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BRIEF REPORT

Dysphoria and the Immediate Interpretation of Ambiguity: Evidence for a Negative Interpretive Bias in Error Rates But Not Response Latencies

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Abstract Cognitive theories of depression (Beck, Journal of Cognitive Psychotherapy: An International Quarterly. 1:5–37, 1987) predict that depressed individuals will have an increased tendency to interpret ambiguous information in a negative manner. Researchers have observed a negative interpretive bias in a variety of situations, but much of the evidence has come from studies that relied on participants' self-reports and other tasks that are highly susceptible to response biases. Studies that have used semantic priming tasks to covertly probe participants' immediate interpretations of ambiguity, and thereby avoid response biases, have not observed an interpretive bias (Lawson and MacLeod, Behaviour Research and Therapy. 37:463–474, 1999; Bisson and Sears, Cognition and Emotion. 21:614–645, 2007). The present study used a task better suited to measure interpretive biases in the immediate interpretation of ambiguity: the semantic relatedness decision task. Participants listened to self-referent ambiguous prime sentences (e.g., *My boyfriend said that I am unlike his past girlfriends*) and responded to visually presented target words related to a negative (*jealous*), positive (*attractive*), or neutral (*relationship*) interpretation of the sentence. The task was to quickly indicate whether or not the target was related to the ambiguous prime (a *yes* or *no* response). The expectation was that dysphoric participants would respond more quickly to targets related to the negative interpretations of the primes because they would be more likely to impose negative interpretations on the ambiguity. This was not the case. On the other hand, the error data revealed that dysphoric participants made fewer errors to targets related to the negative interpretations of the primes (i.e., fewer "no" responses to negatively-related targets) and made more errors to targets related to the positive interpretations of the primes, a pattern consistent with a negative interpretive bias. These findings demonstrate that the semantic relatedness task is a promising tool for the study of interpretive biases in dysphoria and depression.

Keywords Depression · Dysphoria · Interpretation of ambiguity · Negative bias

Introduction

Researchers have shown that depressed individuals experience cognitive distortions that affect the way they interpret their environment, including an increased tendency to impose negative interpretations on ambiguous stimuli, situations, and events (e.g., Cane and Gotlib 1985; Forgas et al. 1984; Norman et al. 1983; Nunn et al. 1997; for a review see Williams et al. 1997). In cognitive theories of depression, a negative interpretive bias has played a central theoretical role, with implications for both the development and maintenance of depression (Beck 1987; Ingram 1984; Teasdale 1983; Williams et al. 1997).

Researchers have used a variety of methods to study interpretive bias in depressed and dysphoric individuals, the most common being self-reports of participants' interpretations of ambiguous stories and scenarios (e.g., Butler and Mathews 1983; Norman et al. 1983; Rusting 1998). The interpretation of these studies is complicated by the fact that self-report methodologies are highly susceptible to response biases; depressed individuals might process both the negative and neutral interpretations of ambiguous

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material no differently than non-depressed individuals, but may have a greater tendency to endorse or report negative interpretations. This possibility was confirmed in a study that examined depressed participants' sucrose taste thresholds using signal detection methodology (Potts et al. 1997). Potts et al. found that the higher thresholds of depressed individuals were due to differences in response bias rather than true differences in taste sensitivity: depressed individuals were equally capable of detecting sucrose in solution, but were less likely to report its presence at any given concentration. A recent study by Mogg et al. (2006) demonstrates the difficultly of distinguishing an interpretive bias from a response bias in depressed individuals. Using a text comprehension task and a homophone interpretation task, Mogg et al. found that depressed participants showed a negative interpretive bias only in the homophone interpretation task, the task more susceptible to a negative reporting bias.

These concerns have led some researchers to use semantic priming tasks to look for evidence of an interpretive bias, because these tasks do not require self-reports and because the response options are not valenced. In these experiments participants listen to or read ambiguous prime stimuli and then make speeded responses to targets that are semantically related to one of the prime's meanings. When a target is related to the participant's interpretation of a prime, responses to the target are facilitated, relative to responses to targets unrelated to the prime (a semantic priming effect; see McNamara 2005, for a review). Semantic priming tasks allow researchers to covertly probe the interpretation of ambiguous primes because participants are not required to report their interpretations. An additional advantage is that responses can be made quickly (in less than 1 s typically), and so response latencies reflect participants' immediate interpretations of the prime. Two studies have used semantic priming tasks to look for evidence of a negative interpretive bias and both shared a similar logic and design (Bisson and Sears 2007; Lawson and MacLeod 1999).

