



Ruminative response style is associated with a negative bias in the perception of emotional facial expressions in healthy women without a history of clinical depression

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ABSTRACT

Background and objectives: Rumination has been shown to be an important cognitive vulnerability factor affecting development and maintenance of depression. Ruminative thinking can be divided into a self-focused component referring to persistent reflection about causes and consequences of depressed mood and a symptom-focused component characterized by repetitive thinking about depressive symptoms. Previous research on clinical depression has shown that rumination is associated with the perception of negative emotions in others' facial expressions. The present study was conducted to investigate the relation between habitual rumination and negative bias in face perception in healthy individuals.

Methods: 100 healthy young women without a history of clinical depression completed the Response Styles Questionnaire along with measures of depressive symptoms, dysfunctional attitudes, and anxiety. A computer-based version of the perception of facial expressions questionnaire using line drawings (schematic faces) was administered to assess perceived emotions in faces with ambiguous and unambiguous emotional expressions.

Results: According to hierarchical regression analyses, symptom-based (but not self-focused) rumination predicted perceived negative emotions in ambiguous as well as in unambiguous negative faces after controlling for current depressive symptoms, state and trait anxiety, intelligence, and dysfunctional attitudes.

Limitations: Generalization of the present findings is limited by the fact that only women were included as study participants.

Conclusions: Habitual ruminating about depressive symptoms in healthy, never clinically depressed individuals goes along with a negative bias in the perception of others' facial expressions. Negatively biasing social perception might be one mechanism by which symptom-focused rumination might increase vulnerability for depression.

1. Introduction

One of the most influential cognitive vulnerability theories of depression, the response styles theory proposed by Nolen-Hoeksema (1991, 2004), refers to two basic coping styles in response to depressed mood: ruminative and distractive coping. Ruminative responses are defined as repetitive and passive thinking about the symptoms of depression and their potential causes and consequences. Distraction implies actively shifting one's attention away from depressive symptoms and onto neutral or pleasurable activities or thoughts. Rumination has been implicated in the development and maintenance of depressive symptoms (Gotlib & Joormann, 2010). In longitudinal studies with non-clinical adults, rumination predicted increase of depressed mood and onset of depressive episodes (Huffziger, Reinhard, & Kühner, 2009).

Predictive effects of rumination have also been found in non-clinical adolescents: rumination focused on the emotional state significantly predicted increases in depressive symptoms over 1.5 years, particularly for girls (Burwell & Shirk, 2007). There is some evidence for a causal contribution of rumination to depressed affect: rumination inductions led to mood deterioration (Hilt & Pollak, 2013; Huffziger et al., 2013). There seems to be gender differences regarding rumination tendencies: women ruminate more about why they feel sad and about possible consequences of feeling sad than men (Nolen-Hoeksema, Morrow, & Fredrickson, 1993).

Ruminative thinking has been subdivided into a self-focused and a symptom-focused component (Bagby & Taylor, 2001; Bürger & Kühner, 2007). Symptom-focused rumination characterizes repetitive thinking about the symptoms of depression such as depressed affect, cognitive

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deficits, somatic complaints, low motivation and anhedonia, whereas self-focused rumination refers to rumination about oneself comprising reflection and self-reproach to understand one's condition and problems. Self-focused rumination appears to represent a more adaptive form of reflective pondering (Treyner, Gonzalez, & Nolen-Hoeksema, 2003) and shows higher temporal stability (Bagby, Rector, Bacchiochi, & McBride, 2004). In contrast, symptom-focused rumination has stronger links to depressed affect and depressive symptoms that are typically fluctuating and episodic (Bagby et al., 2004). In a healthy community sample, higher symptom-focused (but not self-focused) rumination predicted higher future levels of depressive symptoms (Huffziger et al., 2009). Symptom-focused (but not self-focused) rumination had an adverse impact on the long-term course of psychosocial functioning in depressed patients (Kühner & Huffziger, 2012). Against this background, it seems necessary to distinguish between self-focus and symptom-focus when examining rumination as vulnerability factor for depression or predictor of unfavorable course of illness. It appears that symptom-focused rather than self-focused ruminative thinking could become an important target of preventive strategies aimed at reducing the risk of onset of depressive disorders.

Depression has been shown to be associated with negative biases in processes of perception and interpretation (see, for example, Kircanski, Joormann, & Gotlib, 2012, for an overview). In this context, special attention has been given to the processing of emotional expressions in faces (Bistricky, Ingram, & Atchley, 2011). Recognizing facial emotional expressions of others is essential for understanding their intentions, states, and beliefs and a prerequisite for the ability to interact successfully (Erickson & Schulkin, 2003). There is evidence from cross-cultural studies that facial expressions of basic emotions such as sadness or fear are universally identified (Ekman, 1992). According to a recent meta-analysis, clinically depressed individuals exhibit a general deficit of emotion recognition in faces compared to healthy controls (Dalili, Penton-Voak, Harmer, & Munafo, 2015). Importantly, dysphoria as well as clinical depression seem to be associated with a negative interpretation bias in the perception of emotionally ambiguous (or mixed) and neutral facial expressions (Beevers, Wells, Ellis, & Fischer, 2009; Leppänen, Milders, Bell, Terriere, & Hietanen, 2004).

