas, Ey, & Grant, 1993). Typically, depressed patients, compared to non-depressed control subjects, perform less well on tasks that place high demands on attentional resources than on those that place less demands (e.g., Calev & Erwin, 1985; Roy-Byrne, Weingartner, Bierer, Thompson, & Post, 1986; Weingartner, 1986). Performance deficits found in depressed individuals are also evident for dysphoric individuals (e.g., M. Conway & Giannopolous, 1993; Hasher & Zacks, 1979). In addition to findings with depressed and dysphoric individuals, performance deficits on cognitive tasks have been found with induced sad mood (eg. Ellis, Thomas, & Rodriquez, 1984). Research suggests that the more severe the negative mood, the greater are the performance deficits; in addition, the more cognitive effort required for a task, the larger are the performance deficits (see Hartlage et al., 1993, for a review). Attentional resource models suggest that mental activities vary in the amount of demands they place on attentional resources (Hasher & Zacks, 1988; Kahneman, 1973). When task demands exceed available resources, performance degrades. Deficits in performance on a given task could occur either because a portion of available resources are allocated to other activities, or because the pool of resources itself is insufficient for the adequate performance of the task (Kahneman, 1973). As inhibition is resource demanding, a reduction in the amount of attentional resources available may be evidenced in poor inhibition. The deficits in cognitive performance observed for depressed and dysphoric individuals, and those with an acute sad mood, may be due to a reduction in inhibition that accompanies sad mood.

In contrast to deficits found with sad mood, there is evidence that positive mood is associated with improved performance on cognitive tasks (see Sullivan & M. Conway, 1989, for a review). For example, an induced positive mood, relative to neutral mood, has been related to improved performance for children on a discrimination task (Masters, Barden, & Ford, 1979), and to improved performance on mathematical problems (Kirschenbaum, Tomarken, & Humphrey, 1985). Positive mood has also been reliably associated with better performance on creativity tasks (see Isen, 1987, for a review). However, some researchers have suggested that positive mood is associated with reduced attentional resources because subjects in a positive mood are less likely to engage in systematic argument-based elaboration of persuasive appeals (see Schwarz, Bless, & Bohner, 1991, for a review). These latter findings are called into question by the results of other research which suggest that emphasizing the importance of the task or instructing subjects to attend to the arguments results in systematic argument-based elaboration under positive mood (Bless, Bohner, Schwarz, & Strack, 1990; Mackie & Worth, 1989). The latter findings suggest that positive mood is not associated with reduced resources. In sum, previous research taken as a whole gives credence to the view that positive mood is associated with increased attentional resources.

The present experiments addressed the hypothesis that acute sad mood leads to decreased inhibition, whereas acute positive mood leads to increased inhibition. The studies were based on experimental mood induction. This procedure has the advantage of isolating the sad mood that accompanies depression. A negative priming task was employed as the measure of inhibition. In completing this task in the version adopted in the present studies, subjects' read aloud a series of letters. A person's selection of a target letter on each trial requires inhibition of a distractor letter. Colour was used as the selection cue in that target letters were one colour and distractor letters another colour. Because letters are well learned, corresponding internal representations of both the target and distractor letters are activated in memory. However, because only the target is to be named, the competing distractor must be inhibited (Tipper, 1985; Tipper & Cranston, 1985). When the letter to be named was the distractor on the previous trial, response time is increased. The process resulting in the increased latency to name the target is referred to as negative priming. The negative priming effect is taken as evidence that memory representations of distractors are associated with inhibition during target selection. When a current target is the same as the distractor on the preceding trial, the letter must be uninhibited before it can be named, resulting in the slower response time. This type of sequential shift from distractor to target has been employed for letters, as in the present task, as well as for pictograms (Tipper, 1985).

In Experiment 1, the effects of induced sad mood are contrasted with those of induced positive mood. While sad mood was expected to be associated with decreased inhibition, as compared to before mood induction, positive mood was expected to be associated with increased inhibition. In Experiment 2, a neutral mood condition was included in addition to the positive and sad mood conditions in order to examine changes over time in inhibition in the absence of a mood manipulation.

Experiment 1

Method

A between-within subjects design was adopted in order to take into account individual differences in reading speed. Subjects were randomly assigned to either the sad or positive mood condition. Subjects first read the letter columns that included a measure of negative priming, were exposed to mood induction, and then again read the letter columns.

Subjects

Subjects were drawn from a pool of undergraduate students recruited at a booth on the campus of Concordia University. At time of recruitment, respondents indicated if they would be available for paid research. Students that had participated in many psychological studies were excluded from the present study. Forty three men participated in the study. Mean age was 24 years; range was 19 to 39. Subjects were paid $8 for their participation.

Materials

Letter Reading Task. The procedure of Tipper and Cranston (1985, Experiment 1) was used. This task involves reading columns of red target letters while ignoring superimposed green distractor letters. Six letters (*A*, *C*, *E*, *H*, *J*, and *S*) were used in random order as both targets and distractors. The target letters (1 cm in height) were stencilled in red on cards 4 cm x 52 cm. The distractor letters, stencilled in green, were superimposed with a 50% overlap with the target letters. In a random order, the distractor letters were positioned slightly higher or lower, and slightly to the left or right of the position of the target letters. Seven millimetres of vertical distance separated each target-distractor letter pair. Each target and distractor pair is referred to here as a trial. There were 26 trials on each card.

There were four different types of cards, each corresponding to a different stimulus condition. Subjects read three cards of each type, for a total of 12 cards. The order of the 12 cards was randomized in blocks of four, with one card from each stimulus condition in each block. There were twenty orders, and each was implemented at least once in each mood condition.

There were two stimulus conditions of primary interest for the major hypothesis (see Figure 1). In the Negative Prime condition, the distractor letter on one trial is the target letter on the subsequent trial. This stimulus presentation addresses inhibition as the distractor letter must first be inhibited on the first trial, and then named on the next trial. The shift from inhibition to disinhibition is referred to as negative priming. In the Distractor condition, the distractor letter on each trial is different from the target letter, and no distractor letter

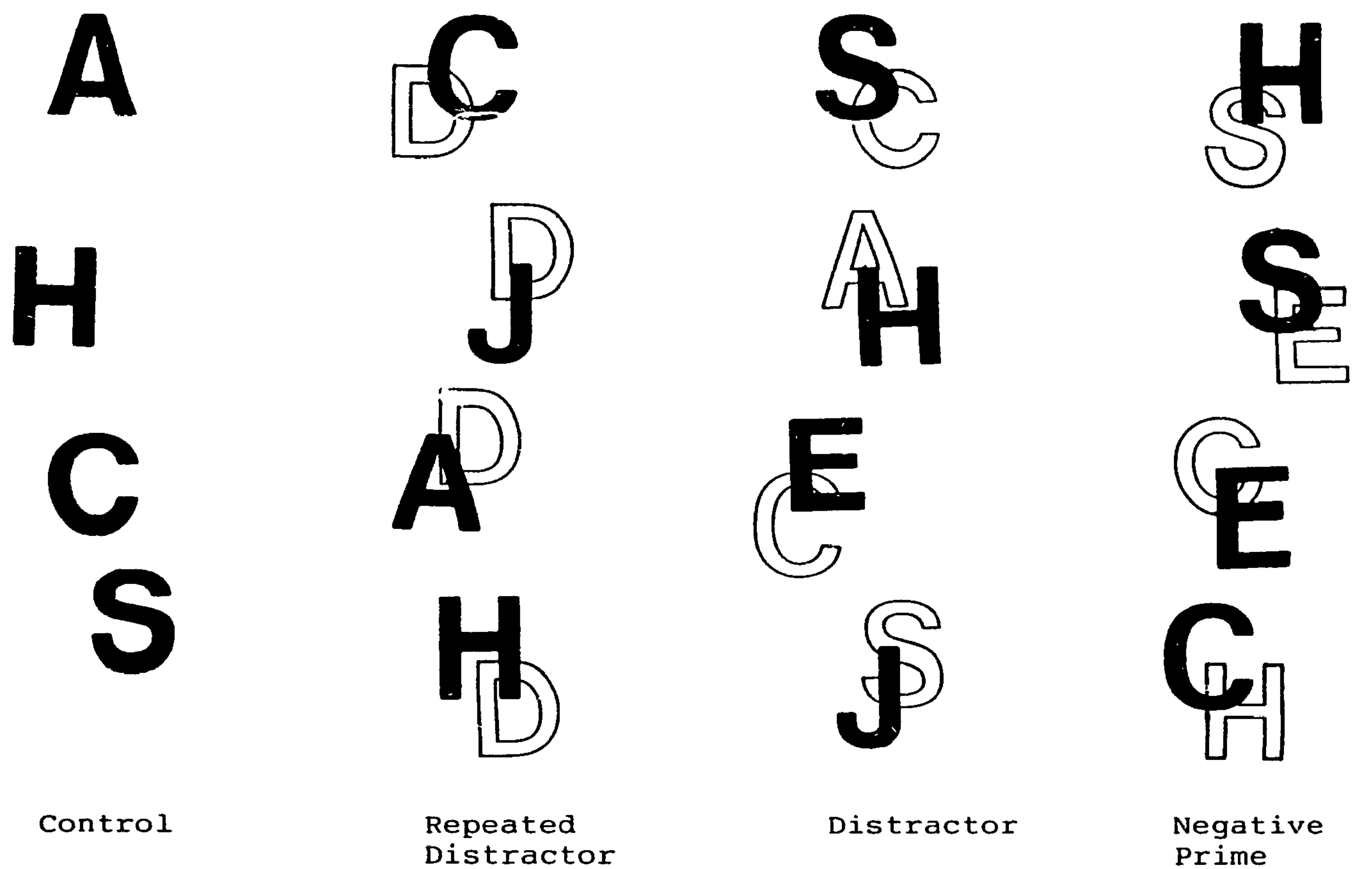

Figure 1. Representation of the four stimuli conditions. Solid letters correspond to targets (red) and outlined letters correspond to distractors (green).

on one trial is the same as the target letter on the subsequent trial. Response time for the Distractor trials is typically faster than for the Negative Prime trials as there is no negative priming on the Distractor trials. The greater reading time of the Negative Prime than the Distractor stimulus condition is taken as the measure of inhibition; larger differences indicate greater inhibition.