In Lawson and MacLeod's (1999) experiment, participants were presented with ambiguous prime sentences which they read aloud (e.g., *The doctor examined little Emily's growth*). After each sentence was read a target word was presented. The participants' task was to read this word aloud as quickly and as accurately as possible. The dependent variable was the pronunciation latency to read the target. Each ambiguous prime sentence was paired with two critical target words, one related to a negative interpretation of the sentence (*tumour*) and the other related to a neutral interpretation of the sentence (*height*). The semantic priming effect was used to infer a participant's interpretation of the ambiguous sentences, as only responses to targets related to the participant's interpretation of the ambiguity would be facilitated. The expectation was that dysphoric participants would be more likely to interpret ambiguous prime sentences in a negative manner and as a consequence would show larger priming effects for targets related to negative interpretations of the primes. Instead, Lawson and MacLeod found that only non-dysphoric participants showed priming for negatively-related targets. They suggested that participants experiencing a depressed mood may have an attenuated tendency to impose negative interpretations on ambiguous prime sentences, which is the opposite of what is expected with a negative interpretive bias.

In Bisson and Sears's (2007) study, participants listened to ambiguous prime sentences (e.g., *Jason's classmates laughed as he made his presentation*) and responded to visually presented target words. Each ambiguous prime sentence was paired with three critical target words, one related to a negative interpretation of the sentence (*foolish*), one related to a positive interpretation of the sentence (*funny*), and one neutrally-related to the sentence (*classroom*). The dependent variable was lexical decision latency to the target (a *word* or *nonword* response, with 50% of the targets being words, a more sensitive measure of semantic priming effects than the pronunciation task). Like Lawson and MacLeod (1999), Bisson and Sears predicted that dysphoric participants would be more likely to interpret ambiguous prime sentences in a negative manner and would therefore show larger priming effects for targets related to negative interpretations of primes. Instead, they found that priming effects for negatively-related targets were no larger for dysphoric participants than for non-dysphoric participants. This was also true in a second experiment that employed a negative mood induction designed to activate a negative schema. Thus, Bisson and Sears could offer no evidence in support of a negative bias in the interpretation of ambiguous information.

The Present Research

For depression researchers, the absence of a negative interpretive bias in semantic priming tasks presents a significant theoretical dilemma. One interpretation of the findings of Lawson and MacLeod (1999) and Bisson and Sears (2007) is that depression and dysphoria are not associated with an interpretive bias like that envisioned by cognitive theories of depression, but are instead associated with a negative reporting bias that produces higher endorsement of negative interpretations in self-report tasks (e.g., Blanchette and Richards 2010). Another interpretation is that the negative interpretive bias is a genuine phenomenon but that depressed and dysphoric individuals do not impose negative interpretations on ambiguous information automatically. In that case, semantic priming effects would be insensitive to an interpretive bias because they gauge the immediate interpretation of ambiguity, not the later processing of ambiguous information. Whether or not the interpretive bias operates in an automatic fashion is an important theoretical distinction (e.g., Moretti and Shaw 1989), but too few studies have used the appropriate cognitive tasks to make this kind of distinction confidently.

A third possibility is that semantic priming effects are not well-suited for assessing interpretations of ambiguity because participants' responses are not directly related to their interpretation of the ambiguous prime. This was the case in both Bisson and Sears's (2007) and Lawson and MacLeod's (1999) experiments, because the participants' were asked to determine whether or not a target was a word (a lexical decision task) or to pronounce a target (a pronunciation task), responses that are not contingent on the interpretation of the prime (i.e., a participant could ignore prime sentences altogether and still respond accurately, although semantic priming effects would be attenuated). Obviously, the stronger the connection between participants' interpretations of the prime and their responses the better the measure of their interpretation of the ambiguity.

