



Depressive Symptoms and Deficits in Stress-Reactive Negative, Positive, and Within-Emotion-Category Differentiation: A Daily Diary Study

Emily C. Willroth¹, Jayde A.M. Flett², Iris B. Mauss¹

¹University of California, Berkeley

²University of Otago

Abstract

Objective: The present research aimed to better understand deficits in emotion differentiation that accompany depressive symptoms. Depressive symptoms have been associated with more undifferentiated negative emotion experiences—experiencing multiple negative emotions simultaneously. We extend previous research by asking: 1) Are depressive symptoms and negative and positive emotion differentiation related above and beyond emotion intensity? 2) Are deficits in negative emotion differentiation specific to distinct categories of negative emotions (sadness, guilt, anger, and anxiety)? and 3) Do age or gender predict emotion differentiation or its associations with depressive symptoms?

Method: In 220 community participants (59% female; 21–60 years), we assessed depressive symptoms using surveys and emotion differentiation using daily-diary emotion ratings in response to daily stressful events.

Results: Greater depressive symptoms were associated with lower negative, but not positive, emotion differentiation, above and beyond emotion intensity. Depressive symptoms were specifically related to lower differentiation among sadness-related emotions, and this sadness-specific deficit accounted for the deficit in negative emotion differentiation. Age and gender did not predict or moderate associations with emotion differentiation.

Conclusion: Depressive symptoms are associated with undifferentiated negative emotions above and beyond emotion intensity, and this association appears to be driven by undifferentiated sadness-related emotions, across gender and age.

Maladaptive emotion experiences play a central role in depressive symptoms and disorders. For example, depression is characterized by low levels of positive emotions and high levels of negative emotions (Brown, Chorpita, & Barlow, 1998; Heller et al., 2009). However, individual differences in emotion experience are more complex than simply differences in mean levels of emotions. One key individual difference is how differentiated emotional

Correspondence concerning this article should be directed to Emily C. Willroth at ecwillroth@berkeley.edu, Psychology Department, University of California, Berkeley, 2121 Berkeley Way, Berkeley, CA 94720.

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experiences are. Some people report feeling many emotions simultaneously (low emotion differentiation), whereas other people report feeling specific emotions such as sadness without necessarily also feeling angry or ashamed (high emotion differentiation). Previous research has shown that lower negative emotion differentiation is associated with greater depressive symptoms in both clinical and non-clinical samples (e.g., Demiralp et al., 2012; Erbas, Ceulemans, Lee Pe, Koval, & Kuppens, 2014), suggesting that emotion differentiation is a clinically-relevant phenomenon that is also important for understanding variation in well-being in healthy individuals. The present research used daily diaries to assess differentiation among stress-reactive emotions (i.e., emotions in response to stressful events) to better understand the link between depressive symptoms and emotion differentiation.

Depressive Symptoms and Negative and Positive Emotion Differentiation

Why would depressive symptoms and emotion differentiation be related? Depressive symptoms may lead to lower emotion differentiation due to deficits in several inter-related processes that are impaired in depression, such as the ability to recognize and verbalize emotions (Honkalampi, Hintikka, Tanskanen, Lehtonen, & Viinamäki, 2000; Lane, Ahern, Schwartz, & Kaszniak, 1997), propositional knowledge of emotions (Frawley & Smith, 2001), and executive functioning (Snyder, 2013). Alternatively or additionally, low emotion differentiation may lead to or exacerbate depressive symptoms by hindering people's ability to respond to their emotions in appropriate and useful ways. When emotions are experienced with a high degree of specificity, they provide better information about the best course of action to take.

