Research Article

NEGATIVE INFORMATION ENHANCES THE ATTENTIONAL BLINK IN DYSPHORIA

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Background: *Research has suggested that depression is characterized by maintained attention for negative information.* **Methods:** *In this study, we examined whether maintained attention for emotional words influenced the attentional blink in a sample of stable dysphoric ($n = 14$) and non-dysphoric ($n = 14$) undergraduates. In a rapid serial visual presentation of white words, two green target words (T1, T2) had to be identified. If attention is maintained at negative information, T2 identification should be hampered by presenting a negative word at T1.* **Results:** *Results supported the hypothesis that negative words as T1 hampered the identification of T2 words if T2 was presented within 300 ms.* **Conclusions:** *These results improve our understanding of the nature of attentional bias in dysphoria. Depression and Anxiety 26:E16–E22, 2009.*

Key words: *depression; dysphoria; attention; attentional blink; emotion; disengagement*

INTRODUCTION

Cognitive theories of depression increasingly recognize that information-processing biases may be at the core of depression vulnerability and enhanced stress-reactivity.[1–3] Emotion-specific biases in the elaboration of negative material in memory and reasoning have been identified as primary information-processing problems in depression. It has been suggested that impaired attentional and inhibitory mechanisms underlie the enhanced elaboration of negative material in depression.[4,5]

Emotion-specific attentional bias has mainly been investigated using Stroop and the dot probe task.[6] Most of the empirical evidence for attentional bias stems from studies employing the dot probe task.[7] In this task, participants are required to respond as fast as possible to a dot replacing one of two stimuli (an emotional word or picture paired with a neutral stimulus) presented on a screen. By analyzing reaction times one can infer whether individuals selectively allocate attention to emotional stimuli. Studies using this task indicate that depression-related attentional bias can be found when negative stimuli are presented for relatively long durations [> 500 ms].[8–10] However, studies using very brief stimulus presentation or examining detection generally failed to find attentional bias in depression.[7]

These findings were further corroborated in studies using the spatial cueing task. This task has the advantage that it allows investigation of multiple components of attention: attentional engagement (attentional drawing) and attentional disengagement [attentional holding].[11] In a recent study with this task,[5] demonstrated that dysphoric individuals are characterized by a pattern of maintained attention for

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and difficulties in disengaging from negative self-descriptive words presented for long durations (marginally significant at 500 ms and significant at 1,500 ms) but not at brief durations (250 ms). Research in clinically depressed individuals has largely confirmed these findings using angry faces as stimulus material.[12] This pattern of attentional bias may explain hallmark features of depression such as heightened and prolonged negative affect upon encountering stressful events and rumination.

Contemporary research examining emotion-specific attentional bias in depression has thus mainly used paradigms that have been developed to examine biases in the orienting of attention. In these paradigms, multiple stimulus durations can be used to explore the time-course of attentional bias effects. However, given the time-specific elements of attentional bias in depression, it is remarkable that little research has investigated the temporal characteristics of attentional bias in a more systematic way. That is, most attentional bias paradigms only allow examining "snapshots" of attention. Moreover, little is known about the consequences of continued attention for negative material for processing of other (subsequently appearing) information. Attentional influences are examined on target detection in dot probe and spatial cueing studies, whereas attention might also influence other important variables such as stimulus awareness or identification.

Fundamental research on the temporal characteristics of attentional processes has consistently shown that the ability to identify a particular masked target is deteriorated when another masked target is presented within a temporal window of about 500 ms after the first [e.g.,].[13,14] When the interval (lag) between the two targets is increased, identification of the second target is no longer hampered. The deficit in the identification of the second target (T2) has been called the attentional blink, referring to the apparent refractory period following the presentation of the first target (T1). It is reasoned that this detriment in T2 identification is due to the participants' difficulty to efficiently divide attention to process both the targets [e.g.,].[15] Instead, they tend to overinvest attention toward T1, which then occupies limited-capacity visual short-term memory , leaving no or little room for T2. It takes some time before attentional resources have recovered (approximately 500 ms), after which T2 processing is no longer impaired.