It has been shown that emotions can be well recognized in line drawings of facial expressions by persons of different cultures (Cüceloglu, 1970). Schematic faces such as line drawings have the advantage of eliminating most of the extraneous information (such as attractiveness, gender, or color composition) from the face other than the cues under investigation (Shepherd, 1989). In this way, control over the face stimulus material and comparability of methods between studies is enhanced. Bouhuys, Bloem, and Groothuis (1995) administered schematic drawn faces to examine the effects of induced dysphoric mood on judgment of facial expressions in healthy individuals. It was found that even mild degrees of dysphoric mood lead to a negative bias in the appreciation of others' facial emotions. In longitudinal studies with depressed patients, it was observed that higher levels of perception of negative emotions in schematic faces predicted less favorable course of illness and outcome (Bouhuys, Geerts, & Gordijn, 1999; Bouhuys, Geerts, Mersch, & Jenner, 1996; Hale, 1998). Evidence was also found that levels of anxiety were positively associated with perceived negative emotions in schematic faces in depressed patients (Bouhuys, Geerts, & Mersch, 1997). Thus, anxiety appears to represent a factor also contributing to negative interpretative bias in the perception of facial displays.

Raes, Hermans, and Williams (2006) investigated the relation between rumination and biased processing of facial emotional expressions in a sample of clinically depressed patients administering schematic facial expressions. The authors analyzed evaluations of ambiguous faces (expressing no or positive as well as negative emotions) and, in addition, evaluations of all faces presented (i.e., unambiguous and ambiguous expressions) which were presented in a booklet controlling for current levels of depressive symptoms, state and trait anxiety, and

dysfunctional attitudes. Dysfunctional attitudes are rigid and maladaptive beliefs about oneself, the world, and the future. These include perfectionism (which entails high, self-imposed standards for oneself around performance and achievement), need for approval and dependence on others (Whisman & Friedman, 1998). Raes et al. (2006) reported significant correlations between rumination and negative bias in the judgment of facial expressions (for the ambiguous faces as well as the all faces condition), independently of other depression-related variables. It was concluded that a ruminative thinking style could make it more likely to endorse negative interpretations when confronted with other persons' facial expressions. Raes et al. (2006) raised the question whether one of many possible ways through which rumination renders people vulnerable for depression could be biasing the perception of facial expressions. For answering this question, it is necessary to investigate the relation between ruminative thinking and emotion perception in samples of young individuals without a history of clinical depression. If ruminative thinking style is associated with negatively biased perception of others' facial expressions among psychiatrically healthy individuals, this may suggest both constructs function as trait vulnerability factors for depression onset. In the study of Raes et al. (2006), it remains unclear whether a correlation between rumination and negative bias in the judgment of faces can be found for unambiguously negative facial expressions.

The objective of the present study was to investigate the relation between rumination and perception of negative emotions in facial expressions in healthy individuals. Our research relates to the field of cognitive vulnerability to depression and may help to identify potential targets of depression prevention and intervention. We recruited a sample of never clinically depressed subjects so that we could exclude an influence of previous depressive episodes on the cognitive variables examined. Only women participated in our study because, in general, they ruminate more about depressed mood and its implications (Nolen-Hoeksema et al., 1993) and they suffer from depression about twice as often as men (American Psychiatric Association, 2013). A computer-based version of the perception of facial expressions questionnaire (Bouhuys et al., 1995) was administered to assess perceived emotions in faces. In our analyses, we controlled for the influence of other potentially relevant variables such as current level of depressive symptoms, state and trait anxiety, intelligence, and dysfunctional attitudes. Dysfunctional attitudes could be regarded as a cognitive vulnerability factor for depression that has to be distinguished from rumination and seems to be involved in the development of negative cognitive biases (Beck, 2008; Hankin, Lakdawalla, Carter, Abela, & Adams, 2007). Most importantly, Raes et al. (2006) found that dysfunctional attitudes tended to correlate positively with perception of negative emotions in unambiguous faces. Against this background, it appeared advisable to control dysfunctional attitudes as a relevant variable. Intelligence was included as a control variable since low intelligence has been found to be a risk factor for the development of mood disorders (Gale, Batty, Tynelius, Deary, & Rasmussen, 2010). Especially in early adulthood, an association between higher intelligence and lower probability of serious depression has been reported (Lager, Melin, Hemmingsson, & Sörberg Wallin, 2017). Better coping and response to depressogenic stressors among people with higher intelligence might be one explanation of this association.

In our study, we differentiated self-focused from symptom-focused rumination (cf. Bürger & Kühner, 2007). Based on the findings of Raes et al. (2006) with depressed patients it was hypothesized that ruminative response style is positively associated with perceived negative emotions in ambiguous as well as in unambiguous negative faces in healthy individuals. Thus, we assumed that, even at rather low levels, habitual ruminating about depressive symptoms and their implications is related to negative interpretation of others' facial expression independent of other relevant factors.