Several studies have directly tested the hypothesis that depressive symptoms are associated with lower emotion differentiation (see Table 1 for study characteristics and a summary of findings). Results from these studies largely support a link between depressive symptoms and lower negative emotion differentiation. For example, patients with major depressive disorder (MDD) had lower negative emotion differentiation in daily life compared to healthy controls (Demiralp et al., 2012). Lower negative emotion differentiation has also been associated with greater symptom severity in MDD patients (Goldston, Gara, & Woolfolk, 1992) as well as in non-clinical samples (Erbas et al., 2014; Plonsker, Gavish Biran, Zvielli, & Bernstein, 2017; Starr, Hershenberg, Li, & Shaw, 2017). In contrast, previous research has not shown support for a link between depressive symptoms and positive emotion differentiation in daily life (Demiralp et al., 2012; Starr et al., 2017).

Depressive Symptoms and Within-Category Emotion Differentiation

Given divergent findings for negative and positive emotion differentiation, the association between depressive symptoms and emotion differentiation cannot be fully explained by broad deficits, but instead appears to be specific to negative emotions. It is possible that emotion differentiation deficits are even more specific. For example, the association between depressive symptoms and emotion differentiation may be specific to emotion categories that are most strongly implicated in depression. For people with greater depressive symptoms,

emotions that are associated with depression (e.g., sadness and guilt; American Psychiatric Association, 2013) may be especially likely to lead to other similar emotions.

We are aware of two previous studies (Erbas et al., 2018; Santorelli et al., 2018) that examined differentiation within emotion categories. Both studies used laboratory measures of emotion differentiation, in which participants rated the similarity of pairs of emotion terms (Santorelli et al., 2018) or reported their emotions in response to standardized laboratory stimuli (Erbas et al., 2018). Santorelli and colleagues (2018) assessed differentiation within low and high arousal negative and positive emotions. Depressive symptoms were associated with less differentiation within all arousal and valence categories (Santorelli et al., 2018). Erbas and colleagues (2018) were the first to examine differentiation within more fine-grained emotion categories, beyond arousal and valence (i.e., sadness-, guilt-, anxiety-, and anger-related emotions). They found that average within-category negative emotion differentiation (i.e., the mean of four within-category emotion differentiation scores computed within four emotion categories) was not associated with depressive symptoms. However, when examining each type of within-category emotion differentiation individually, sadness-related emotion differentiation, but not guilt-, anxiety-, or anger-related emotion differentiation, was marginally associated with depressive symptoms.

Several open questions remain concerning the link between depressive symptoms and within-category emotion differentiation. First, previous research on this question has relied on laboratory measures of emotion differentiation. Thus, it is unclear whether the same associations exist in daily life. Second, although Erbas and colleagues (2018) reported associations between depressive symptoms and average within-category emotion differentiation above and beyond mean emotion intensity, they did not report these results for the individual emotion categories. Thus, it is unknown how depressive symptoms are associated with differentiation within individual emotion categories, above and beyond mean emotion intensity. This is important given that high levels of particular emotions (i.e., sadness- and guilt-related emotions) are symptoms of depression. Moreover, because the association between depressive symptoms and sadness-related emotion differentiation was marginal in Erbas et al. (2018), replication is especially needed. Finally, it is unknown how depressive symptoms are associated with differentiation within emotion categories, above and beyond general emotion differentiation.

The Present Study

The present study used daily diary reports of emotions in response to daily stressful events in a diverse community sample ($N = 220$) to address three aims. The first aim of the present study was to examine associations between depressive symptoms and negative and positive emotion differentiation, above and beyond mean emotion intensity. In line with previous research (e.g., Erbas et al., 2014; Starr et al., 2017), we predicted that depressive symptoms would be associated with lower negative, but not positive, emotion differentiation, and that this association would hold above and beyond mean emotion intensity.