In recent years, research has examined the effects of emotional information on the attentional blink phenomenon. Several versions of the rapid serial visual presentation (RSVP) task have been applied in studies on the processing of emotion. First, it has been examined whether the interference effects of T1 are attenuated when T2 is an emotional stimulus.[16–19] By and large these studies showed that people indeed display an attenuated attentional blink when T2 was an emotional stimulus (e.g., an angry face or an arousing word) compared with a neutral stimulus, probably because saliency lowers the threshold of detecting a particular stimulus [e.g.,],[20] or because they have a preferential attentional status and are thus encoded better [e.g.,].[16] Second, it has been tested whether using an emotional T1 stimulus influences the accurate identification of T2. One could speculate that the appearance of an emotional stimulus as T1 may result in a relatively strong deterioration of the detection of a subsequently appearing T2 [i.e., enhanced attentional blink;[18,21] Mathewson et al., in press]. Yet, presenting angry faces as T1 did not affect the detection of subsequently presented emotional faces as T2.[18] When using emotional words rather than faces as T1 stimuli,[21] even found that highly anxious individuals displayed an enhanced detection of T2 (i.e., attenuated attentional blink). The attenuated interference effect of emotional T1s was explained by assuming a highly efficient processing of negative material in highly anxious individuals (i.e., requiring relatively few attentional resources). So the available evidence suggests that, if anything, in anxiety the attentional blink will be attenuated rather than inflated when negative words are used as the T1. Recently, however, Mathewson et al. [in press] have shown that when highly arousing taboo words are presented, the attentional blink effect is significantly enhanced.

In this study, a modification of the RSVP procedure was designed to examine whether presentation of a negative word as T1 reduces identification of the subsequently presented T2. If dysphoria is related to maintained attention for and impaired disengagement from negative material,[5] presenting negative stimuli as T1 (e.g., worthless) should give rise to an enhanced attentional blink. This allows examining whether the data obtained in the context of spatial attention can be generalized to information processing in the temporal domain. Compared with attentional tasks used in previous research on attentional bias in depression, the RSVP paradigm provides a more fine-grained analysis of the time window of attentional bias because stimuli are presented at various points in time. Another advantage of this task is that, contrary to most attentional tasks, measurement relies on identification accuracy instead of reaction times. The use of reaction times in dysphoria and depression has some disadvantages in being susceptible to impaired motor responding and cognitive load.

The RSVP was administered in a sample of stable dysphoric individuals. The use of dysphoric individuals provides an opportunity to examine attentional blink effects in a sample with relatively good attentional functioning to generate preliminary data that can justify future work with distressed patients suffering from more severe conditions. Participants were presented with a RSVP stream of neutral white words. During each trial, two green words were presented as T1 and T2, respectively. T1 was either a positive, negative, or neutral word and T2 was always a neutral word. Positive words were included to examine

whether any attentional blink effects are related to a specific bias in the processing of negative information or to a bias in the processing of emotional information in general. To examine the time window of the attentional blink effect, T2s followed at either the second (lag 2), fourth (lag 4), or sixth (lag 6) word position after T1.

METHODS

PARTICIPANTS

Presence of dysphoria was assessed via the Beck Depression Inventory [BDI-II[22] Dutch translation].[23] Using the criteria proposed by Beck et al. (14–19 mild, 20–28 moderate, and >29 severe), 14 stable dysphoric participants were selected who had a BDI score >13 at an initial screening and at testing 1 month later. Another 14 students were selected on stable low (<5) BDI scores. The participants' characteristics are shown in Table 1. According to the cut-offs proposed by Beck et al., individuals in the dysphoric group were mildly ($n = 9$), moderately ($n = 4$), and severely depressed ($n = 1$) at testing. All the individuals participated in return for course credit.

MATERIALS AND PROCEDURE

Measures. The Beck Depression Inventory (BDI-II-NL) was used to measure depression.[22,23] The BDI-II is a 21-item, self-report measure of the severity of depressive symptoms. Higher scores on the BDI-II-NL reflect more depressive symptoms with scores ranging from 0 to 63. The acceptable reliability and validity of the BDI-II have been well documented.