In addition to inhibition, the effect of mood on baseline reading time and possible practice effects were also of interest. To address these factors, there were two control stimulus conditions (see Figure 1). In the Repeated Distractor condition, the same letter D was used as the distractor on every trial. This condition provided a comparison for reading time with the presence of a distractor. Repeated ignoring of the same distractor is posited to result in facilitation because of a buildup of inhibition (Neill & Westbury, 1987) or habituation of the distractor (Lorch, Anderson, & Well, 1984). Therefore, mean reading time for the Repeated Distractor condition is expected to be less than that for the Distractor and Negative Prime condition. In the Control condition, red target letters only were used as a basis of comparison for reading speed without the presence of a distractor. Mean reading time for the Control stimulus condition is expected to be less than that for the other three stimulus conditions.

Each of the twelve letter columns was drawn on a 4cm x 52cm card and the cards were mounted side by side on an illustration board. A blank covering board of the same size allowed subjects to view one column through a 4 cm x 52 cm slot. Both the mounting and covering boards sat in a sleeve. Sliding the covering board to one side allowed the next column to be revealed. Marks on the bottom edge of the covering board, when aligned with the edge of the sleeve, indicated correct placement of the covering board for each column.

Mood Induction. Instrumental music served to induce either a sad or a positive mood (Pignatiello, Camp, & Rasar, 1986; see Appendix A). For the sad mood condition, the music selections were initially neutral and became progressively more sad. For the positive mood condition, the selections began neutrally and became progressively more positive. The duration of each induction was 20 min. This method of mood induction has been successfully used in previous research in our laboratory (e.g., Howell & M. Conway, 1992).

Mood Assessment. Subjects responded to the question "How did the music make you feel?" on a 7-point scale with endpoints labelled "positive uplifted" (1) and "negative blue" (7). This item was included along with four filler items in a questionnaire concerning reactions to the music (see Appendix B). The filler items were included to support the auditory perception cover story (as described below).

Procedure

There was one subject present at each experimental session. Each subject was guided through the procedure by an experimenter who remained blind to mood condition. To avoid demand characteristics, subjects were informed that the study concerned age differences in auditory and visual perception (see Appendix C). Subjects were told that for the visual portion of the study, they would be reading columns of letters. They were given instructions to read the red letters as quickly as possible. Subjects were informed that they would be timed, and were asked to avoid making errors (see Appendix D). The requirement of accuracy is important for showing inhibitory effects (Neill, 1979). Subjects were asked to move the covering board to the first mark, and then to immediately start reading the red letters from top to bottom. For each column, the experimenter started timing when the subject started to read the first letter, and stopped timing when the last letter was read. The experimenter recorded any misread letters. After subjects completed a column, the experimenter indicated when they were to move on to the next column.

Following the first reading of the letter columns, the subjects were told that they would now proceed to the auditory portion of the study. This was in fact to be the mood induction. In order to prevent subjects approaching the mood induction in a performance related manner, they were asked to listen to the music as if they were listening to the radio at home (see Appendix E). They were told that they would be asked general questions about their impressions of the music. Subjects were left alone while they listened to the music over headphones. When the recording of musical selections ended, the experimenter returned and gave subjects the music evaluation questionnaire that included the mood assessment item.

Subjects were then told that performance on tasks such as letter reading is assessed more accurately when the tasks are completed repeatedly. Subjects were asked to again read all the columns. The procedure was exactly as for the first reading. Subjects were then debriefed (see Appendix F) and paid for their participation.

Results

Two subjects failed to comply with instructions. There was one outlier for reading time; that subject's data was excluded from analysis. The final sample therefore consisted of 40 men, twenty in each of the Sad and the Positive mood conditions.

Mood Assessment

As expected, Positive subjects rated their mood as significantly more positive (M = 2.10) than did Sad subjects (M = 4.45; $t(37) = 6.56$, $p<.001$).

Letter Reading

Although the focus for the letter reading task was on speed, accuracy was also emphasized. In general, errors were minimal and did not seem to affect reading time. However, in some cases, errors were disruptive. Some subjects apologized or returned to the beginning of the column to resume reading after making an error. Such disruptions effectively voided the reading time for that column. Four stimulus columns across all subjects were voided. In such cases, the mean reading time for the corresponding stimulus condition was calculated by averaging across the two remaining columns.

Reading times across the four stimulus conditions were examined to determine whether subjects in the Sad and Positive mood conditions had similar reading times prior to mood induction. A 4 (Stimulus condition: Control, Repeated Distractor, Negative Prime, Distractor) x 2 (Mood: Sad, Positive) analysis of variance (ANOVA) was conducted to address possible differences in reading time. The Stimulus Condition x Mood interaction was not significant, $F<1$, indicating no difference between the Sad and Positive mood conditions prior to mood induction on overall reading time.

The major focus of the experiment was on inhibition. Inhibition is indicated by longer mean reading time for the Negative Prime stimulus than the Distractor stimulus. Prior to mood induction, Sad subjects evidenced longer reading time for the Negative Prime than for the Distractor stimulus ($t(19) = 2.23$, $p<.05$). Similarly, subjects in the Positive mood condition evidenced longer reading times for the Negative Prime than for the Distractor stimulus ($t(19) = 2.19$, $p<.05$) prior to mood induction. See Table 1 for means for all stimulus conditions. Thus, both Sad and Positive subjects evidenced a significant inhibition effect before mood induction.

Although the emphasis of the study was on inhibition and thus on comparisons of reading times for the Negative Prime and Distractor stimulus, an overall repeated measures analysis of variance (ANOVA) was conducted with mood condition and stimulus condition as factors to examine changes over time. The three-way interaction among mood (Sad, Positive), stimulus condition (Control, Repeated Distractor, Distractor, Negative Prime), and time (pre-post-mood induction) was not significant, $F(3, 114) = 1.84$, ns. Simple effects analyses were conducted to address the major hypothesis that Sad subjects would evidence less inhibition following mood induction, and that subjects in the Positive mood condition would evidence increased inhibition. This hypothesis translates into an expected three way interaction among mood condition, stimulus condition, and time. The hypothesis was addressed with a 2 (Mood: Sad, Positive) x 2 (Stimulus: Distractor, Negative Prime) x 2 (Time: pre-, post-mood induction) repeated

Table 1

Means and Standard Deviations (s) for Reading Time of Stimuli Pre- and Post-Mood Induction in Experiment 1.

	Control		Repeated Distractor		Distractor		Negative Prime	
Condition	M	SD	M	SD	M	SD	M	SD
Sad								
Pre	9.2	1.2	9.7	1.1	10.5	1.2	10.9	1.3
Post	8.9	1.1	9.5	1.3	10.3	1.7	10.0	1.5
Positive								
Pre	9.6	1.3	10.3	1.4	10.9	1.6	11.2	1.8
Post	9.3	1.3	9.8	1.5	10.3	1.5	10.6	1.5

measures ANOVA. The expected three-way interaction was significant, $F(1, 38) = 4.55$, $p<.05$.

The significant three-way interaction among mood, stimulus condition, and time can best be addressed by examining the relative change from pre- to post-mood induction in reading time for each mood condition. For Sad subjects, it was expected that there would be less of a difference in reading time between the Negative Prime and the Distractor stimulus conditions following mood induction, which would indicate a decrease in inhibition. This expectation was addressed with a 2 (Stimulus Condition: Distractor, Negative Prime) x 2 (Time: pre-, post-mood induction) repeated measures ANOVA. As expected, this interaction was significant, $F(1, 19) = 8.62$, $p<.01$. This stimulus condition x mood interaction reflects the fact that the inhibition effect that was evident prior to sad mood induction was no longer evident after mood induction (see Figure 2). The main effect for stimulus condition (Negative Prime, Distractor) was not significant, $F<1$. An examination of the means indicated that reading time for the Negative Prime stimulus was now less than that for the Distractor stimulus, albeit not significantly so, $t(19) = 1.47$, $p = .15$. Normally an inhibition effect is demonstrated by longer reading time for the Negative Prime stimulus than for the Distractor stimulus. The main effect for Time (pre-post mood induction) was significant, $F(1, 19) = 11.43$, $p<.01$.