The second aim of the present study was to examine whether the association between depressive symptoms and emotion differentiation is specific to four categories of negative emotions (sadness-, guilt-, anxiety-, and anger-related emotions) and whether differentiation within these categories drives the association between depressive symptoms and negative emotion differentiation. We predicted that depressive symptoms would be associated with sadness- and guilt-related emotion differentiation, but not with differentiation within other emotion categories. Because anxiety symptoms are highly comorbid with depressive symptoms (Hirschfeld, 2001) but anxiety is not a core depressive symptom, we did not make specific predictions about anxiety-related emotion differentiation. Importantly, we predicted that associations between depressive symptoms and sadness- and guilt-related emotion differentiation would hold above and beyond mean intensity of sadness- and guilt-related emotions and above and beyond other types of emotion differentiation. We also tested whether within-category emotion differentiation could account for the link between depressive symptoms and general negative emotion differentiation, however, we did not make a specific prediction.

The third aim of the present study was to test for gender or age links with emotion differentiation and whether gender or age moderates the associations between depressive symptoms and emotion differentiation. Because of a dearth of and inconsistent prior research on these factors, we considered tests of group differences and moderation analyses to be exploratory and did not make specific predictions.

The design of the present study had several key features. First, we assessed differentiation of participants' own emotional responses in daily life using daily diaries (like in Barrett, Gross, Conner, & Benvenuto, 2001). Many previous studies of the link between depressive symptoms and emotion differentiation have used single-timepoint questionnaire measures that asked people to rate the emotions of *other* people (Erbas et al., 2014; Goldston et al., 1992) or to rate the similarity of pairs of emotion terms (Santorelli, Ready, & Mather, 2018). These measures assess differentiation of emotion concepts, but not differentiation of participants' own emotional responses. We chose to assess emotions in response to daily stressful events (stress-reactive emotions) in particular, because of the effects of stress exposure on depressive symptoms (Hammen, 2005).

Second, because mean levels of emotion experience are associated with both depressive symptoms and emotion differentiation, we controlled for mean emotion intensity in all analyses. Third, we assessed a broad range of eleven negative emotions (sad, hopeless, guilty, ashamed, distressed, anxious, nervous, worried, angry, hostile, irritable) and five positive emotions (happy, excited, optimistic, strong, proud) to provide comprehensive measures of emotion differentiation and to allow for examination of emotion differentiation within individual emotion categories (sadness-, guilt-, anxiety-, and anger-related emotions). Fourth, we used a well-powered community sample that was diverse in terms of age and gender. This is important given that the majority of previous studies of the association between depressive symptoms and emotion differentiation in nonclinical populations have used student samples and findings from student samples often do not generalize to the general population (Hanel & Vione, 2016). Taken together, the present study provided a

strong test of the nature of the association between depressive symptoms and emotion differentiation as well as generalizability.

Method

Statistical Power and Sampling Considerations

The present research was part of a larger study on stress and emotions. The sample size was determined based on the minimum sample size ($N = 193$) required to detect small effects ($r_s = .20$ when power is 80%). Power analyses were conducted using the `pwr()` package in R. After exclusions and correcting the alpha level for multiple comparisons ($\alpha = .008$), the final sample ($N = 220$) remained sufficiently powered to detect small associations between depressive symptoms and emotion differentiation and between age and emotion differentiation (r_s and $\beta_s = .23$), small gender differences in emotion differentiation ($d = .34$), and cross-over interactions between age/gender and emotion differentiation (interaction $\beta_s = .23$).

Participants

Participants were recruited from the Denver community. Two-hundred and forty-seven participants completed the diary portion of the study and thus, were eligible for inclusion in the present study. To increase reliability of the emotion differentiation scores, participants who completed fewer than 7 measurement observations were excluded from primary analyses ($N = 27$). Results remained unchanged at every cut-off value greater than 6. The pattern of results is the same for cutoff values of 6 and lower, however, some of the results become statistically non-significant at $\alpha = .008$. The final sample consisted of 220 participants (59.1% female; $M_{\text{age}} = 40.4$, $SD = 11.4$). Participants were 83.6% White, 5.9% multiple races, 3.6% Black or African American, 1.8% Asian, and 0.3% American Indian or Alaskan Native, and 1.8% declined to answer; 12.7% identified as Hispanic/Latinx, 68.6% identified as not Hispanic/Latinx, 11.8% identified as multiple ethnicities, and 6.8% declined to answer. Participants were over-sampled (74.1%) for having experienced a significant stressful life event in the six months preceding the study.