An anxiety scale was incorporated to explore the depression-specificity of attentional effects. For this purpose, the trait version of the State and Trait Anxiety Inventory (STAI) was administered[24] translated in Dutch.[25] This questionnaire consists of 20 short statements (e.g., "I feel afraid") to be rated on a 4-point scale (1 = seldom/never, 4 = very often/always). Higher scores on the STAI reflect higher trait anxiety with scores ranging from 20 to 80. The reliability and validity is well documented.

To test both groups on general attentional functioning, the Attentional Control Scale [ACS; [26] Dutch translation by Morren, unpublished[1]] was administered. This questionnaire consists of 20 items (e.g., "When I try to concentrate myself, I find it difficult not to think about other things") to be rated on a 5-point scale (1 = almost never, 5 = always). There are two subscales: attentional focusing and attentional shifting. Higher scores reflect less attentional control with scores ranging from 20 to 100. Although there are no data available on the reliability of this scale, Derryberry and Reed found that the level of attentional control was an important mediating factor between anxiety and attentional bias.

Stimulus words. The stimuli at T1 were words comprised of four to six characters, selected from valence and familiarity ratings (valence: 1 = extremely positive–7 = extremely negative; familiarity: 1 = very unfamiliar–7 = very familiar) provided by a group of 100 Flemish undergraduates rating 300 words (100 positive, negative, and neutral words). As an additional criterion for the emotional words, we selected words that were self-descriptive adjectives. We selected nine negative (valence: $M = 2.37$, $SD = 0.49$, range = 1.62–3.16; familiarity: $M = 6.20$, $SD = 0.23$), nine positive (valence: $M = 5.93$, $SD = 0.63$, range = 4.50–6.54; familiarity: $M = 6.42$, $SD = 0.21$), and nine neutral words (valence: $M = 4.20$, $SD = 0.34$, range = 3.76–4.25; familiarity: $M = 6.12$, $SD = 0.16$) as T1. The negative and positive word sets were matched as closely as possible on familiarity ratings and emotional intensity. The exact words that were used are displayed in the appendix. A set of 27 neutral words functioned as T2. These words were comprised of three to six characters. The words at T1 and T2 were each presented five times during the task. Another set of 79 unfamiliar neutral words served as distracting words. These words were comprised of nine to 18 characters. All the words were presented at font size 20.

TABLE 1. Group characteristics

	Group	
Variable	Dysphoric	Non-dysphoric
N	14	14
Age	18.79 (1.25)	18.64 (1.50)
Gender ratio (male/female)	1/13	3/11
BDI*	20.43 (5.89)	3.64 (2.31)
STAI-T*	57.43 (12.46)	33.36 (6.39)
ACS-focusing	24.71 (6.90)	20.86 (5.84)
ACS-shifting	28.07 (5.68)	24.00 (6.41)

*$P < .001$ between the dysphoric and non-dysphoric group.
BDI, Beck Depression Inventory; STAI-T, State-Trait Anxiety Inventory; ACS, Attentional Control Scale.

Rapid serial visual presentation. The RSVP task was programmed and ran in INQUISIT 2.0.[27] The program ran on a Pentium desktop and stimuli were presented on a 17-in, 72-Hz CRT screen. Responses were collected using a standard AZERTY keyboard.

Each trial consisted of a 500-ms fixation cross followed by the RSVP of 13 word presentations, including two green words (T1 and T2) and 11 neutral white distracting words (depicted in Fig. 1). Each word was presented for 100 ms, and there was a 14-ms inter stimulus interval (ISI) before a new word appeared. T1 was presented on a fixed random position in the stream (position 3, 4, or 5) with the restriction that each type of T1 was equally often presented in a certain position. T2 words were also presented in a fixed random order with the restriction that T2 was equally often presented at 2 (228 ms), 4 (456 ms), and 6 (684 ms) positions following each type of T1. In the present set-up there were 3 (T1: negative, positive, and neutral) × 3 (lags: 2, 4, or 6) different types of trials that were each presented 15 times. Participants were instructed to identify the green words and to report them at the end of each presentation. Individuals were presented separate prompts to type in the word for T1 and T2. After they finished, the word "READY?" appeared and they had to press the spacebar to start the next trial.