2. Methods

2.1. Participants

Our final sample consisted of 100 young women with a mean age of 23.8 years ($SD = 3.0$; range: 19–30). All were native speakers of German. The mean duration of participants' school education was 12.3 years ($SD = 0.6$). Exclusion criteria for study participation were a lifetime history of psychiatric or neurological diseases and any psychotropic medication use according to self-report. Diagnostic interviews were conducted by two doctoral students. The "Major depression episode" module of the German version of the Structured Clinical Interview for DSM-IV Axis I disorders (SCID-I, Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997) was administered to exclude lifetime diagnosis of Major depression. In addition, the interviewers searched for any evidence indicating actual or past presence of mental or neurological disorders (mental health problems, neurological problems, psychiatric hospitalizations and treatments, psychotherapies, use of psychotropic medication, neurological treatments). Individuals with any indication of mental or neurologic disorders or psychotropic medication use were excluded from the study. The interviewers were instructed, trained, and supervised by two experienced clinical psychologists. The interview and testing session took place on different days. Participants were recruited via online announcements in social networks and public notices posted in libraries, canteens, and other public buildings of the University. One hundred twenty-four interested individuals responded to the public notice, but twenty-four individuals met exclusion criteria. Most of our study participants were university students. The study was conducted in accordance with the Declaration of Helsinki (World Medical Association, 2013) and was approved by the competent ethics committee. After a complete description of the study, written informed consent was obtained. Participants received a financial compensation.

2.2. Perception of facial expressions

Our perception of facial expressions (PFE) task consisted of 12 schematic oval faces (line drawings) as administered by Bouhuys et al. (1995, 1997). The facial expression line drawings were composed from one eyes and nose type, four eyebrow types and three mouth types (see Fig. 1). The faces were presented in random order one at a time on a computer screen. At the beginning of the task, subjects were instructed that they will see schematic drawings of faces and that they should judge how much faces express certain emotions. Subjects evaluated the faces with respect to seven (basic or relational) emotions: happiness, fear, anger, sadness, disgust, invitation, and rejection (the same emotional categories in evaluating schematic faces have been administered

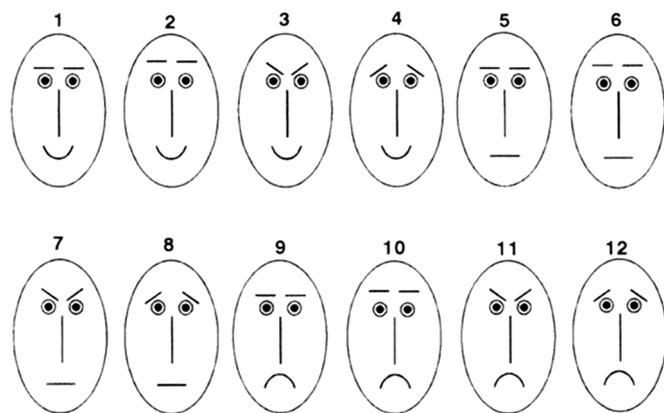


Fig. 1. Schematic faces presented in the Perception of Facial Expressions task. Faces 3, 4, 5, and 6 are ambiguous. Faces 1 and 2 express positive emotions and faces 7–12 express negative emotions.

previously, for example, by Hale, Jansen, Bouhuys, and van den Hoofdakker (1998) and Raes et al. (2006)). Emotion words were judged one at a time on a five-point scale ranging from 1 (not at all, 0%) to 5 (very strongly, 100%). Responses were given on a keyboard by pressing the "1", "2", "3", "4", or "5" key. On each trial, images of faces remained on the screen until a response was made. At the top of the screen, a question was displayed (e.g., How strongly does the face express *happiness*?). At the bottom of the screen, the response format was presented (i.e., the five-point scale ranging from 1 (not at all, 0%) to 5 (very strongly, 100%)). Five of the seven emotion words (fear, anger, sadness, disgust, and rejection) were grouped into a category called "negative emotions" and the two emotions happiness and invitation were grouped together as "positive emotions" (cf. Bouhuys et al., 1997; Hale et al., 1998). Overall, subjects made 84 judgments in the PFE task.

Our study focuses on evaluations of ambiguous facial expressions but included also evaluations of faces expressing (relatively) unambiguous emotions. Of the 12 schematic faces, it has been shown that some expressions are of rather low intensity and convey ambiguous (i.e., mixed emotions) facial expressions (Bouhuys et al., 1995) in which ambiguous is defined as an expression that expresses equal amounts of positive and negative emotions. In our study, the faces 3, 4, 5 and 6 were selected as ambiguous expressions (see Fig. 1). Faces 3 and 4 are characterized by a "happy" mouth but "angry" or "sad" eyes, whereas faces 5 and 6 consist of a neutral mouth (horizontal line) and neutral eyebrows (horizontal lines). Four judgment averages were used in the statistical analyses of the PFE data. The judgments of the five negative emotional categories were averaged over the four ambiguous expressions and separately over the six unambiguous negative facial expressions (i.e. faces 7–12). These two scores refer to perceived negative emotions in ambiguous faces and perceived negative emotions in unambiguous negative faces. Likewise, the judgments of the two positive emotional categories were averaged over the ambiguous expressions. Finally, judgments of the two positive emotional categories were averaged over the two unambiguous positive expressions (i.e. faces 1 and 2). The latter scores refer to perceived positive emotions in ambiguous faces and perceived positive emotions in unambiguous positive faces. Presentation software (Version 16.3, Neurobehavioral Systems, Inc., Berkeley, CA, www.neurobs.com) was used to control stimulus presentation and to record task performance.