Procedure

Participants completed the study in two phases. First, participants completed an online entrance questionnaire that assessed several aspects of personality and health, including depressive symptoms. Next ($M = 11$ days later, $SD = 26$ days), participants completed 14 consecutive days of daily diaries. On average, participants completed 11.85 out of 14 diaries ($SD = 2.07$).

Participants were instructed to complete one paper diary at the end of each day. Participants were instructed to mail the first week of completed diaries back to the researchers at the end of the first week of data collection and to mail the second week of completed diaries back to the researchers at the end of the second week of data collection using a pre-addressed stamped envelope. To reduce faked compliance, participants were instructed to skip missed diary days rather than complete missed diaries on a later date and participants were not penalized for missing diary days.

Although electronic diaries provide more precise timing control and assurance compared to paper diaries, research suggests data obtained through paper diaries is psychometrically equivalent to data obtained through electronic diaries (Green et al., 2006) and extreme concerns with the validity of data obtained from paper diaries are unwarranted (Conner & Lehman, 2011). Thus, we believe that paper diaries were a suitable alternative to electronic diaries for the present study.

Measures

Depressive symptoms.—We assessed depressive symptoms during the previous one-week period using the Beck Depression Inventory (Beck, Steer, & Brown, 1996), a self-report measure consisting of 21 items. One question pertaining to suicidal thoughts was not included because of institutional review board concerns. Participants rated each item on a scale from 0 to 3, with higher scores indicating greater depressive symptoms.

Stress-reactive emotion differentiation.—In each diary, participants were prompted to think of the most stressful event of the day and to rate “the greatest amount of each emotion you felt during the event” using a 1 (very slightly or not at all) to 5 (extremely) scale. Participants rated eleven negative emotion terms (sad, hopeless, guilty, ashamed, distressed, anxious, nervous, worried, angry, hostile, irritable) and five positive emotion terms (happy, excited, optimistic, strong, proud).

All emotion differentiation variables were calculated using stress-reactive emotions and therefore reflect stress-reactive emotion differentiation. For simplicity, we refer to these stress-reactive emotion differentiation variables simply as “emotion differentiation” throughout. We calculated negative and positive emotion differentiation as the intraclass correlation coefficient (ICC; absolute agreement) of the eleven negative emotion terms and the five positive emotion terms, respectively, across 14 measurement occasions. The ICC provides a measure of the similarity of ratings of multiple emotions across time. We chose ICCs (absolute agreement) for consistency with previous computations of emotion differentiation (e.g., Lindquist, Gendron, Oosterwijk, & Barrett, 2013; Tugade, Fredrickson, & Barrett, 2004) and because it is conceptually consistent with the viewpoint that lack of emotion differentiation involves the inability to distinguish between emotions. ICCs were subtracted from 1 so that higher scores reflect greater emotion differentiation.

Sadness-related emotion differentiation was calculated using the emotion terms sad and hopeless. Guilt-related negative emotion differentiation was calculated using the emotion terms guilty and ashamed. Anxiety-related differentiation was calculated using the emotion terms distressed, anxious, nervous, and worried. Anger-related differentiation was calculated using the emotion terms angry, hostile, and irritable. We calculated all ICCs using the ICC() function in the psych() package in R. We winsorized all emotion differentiation scores by constraining 2.5% of the most extreme scores at each end. This approach allowed us to retain data from all participants without results being unduly affected by statistically extreme scores.

Mean emotion intensity.—We computed mean emotion intensity in two steps. First, we calculated the mean across emotions for each person and each day. Next, we averaged across

these daily means for each person. The procedure yielded mean intensity of negative emotions, positive emotions, and the four negative emotion categories.