PROCEDURE

Individuals identified as dysphoric/non-dysphoric in a mass screening of first-year psychology students were invited to participate in the experiment. Participants were tested individually in a dimly lit laboratory. The experimenter was left blind to the participants' depression status. The participants were first presented an informed consent form and were then administered the questionnaires in the following fixed order: BDI, STAI, and ACS. After completion of the questionnaires, participants were seated in front of the computer screen with their head mounted in a head coil set at a fixed distance of

[1]Please note that this Dutch translation of the ACS has a different scoring procedure compared with the original version of the ACS.

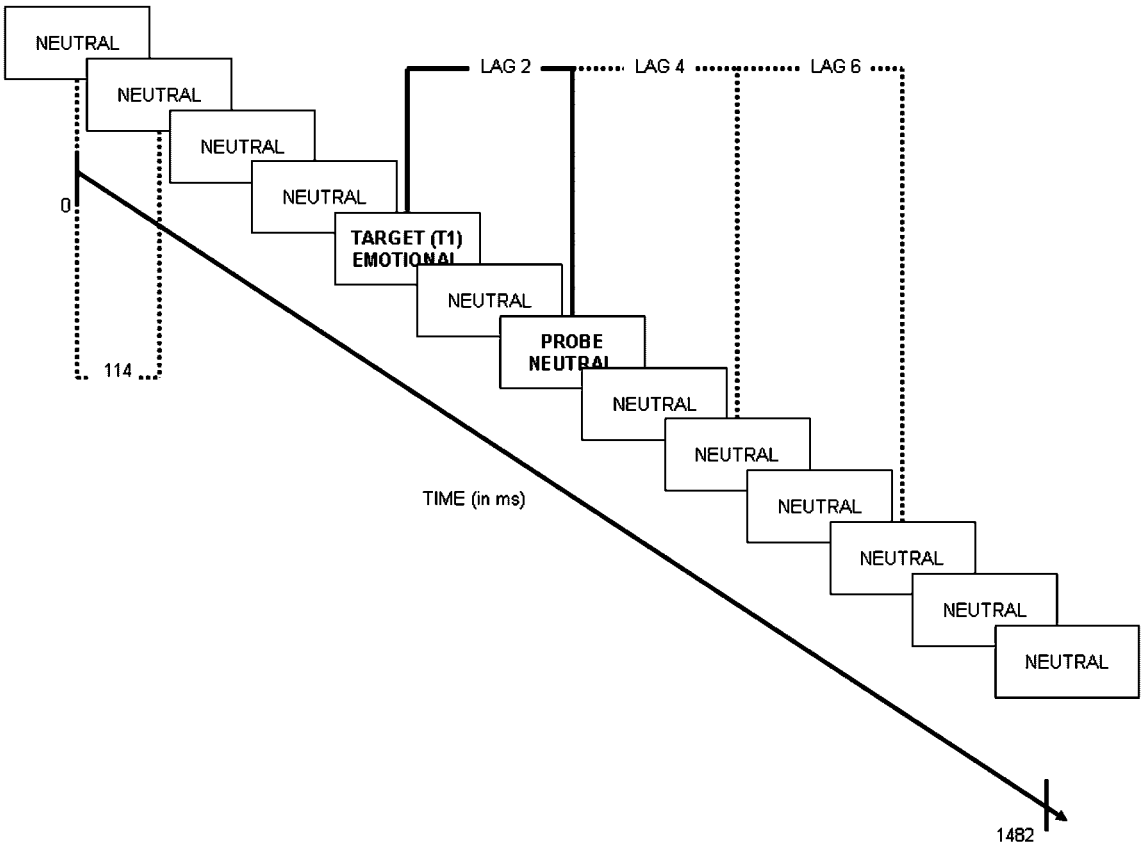

Figure 1. Schematic overview of trial presentation.

50 cm from the screen to perform the attentional blink task.[2] The participants completed 10 practice trials and 135 test trials (15 trials for each word type–lag combination).