2.3. Self-report psychometric measures

The Response Styles Questionnaire (RSQ; Nolen-Hoeksema & Morrow, 1991) was developed to measure responses to depressed mood by asking respondents what they generally do when they feel depressed. The RSQ assesses habitual trait-like coping styles. In the present study, a German short form of the RSQ (Kühner, Huffziger, & Nolen-Hoeksema, 2007) consisting of 23 items was administered. The three subscales of the RSQ are "symptom-focused rumination" (8 items), "self-focused rumination" (7 items) and "distraction" (8 items). Symptom-focused rumination reflects ruminative thinking about the symptoms of depression, including depressed mood, cognitive deficits, somatic complaints, reduced motivation and anhedonia (example of an item: "think about how passive and unmotivated I feel"). Self-focused rumination refers to rumination about one's own person to understand one's problems, including self-reproach, reflection, and self-analysis (example of an item: "analyze my personality to try to understand why I'm depressed"). Distraction refers to cognitions and behaviors that take an individual's mind off his or her depressed mood (example of an item: "remind myself that these feelings won't last"). The subscales of the RSQ demonstrate good internal consistency, retest reliability, and construct validity (see Bürger & Kühner, 2007). In our study, we found rather low internal consistencies for the rumination subscales. Cronbach's alpha was 0.66 for the symptom-focused rumination scale and 0.70 for the self-focused rumination scale. In previous studies, higher internal consistencies ($\alpha > 0.75$) have been reported for the

rumination scales of the RSQ (Bagby et al., 2004; Bagby & Taylor, 2001; Bürger & Kühner, 2007). Looking at the RSQ rumination scores in our sample it must be noted that symptom-focused as well as self-focused rumination scores were somewhat higher than those found in women from a German community sample (Bürger & Kühner, 2007). However, the latter were twenty years older than our participants and age has been found to be negatively correlated with habitual rumination (Bürger & Kühner, 2007).

Depressive symptoms of participants were measured with the Beck Depression Inventory (BDI-II; German version: Hautzinger, Keller, & Kühner, 2006). Based on the standardized cutoff values of the BDI-II level of depression is interpreted as *minimal* (0–13), *mild* (14–19), *moderate* (20–28), or *severe* (≥ 29). According to the self-report data of our sample, 88 women had BDI-II scores indicating no or minimal depression, 8 women showed scores reflecting mild depressive symptoms, 4 women had scores indicating a moderate level of depression and no woman had a score indicative of severe depression. Trait anxiety was assessed by the German version of the State-Trait Anxiety Inventory (STAI-Trait-version; Laux, Glanzmann, Schaffner, & Spielberger, 1981). Level of current anxiety was evaluated by the Beck Anxiety Inventory (BAI, German version: Margraf & Ehlers, 2007). The Dysfunctional Attitude Scale (DAS; German version: Hautzinger, Luka, & Trautmann, 1985) was administered to measure dysfunctional assumptions and maladaptive thinking patterns. There is evidence for a two-factor model of the DAS in non-clinical samples, consisting of “performance evaluation” and “approval by others” (Joormann, 2004).

2.4. Intelligence assessment

Verbal intelligence of participants was determined by means of the Mehrfachwahl-Wortschatz-Intelligenztest (MWT-B), a multiple-choice test using artificial and existent vocabulary of the German language (Lehrl, 2005).

2.5. General procedure

All subjects were tested individually in a quiet room. After consenting to participate, the clinical diagnostic interview was conducted. On another day, subjects participated in the Perception of facial expressions task and filled out the RSQ and DAS. After the administration of the MWT-B, participants were given the BDI-II, BAI and STAI-T.

2.6. Statistical analysis

Product moment correlation analyses were performed to explore the relationships between affective measures (BDI-II, BAI, STAI), dysfunctional attitudes (DAS), coping styles in response to depressed symptoms (RSQ), intelligence (MWT-B) and perceived negative and positive emotions (as assessed by the PFE task). In addition, hierarchical regression analyses were conducted for perceived negative emotions in ambiguous faces as well as for perceived negative emotions in unambiguous negative faces. Affective measures (BDI-II, BAI and STAI) and intelligence scores were entered as predictors in the first step. Performance evaluation and approval by others (i.e. dysfunctional attitudes as assessed by the DAS) were entered as predictors in the second step of the regression model. In a third and final step, the RSQ scores *self-focused rumination* and *symptom-focused rumination* were entered as predictors of interest.