Results

To correct for multiple tests, we divided our alpha level by the number of emotion differentiation variables ($\alpha = .05/6 = .008$). Thus, we considered results with p values $< .008$ to be statistically significant.

Descriptive Statistics and Intercorrelations

Descriptive statistics of emotion differentiation variables as well as correlations among emotion differentiation variables and matched emotion intensity variables are shown in Table 2. All emotion differentiation variables were negatively correlated with mean intensity of the corresponding emotions ($-.14 > r > -.35$). That is, people with more intense emotional experiences tended to be lower in emotion differentiation. However, the correlations between positive emotion differentiation and positive emotion intensity ($r = -.15$) and between anxiety-related emotion differentiation and anxiety-related emotion intensity ($r = -.14$) were not statistically significant.

Associations among emotion differentiation variables are shown in Table 2. Negative and positive emotion differentiation were not correlated with one another, $r = .02$. Negative emotion differentiation was moderately correlated with differentiation within all negative emotion categories, $.23 < r < .45$. Differentiation scores within all negative emotion categories were modestly correlated with one another, $.10 < r < .23$.

Are depressive symptoms and negative and positive emotion differentiation related above and beyond mean emotion intensity?

The first aim of the present study was to examine associations between depressive symptoms and negative and positive emotion differentiation, above and beyond mean emotion intensity. Depressive symptoms were significantly associated with lower negative emotion differentiation, $r = -.26, p < .001$. In contrast, depressive symptoms were not associated with positive emotion differentiation, $r = .07, p = .27$. To examine the associations between depressive symptoms and emotion differentiation, above and beyond mean emotion intensity, we entered emotion differentiation and mean emotion intensity into multiple regressions predicting depressive symptoms. Depressive symptoms were associated with significantly lower negative emotion differentiation, $B = -.16, p = .004$, when controlling for mean negative emotion intensity. The association between depressive symptoms and positive emotion differentiation remained not statistically significant when controlling for mean positive emotion intensity, $B = .06, p = .24$.

Are deficits in negative emotion differentiation specific to distinct categories of negative emotions?

The second aim of the present study was to examine whether the association between depressive symptoms and emotion differentiation is specific to four categories of negative emotions (sadness-, guilt-, anxiety-, and anger-related emotions) and whether differentiation

within these categories drives the association between depressive symptoms and negative emotion differentiation. Depressive symptoms were associated with significantly lower differentiation among sadness-related emotions, $r = -.33$, $p < .001$, and this association held when controlling for mean intensity of sadness-related emotions, $\beta = -.23$, $p < .001$. Depressive symptoms were associated with significantly lower differentiation among guilt-related emotions, $r = -.29$, $p < .001$, but this association was not statistically significant at the $\alpha = .008$ level when controlling for mean intensity of guilt-related emotions, $\beta = -.14$, $p = .02$. Depressive symptoms were not significantly associated with differentiation among anxiety-related emotions, $r = .11$, $p = .11$, including when controlling for mean intensity of anxiety-related emotions, $\beta = -.04$, $p = .53$. Depressive symptoms were associated with significantly lower differentiation among anger-related emotions, $r = -.19$, $p = .005$, but this association was not statistically significant when controlling for mean intensity of anger-related emotions, $\beta = -.07$, $p = .30$.

To determine whether individual categories of negative emotion differentiation uniquely contributed to depressive symptoms and whether individual categories of negative emotion differentiation were driving the association between depressive symptoms and general negative emotion differentiation, we also examined unique associations between depressive symptoms and each of the negative emotion differentiation categories in a multiple regression model (see Table 3). We entered general negative emotion differentiation, sadness-related emotion differentiation, guilt-related emotion differentiation, anxiety-related emotion differentiation, anger-related emotion differentiation, and the mean intensity of all negative emotions as predictors in a multiple regression predicting depressive symptoms. There were no issues with multicollinearity, all VIFs < 2 . Only sadness-related emotion differentiation, $\beta = -.19$, $p < .001$, and mean negative emotion intensity, $\beta = .51$, $p < .001$, were unique predictors of depressive symptoms above and beyond the other types of negative emotion differentiation.