With these considerations in mind, the present study used a different semantic processing task–the semantic relatedness decision task–to study the immediate interpretation of ambiguity. This task is often used in studies of semantic ambiguity resolution (e.g., Gottlob et al. 1999; Rodd et al. 2005). With this task the participant indicates whether or not a target word is related to an ambiguous prime (a *yes* or *no* response), and thus, the participant is required to process the ambiguity to respond accurately. For example, the ambiguous prime *bank* is followed by the target *money* or *river*, and the participant's task is to indicate, as quickly and as accurately as possible, whether or not the target is related to the prime (typically 50% of the targets are not related to the prime). Unlike the lexical decision task and the pronunciation task, there is a clear connection between the participants' interpretations of the prime and their responses with this task, and therefore response latencies better reflect the participant's interpretation of the ambiguity (e.g., faster responding to *money* than to *river* reveals which meaning of the ambiguous prime *bank* was accessed first). The presentation of unrelated targets requires participants to evaluate the relation between the prime and target in order to respond accurately; the percentage of "no" responses to unrelated targets (the correct rejection data) can be used to assess participants' attention to the task and to the processing of the ambiguity. Like the lexical decision and pronunciation tasks, responses are not valenced in this task (the task is to determine whether the prime and target are related in meaning, a *yes* or *no* response), and therefore the potential for a negative reporting bias to affect responding is greatly reduced.

An additional and unique advantage of the semantic relatedness task is that it allows one to identify the trials where a target, though semantically related to one of the interpretations of the ambiguous prime, was not related to a participant's immediate interpretation of the prime; on these trials, the participant would respond *no* to a related target. For example, after listening to the prime, *My supervisor suggested that I take some time off* and then seeing the target, *fired*, a participant would respond *no* if the target is not related to their immediate interpretation of the ambiguity. An analysis of these errors (hereafter referred to as the miss data) provides another means of testing for an interpretive bias. Dysphoric participants may be less likely to respond *no* to targets related to the negative interpretation of a prime because these targets may frequently be related to their immediate interpretation of the ambiguity; conversely, non-dysphoric participants may be more likely to respond *no* to negatively-related targets because these targets may seldom be related to their immediate interpretation of the prime. Researchers have argued that response latencies may not be well-suited for the study of cognitive processing in depression because depressed individuals tend to have slower and more variable response times in speeded tasks that make it difficult to measure an interpretive bias (e.g., Lawson et al. 2002; Moretti et al. 1996); one of the advantages of the semantic relatedness task is that it provides a means of testing for a negative interpretive bias that does not rely solely on response latencies.

In the present study, participants listened to ambiguous sentences (e.g., *My boyfriend said that I am unlike his past girlfriends*) and responded to target words that were related to a negative (*jealous*) or positive (*attractive*) interpretation of the sentence. Neutrally-related targets (*relationship*) and unrelated targets (*democracy*) were also presented. The participants' task was to indicate, as quickly as possible, whether or not the target was related to the prime (a *yes* or *no* response). For dysphoric participants, a negative interpretive bias would manifest itself as faster responding and possibly lower miss rates for targets related to negative interpretations of the prime sentences.

Method

Participants

The participants were 207 undergraduate students from the University of Calgary who participated in exchange for extra course credit. To control for gender only women were recruited for the study. The mean age of the participants was 20.8 years (range of 17–52).

Participants completed the second edition of the Beck Depression Inventory (BDI-II; Beck et al. 1996) and the Positive and Negative Affect Scale (PANAS; Watson et al. 1988) while alone in a private room. The BDI is a self-report inventory consisting of 21 items that assesses participants' depressive symptoms over the past two weeks. Each item is rated on a scale from 0 to 3, with summary scores ranging between 0 and 63. The PANAS assesses participants' pleasant and unpleasant mood states. It consists of 20 words that describe different emotions (e.g., excited, proud, upset, guilty, distressed); participants read each word and indicate "to what extent you have felt this way", using a scale from 1 (*very slightly or not at all*) to 5 (*extremely*). These same 20 words were rated for two time frames: "during the past few days" and "during the past few weeks". For the 10 positive affect items and for the 10 negative affect items the minimum score was 10 and the maximum score was 50.

Participants were assigned to groups based on their BDI scores. Participants in the dysphoric group had BDI scores greater than or equal to 20, the BDI cutoff score recommended by Dozois et al. (1998) for a "dysphoric-depressed" classification when using undergraduate samples. There were 21 participants in the dysphoric group (mean age = 20.9). For the non-dysphoric group, we selected participants with BDI scores less than or equal to 6, a lower cutoff than recommended by Dozois et al. (they recommended a score less than or equal to 12). Using a lower cutoff allowed us to create a greater separation between the groups, and because of the large number of participants in our study ($N = 207$) we could still assign a large number of participants to the non-dysphoric group ($N = 61$, mean age = 20.4). Table 1 shows the group differences on the various measures.