RESULTS

PARTICIPANTS' CHARACTERISTICS

Dysphoric and non-dysphoric participants had equal age and similar sex distributions and only differed significantly in their BDI-II and STAI-T scores (see Table 1). It is important to note that the self-reported ability to control attention did not differ significantly between both the groups, although attentional control seemed slightly better in the non-dysphorics ($t < 1.6$).

T1 IDENTIFICATION

Percentage accuracies were calculated for all trial types and lags for each participant for T1.

Analysis of T1 identification was performed to examine differential processing of the emotional initial targets in dysphorics versus non-dysphorics. Therefore, a 3 emotion (negative, positive, neutral) × 3 lag (lag 2, lag 4, lag 6) × 2 group (dysphoric, non-dysphoric) repeated-measures analysis of variance was conducted on the correct number of responses at T1, with repeated measures treated as variates. All the factors except group are within-subjects factors. Only a significant effect of lag was found, $F(2, 25) = 3.93$, $P < .05$, with contrasts showing a significantly lower identification accuracy at lag 2 ($M = 95.3$) compared with lag 6 ($M = 97.0$), $F(2, 26) = 8.22$, $P < .01$, but not lag 4 ($M = 96.4$), $F(2, 26) = 2.24$, $P > .1$. None of the other effects reached significance (all $F < 2$). Thus, there was no main effect of group on the identification of T1 words.

EFFECTS OF T1 ON T2 IDENTIFICATION

Note that analyses of T2 were restricted to the trials with an accurate responding on T1.

A 3 emotion × 3 lag × 2 group repeated-measures analysis of variance was conducted on the correct number of responses at T2. Mean accuracy rates of T2 identification are presented in Table 2. As expected,

[2]This study reports on one aspect of a larger study on attention and dysphoria. Participants performed a spatial cueing task and a memory test before the attentional blink test was performed. Given the high accuracy rates and absence of any main effects of dysphoria on the number of errors, this procedure did not lead to fatigue.

TABLE 2. Mean (*SE*) percentage correct identifications of the T2 as a function of the valence of T1, lag, and dysphoria

	Dysphoric		Non-dysphoric	
	M	*SD*	*M*	*SD*
Lag 2				
Negative T1	87.9	8.7	93.5	5.6
Positive T1	93.2	6.4	92.9	6.9
Neutral T1	92.5	4.7	93.0	6.0
Lag 4				
Negative T1	96.2	3.9	98.3	2.2
Positive T1	97.9	4.2	99.2	1.4
Neutral T1	98.4	2.8	98.7	2.1
Lag 6				
Negative T1	99.2	1.9	99.2	1.7
Positive T1	99.5	0.9	99.2	1.4
Neutral T1	98.4	2.7	99.0	1.7

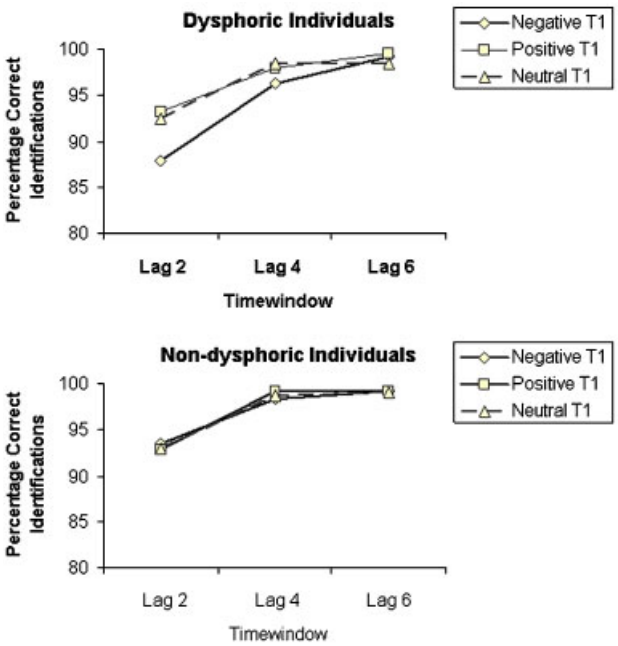

Figure 2. Percentage of correct probe responding in function of dysphoria, time window, and first target (T1) valence.