A large portion of the variance in general negative emotion differentiation overlaps with the other four emotion differentiation categories, leaving only a small portion of the variance to uniquely explain variance in depressive symptoms. Thus, we followed up with a simpler multiple regression model, excluding all of the nonsignificant emotion differentiation categories. We entered general negative emotion differentiation, sadness-related emotion differentiation, and mean negative emotion intensity into a multiple regression predicting depressive symptoms. Consistent with the larger model, only sadness-related emotion differentiation, $\beta = -.19$, $p < .001$, and mean negative emotion intensity, $\beta = .54$, $p < .001$, but not general negative emotion differentiation, $\beta = -.11$, $p = .04$, were statistically significant predictors of depressive symptoms at the $\alpha = .008$ level. Thus, even when leaving more variance in general negative emotion differentiation available to explain variance in depressive symptoms, only sadness-related emotion differentiation uniquely predicted depressive symptoms.

Different numbers of emotion terms were used to compute the individual within-category emotion differentiation variables. To test whether this affected the results, we recalculated the within-category emotion differentiation variables such that two emotion terms were used for each category: (sadness-related emotions: sad and hopeless; guilt-related emotions:

guilty and ashamed; anxiety-related emotions: anxious and worried; anger-related emotions: angry and irritable). The emotion differentiation scores computed using two emotion terms were highly correlated with their corresponding variables computed using three or four emotion terms, $r_s > .72$. Moreover, all results remained the same using the two-item versions.

Do age (younger and middle adulthood) or gender predict emotion differentiation or its associations with depressive symptoms?

The third aim of the present study was to test for gender or age links with emotion differentiation and whether gender or age moderates the associations between depressive symptoms and emotion differentiation. After controlling for mean emotion intensity, men and women did not significantly differ on any of the emotion differentiation variables, $t_s < 1.68$, $p_s > .09$. After controlling for mean emotion intensity, age was not significantly associated with any of the emotion differentiation variables, $t_s < 1.08$, $p_s > .28$.

To test for moderation by gender, emotion differentiation, dummy-coded gender (men = 0, women = 1), and their interaction were entered into multiple regressions predicting depressive symptoms. To test for moderation by age, emotion differentiation, continuous age, and their interaction were entered into multiple regressions predicting depressive symptoms. Mean emotion intensity was also entered as a covariate. The interaction terms were not statistically significant for any of the types of emotion differentiation at the $\alpha = .008$ level, $t_s < 2.53$, $p_s > .01$. The interaction between age and negative emotion differentiation was marginally significant, such that the negative association between depressive symptoms and negative emotion differentiation became weaker as age increased.

Discussion

Emotion dysfunction is a core feature of depressive symptoms and disorders. Low negative emotion differentiation—the tendency to experience multiple negative emotions together rather than specific negative emotions, such as sadness—is a key type of emotion dysfunction that has been associated with depressive symptoms. In the present study, we examined stress-reactive emotion differentiation in daily life in a sample of 220 community participants. Results from this study address key open questions regarding the links between depressive symptoms and emotion differentiation.

Are depressive symptoms and negative and positive emotion differentiation related above and beyond mean emotion intensity?

The first aim of the present study was to examine associations between depressive symptoms and negative and positive emotion differentiation, above and beyond mean emotion intensity. In line with our hypotheses and with previous research (e.g., Demiralp et al., 2012; Starr et al., 2017), greater depressive symptoms were associated with lower negative, but not positive, emotion differentiation. Correlations among emotion differentiation variables and mean emotion intensity showed that people with more intense emotional experiences tended to be lower in emotion differentiation. This suggests that mean emotion intensity is an important potential confound to control for. When controlling for mean emotion intensity,

the association between greater depressive symptoms and lower negative emotion differentiation held.