Table 1 Participant characteristics for the non-dysphoric and dysphoric groups

	Non-dysphoric ($n = 61$)		Dysphoric ($n = 21$)		*t* Statistic
	M	SD	M	SD	
BDI	2.6	1.8	25.1	7.1	$t(80) = 17.4^{*}$
NA Day	15.1	4.1	29.3	6.6	$t(80) = 11.6^{*}$
PA Day	34.9	5.4	24.3	7.5	$t(80) = 6.88^{*}$
NA Week	16.0	4.4	29.9	7.6	$t(80) = 10.1^{*}$
PA Week	34.8	5.4	21.5	5.7	$t(80) = 9.53^{*}$

BDI Beck Depression Inventory, *NA* PANAS negative affect score, *PA* PANAS positive affect score

* $P < .001$, two-tailed

Stimuli

Eighty critical ambiguous prime sentences were presented to each participant. Unlike Lawson and MacLeod (1999) and Bisson and Sears (2007), we used only self-referent sentence primes (e.g., *Your classmates laughed as you made your presentation*). Several studies have reported that self-referent information facilitates information processing biases in depression and dysphoria (e.g., Bradley and Mathews 1983; Nasby 1994), and for this reason we hypothesized that using ambiguous self-referent primes would produce a more sensitive test of an interpretive bias.

Each prime sentence was paired with a target related to a negative interpretation of the prime and a target related to a positive interpretation of the prime. For example, the sentence, *My mom called me to tell me the news* was paired with the target *death* (negatively-related) and the target *wedding* (positively-related). Each prime sentence was also paired with two other targets, one neutrally-related to the prime (*telephone*) and the other unrelated to the prime (*summer*). Each participant saw only one of the four possible pairings in the experiment (i.e., each prime sentence was presented only once). The targets in the positive, negative, neutral, and unrelated conditions were matched for the number of letters and for printed word frequency (the mean normative frequencies per million words were 36.9, 31.6, 36.6, and 31.3, respectively; Kucera and Francis 1967). An additional 40 ambiguous sentences were paired with an unrelated target word and were presented along with the critical ambiguous sentences in order to create a relatedness proportion of 50% (i.e., 50% of the target words were related to the prime sentences and 50% were not, and hence 50% of correct responses would be *yes* responses and 50% would be *no* responses). Like the related targets, the unrelated targets consisted of a variety of words with positive, negative, and neutral valence, which ensured that the related targets were not unique with respect to their valences.

Semantic relatedness ratings were collected prior to data collection to ensure that the prime and target pairs used in each of the conditions were properly selected. The ratings were collected from 28 female undergraduate students (none of whom participated in the semantic relatedness task) who were asked to judge the extent to which each pair was related in meaning using a seven-point scale from 0 (*unrelated*) to 6 (*strongly related*). They were also asked to judge whether the relationship between each pair was positive, negative, or neutral, using a seven-point scale from −3 (*very negative*) to +3 (*very positive*), with a midpoint of zero (*neutral*). Each prime sentence was paired with each of its possible word targets (positively-related, negatively-related, neutrally-related, and unrelated) and these were randomly ordered and listed in a questionnaire.

The mean relatedness ratings for the positively-related, negatively-related, and neutrally-related pairs (5.28, 5.22, and 4.85, respectively) were significantly greater than the mean rating for the unrelated pairs (0.20; all Ps $< .001$), but not significantly different from each other, $F(2, 237) = 2.21$, $P > .10$. Analyses of the valence ratings confirmed that the prime and target pairs in the positively-related condition were rated as being significantly more positively related than the prime and target pairs in the neutrally-related condition (2.65 vs. 0.10), $t(158) = 48.85$, $P < .001$, and that the prime and target pairs in the negatively-related condition were rated as being significantly more negatively related than the pairs in the neutrally-related condition (−2.63 vs. 0.10), $t(158) = 49.14$, $P < .001$.

Four lists of prime and target word pairs were created. Each list consisted of the same prime sentences but different pairings of prime sentences and target words; this allowed the same prime sentences to be used in the positively-related, negatively-related, neutrally-related, and unrelated conditions and ensured that any differences between these conditions could not be due to differences between primes. For example, in List 1, the prime sentence, *People were yelling at me during the game* was paired with the target *volleyball* (a neutrally-related target). In Lists 2, 3, and 4, the same prime was paired with the target *insult* (a negatively-related target), the target *cheer* (a positively-related target), and the target *bracelet* (an unrelated target), respectively. The presentation of the lists was counterbalanced across participants.