this analysis yielded a significant main effect of lag, $F(2, 25) = 29.11$, $P < .001$, with lower accuracy rates at lag 2 ($M = 92.2$) compared with lag 4 ($M = 98.1$), $F(1, 26) = 11.95$, $P < .01$, and lag 6 ($M = 99.1$), $F(1, 26) = 60.30$, $P < .001$. Moreover, a marginally significant effect of emotion was found, $F(2, 25) = 2.82$, $P < .08$. There was a two-way interaction of emotion × lag, $F(4, 23) = 3.38$, $P < .05$, that could be subsumed under the three-way interaction between emotion × lag × group, $F(4, 23) = 2.78$, $P < .05$.

To examine this interaction, we performed separate analyses at each lag. At lag 2, the two-way interaction between emotion × group was significant, $F(2, 25) = 3.74$, $P < .05$. This effect is depicted in Figure 2. Planned-comparison *t* tests indicate that identification of the words at T2 was significantly impaired after presentation of negative words as T1 in dysphoric individuals ($M = 87.9$) compared with non-dysphoric individuals ($M = 93.5$), $t(26) = 2.01$, $P = .05$, ES: $d = 0.79$. The identification impairment was only found when the preceding T1 was negative (all other $t < 1$). In the dysphoric group, *t* tests indicate that T2 identification was significantly hampered after negative T1 compared with a positive T1, $t(13) = 3.45$, $P < .05$, or a neutral T1, $t(13) = 2.28$, $P < .05$. $t(26) = 2.01$, $P = .05$. This effect was not significant in the non-dysphoric group ($t < 1$).

Analysis at lag 4 revealed only a marginally significant effect of emotion, $F(2, 25) = 2.95$, $P = .07$, with slightly lower identification rates for T2 that were preceded by negative T1 ($M = 97.2$) compared with neutral and positive T1 (both $M = 98.6$). No other effects were significant ($F < 2$). At lag 6, no significant effects were found ($F < 1.2$), probably due to a ceiling effect in identification accuracy.

DISCUSSION

This study is the first to our knowledge to examine the effect of emotional stimuli on the attentional blink in the context of dysphoria or depression. The results clearly indicate that target identification is significantly impaired in dysphorics when it is preceded by a negative word. This effect was only found when T2 was presented in close temporal proximity to T1 (228 ms). The present results add to the existing literature on the nature of attentional bias in dysphoria and depression, which is discussed below.

A first important feature of the present data is that it provides some new insights on the nature of attentional bias in dysphoria: although most studies examining spatial attention have found that prolonged stimulus presentation is required to elicit attentional bias in dysphoria, word presentation was very short in this study. Provided that there is extensive literature using the Stroop and dot probe task that failed to observe enhanced automatic processing of negative material [see],[6] this may be considered a discrepant finding. However, a crucial difference between the attentional blink paradigms and the paradigms used in previous studies is that negative material was task-relevant in the attentional blink task whereas negative material had to be ignored in spatial cueing, dot probe, and stroop studies. Across these paradigms, it seems that attentional operations are impaired once negative information is processed, caused by either task-relevance or extended presentation durations. Thus, the present data provide additional support for

an impaired disengagement account for attentional bias in dysphoria.

Interestingly, the present data extend the impaired disengagement account in several ways. First, in previous research, impaired disengagement was reflected by a reduced ability to shift attention from a spatial location occupied by negative material to the location of a neutral stimulus. Data from this study can be taken to imply that the impaired disengagement is not limited to the spatial domain but also operated in the RSVP task: there was a specifically enhanced difficulty when processing resources required to identify negative T1 words had to be redirected to temporally close T2 words. Second, previous studies demonstrating attentional bias have mainly relied on reaction time paradigms that are potentially subject to retarded behavioral responding in dysphoria and depression. Therefore, it is important that the disengagement hypothesis is also supported in a paradigm relying on identification.