Are deficits in negative emotion differentiation specific to distinct categories of negative emotions?

The second aim of the present study was to examine whether the association between depressive symptoms and emotion differentiation is specific to four categories of negative emotions (sadness-, guilt-, anxiety-, and anger-related emotions) and whether differentiation within these categories drives the association between depressive symptoms and negative emotion differentiation. We hypothesized that emotion differentiation within emotion categories most strongly implicated in depression (i.e., sadness- and guilt-related emotions), but not within other emotion categories, would be linked with depressive symptoms. We found partial support for this hypothesis. Specifically, greater depressive symptoms were associated with lower sadness-related emotion differentiation, but not differentiation within any of the other emotion categories, above and beyond mean emotion intensity. Furthermore, sadness-related emotion differentiation fully accounted for the link between greater depressive symptoms and lower negative emotion differentiation.

These findings are consistent with the previous finding that differentiation within sadness-related emotions (but not guilt-, anxiety-, or anger-related emotions) was marginally associated with depressive symptoms (Erbas et al., 2018). The present findings build on this previous study of within-category emotion differentiation in several key ways. First, we examined within-category emotion differentiation in daily life, rather than in the laboratory. Second, we focused specifically on stress-reactive emotions. Third, we examined associations between depressive symptoms and individual types of within-emotion category differentiation, above and beyond mean emotion intensity and above and beyond other types of emotion differentiation. The association between depressive symptoms and sadness-related emotion differentiation observed in the present study ($r = -.33$) was larger than in Erbas et al. (2018) ($r = -.09$). This difference could be driven by our focus on stress-reactive emotion differentiation in daily life compared to emotion differentiation assessed in the laboratory or by differing emotion terms between the two studies (i.e., “sad” and “hopeless” in the present study compared to “sad,” “unhappy,” “depressed,” and “lonely” in Erbas et al., 2018).

It should be noted that previous studies have found associations between depressive symptoms and negative emotion differentiation using emotion terms that only included one sadness-related emotion (Starr et al., 2017; Demiralp et al., 2012). This might at first glance seem at odds with our findings. However, given that general negative emotion differentiation is positively associated with sadness-related emotion differentiation, it is possible that these associations were still driven by sadness-related emotion differentiation, even though it was not measured. Further research is needed that measures both general negative emotion differentiation and sadness-related emotion differentiation to replicate and test the robustness of the present findings.

Do age (younger and middle adulthood) or gender predict emotion differentiation or its associations with depressive symptoms?

The third aim of the present study was to test for gender or age links with emotion differentiation and whether gender or age moderates the associations between depressive symptoms and emotion differentiation. We did not find any evidence for gender or age effects on any type of emotion differentiation or for moderation of the association between depressive symptoms and emotion differentiation by gender or age. We had 80% power to detect small gender differences in emotion differentiation ($d = .34$), small correlations between age and emotion differentiation ($r = .23$), and cross-over interactions between age/gender and emotion differentiation (interaction $\beta_s = .23$).

Little previous research has examined gender differences in emotion differentiation. Relatively more attention has been given to associations between age and emotion differentiation, but the evidence is mixed. Previous research has shown that emotion differentiation from age 5 to 25 follows a curvilinear trajectory and is lowest in adolescence (Nook, Sasse, Lambert, McLaughlin, & Somerville, 2018). Moreover, at least one study did not find an association between depressive symptoms and emotion differentiation in adolescence (Lennarz, Lichtwarck-Aschoff, Timmerman, & Granic, 2018), suggesting that age may be a moderator of the link between depressive symptoms and emotion differentiation. Some previous research has shown that older adults have more differentiated emotional experiences than younger adults (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000) and perceive less similarity among emotions (Santorelli et al., 2018). In contrast, one study found that older compared to younger adults were more likely to experience undifferentiated negative emotions during a film viewing paradigm (Charles, 2005). Considered alongside the present findings, the association between age and emotion differentiation in younger and middle adulthood appears to be null or small and may depend on context.