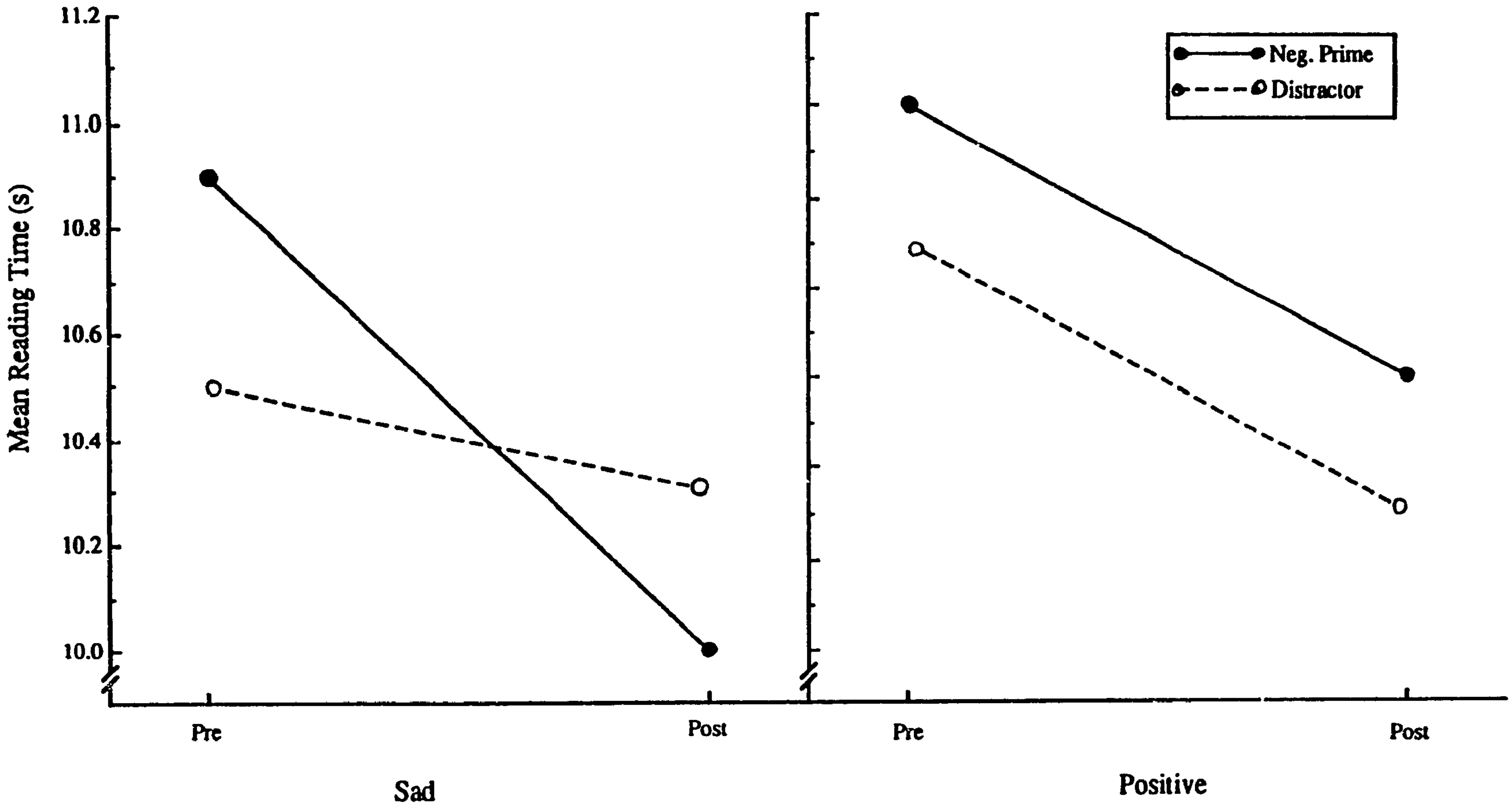

Figure 2. Inhibition index for Sad and Positive subjects before and after mood induction in Experiment 1.

An examination of changes for the individual stimulus over time indicated that mean reading time for the Distractor stimulus after mood induction was not significantly different as compared to before, $t<1$. In contrast, the mean reading time for the Negative Prime stimulus was significantly less after as compared to before mood induction ($t(19) = 7.27$, $p<.001$), reflecting the significant two-way interaction. In sum, consistent with the hypothesis, a significant inhibition effect was observed before mood induction for Sad subjects and was not evident after mood induction.

In contrast to Sad subjects, it was expected that following mood induction Positive subjects would evidence increased inhibition. This hypothesis was addressed with a 2 (Stimulus Condition: Distractor, Negative Prime) x 2 (Time: pre-, post-mood induction) repeated measures ANOVA. The two-way interaction for Positive subjects was not significant, $F <1$. The main effect for stimulus condition was significant $F(1, 19) = 6.7$, $p<.05$, reflecting a longer mean reading time for the Negative Prime stimulus than for the Distractor stimulus after mood induction. The longer reading time for the Negative Prime stimulus indicates a significant inhibition effect, $t(19) = 1.92$, $p<.05$, one-tailed, maintained from before mood induction. As such, the expected increase in inhibition for positive mood was not observed. The main effect for Time (pre-post mood induction) was also significant, $F(1, 19) = 28.47$, $p <.001$. A comparison of mean reading times for the individual stimulus conditions from before to after mood induction revealed significantly faster reading times following mood induction for both the Distractor and Negative Prime stimulus ($ts(19) > 4.00$, $ps<.01$). In sum, subjects in the Positive mood condition maintained, but did not increase, the inhibition effect following mood induction, even while exhibiting increased reading speed for both the Negative Prime and Distractor stimulus (see Figure 2).

In addition to inhibition, a comparison of Sad and Positive subjects on baseline reading times (see Table 1) was of interest to investigate changes from before to after mood induction. Analyses were conducted on the Control and Repeated Distractor stimulus reading times to compare times from before to after mood induction. For Sad subjects, there was no change from before to after mood induction for the Control stimulus ($t(19) = 1.88$, $p = .08$). As well, for Sad subjects, there was no significant change from before to after mood induction ($t <1$) for the Repeated Distractor stimulus. In sum, these and the analyses reported above indicate that Sad subjects were significantly faster after as compared to before mood induction <u>only</u> on the Negative Prime stimulus. In contrast, subjects in the Positive mood condition had significantly shorter reading times after mood induction as compared to before for the Control stimulus

($\underline{t}(19) = 2.78$, $\underline{p}<.05$), and shorter reading times after mood induction as compared to before for the Repeated Distractor stimulus ($\underline{t}(19) = 3.89$, $\underline{p}<.01$). In sum, these and the analyses reported above indicate that Positive subjects were significantly faster in reading time after mood induction as compared to before on all four stimulus conditions (see Table 2).

The changes in reading time for the two mood conditions can also be addressed in terms of the linear pattern across the four stimulus conditions. Due to the increasing difficulty in selecting the target letter across the stimulus conditions, the shortest reading time typically would be expected for the Control stimulus, followed with longer times for the Repeated Distractor, Distractor, and Negative Prime stimulus, in that order. As such, before mood induction, for both the Sad and Positive conditions, a significant linear coefficient was expected. This expectation was addressed with polynomial regressions for each mood condition with the four stimulus conditions entered as predictors, conducted separately for pre-and post-mood induction. For Sad subjects, there was a significant linear coefficient prior to mood induction, $\underline{F}(1, 19) = 127.63$, $\underline{p} <.001$ ($\underline{r}^2 = .29$). The quadratic and cubic coefficients were not significant for Sad subjects, $\underline{F}$s<1 (see Figure 3). For the analysis for Positive subjects, the linear coefficient for the four stimulus conditions prior to

Table 2

Change in Mean Reading Time from Pre- to Post-Mood Induction by Stimuli in Experiment 1.

Condition	Control	Repeated Distractor	Distractor	Negative Prime
Sad	no	no	no	decrease
Positive	decrease	decrease	decrease	decrease

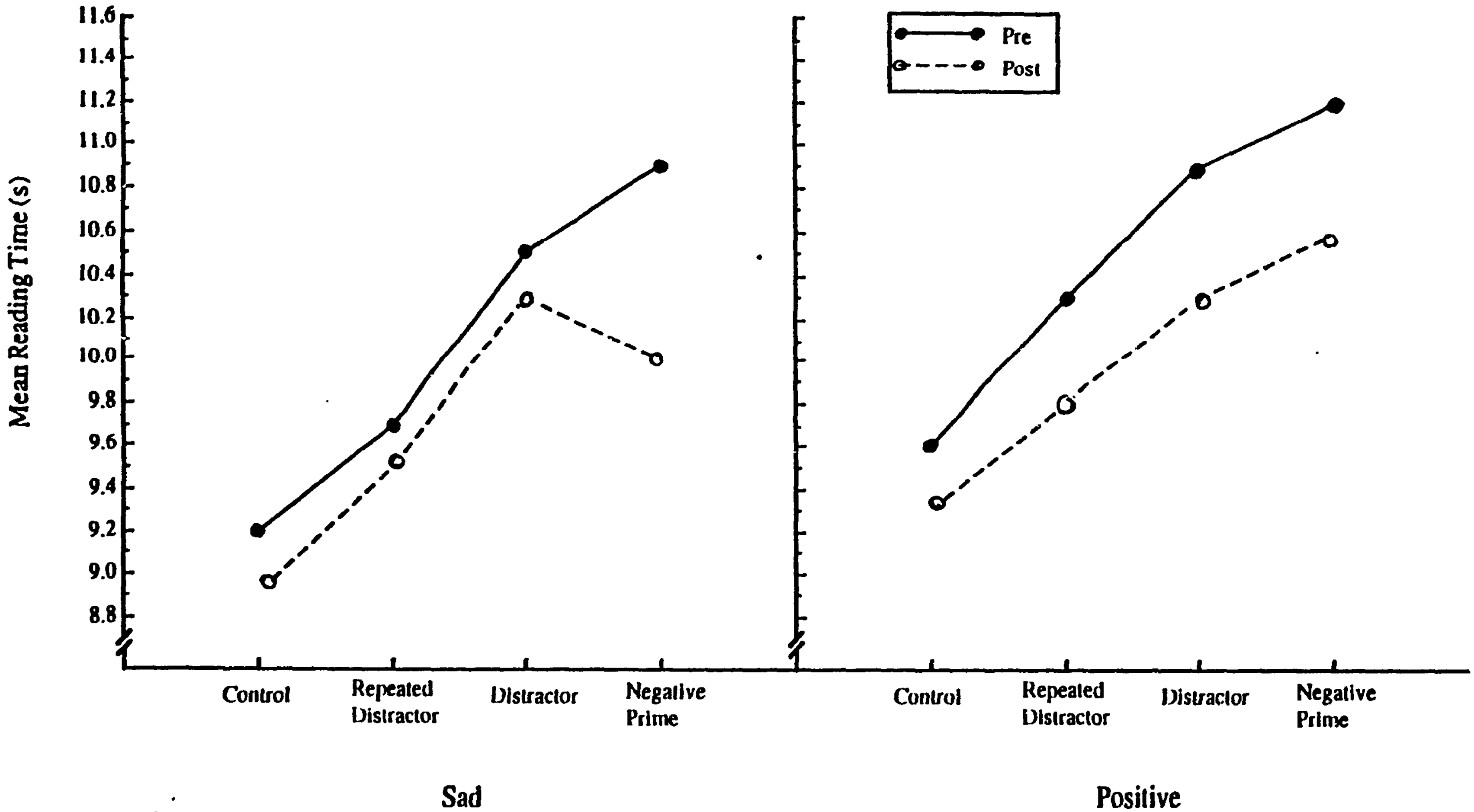

Figure 3. Polynomial regressions with Control, Repeated Distractor, Distractor, and Negative Prime stimuli for Sad and Positive Subjects, before and after mood induction in Experiment 1.

mood induction was also significant, $F(1, 19) = 80.10$, $p < .001$, ($r^2 = .16$). The quadratic, $F(1, 19) = 2.80$, ns, and cubic, $F<1$, coefficients were not significant for positive subjects (see Figure 3).