3. Results

The descriptive statistics for the self-report measures and the intelligence test are listed in Table 1. As could be expected, the measures of depressive symptoms and anxiety (BDI-II, BAI, and STAI) were substantially correlated with each other. Moreover, the dysfunctional attitude factors performance evaluation and approval by others showed

medium to high correlations with the measures of depressive symptoms and anxiety (see Table 1). Similarly, the rumination scales of the RSQ were also positively correlated with depression symptoms and anxiety. In contrast, distraction as assessed by the RSQ showed negative correlations with depression symptoms and trait anxiety as well as with performance evaluation and symptom-focused rumination. Intelligence was only negatively associated with depression symptoms and trait anxiety. Self-focused rumination and symptom-focused rumination were substantially correlated ($r = 0.53$, $p < .001$). In line with expectations, symptom-focused rumination tended to show higher correlations with depression symptoms and anxiety measures compared to self-focused rumination (see Table 1).

Mean evaluative ratings (i.e. perceived negative and positive emotions in ambiguous and unambiguous negative and unambiguous positive schematic faces) are shown in Table 2. Results from dependent t -tests indicate that on average participants perceived more negative emotions in unambiguous negative faces than in ambiguous faces ($t(99) = 18.89$; $p < .001$). As could be expected, subjects ascribed more positive emotions to unambiguous positive faces compared to ambiguous faces ($t(99) = 25.31$; $p < .001$).

According to our data, participants' depressive symptoms as assessed by the BDI-II were positively associated with the extent of perceived negative emotions in unambiguous negative faces (see Table 2). Moreover, intelligence (as assessed by the MWT-B) was negatively correlated with perceived negative emotions in unambiguous negative faces. Finally, symptom-focused rumination was positively correlated with perceived negative emotions in ambiguous faces (see Fig. 2) as well as in unambiguous negative faces (see Fig. 3 and Table 2). No other correlations between self-report measures and perception of negative emotions in schematic faces were observed. Finally, none of the psychometric measures were significantly correlated with the perception of positive emotions in the PFE task.

Hierarchical regression analysis was conducted to examine the relationship of rumination style with negative emotion perception, after adjusting the effects of affectivity (i.e. current and dispositional anxiety and current depression symptoms), intelligence, and dysfunctional attitudes. Results of the hierarchical regression models are presented in Table 3. First, a regression model was calculated for the perception of negative emotions in ambiguous faces. Neither the first step (including BDI-II, BAI, STAI and MWT-B) nor the second step of the regression analysis (with performance evaluation and approval of others) predicted perception of negative emotions in ambiguous faces to a statistically significant degree. In the third step, after the inclusion of rumination styles symptom-based rumination was found to significantly predict perceived negative emotions in ambiguous faces (see Table 3). Second, we calculated a regression model for the perception of negative emotions in unambiguous negative faces and obtained similar findings. Neither the first nor the second step of the regression analysis predicted perceived negative emotions in unambiguous negative faces. However, after the inclusion of rumination styles in the third step symptom-based rumination was found to significantly predict perceived negative emotions in unambiguous negative faces (see Table 3).

4. Discussion

In the present study, the relationship between rumination and perception of emotions in facial expressions was examined in a sample of healthy young women. Importantly, none of our participants had suffered from previous episodes of clinical depression. In this way, we ruled out potential effects of scarring, i.e. vulnerability resulting from having experienced previous episodes. Scars in depression could occur in neurobiological, psychosocial, or cognitive domains (Wichers, Geschwind, van Os, & Peeters, 2010). It has been argued that dysphoric mood states might activate negatively biased interpretations and, in those who experienced clinical depression, these negative cognitive processes more easily exacerbate dysphoric mood and lead to a new

Table 1
Descriptive statistics and correlations between psychometric measures.

	1	2	3	4	5	6	7	8	9
1. BDI-II	<i>.89</i>								
2. BAI	.35***	<i>.91</i>							
3. STAI-T	.76***	.43***	<i>.91</i>						
4. DAS P	.54***	.29**	.61***	<i>.87</i>					
5. DAS A	.35***	.31**	.40***	.41***	<i>.67</i>				
6. RSQ Self	.37***	.20*	.44***	.33**	.29**	<i>.70</i>			
7. RSQ Sym	.50***	.36***	.61***	.44***	.34**	.53***	<i>.66</i>		
8. RSQ Dis	-.28**	-.10	-.35***	-.28**	-.14	-.18	-.26**	<i>.81</i>	
9. MWT-B	-.33**	-.11	-.25*	-.18	-.14	-.05	-.11	.17	–
Mean	6.40	8.26	35.84	39.92	30.54	14.23	15.76	20.39	111.71
SD	6.20	8.59	8.87	12.54	6.03	3.89	3.64	4.92	10.82
Range	0–27	0–51	22–61	20–96	17–47	7–27	8–25	8–30	95–143

Note: N = 100 for all variables. *p < .05; **p < .01; ***p < .001 (two-tailed). Values on the diagonal (in italics) represent Cronbach's α . BDI-II: Beck Depression Inventory; BAI: Beck Anxiety Inventory; STAI-T: State Trait Anxiety Inventory - trait version; DAS P = Dysfunctional Attitude Scale subscale Performance evaluation; DAS A = Dysfunctional Attitude Scale subscale Approval by others; RSQ Self: Response Styles Questionnaire subscale Self-focused rumination; RSQ Sym: Response Styles Questionnaire subscale Symptom-focused rumination; RSQ Dis: Response Styles Questionnaire subscale Distraction; MWT-B: Multiple-choice vocabulary test version B, intelligence test.