Apparatus and Procedure

Prior to the experiment the prime sentences were digitally recorded at 22,050 Hz (stereo) by a native English female speaker at a typical conversational pace. The mean sentence length was 8.9 words and the mean sentence duration was 3.1 s. Each sentence was digitally edited to ensure that the interval between the offset of the prime sentence and the onset of the target could be precisely controlled.

The semantic relatedness task was programmed using the DMDX software package (Forster and Forster 2003). The participant sat approximately 50 cm from a computer monitor and wore a set of stereo headphones connected to a computer. On each trial the participant first heard an ambiguous prime sentence through the headphones. A target was then presented in white lower case letters on a dark background in the center of the display, and remained on the display until the participant made a response. To reduce anticipatory responses, half of the targets were presented immediately after the offset of the prime sentence (a 0 ms interstimulus interval, or ISI) and the remainder were presented 1,000 ms after the offset of the prime (a 1,000 ms ISI), with the ISI from trial to trial being unpredictable. The participant's task was to indicate, as quickly and as accurately as possible, whether the target was related to the prime, pressing the *yes* button on the button box placed in front of them if the target was related and the *no* button if it was not. Response latencies were measured from the onset of the target to the participant's response. Participants completed 12 practice trials prior to the collection of data. Participants were informed that 50% of the targets would be related to the prime sentences and 50% would not. The order in which the 120 trials were presented was randomized separately for each participant.

Results

The mean latencies of correct responses and the mean percentage of misses are shown in Table 2. Response latencies greater than 2,000 ms were considered outliers and were excluded from all analyses (0.6% of the data).

Analysis of Correct Rejections and Errors for Unrelated Targets

Correct rejections occurred when the prime and target were not related and the participant correctly responded *no* ("not

Table 2 Mean response latencies and percent misses for targets related to positive, negative, and neutral interpretations of ambiguous prime sentences

Relation	Response latency (ms)			Percent misses		
	Non-dysphoric	Dysphoric	Difference	Non-dysphoric	Dysphoric	Difference
Positive	674 (18.7)	751 (24.8)	+77	6.4 (1.4)	13.6 (2.7)	+7.2
Negative	754 (20.2)	786 (38.8)	+32	17.6 (2.1)	10.2 (2.3)	−7.4
Neutral	703 (17.1)	765 (33.9)	+62	8.0 (1.0)	8.3 (1.7)	+0.3
M	710 (17.6)	767 (30.1)		10.6 (1.2)	10.7 (2.1)	

The data are averaged across ISI (0 ms and 1,000 ms). Standard errors shown in parentheses

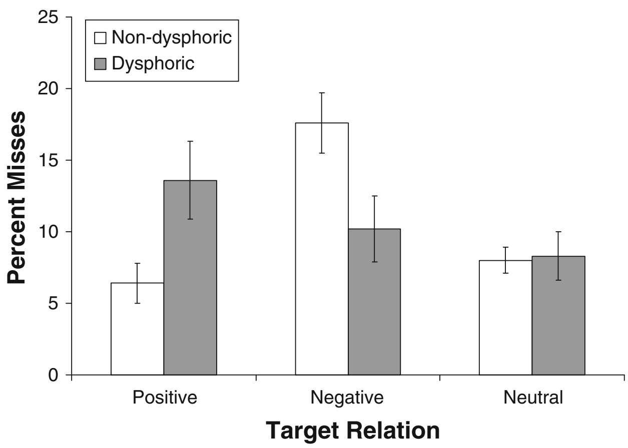

Fig. 1 Mean percentage of misses for targets related to positive, negative, and neutral interpretations of ambiguous prime sentences

related"). The correct rejection data were examined to determine if both groups of participants responded to unrelated targets with equivalent accuracy. For dysphoric participants the correct rejection rate was 97.8% and for non-dysphoric participants it was 98.9%; the 1.1% difference was not statistically significant, $t(80) = 1.69$, $P > .10$. The very high correct rejection rate for both groups of participants indicates that participants were processing the relation between the primes and targets before responding. The absence of a group difference in the correct rejection data also indicates that neither group of participants was any more or less likely to respond "yes" to unrelated targets.