With the expected decrease in inhibition following sad mood induction, the pattern across the four stimulus conditions was expected to change. A significant quadratic coefficient, in addition to a significant linear coefficient was expected due to the anticipated decrease in the difference for the mean reading times between the Negative Prime and Distractor stimulus. Following sad mood induction the linear coefficient was significant, $F(1, 19) = 41.77$, $p<.001$, ($r^2 = .12$), as was the expected quadratic coefficient, $F(1, 19) = 8.95$, $p<.01$, ($r^2 = .03$). The cubic coefficient was significant as well, $F(1, 19) = 5.64$, $p<.05$, but accounted for a small proportion of the explained variance ($r^2 <.01$) (see Figure 3). These results reflect the fact that for Sad subjects mean reading time for the Negative Prime stimulus following mood induction was less than that for the Distractor stimulus. In contrast, for Positive subjects, the pattern in reading time across the four stimulus conditions after mood induction was expected to be reflected in a significant linear coefficient, as it was prior to mood induction. The linear coefficient for Positive subjects after mood induction was indeed significant $F(1, 19) = 74.86$, $p <.001$, ($r^2 = .12$).

Quadratic $F(1, 19) = 2.50$, *ns*, and cubic coefficients were not significant $F < 1$ (see Figure 3).

Discussion

Experiment 1 addressed the hypothesis that sad mood is associated with decreased inhibition, whereas positive mood is associated with increased inhibition. Consistent with this hypothesis, subjects in the sad mood condition exhibited a significant inhibition effect before mood induction and did not evidence an inhibition effect after mood induction. In contrast, subjects in the positive mood condition consistently demonstrated an inhibition effect both before and after mood induction. Contrary to expectation, there was no significant increase in inhibition with positive mood, possibly due to a ceiling effect, but there was maintenance of pre-existing levels of inhibition. In addition, while reading speed for subjects in the positive mood condition increased following mood induction for all stimulus, reading speed for sad subjects increased only for those letter columns that normally elicit negative priming. This latter increase in speed indicates that for sad subjects, the negative priming effect was diminished, allowing for faster reading of the letters for this stimulus condition only.

These results provide evidence for reduced inhibition with sad mood and intact inhibition with positive mood. However, there was a methodological problem in Experiment 1. For the Distractor stimulus letter columns, there should be no relation between target and distractor letters between trials. Yet on 25 of the 78 Distractor trials in Experiment 1, the target letter on one trial became the distractor letter on the next trial. The possible consequences, in terms of response time, are unclear (see McLeod, 1991), thus raising problems of interpretation. In Experiment 2, the Distractor columns were corrected to avoid any matching between the target and distractor letters on any two consecutive trials.

Changes in inhibition were observed from before to after mood induction in Experiment 1 in a pre-post experimental design that included sad and positive mood conditions. Experiment 2 was aimed at replicating the findings of Experiment 1. In Experiment 2, a neutral mood control condition was also included to examine changes over time in performance in the absence of mood change. Following from Experiment 1, the main hypothesis of interest was that following sad mood induction, subjects would evidence decreased inhibition; in contrast, subjects in a positive mood condition would evidence increased inhibition. The effect of mood on reading speed was also of interest. In Experiment 1, subjects in the positive mood condition evidenced increased reading speed after mood induction for all four stimulus conditions, perhaps because of an enhancement of practice effects due to the positive mood. In contrast, subjects in the sad mood condition increased reading speed after mood induction only on the columns that normally elicit negative priming. As such, subjects in the sad mood condition did not appear to benefit from practise. The addition of a neutral mood condition was expected to clarify the effects of practice on reading speed. Subjects in the neutral mood condition were expected to demonstrate weaker practice effects than positive subjects.

Experiment 2

Method

Subjects

Subjects were selected from a pool of undergraduate students recruited at a booth on the campus of Concordia University. At time of recruitment, students indicated if they would be available for paid research. Students that had participated in many psychological studies were excluded. Fifty subjects (25 men, 25 women) participated in the present study. Approximately equal numbers of men and women were randomly assigned to each mood condition. Mean age was 24 years; range was 18 to 34. Subjects were paid $8 for their participation in the present study.

Measures and Procedure

The procedure and materials were identical to those of Experiment 1, with the following exceptions: 1) the Distractor stimulus trials were amended so that there was no relation between targets and distractors on subsequent trials, and 2) a Neutral mood condition was added. The procedure for Neutral subjects was identical to that for Positive and Sad subjects, with the exception that the musical selections remained neutral in tone for the entire 20 min recording (see Appendix G).

Results

Three subjects' data were excluded from analyses: one because he was colorblind, another for failing to comply with instructions, and a third who reported that the positive music made her agitated. Another subject's data were excluded from analyses because of outlier reading times on several of the stimulus columns. The final sample therefore consisted of 15 subjects in each of the Sad and Positive conditions, and 16 subjects in the Neutral condition. There were no gender differences on any variable, therefore all analyses were collapsed across gender.

Mood Assessment

To ascertain whether mood induction was successful, an analysis of variance (ANOVA) was conducted on the mood check item with mood condition (Sad, Positive, Neutral) as the between subject factor. The main effect for mood condition was significant, $F(2, 43) = 12.25$, $p<.001$. A priori analyses indicated that Sad subjects ($M = 4.28$) rated their mood as significantly more negative than did Neutral subjects, ($M = 2.75$; $t\ (29) = 3.00$, $p<.01$). Positive subjects rated their mood as significantly more positive than did Neutral subjects, ($t\ (29) = 1.89$, $p <.05$, one-tailed).

Letter Reading

As in Experiment 1, errors on the letter reading task were minimal. For three subjects who stumbled while reading a column, the mean for that stimulus condition was calculated by averaging across the reading times for the remaining two columns.

Reading times before mood induction were examined across all four stimulus conditions to determine whether Sad, Positive, and Neutral subjects had similar reading times. A 4 (Stimulus Condition: Distractor, Negative Prime, Control, Repeated Distractor) x 3 (Mood: Sad, Positive, Neutral) ANOVA revealed no main effect for mood condition, $\underline{F}(2, 43) = 2.11$, ns, indicating no overall differences in reading speed across mood condition prior to mood induction.

Although the emphasis of the study was on inhibition, an overall repeated measures ANOVA was conducted with mood condition as the between-subjects factor and all four stimulus conditions and time as the within-subjects factor to examine changes in reading speed from before to after mood induction. The 3 (Mood: Sad, Positive, Neutral) x 4 (Stimulus Condition: Control, Repeated Distractor, Distractor, Negative Prime) x 2 (Time: pre-, post-mood induction) interaction was significant, $\underline{F}(6, 129) = 2.31$, $\underline{p} < .05$.

The major focus of the study was on inhibition. Inhibition is indicated by longer mean reading time for the Negative Prime than the Distractor stimulus. The presence of inhibition was considered within each mood condition prior to mood induction. For Sad subjects, there was a marginally longer reading time for the Negative Prime Disractor stimulus, ($\underline{t}(1, 14) = 1.54$, $\underline{p} = .07$, one-tailed.

For Positive subjects, there was no significant difference between the Negative Prime stimulus and Distractor stimulus $\underline{t}$ <1; nor was there a significant difference between the Negative Prime and Distractor stimulus for Neutral subjects $\underline{t}$<1 (see Table 3). As such, prior to mood condition, only Sad subjects evidenced an inhibition effect, albeit weakly.

It was expected that following mood induction, Sad subjects would evidence decreased inhibition. Positive subjects were expected to evidence increased inhibition after mood induction, which they did not evidence before mood induction, and no change was anticipated for Neutral subjects. The hypothesis was examined with a 3 (Mood: Sad, Positive, Neutral) x 2 (Stimulus Condition: Negative Prime, Distractor) x 2 (Time: pre-, post-mood induction) repeated measures ANOVA. The expected three-way interaction was significant $\underline{F}(2, 43) = 3.14$, $\underline{p} < .05$. This Mood x Stimulus x Time interaction can best be addressed by examining the relation between reading times for the Negative Prime and Distractor stimulus and Time within each of the three mood conditions (see Figure 4). Contrary to the initially observed inhibition effect for sad subjects, an inhibition effect was not expected after mood induction. This expectation translates into an expected 2 (Stimulus Condition: Negative Prime, Distractor) X 2 (Time: pre-, post-mood induction) interaction in a repeated measures ANOVA.