Table 2
Correlations of psychometric measures with perception of facial expressions and descriptive statistics of evaluative ratings.

	Negative emotions in		Positive emotions in	
	ambiguous	unambiguous	ambiguous	unambiguous
	faces	negative faces	faces	positive faces
BDI-II	.20	.22*	.06	.04
BAI	.10	.15	.12	.03
STAI-T	.18	.16	.09	.10
DAS P	.03	.10	.11	.14
DAS A	.10	.13	.05	.01
RSQ Self	.13	.09	.14	.05
RSQ Sym	.31**	.29**	.18	.13
RSQ Dis	-.01	.07	.16	-.04
MWT-B	-.15	-.22*	.05	-.01
Mean	2.30	2.93	2.18	4.11
SD	0.41	0.40	0.43	0.74

Note: N = 100 for all variables. *p < .05; **p < .01 (two-tailed). BDI-II: Beck Depression Inventory; BAI: Beck Anxiety Inventory; STAI-T: State Trait Anxiety Inventory - trait version; DAS P = Dysfunctional Attitude Scale subscale Performance evaluation; DAS A = Dysfunctional Attitude Scale subscale Approval by others; RSQ Self: Response Styles Questionnaire subscale Self-focused rumination; RSQ Sym: Response Styles Questionnaire subscale Symptom-focused rumination; RSQ Dis: Response Styles Questionnaire subscale Distraction; MWT-B: Multiple-choice vocabulary test version B, intelligence test.

episode of depression (Borcusa & Iacono, 2007). As could be expected, especially symptom-focused but also self-focused rumination was substantially correlated with depressive symptoms, trait anxiety, and dysfunctional attitudes in our sample.

According to our regression analysis results, symptom-based rumination was found to predict perceived negative emotions in ambiguous faces as well as in unambiguous negative faces. In our analyses, we controlled for current depressive symptoms, state and trait anxiety, intelligence, and dysfunctional attitudes. Previous research based on the Perception of facial expressions task found correlations between perception of negative emotions and current level of depressive symptoms (Bouhuys et al., 1995) and anxiety (Bouhuys et al., 1997). Intelligence was included as a control variable since low intelligence has been found to be a risk factor for the development of mood disorders (Gale et al., 2010). Interestingly, we found that intelligence was negatively correlated with level of depressive symptoms and perception of negative emotions in unambiguous (negative) faces. In this context, it can be hypothesized that more intelligent individuals could be less

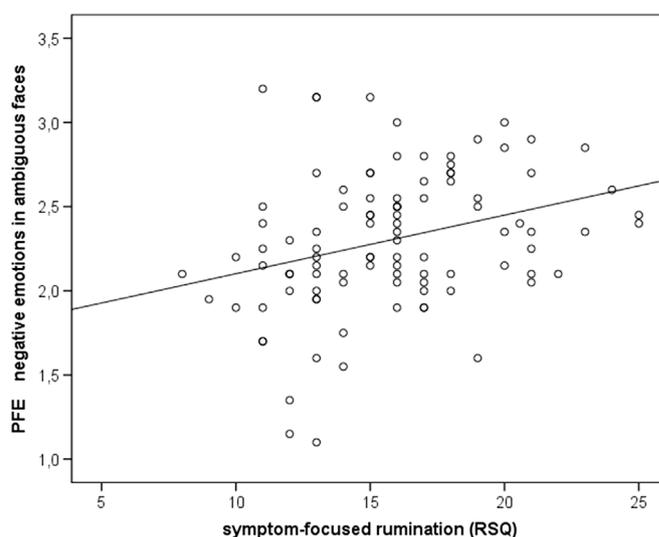


Fig. 2. The scatterplot depicts the positive correlation between symptom-focused rumination as assessed by the RSQ and perceived negative emotions in ambiguous faces (in the Perception of facial expressions task) ($r = 0.31$, $p < .01$).

negatively biased during face perception because they are more analytical and base their judgements of expressions more on objective facial characteristics. It is also possible that more intelligent individuals are less dysphoric and therefore less negatively biased during face perception. Finally, we controlled dysfunctional attitudes because in the study of Raes et al. (2006) dysfunctional attitudes tended to be positively associated with perception of negative emotions in unambiguous faces in clinically depressed patients.

In our study, we obtained evidence confirming the hypothesis that ruminative response style is positively associated with perception of negative emotions in ambiguous and unambiguous negative faces. Our findings are consistent with and expand those of Raes et al. (2006) by showing that ruminative tendencies go along with a negative bias in the perception of others' facial expressions not only in depressed patients but also in non-clinical individuals. Since in our study self-focused rumination was not related to perceived negative emotions in ambiguous or unambiguous negative faces, our results could specify the findings of Raes et al. (2006) who did not distinguish between symptom-focused and self-focused rumination. It appears that repetitive, perseverative thinking about low mood and depressive symptoms biases perception and interpretation of external emotional stimuli more than persistent