Errors occurred when the prime and target were not related and the participant mistakenly responded *yes* ("related"). Errors were very infrequent and not significantly different for dysphoric participants (1.1%) and non-dysphoric participants (2.2%), $t(80) = 1.70$, $P > .10$.

Analysis of Response Latencies

The response latency data for related targets were analyzed using a 2 (Group: dysphoric, non-dysphoric) × 2 (ISI: 0 ms, 1,000 ms) × 3 (Target Relation: positively-related, negatively-related, neutrally-related) mixed-model factorial analysis of variance (ANOVA), with Group a between-subjects factor and Target Relation and ISI within-subjects factors (ISI was included as a factor to reduce the error variance in the ANOVA).

The analysis produced two significant main effects and one interaction. There was a main effect of Target Relation, $F(2, 160) = 15.21$, $P < .001$, MSE = 6,963.21, with responses to targets related to negative interpretations of the prime being slower (781 ms) than responses to targets related to positive interpretations of the prime (712 ms) and targets neutrally-related to the prime (734 ms). There was also a main effect of ISI, with slower responses when the ISI was 0 ms than when it was 1,000 ms (748 ms vs. 730 ms), $F(1, 80) = 4.30$, $P < .05$, MSE = 7,124.25. The interaction between ISI and Target Relation was significant, $F(2, 160) = 3.08$, $P < .05$, MSE = 4,917.20, such that the difference in response latencies between the negatively-related targets and the positively-related and neutrally-related targets was larger when the ISI was 1,000 ms (773 ms, 694 ms, and 722 ms, respectively) than when it was 0 ms (767 ms, 731 ms, and 746 ms, respectively). There was no interaction between Group and ISI, $F(1, 80) = 1.86$, $P > .10$, MSE = 7,124.25, or between Group, ISI, and Target Relation, $F(1, 160) = 1.46$, $P > .10$, MSE = 4,917.20.

The critical interaction between Group and Target Relation was not statistically significant, $F(2, 160) = 2.45$, $P = .08$, MSE = 6,963.21. Recall that a negative interpretive bias should manifest itself as faster responding to targets related to negative interpretations of the prime. As can be seen in Fig. 1, the dysphoric participants were 77 ms slower than the non-dysphoric participants when responding to positively-related targets, 62 ms slower responding to neutrally-related targets, and 32 ms slower responding to negatively-related targets. Because dysphoric participants were no faster than non-dysphoric participants when responding to negatively-related targets, it would appear that they were no more likely to interpret the ambiguous primes in a negative manner. Thus, the response latency data do not suggest that dysphoric participants' responding was affected by an interpretive bias.

Analysis of Misses

Misses occurred when the participant failed to detect that the ambiguous prime and target were related (i.e., responding *no* when the prime and target were related). The mean percentage of misses for the two groups is shown in Table 2 and these data were analyzed with the same ANOVA used for response latencies. The only significant effects were the main effect of Target Relation, $F(2, 160) = 5.39$, $P < .01$, MSE = 199.48, and, more important, the interaction between Group and Target Relation, $F(2, 160) = 8.22$, $P < .001$, MSE = 199.48. As can be seen in Fig. 1, the interaction reflected the varying group differences in miss rates for the negatively-related, positively-related, and neutrally-related targets. For neutrally-related targets, dysphoric and non-dysphoric participants missed a similar percentage of targets (8.3% and 8.0%, respectively), $t(80) = 0.15$, $P > .10$. For positively-related targets and negatively-related targets a different pattern emerged. Dysphoric participants missed significantly fewer negatively-related targets than non-dysphoric participants (10.2% vs. 17.6%), $t(80) = 2.21$, $P < .05$. Just the opposite was true for positively-related targets—dysphoric participants missed significantly more positively-related targets than non-dysphoric participants (13.6% vs. 6.4%), $t(80) = 2.41$, $P < .05$. Thus, dysphoric participants were less likely to miss targets related to negative interpretations of ambiguous primes and were more likely to miss targets related to positive interpretations of ambiguous primes. Unlike the response latency data, these data suggest that dysphoric participants were more likely to interpret the ambiguous primes in a negative manner and, in addition, were less likely to interpret the primes in a positive manner, consistent with a negative interpretive bias.