Table 3

Means and Standard Deviations (s) for Reading Time of Stimuli Pre- and Post-Mood Induction in Experiment 2.

	Control		Repeated Distractor		Distractor		Negative Prime	
Condition	M	SD	M	SD	M	SD	M	SD
Sad								
Pre	9.9	1.2	9.9	1.3	10.7	1.2	11.0	1.3
Post	9.7	1.3	9.9	1.2	10.5	1.3	10.3	1.3
Positive								
Pre	10.9	1.7	11.0	1.6	11.7	1.5	11.7	1.6
Post	10.1	1.7	10.7	1.7	10.9	1.3	11.4	1.6
Neutral								
Pre	9.8	1.3	10.7	1.0	11.2	1.2	11.3	1.1
Post	9.5	1.2	10.1	1.4	10.7	1.1	10.8	1.5

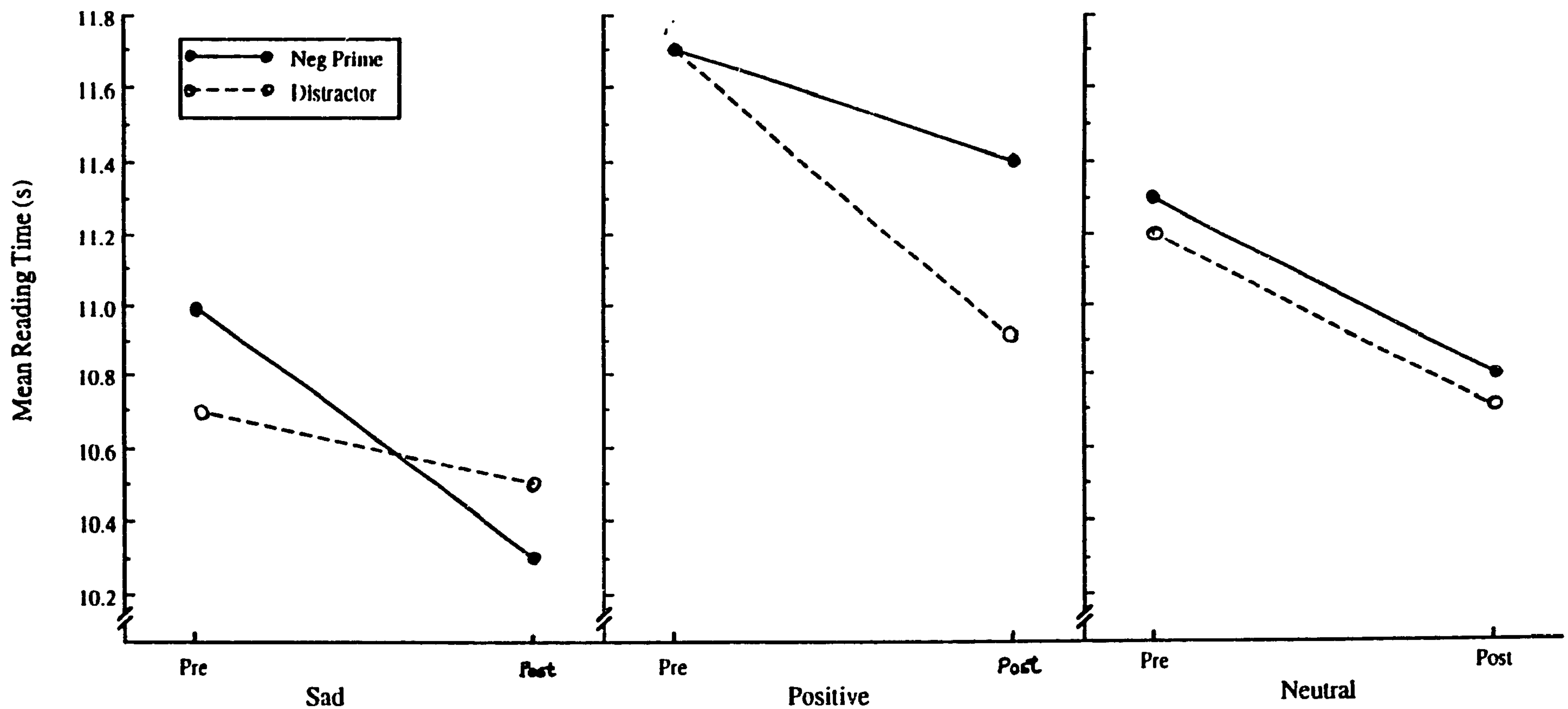

Figure 4. Inhibition index for Sad, Positive, and Neutral subjects before and after mood induction in Experiment 2.

The two-way interaction was significant, $F(1, 14) = 6.22$, $p<.05$. The main effect for stimulus was not significant, $F<1$. As in Experiment 1, the mean reading time for the Negative Prime stimulus was now less than that for Distractor stimulus, albeit not significantly, $t(14) = 1.17$, Inhibition is indicated if reading time for the Negative Prime stimulus is greater than for the Distractor stimulus. As such, the inhibition effect evident for Sad subjects before mood induction was not evident after mood induction. For Sad subjects, the main effect for time was significant, $F(1, 14) = 11.73$, $p <.005$. Mean reading time for the Distractor stimulus did not change significantly from before to after mood induction ($t(14) = 1.37$, ns). In contrast, reading time for the Negative Prime stimulus was significantly faster after as compared to before mood induction ($t(14) = 3.85$, $p<.01$).

Positive subjects were expected to evidence an inhibition effect following mood induction. As there was no inhibition effect for Positive subjects before mood induction, this translates into an expected 2 (Stimulus Condition: Negative Prime, Distractor) x 2 (Time: pre-, post-mood induction) interaction. The two-way interaction was marginally significant, $F(1, 14) = 3.55$, $p = .08$. The main effect for stimulus was not significant $F(1, 14) = 1.49$, ns. A comparison of reading time for the Negative Prime and Distractor stimulus after mood induction for positive subjects revealed a significant inhibition effect, $t(14) = 2.14$, $p < .05$ that did not exist prior to mood induction (see Figure 4). The main effect for Time was significant $F(1, 14) = 12.35$, $p < .005$. Reading time for Distractor stimulus after the positive mood induction was significantly faster as compared to before ($t(14) = 3.83$, $p < .01$). There was no significant difference in reading time for the Negative Prime stimulus from before to after positive mood induction ($t(14) = 1.73$, $p = .11$).

Neutral subjects were not expected to evidence any change in inhibition from before to after mood induction. The 2 (Stimulus Condition: Negative Prime, Distractor) x 2 (Time: pre-, post-mood induction) interaction was not significant for Neutral subjects, $F<1$. The main effect for stimulus was not significant, $F<1$, whereas the main effect for Time was significant, $F(1, 15) = 5.67$, $p < .05$. Mean reading time for Distractor stimulus was significantly faster after as compared to before neutral mood induction ($t(15) = 2.05$, $p = .05$). Mean reading time for the Negative Prime stimulus did not significantly change from before to after neutral mood induction ($t(15) = 1.76$, $p = .10$). A comparison of the Negative Prime and Distractor stimulus after neutral mood induction revealed no inhibition effect, $t<1$, just as there was no inhibition effect prior to mood induction for Neutral subjects.

Baseline reading times were examined for any changes from before to after mood induction within each mood condition (see Table 3). Within the Sad mood condition, there was no significant change from before to after mood induction on the Control stimulus, $\underline{t}(14) = 1.06$, ns, and no significant change from before to after mood induction for the Repeated Distractor stimulus, $\underline{t}<1$. These and other analyses reported above indicate that for Sad subjects reading time changed significantly from before to after sad mood induction only for the Negative Prime stimulus (see Table 4).

For Positive subjects, reading time for the Control stimulus was significantly faster after mood induction as compared to before ($\underline{t}(14) = 3.29$, $\underline{p}<.01$). There was no significant change in reading time for Repeated Distractor stimulus from before to after positive mood induction ($\underline{t}(14) = 1.66$, $\underline{p} = .12$). In sum, for Positive subjects there were significantly faster reading times from before to after mood induction for the Control and Distractor stimulus, but not for the Negative Prime or Repeated Distractor stimulus (see Table 4).

For Neutral subjects, reading time for the Control stimulus was not significantly different from before to after mood induction ($\underline{t}(15) = 1.40$, ns). For Repeated Distractor stimulus, reading time was significantly faster after as compared to before neutral mood induction ($\underline{t}(15) = 2.08$, $\underline{p} <.05$).

Table 4

Change in Mean Reading Time from Pre- to Post-Mood Induction by Stimuli in Experiment 2.

Condition	Control	Repeated Distractor	Distractor	Negative Prime
Sad	no	no	no	decrease
Positive	decrease	no	decrease	no
Neutral	no	decrease	decrease	no

In sum, Neutral subjects had faster reading times for the Distractor and Repeated Distractor stimulus after as compared to before mood induction, but not for the Negative Prime or Control stimulus.

The changes in reading time from before to after mood induction for the three mood conditions can also be addressed in terms of the linear pattern across the four stimulus conditions. As in Experiment 1, the shortest reading time typically would be expected for the Control stimulus, followed respectively with longer times for the Repeated Distractor, Distractor, and Negative Prime stimulus. As such, a linear relation across the four stimulus conditions would normally be expected before mood induction for all three mood conditions. This expectation was addressed with a polynomial regression within each mood condition with the four stimulus conditions entered as predictors, conducted separately pre- and post-mood induction.