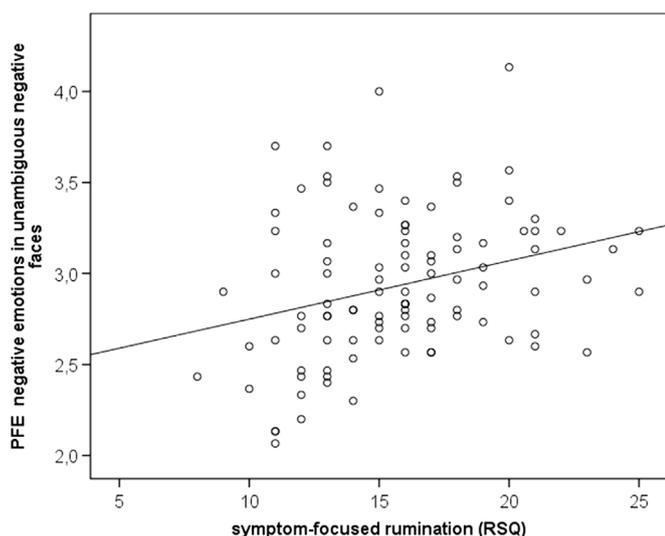


Fig. 3. The scatterplot depicts the positive correlation between symptom-focused rumination as assessed by the RSQ and perceived negative emotions in unambiguous negative faces (in the Perception of facial expressions task) ($r = 0.29, p < .01$).

Table 3

Hierarchical regression analyses with affectivity, intelligence, dysfunctional attitudes, and rumination predicting perception of negative emotions in ambiguous and unambiguous negative faces.

	Negative emotions in ambiguous faces			Negative emotions in unambiguous negative faces		
	β	R ²	ΔR^2	β	R ²	ΔR^2
Step 1		.050	.050		.082	.082
BDI-II	.11			.18		
BAI	.03			.10		
STAI-T	.05			-.07		
MWT-B	-.10			-.17		
Step 2		.065	.015		.085	.003
DAS P	-.16			-.04		
DAS A	.05			.05		
Step 3		.132	.068*		.146	.061*
RSQ Self	-.03			-.07		
RSQ Sym	.35*			.34*		

Note: N = 100 for all variables. * $p < .05$.

BDI-II: Beck Depression Inventory; BAI: Beck Anxiety Inventory; STAI-T: State Trait Anxiety Inventory - trait version; DAS P = Dysfunctional Attitude Scale subscale Performance evaluation; DAS A = Dysfunctional Attitude Scale subscale Approval by others; RSQ Self: Response Styles Questionnaire subscale Self-focused rumination; RSQ Sym: Response Styles Questionnaire subscale Symptom-focused rumination; MWT-B: Multiple-choice vocabulary test version B, intelligence test.

self-analysis and reflection on causes and consequences of depressed mood.

One mechanism by which focusing on depressed mood may negatively bias thinking and perception has already been mentioned by Nolen-Hoeksema (1991): people often use their own negative affect as information when making evaluations of other people or situations (Schwarz & Clore, 1987). When instructed to make evaluative judgments, individuals ask themselves how they feel about an object. If they are in a negative mood state, they may decide that a negative evaluation is appropriate. Moreover, it has been shown that affect is more likely to influence judgment when salient (Greifeneder, Bless, & Pham, 2011). In this context, salience relates to the notion that some pieces of information are more attended to than others. It appears plausible that in individuals ruminating on depressive symptoms the saliency of

negative emotions is enhanced so that during perception pieces of negative information can “stick out” relative to other pieces of information. Thus, rumination on depressed mood could make it more salient and, in this way, increase the reliance on negative feelings during the judgment of facial expressions.

Another explanation for negative biases in depressive rumination has been formulated by Koster, de Lissnyder, Derakshan, and de Raedt (2011). There is evidence that brooding on depressive symptoms is associated with impairments and valence-specific biases in attentional control functions. The authors argued that deficits in attentional control could make it difficult for ruminators to disengage from negative content. Thus, when looking at ambiguous or unambiguously negative facial expressions individuals high in ruminating about depressed mood could be impaired in disengaging their attention from facial characteristics expressing negative emotions (e.g., mouth corners pulled down or oblique eyebrows). Prolonged processing could give negative facial characteristics more weight during face evaluation. The use of eye tracking technology in future studies on rumination and face perception could be helpful to further clarify this assumption. In a recent eye-tracking investigation, non-depressed adults viewed emotional faces. Higher levels of brooding rumination but not of reflective rumination were found to be associated with increased attention to sad faces and less attention to happy faces (Owens & Gibb, 2017). These results support the link between brooding rumination and attentional biases for depression-relevant social stimuli and suggest that these links are not simply due to a state of depression.

In a broader sense, the present study relates to the field of cognitive vulnerability to depression even though we did not collect prospective data on the development of depressive symptoms or onset of clinical depression. We found that even in a non-clinical sample, healthy women without a history of clinical depression, habitual ruminating about depressive symptoms is related to negative interpretation of others' facial expressions. A negative bias in face perception as assessed by the Perception of facial expressions (PFE) task may represent a psychological marker of risk for depressive disorders. It is conceivable that transactional processes among rumination and biased emotion perception could contribute to the onset of depression: high ruminators might perceive more negative emotion in social encounters which feeds back into greater rumination resulting in the development of clinical depression. Negatively biasing social perception could be one way through which rumination renders people vulnerable for depression (cf. Raes et al., 2006). Individuals at risk for depression have been shown to be characterized by a tendency to interpret neutral facial expressions in a negative way (Maniglio et al., 2014). Beevers et al. (2009) pointed out that tendencies to perceive negative emotions in others may impact the persons' ability to effectively interact with social partners. In the long run, the attribution of negative emotions could be experienced by others as annoying and exhausting and might contribute to the erosion of relationships and social support (Joiner, 2002).