There are several alternatives for the impaired disengagement account. First, it may be that dysphoric individuals are slower at identifying negative words, causing the observed enhanced attentional blink effect. However,[28] found that depressed individuals performed worse in identifying briefly presented emotional as well as neutral words. Moreover, T1 identification rates were similar for emotional and neutral words, which suggests that identification of negative words was not impaired in the current sample. Second, although we did not include word ratings in this study, one could suspect that the negative words were more salient for dysphoric compared with nondysphoric individuals. One could argue that these salience effects explain the enhanced attentional blink rather than the impaired disengagement. However, it has been demonstrated that the participants' own names as T1, which are highly salient stimuli, do not produce an enhanced attentional blink compared with the names of others.[20] Thus, it seems that salience effects cannot account for the enhanced attentional blink effect. Nonetheless, we cannot fully exclude the possibility that valence and arousal value of the stimuli were in some way related to the enhanced attentional blink. In particular, arousal has recently been shown to influence the attentional blink effect [e.g., Mathewson et al., in press]. However, it is noteworthy that in those studies highly arousing taboo words were used whereas the words used here are not highly arousing.

Another alternative explanation for the present data, unrelated to the impaired disengagement account, is selective rehearsal of the negative T1 words at the expense of T2 identification accuracy. However, the memory-rehearsal account seems problematic here as (1) there probably is insufficient time for rehearsal [see],[29] (2) selective rehearsal would probably lead to better accuracy rates for negative T1 words in dyshorics which is not observed in this study, and (3) a memory-rehearsal account does not provide an explanation for the specific lag effect, with only an enhanced attentional blink for negative information at lag 2 in dysphoria. Given these reasons, the results seem to be best explained by an impaired disengagement account.

Data from this study clearly show that processing of information presented shortly after negative information is hampered in dysphoric individuals. Although it is not clear whether the present findings can be generalized to daily life, it may be that impaired disengagement from negative material can enhance memory for emotional material and interfere with the efficient processing of task-relevant information. In fact, the present findings warrant research into the influence of attentional bias in dysphoria. Provided that during naturalistic viewing we continuously perceive sequences of information, one could hypothesize that in dysphorics enhanced attentive processing of negative material influences cognitive processing of information in real life.

This study is limited in several ways. First, the sample was an undergraduate sample characterized by a relatively good attentional functioning. Further study is needed in a clinically depressed sample to examine whether the present data generalize to depression. It may be that the use of dysphoric undergraduates provides an underestimation of the time window of the emotional enhancement of the attentional blink effect. In clinically depressed individuals, the effect of negative information on probe detection might also be evident at lags 4 and 6. Another reason that attentional blink effects were restricted to lag 2 may be ceiling effects in the identification rates. The high identification rate may be explained by the introduction of the 14-ms ISI which is not standard procedure in the RSVP. Masking distracters were thus delayed, which made the task substantially easier. Future studies could remove this ISI to avoid a ceiling effect. Moreover, in this study, the correlation between dysphoria and trait anxiety was very high ($r = .83$, $P < .001$). Unfortunately, with these high correlations it is not warranted to perform covariation analysis to partial out the effects of anxiety.[30] Therefore, it is not possible to attribute the results unambiguously to the depression scores. Provided that previous research in the context of anxiety found results opposite to this study,[21] it may be assumed that the present findings are specific to depression.[3] However, more research is necessary to be conclusive on this matter.

In sum, this study provides further evidence to suggest that dysphoria is characterized by an attentional bias for negative material. An enhanced attentional blink effect was found for negative words. As this is the first study to examine attentional bias in

[3]Exploratory correlational analysis showed that an index score of enhanced attentional blink for negative relative to neutral words (attentional blink neutral T1–attentional blink negative T1) did not correlate significantly with trait anxiety scores ($r = .19$, $P = .34$).

dysphoria using the RSVP paradigm, the results of this study encourage further research into the nature of the enhanced attentional blink for negative material and its relevance to dysphoria and symptoms of depression.

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Appendix

Table A1

TABLE A1. Words used as T1 (English translation)

Negative words	Positive words	Neutral words
Weak	Nice	Wide
Ugly	Lovely	Green
Sad	Healthy	Known
Dark	Big	Cheese
Pathetic	Proud	Foam
Empty	Safe	Double
Cold	Warm	Closet
Alone	Strong	Horse
Depressed	Great	Image

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