For Sad subjects, prior to mood induction, the expected linear coefficient was significant, $F(1, 14) = 45.45$, $p < .001$, ($r^2 = .14$). The quadratic coefficient was not significant, $F(1, 14) = 1.23$, ns. The cubic coefficient was significant, $F(1, 14) = 4.98$, $p < .05$, accounting for a small proportion of the explained variance ($r^2 = .01$) (see Figure 5). For Positive subjects, prior to mood induction, the linear coefficient was significant, $F(1, 14) = 18.62$,

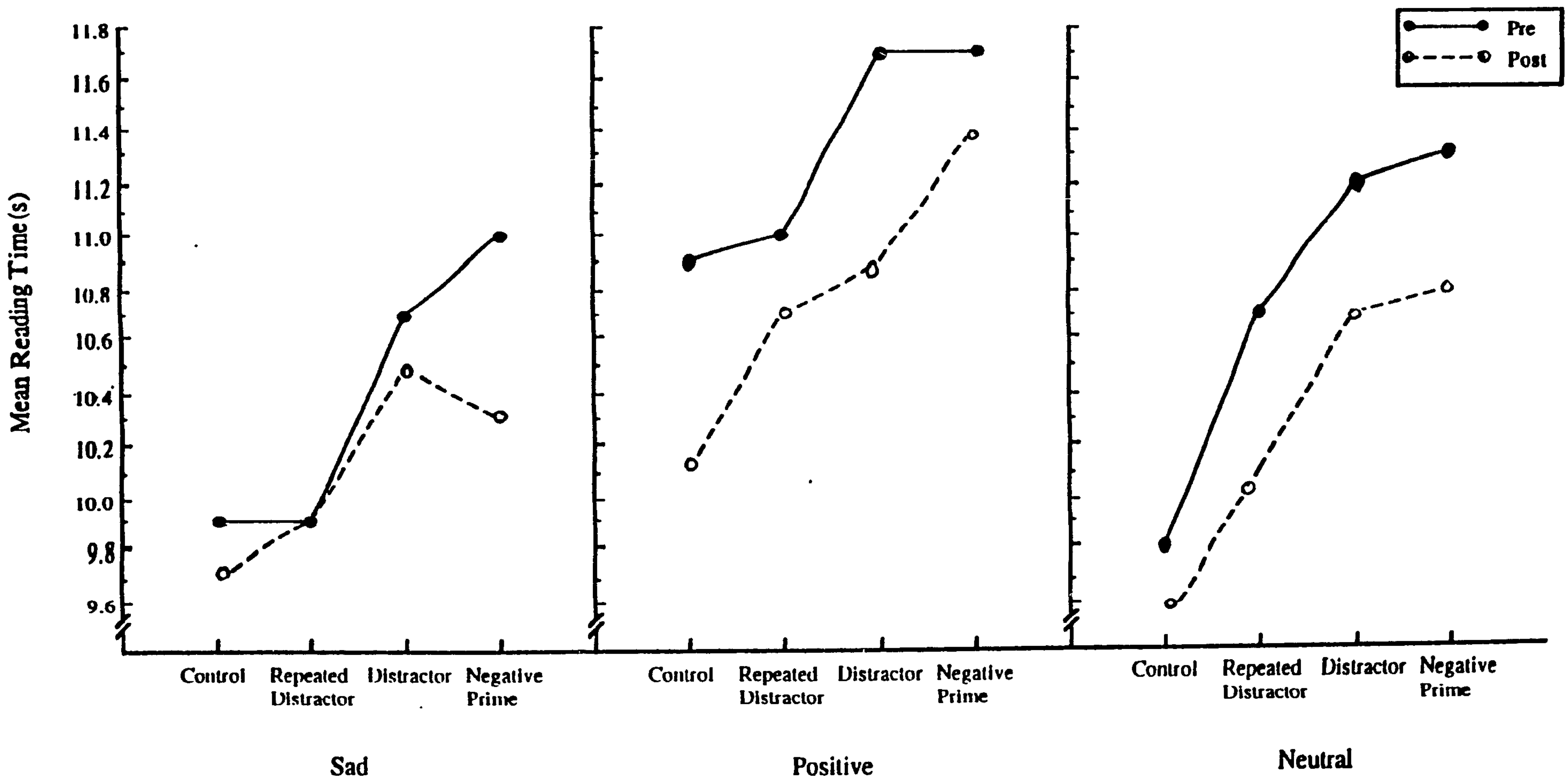

Figure 5. Polynomial regressions with Control, Repeated Distractor, Distractor, and Negative Prime stimuli for Sad, Positive, and Neutral subjects, before and after mood induction in Experiment 2.

$p<.001$, ($r^2 = .05$). The quadratic coefficient was not significant, $F<1$, nor was the cubic coefficient, $F = 3.36$, $p = .09$. For Neutral subjects, there was a significant linear coefficient, $F(1, 15) = 67.78$, $p <.001$, ($r^2 = .22$) as well as a significant quadratic coefficient, $F(1, 15) = 6.39$, $p <.05$ ($r^2 = .03$). The cubic coefficient was not significant, $F <1$ (see Figure 5).

Following mood induction, the reading speed for Sad subjects was less for the Negative Prime than for the Distractor stimulus, revealing a pattern opposite to what is typically observed for negative priming. This opposite pattern translates into an expectation that, in addition to the linear coefficient, the quadratic coefficient for the four stimulus would also be significant. As expected, the linear coefficient was significant, $F(1, 14) = 28.23$, $p <.001$, ($r^2 = .05$) and the quadratic coefficient was marginally significant $F(1, 14) = 3.48$, $p = .08$, accounting for a small proportion of the explained variance ($r^2 = .01$). The cubic coefficient was also significant, $F(1, 14) = 6.8$, $p<.05$, also accounting for a small proportion of the explained variance ($r^2 = .01$) (see Figure 5). For Positive subjects following mood induction the linear coefficient was significant, $F(1, 14) = 25.60$, $p <.001$, ($r^2 = .08$) while the quadratic and cubic coefficients were not, Fs <1 (see Figure 5). For Neutral subjects following mood induction the linear coefficient was significant, $F(1, 15) = 37.85$, p

<.001 ($\underline{r}^2$ = .15). The quadratic coefficient was significant, $\underline{F}(1, 15) = 6.95$, $\underline{p} < .05$, accounting for a small proportion of the explained variance ($\underline{r}^2$ = .01). The cubic coefficient was not significant, $\underline{F} < 1$ for neutral subjects (see Figure 5).

General Discussion

Inhibition and Mood

The main hypothesis in both Experiments 1 and 2 was that sad mood is associated with reduced inhibition, whereas positive mood is associated with enhanced inhibition. The present studies used a visual selective attention task that requires selection by colour of target stimulus while ignoring overlapping distracting stimulus in a different colour. In order to select the targets, the distractors must be inhibited. In the present studies, degree of negative priming observed was used as the measure of inhibition, in that increased response latency results when the target to be selected on one trial was the distractor on the previous trial. Because the target was inhibited on the previous trial and then subsequently named, the inhibition must be lifted, resulting in a slower response time. Such a process of inhibition followed by disinhibition is referred to as negative priming. The present hypothesis was that because of a decrease in inhibition with sad mood, the normal slowing on the negative priming trials would be absent. An absence of slowing would be evidenced by comparing mean reading times for letter columns that consisted of negative priming trials with letter columns in which the distractor on all trials was unrelated to the target. In contrast to sad mood, positive mood was expected to be associated with slowing on the negative prime trials as compared to those trials which did not elicit negative priming due to increased inhibition.

Both studies supported the hypothesis that sad mood is associated with decreased inhibition. In both Experiments 1 and 2, prior to sad mood induction, individuals had longer reading times for the letter columns that elicited negative priming than for those columns which did not elicit negative priming, effectively indicating inhibition. After sad mood induction in both Experiments 1 and 2, a faster reading time for the negative priming columns as compared to reading times for columns without negative priming indicated decreased inhibition with sad mood.

The finding that following sad mood induction the distractor columns had somewhat longer reading times than the negative priming columns, in both Experiments 1 and 2, warrants further interpretation. With intact inhibition, the distractor columns take less time to read than the negative prime columns. Yet a trend for an opposite effect was observed after sad mood induction. There is evidence from other research that on negative priming trials, if the distractor object is not successfully inhibited, it may become a positive prime (Tipper, 1985). Positive priming generally results when target letters are repeated on subsequent trials; the outcome is a faster response time, possibly because the prime, having been previously selected and named, is more readily available. In the present research, the distractor for sad subjects may have acted as a positive prime on the negative priming columns, resulting in decreased response time on the subsequent trial when the distractor becomes the target. That is, if the distractor letters on the negative prime trials were not successfully inhibited, the result may have been to facilitate reading of the targets. To address this question, future research could investigate whether sad subjects could name the distractor on negative prime trials. When the distractor can later be recalled, inhibition is likely to not have occurred (Tipper, 1979).

In contrast to sad mood, it was hypothesized that positive mood would be associated with increased inhibition. This hypothesis translates to the expectation that, following a positive mood induction, individuals would evidence even slower reading times for the negative prime columns relative to the distractor columns. In Experiment 1, a significant inhibition effect evident prior to an induction of positive mood was maintained following mood induction but not increased, possibly due to a ceiling effect. In Experiment 2, positive mood subjects did not evidence a significant inhibition effect prior to mood induction but did evidence a significant inhibition effect after mood induction, consistent with the hypothesis that a positive mood is associated with increased inhibition. This finding also suggests that the lack of increase in inhibition observed for positive subjects in Experiment 1 was due to a ceiling effect. The observed increase in inhibition observed for positive subjects is consistent with findings that positive mood improves performance on cognitive tasks (eg. Sullivan & M. Conway, 1992).