Our data provide no evidence that ruminative response is more related to perceived negative emotions in *ambiguous* in comparison with *unambiguous negative* facial expressions. This finding is consistent with the results of Raes et al. (2006) in clinical depression. It has been claimed that ambiguous faces which, by definition, contain conflicting emotional information should be more effective for investigating interpretation biases (Bouhuys et al., 1995; Jusyte & Schönenberg, 2014). Based on our findings, it appears that unambiguous negative and ambiguous facial expressions are equally useful in studying rumination and face perception in clinical and non-clinical samples.

Given the correlational nature of our data, we cannot draw any conclusions about the causal relationship between rumination and biased face processing. We only excluded individuals with a history of major depressive disorder, but future studies may also take the presence of subthreshold depressive episodes into account. Our study included primarily well-educated women as participants, limiting the generalizability of our findings. To further elucidate the relation between

rumination and perception of emotional expressions, it would be useful to examine the effects of experimentally induced rumination and recruit also samples of men and individuals with lower education in future studies. Finally, it must be acknowledged that the administration of schematic faces has been criticized in emotion research because of their lack of ecological validity (Pinkham, Griffin, Baron, Sasson, & Gur, 2010). Thus, generalizability of our findings based on schematic faces to real social interactions may be limited. We propose to use real human facial expressions in future studies on negative bias in face perception.

Ruminative response styles have been identified as substantial predisposing factors in the development of clinical depression (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Symptom-focused rumination appears to represent the more important vulnerability component compared to self-focused rumination. Symptom-focused but not self-focused rumination was found to be predictive of future levels of depressive symptoms in healthy individuals (Huffziger et al., 2009). It has been argued that not all types of rumination might equally contribute to the onset, maintenance or intensification of depressive symptoms (Burwell & Shirk, 2007). Self-focused rumination which includes aspects of analytical thinking and reflection seems to be a more adaptive form of ruminative response compared to rumination focused on the emotional state (i.e., brooding) (Smith & Alloy, 2009). In this context, it is interesting to note that depressive brooding, but not reflective pondering, was correlated to attentional bias for sad faces on a dot-probe task in depressed patients (Joormann, Dkane, & Gotlib, 2006).

The present results support the idea that reducing ruminative thinking in healthy people could be a promising target for preventive intervention that aims to reduce the risk for future onset of depression (Topper, Emmelkamp, & Ehring, 2010). Due to the early onset of depression (Fergusson, Horwood, Ridder, & Beautrais, 2005), preventive interventions should be targeted at adolescence and youth. Topper, Emmelkamp, Watkins, and Ehring (2017) developed a novel prevention program for depression (and anxiety disorders) targeting repetitive negative thinking. Their intervention uses, for example, psycho-education, functional analysis, reflective exercises, and behavioral activation to facilitate a shift from dysfunctional ruminative thinking into a more helpful concrete thinking style. Importantly, it was shown that this prevention program targeting rumination reduced the depression prevalence rates for participants (Topper et al., 2017).

Attentional training programs have been developed to reduce negative biases in individuals who are experiencing depression or who are at risk for the disorder. Modified versions of the dot-probe task based on two facial expressions have been administered to train more positive and/or less negative attentional biases (Hallion & Ruscio, 2011). It has been shown that attentional bias training is effective for adults with mild depressive symptoms (Baert, De Raedt, Schacht, & Koster, 2010) and that attentional biases can be modified in youth at risk for depression and might protect them against maladaptive psychophysiological reactivity to stress (LeMoult, Joormann, Kircanski, & Gotlib, 2016). The facial expressions we encounter in everyday life are frequently ambiguous (Hess, Adams, & Kleck, 2009). Against this background, it should be examined whether attention trainings utilizing ambiguous facial expressions could be a useful complement to traditional attention bias modification programs. In such trainings, individuals (with high familial risk for depression) could learn to disengage their attention from ambiguous facial characteristics expressing negative emotions such as frown lines and to pay more attention to positive facial characteristics such as a smile. Training programs incorporating eye-tracking technology appear to be especially suited to guide gaze behavior and to exercise specific attention processes that are biased in depression (Möbius, Ferrari, van den Bergh, Becker, & Rinck, 2018).

To summarize, the findings of the present study provide evidence that ruminative response style is associated with perceived negative emotions in facial expressions in healthy women, thus extending previous findings in clinical depression. It can be concluded that habitual

ruminating about depressive symptoms in healthy individuals without a history of clinical depression goes along with a negative bias in the perception of others' facial expressions. Negatively biasing social perception might be one mechanism by which symptom-focused rumination could increase vulnerability for depression.

Conflicts of interest

The authors have no conflicts of interest to declare in relation to this article.

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