One possibility that should not be overlooked is that miss rates and response latencies could be negatively correlated and that this correlation could be contributing to group differences in miss rates. That is, the longer a participant takes to respond to a target the more time they have to consider the meaning of the ambiguous prime and the more time they have to detect a relation between the prime and target. An examination of the data in Table 2 does not reveal any consistent correlation between response latencies and miss rates of this nature (i.e., longer response latencies always being associated with lower miss rates), but dysphoric participants were slower than non-dysphoric participants overall and so it would seem wise to control for this difference when comparing group differences in the miss rates. To do so, we analyzed the miss data with an analysis of covariance (ANCOVA), using a participant's mean response latency to neutrally-related targets as a covariate, thereby controlling for any correlation between response latencies and miss rates. In the ANCOVA analysis, the Group x Type of Relation interaction was significant, $F(2, 158) = 9.00$, $P < .001$, MSE = 193.41, and the pattern of group differences in the corrected means was unchanged, with dysphoric participants making fewer misses to negatively-related targets (8.9% vs. 18.0% for the non-dysphoric participants) and more misses to positively-related targets (12.7% vs. 6.7%, respectively). As a result, we can conclude that the differences in miss rates between the groups were not due to group differences in response latencies.

Discussion

The purpose of this study was to look for evidence of a negative interpretive bias on the immediate interpretation of ambiguity, one of the more important predictions of cognitive models of depression (Beck 1987; Williams et al. 1997). Using semantic priming tasks, Lawson and MacLeod (1999) and Bisson and Sears (2007) tested for an interpretive bias by examining whether dysphoric individuals would show larger priming effects for targets related to negative interpretations of ambiguous primes. In neither study was this the case, which suggests that the interpretive biases observed in other studies (e.g., Butler and Mathews 1983; Norman et al. 1983; Rusting 1998) may have been due to reporting biases that produced higher endorsement of negative interpretations. On the other hand, the tasks used in previous semantic priming studies (the lexical decision and pronunciation tasks) are not particularly well-suited for assessing participants' interpretations of ambiguity because participant's responses are not directly related to their interpretations of primes. In the present study, the participants' task was to listen to an ambiguous prime and to quickly indicate whether a target word was related to the prime, a task with a direct connection between their interpretation of the ambiguity and their response.

With respect to response latencies, there was no evidence of an interpretive bias predicted by cognitive theories of depression. On the other hand, the miss data revealed that dysphoric participants were less likely to miss targets related to negative interpretations of the primes and more likely to miss targets related to positive interpretations of the primes. This finding suggests that dysphoric participants were more likely to interpret the ambiguous primes in a negative manner and less likely to interpret the ambiguous primes in a positive manner. Thus, the miss data suggest that for the dysphoric participants a negative interpretive bias affected their responding. The fact that these group differences were not present in the response latency data demonstrates the validity of researchers' concerns with using experimental tasks that rely solely on response latencies to measure cognitive biases in depression. As Lawson et al. (2002) and others have pointed out, depressed individuals tend to have slower and more variable response times, and this likely makes it difficult to discern small group differences in response latencies due to interpretive biases, a possibility that appears to have been borne out in the present study.

Our study has shown that dysphoric individuals differ from non-dysphoric individuals in their immediate interpretation of ambiguous sentences. Our results are consistent with the prediction that dysphoric individuals are more likely to impose negative interpretations on ambiguous primes, as they had lower miss rates for negatively-related targets and higher miss rates for positively-related targets relative to nondysphroric individuals. Our results compliment the findings of other investigators who have observed negative biases in self-reported interpretations of ambiguous stimuli. Although demonstrably difficult to measure when relying on response latency data alone, covertly probing participants' interpretations of ambiguity with the semantic relatedness task reveals a pattern of responding consistent with the negative interpretive bias observed in self-report tasks.

Conclusions

The present study demonstrates that a dysphoria-related bias in the interpretation of ambiguous information can be observed in a speeded cognitive task that measures the immediate interpretation of ambiguity. The novel result was that dysphoric individuals were less likely to miss targets related to negative interpretations of ambiguous prime sentences and more likely to miss targets related to positive interpretations of ambiguous primes, which we interpret as being due to a negative interpretive bias. Future research should determine whether the same pattern of responding is also present for a clinically depressed sample. In addition, the generalizability of our results is limited by the fact that all our participants were women, and thus future studies would ideally use a clinical sample consisting of participants of both genders. Our findings lend support to cognitive theories of depression that emphasize the importance of a negative interpretive bias. Our study also demonstrates that the semantic relatedness task is a promising tool for the study of this phenomenon.

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