In Experiment 2, a neutral mood condition was included to examine change over time in reading speed in the absence of induced sad or positive mood. No change in inhibition was expected. Subjects in the neutral mood condition did not evidence a significant inhibition effect either before or after mood induction. Means were in the expected direction, but the effect was not significant. It is unclear why inhibition was not observed for neutral mood subjects. Nevertheless, the findings for neutral mood revealed consistency in reading speed over time in contrast to the results observed with sad and positive mood. In sum, the results of Experiment 2, in which sadness resulted in decreased inhibition, positive mood enhanced inhibition, and neutral mood had no effect on inhibition, provides strong support for the hypothesis that individuals' moods moderate their ability to inhibit irrelevant information.

Mood and Reading Performance

A possible concern in the present research is that the results obtained for sad mood are due to a general slowing of response time, because of the common finding in the depression literature of psychomotor slowing. While in

Experiment 1 a positive mood induction resulted in faster reading time for all the reading conditions, a sad mood resulted in faster reading only for the stimulus that normally produce negative priming (i.e., which normally slows reading). The speeding observed with positive mood could be attributed to practice effects, while the lack of speeding with a sad mood could be attributed to psychomotor slowing. If practice effects normally result from task repetition, then the lack of such within the sad mood condition may be the result of slowing. Induced sad mood has been shown to result in psychomotor slowing, while positive mood is associated with acceleration (Natale & Hantas, 1982; Velten, 1968). However, without a control group in Experiment 1, interpretation is difficult for the speeding found with positive mood and the lack of change in reading speed with sad mood.

To clarify the benefits of practice as related to mood, a neutral mood condition was included in Experiment 2. If there was no evidence of a practice effect within the neutral mood condition, then it is less likely that the lack of practice benefits within the sad mood condition in Experiment 1 was due to psychomotor slowing. As such, it would be more likely that the speeding evidenced by positive mood subjects is due to psychomotor acceleration with a positive mood, and not simply the effects of practice. However, if neutral mood was associated with speeding, then both the lack of practice effects with a sad mood, and the presence of such with a positive mood would be difficult to interpret.

Although the change in speed after the neutral mood induction was not uniform, the lack of speeding on the red-letter-only control columns suggests a lack of practice effects. In Experiment 2, as in Experiment 1, individuals who underwent sad mood induction evidenced no change in reading speed, while those who underwent positive mood induction read faster than before mood induction. The results of both experiments strongly suggest that sad mood induction did not result in psychomotor slowing in the present studies; rather the change after sad mood induction is specific to a decrease in inhibition. Conversely, results for positive mood suggest that individuals in this condition evidenced enhanced performance overall, as reflected in accelerated reading as well as the increased inhibition.

Alternate Explanations for the Inhibition Effect

There has been a debate in recent years as to whether inhibition is responsible for delayed response time in tasks such as the one utilized in the present studies, and on similar selective attention tasks that are assumed to require inhibition of a competing representation. Some theorists maintain that increased activation of one of the competitors can account for delayed response, and postulation of an inhibitory mechanism is unnecessary (see Anderson & Bjork, 1994, for a review). In the negative priming paradigm utilized here it is possible that the delayed response on negative priming trials in naming the target letter is due to increased activation of the previous distractor, resulting in competition between the two responses. Such competition could result in the response latency observed on negative priming trials, as the less-activated distractor must compete with the more-activated competitor. However, a number of studies reported recently by Anderson and Spellman (1995) provide support for an inhibitory explanation over an increased activation explanation in memory retrieval tasks, which may be extended to negative priming.

The results of the present studies are interpreted as providing support for decreased inhibition with sad mood and increased inhibition with positive mood. The possibility that it is not inhibition but a failure of increased activation can be entertained without significantly altering the implications of the present findings for the performance deficits observed with sad mood. Both inhibition and activation require resources (Neumann & DeSchepper, 1991). Whether the present findings are due to decreased inhibition with sad mood or dampened activation, the result is similar: information that normally is peripheral competes for attention.

Attentional Resources and Inhibition

The present findings provide support for the contention that depression is associated with a decrease in attentional resources. As inhibition requires resources, a decrease in the inability to inhibit irrelevant information with a sad mood suggests that resources are limited. However, it is not possible to determine precisely the mechanism by which resources are limited, or inhibition is impaired. Is a lack of inhibition responsible for limiting resources by allowing extraneous information to compete for attention? Or, conversely, is a reduction of attentional resources with a sad mood, by some unspecified mechanism, responsible for deficient inhibition by reducing the "energy" available to apply inhibition when needed? Either or both processes may occur.

Implications of the Reduction in Inhibition

The present studies are unique in that they demonstrate that the experimental manipulation of sad mood leads to decreased inhibition, while the induction of positive mood leads to increased inhibition. Further, the finding that it was sad mood per se supports the notion that the sad mood that accompanies depression, in and of itself, has deleterious effects on cognitive performance. Thus the present findings have implications not only for depression, but also for non-depressed individuals' ability as a function of everyday fluctuations in mood to carry out tasks that require the focusing of attention.

Reduced inhibition with sad mood has implications for the performance of a wide variety of tasks, including reading comprehension and memory recall. Dempster (1992) suggests that the number of tasks that require inhibition of irrelevant information for effective performance are far greater than commonly supposed. Further, he suggests that the ability to effectively inhibit may be as important as effective activation, and as the amount of information in memory. Interference, made more likely with a lessening of inhibition, contributes to performance decrement in a variety of tasks.

Aside from the apparent deleterious effects on cognitive performance, difficulties in inhibition have implications for other concommitants of depression. The response styles to sadness theory posited by Nolen-Hoeksema (1989) suggests that depression results because of a propensity for individuals, particularly women, to ruminate on the causes of their sadness. Rumination can be construed as difficulty in inhibiting unwanted negative and disturbing thoughts. The present findings suggest that, with sad mood, both men and women may have difficulty inhibiting unwanted thoughts, which may in turn contribute to the development of depression.

The present findings also have implications for the role of depressive schema as disposing some individuals to experience multiple depressive episodes. Although a depressive schema cannot normally be detected in previously depressed individuals' information processing, there is evidence that with a sad mood induction, the depressive schema influences information processing (Teasdale & Dent, 1987). This influencing of information processing under sad mood suggests that the depressive schema is latent and that the negative thoughts that are engendered by the schema may be inhibited when individuals' affect is positive. However, with a reduction in the ability to inhibit with a sad mood, inhibition of the thoughts generated on the basis of the latent schema may become difficult.

Summary

The present studies provide support for the hypothesis that sad mood is related to reduction in the ability to inhibit irrelevant information. In addition, positive mood appears to increase inhibition. Decreased inhibition with sad mood has implications for the deficits in cognitive associated with depression, and provides support for a reduction in attentional resources with depression.

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APPENDIX A

Musical Selections for Sad and Positive Mood Induction

for Experiments 1 and 2

Musical Selections for Sad Mood Induction

1. Intermezzo, Bizet, conductor Anthony Bramall, Slovak Philharmonic Orchestra, L'Arlesienne Carmen Suites Nos. 1 & 2: Digital 4.550061. 2:40.

2. Egmont Overture Opus 84, Beethoven, conductor George Szell, The Cleveland Orchestra: Columbia MS 6966. Side 1, first 1:17.

3. A Song to the Evening Star, Wagner, Young Listener's Library, Lillian Baldwin, Ed., Sound Book Press Society, Inc, MSB 33103B. 3:15.

4. Fantasy Overture from Romeo and Juliet, Tchaikovsky, conductor A. Previn, London Symphony Orchestra, Angel S 36890. Side 2, first 2:37.

5. Introduction from Scottish Fantasy, Opus 46, Bruch, conductor Sir Malcolm Sargent, New Symphony Orchestra of London, RCA LSC-3205. First 2:28.

6. Sonata No. 7 in D major Opus 10, No. 3, Beethoven, Sviatoslav Richter Beethoven Piano Sonatas, Angel S-37266. Side 2, second piece, first 2:39.

7. Sonata No. 2 Funeral March Opus 35, Chopin, Vladimir Ashkenazy, Ashkenazy in Concert, London Records CS 6794. 2:15.

8. Symphonie No. 6 in B minor Opus 74 Pathetique, Tchaikowsky, conductor Carlo Maria Guilini, Philharmonia, EMI Laser Angel 4LZ 62603. Side 1, first piece, last 2:15.

Musical Selections for Positive Mood Induction

1. Intermezzo, Bizet, conductor Anthony Bramall, Slovak Philharmonic Orchestra, L'Arlesienne Carmen Suites Nos. 1 & 2: Digital 4.550061. 2:40.

2. An American in Paris, Gershwin, conductor Andre Previn, London Symphony Orchestra, Previn Plays Gershwin, Angel, SFO-36810. Side one, second piece, first 3:16.

3. Ode to Joy, Beethoven, conductor Janos Ferenscisk, Hungarian State Orchestra, Symphony No. 9 D minor Opus 125, white Label, CD HRC115. In IV Finale, start at 3:37, record for 2:32.

4. Guadalcanal March, Rodgers, conductor Erich Kunsel, Cincinnati Pops Orchestra, Victory at Sea, Telarc, CS-30175. 3:00.

5. Le Basque, Marias, James Galway Plays Songs for Annie. Accompanmiet by the National Philharmonic Orchestra, RCA KRL 1-0294. Side one, first piece, 1:14.

6. Les Torreadors, Bizet, conductor Anthony Bramall, Slovak Philharmonic Orchestra, L'Arlesiencce Carmen Suites Nos. 1 & 2, Digital 4.550061. In Carmen Suite, No. 1, Part F, 2:10.

7. Overture, Conti, conducted and orchestrated by Conti. Rocky II the Story Continues, CD Liberty CDP 7 46082 2. Start at 00:16, record for 1:38, omit 2:51, start at 4:45 record for 1:43.

APPENDIX B

Music questionnaire with mood assessment item for Experiments 1 and 2

QUESTIONNAIRE A

For each of the following questions, circle the number on the scale that best represents your response. If you are not sure, make your best guess. It is important that you answer every question.

1. Were you familiar with the music selections?

1	**2**	**3**	**4**	**5**	**6**	**7**
not at all	**a little**	**somewhat**	**very much**			**a great deal**

2. How interesting did you find the music selections?

1	**2**	**3**	**4**	**5**	**6**	**7**
not at all	**a little**	**somewhat**	**very much**			**a great deal**

3. How did the music make you feel?

1	**2**	**3**	**4**	**5**	**6**	**7**
Positive **Uplifted**						**Negative** **Blue**

4. If you were doing some important work, such as studying, would you find the music you listened to distracting?

1	**2**	**3**	**4**	**5**	**6**	**7**
not at all	**a little**	**somewhat**	**very much**			**a great deal**

5. Do you normally listen to music when working or studying?

1	**2**	**3**	**4**	**5**	**6**	**7**
never			**sometimes**			**all the time**

APPENDIX C

Introduction for subjects,
Experiments 1 and 2

Introduction for Experiments 1 and 2

In this study, we are interested in age differences in human perception, or how people perceive different things in the world around them. Researchers have been interested in changes with age in many different types of perception, including hearing, vision, taste, smell, and touch. There is evidence for age related changes in perception for all of these senses.

We have chosen to focus on changes in two types of perception, visual and auditory. Both vision and hearing are very important in determining the way people judge and interact with the world around them. In order to study changes in these domains, we are asking people of different ages to do some visual and auditory perceptual tasks. The tasks will be presented in a random order, so in a sense we are doing two studies in one. Let's go over the different parts of the study.

We know that changes in visual contrast sensitivity occur with aging. For example, if two bars of different shades of grey occur side by side, older adults have more difficulty distinguishing them. This could have an impact on everyday tasks such as reading a newspaper. However, there are other situations where we must be able to distinguish different colours, and sometimes this is very important, such as when we must know whether a traffic light is red or green. For this reason, we are interested in the ability of adults of different ages to be able to quickly distinguish different colours. So, for the visual perception part of the study, you will be asked to complete a simple task which requires the ability to distinguish different colours.

In the past, researchers have been interested in particular aspects of auditory perception, for example the ability to distinguish between different tones. From this work, we have learned that everyone loses some range for tone perception as they age. By age forty, most people have begun to have problems hearing high pitched tones. However, most of this research has used isolated tones to test auditory perception, and we are more interested in the kinds of sounds that people encounter in their everyday lives. For this reason, we have chosen to have people listen to music. Most of us encounter music in our everyday lives - on the car radio as we are driving, commercials on television, and so on. We will ask you to listen to some musical selections, and later you will be asked some general questions about what you heard.

Finally, I want to assure you that everything we do today will be kept confidential. Your name will not be put on any of the materials we use today.

APPENDIX D

Letter reading instructions
for Experiments 1 and 2

In front of you are two boards. The cards you will read are on the board behind, so they're hidden right now. You can see there's a slot in the front board, and when we move it we will be able to reveal one card at a time. On these cards are rows of letters that I'll ask you to read out loud.

I'm going to ask you to move the board when we're ready to show a card. You can either pull it from this end or push it from the other end. For the first card, you'll need to move this board so this mark here is flush with the end here. Try not to move the board in back. For each card after, you'll move the front board so that these pen marks here are lined up with the end here.

Now I'm going to explain how I'd like you to read the letters. I'll always be asking you to read the red letters. Sometimes there will be both red and green letters on the card, but always just read the red letters. Start reading at the top of the card and say each red letter out loud. I will be timing you, so you should read as quickly as possible, but try not to make mistakes. And if I could just get you to wait each time to move the board until I say okay, and then you can just look up and immediately start reading.

Any questions? All right, we'll start now. Remember the first position is here.

Ready? Okay, go ahead.

APPENDIX E

Mood induction instructions for Experiments 1 and 2

Mood Induction Instructions

All right, we're just going to move back to the other table now. We are going to do the auditory part of the study now. You will be listening to one of the sets of musical selections we are examining in this study. Some of the musical selections you hear may be quite intense or powerful, whereas other pieces you hear may be quieter or softer. Please listen to the musical selections as you might do at home if you were listening to the radio. Afterwards, I'll ask you some general questions on your reactions to the music. The volume is already set at a comfortable level, but feel free to adjust it here if you want here. I'm going to leave you alone to listen to the music. I will be in the room there, you can come and find me when the music is done. Okay? You'll be listening to the music through these headphones, this is the right side here, you can adjust them here if you want. Ready? (Start the music).

(Experimenter returns).

Okay, if you just want to have a seat again. I have a short questionnaire that I'd like you to fill out now. The instructions are written on the top. There will be a bit more music later, and I'll be asking you more detailed questions then, but for now I'd just like you to fill out this questionnaire. I'll be sitting over here.

Done? Okay, if you just want to come back over here.

Now we are going to do another reading task. It is the same as the first one. We find that we get more accurate results with tasks like these if people do it more than once. The procedure will be the same as the first time. Ready?

APPENDIX F

Debriefing for subjects, Experiments 1 and 2

Debriefing

You have now completed all of the tasks for this study. I would now like to talk to you about the details of the study, and give you an opportunity to ask any questions you may have about your participation today. First, I'd like to ask you if you have any questions right now.

At the beginning of the study, I told you that we were interested in studying different aspects of human perception, in relation to aging. Actually, there is a little bit more to the study than I originally told you. I'd like to talk to you about the music perception task first. What did you think about it? The reason I asked you that question is that we were not actually interested in your perception of the music. The purpose of asking you to listen to the music was to influence your mood for a brief period of time. You could have been given a music selection that was designed either to induce a more negative or a more positive mood. In your case, you listened to the ____________ music selections.

Now I'd like to tell you about why we wanted to influence your mood, and why it was necessary not to tell you the true purpose of the study. We are not concerned with the effects of age on perception as I told you. Instead, our major focus is on the effects of mood on the reading of the cards that you did. There is research that suggests that people in a negative or depressed mood may react differently to some of the cards. Research has shown that a negative mood can have a negative impact on a person's performance on memory tasks. People in a negative mood do less well. Some researchers have suggested that this poorer performance may be caused by the person's having difficulty focusing their attention. In particular, people in a negative mood may have difficulty putting aside or suppressing unwanted thoughts. We were interested in looking at this question. What we did is develop some cards that allow us to get an idea of how well people are able to suppress thoughts that are unwanted. Take this card. The thinking is that in order to read the correct letter in red, you had to suppress the other letter in green, which is like not paying attention to it. Our hypothesis is that if negative mood reduces a person's ability to suppress irrelevant information in the environment, then they will not suppress the other letter as well as people in a positive mood will. Let me describe how we look at this. We present some cards where the letter you are asked to read is the letter that you just ignored previously. You can see that the green letter here becomes the red letter in the next set. If people had earlier suppressed the green letter, then we think it will take them longer, in general, to read it in red next, because people have to "unsuppress" it, so to speak. So, on these cards what people are asked to ignore or suppress is what people were next asked to say out loud.

We think that people in a positive mood will be slowed down reading the red letter because they're really good at suppressing the green, and so they have to "unsuppress" a great deal. On the other hand, people in a negative mood will take about the same time to read the ignored letter, that is the letter that was green on the previous pair, as it took them to read other letters, because they will not have suppressed it that much in the first place.

You may be wondering why we would be interested in something like this, and how it relates to the real world. Well, some researchers think that one of the difficulties people have when they are depressed is an inability to "turn off" negative thoughts, and this tends to keep them in the depressed mood longer. We think that this inability to "turn off" the negative thoughts might be due to a general difficulty with suppressing unwanted or irrelevant stimuli. The results of this study should help us to answer this question.

Now I want to tell you why we didn't just tell you all this in the first place. The reason is that, if you knew that we wanted you to feel a specific mood, you may have tried to help us out, and this may have affected the results of our experiment. It may also have made you self-conscious. I should also tell you that the music's influence on mood only lasts for a brief amount of time, actually for only a few minutes. I also want to tell you that most psychological research is not like this. In most studies, people can be told the details of the study beforehand.

Do you have any more questions? I would really appreciate your comments about the study. Was there anything about the procedure that you found difficult?

Let me tell you one more thing. Everything that happened here today is confidential. Also, I want to tell you that it is important that you not tell any other Concordia students about what happened here today for a few months. We will be conducting this study for a while longer, and if people knew about it before they came in, it would be the same problem as I told you about before.

Thank you very much for participating today.

APPENDIX G

Musical selections for neutral mood induction,

Experiment 2

Musical Selections for Neutral Mood Induction

1. Intermezzo, Bizet, conductor Anthony Bramall, Slovak Philharmonic Orchestra, L'Arlesienne Carmen Suites Nos. 1 & 2: Digital 4.550061. 2:40.

2. Pachelbel Canon in D, Pachelbel, conductor Jean-Francois Paillard, Jean Francois Paillard Chamber Orchestra, The Pachelbel Canon and Other Baroque Favourites, RCA AGL 1-3365. Side A, first 4:17.

3. Les Parfums de la Nuit, Debussy, conductor Charles Munch, French National Radio Orchestra, Nonesuch Records, H-71189. Side 1, first 3:10.

4. Othello Overture Opus 93, Dworak, conductor Istvan Kertesz, the London Symphony Orchestra, London, CS 7128. Omit first 3:20, record 2:53.

5. Symphonic Variations for Piano and Orchestra, Franck, conductor Eugene Ormandy, The Philadelphia Orchestra, Columbia, MS 6070. First 3:50.

6. The Homecoming, Hardy, The Hagood Hardy Collection, Attic Records Ltd., LAT 1073. 2:28.