Theoretical and Clinical Implications

The observed specificity of emotion differentiation deficits to sadness-related emotions has several implications for theoretical models of the associations between depressive symptoms and emotion differentiation. First, these findings suggest that negative emotion differentiation is not a single, uniform construct. Intercorrelations between the four within-category emotion differentiation variables were modest ($.10 < r_s < .23$), and within-category emotion differentiation variables were differentially associated with depressive symptoms. Thus, the association between depressive symptoms and negative emotion differentiation may be more specific than previously believed.

The link between depressive symptoms and sadness-related emotion differentiation is in line with existing models of the link between depressive symptoms and emotion differentiation. One theoretical model suggests that depressive symptoms lead to lower emotion differentiation, due in part to impaired executive functioning and working memory. People with depression have difficulties updating the contents of their working memory due to interference from prior emotions and/or anticipated future emotions (Snyder, 2013). Because these working memory interferences are primarily negative, and sadness in particular is a

core feature of depression, it follows that differentiation among sadness-related emotions would be most affected. A complementary theoretical model posits that lower emotion differentiation leads to greater depressive symptoms, in part due to less adaptive emotion regulation (Barrett et al., 2001). Poor regulation of sadness-related emotions may be particularly likely to lead to depressive symptoms, given that disordered sadness-related emotions are a core symptom of depression. In sum, the specificity of the link between depressive symptoms and sadness-related emotion differentiation is theoretically consistent with the current understanding of why depressive symptoms and emotion differentiation are related. Future research should directly test the role of sadness-related emotion differentiation in these models.

The present findings also have important implications for informing intervention and prevention programs aimed at increasing well-being and decreasing depressive symptoms. Specifically, these findings suggest that emotional targets for such programs should go beyond mean levels of positive and negative emotions. In particular, differentiation of negative, and perhaps especially sadness-related, emotions may be an important target.

Future Directions and Open Questions

A key limitation of the present study was the inclusion of only two sadness-related emotion terms. To better understand the nature of emotion differentiation deficits within individual emotion categories, future research should aim to replicate and extend the present findings using additional emotion categories and more emotion terms. Furthermore, we focused on individual categories of *negative* emotion differentiation in the present study, because of the link between depressive symptoms and general negative emotion differentiation. Future research should examine differentiation within individual categories of positive emotion differentiation (e.g., joy-related emotions, high-arousal positive emotions, low-arousal positive emotions). Although depressive symptoms were not associated with general positive emotion differentiation, it is possible that depressive symptoms are associated with differentiation within individual positive emotion categories.

The present study differed from most previous studies of emotion differentiation in that emotions were assessed in response to stressful events in participants' daily lives. Given the effects of stress exposure on depressive symptoms (Hammen, 2005), stress-reactive emotion differentiation may have particularly important implications for depressive symptoms. Moreover, positive emotion experience during stress has been shown to protect against depressive symptoms (Ong, Bergeman, Bisconti, & Wallace, 2006), suggesting that stress may be an important context for examining associations between depressive symptoms and both positive and negative emotion differentiation. However, some limitations to assessing stress-reactive emotion differentiation warrant discussion. First, effects of positive emotion differentiation may exist in contexts that elicit higher levels of positive emotions. Thus, assessing only stress-reactive emotion differentiation may mask potential effects of positive emotion differentiation. Second, stressful events unfold over a period of time. Thus, low stress-reactive emotion differentiation may reflect transition from one emotion to another during the stressful event, rather than simultaneous experience of multiple emotions. Third,

emotions were reported retrospectively at the end of the day, and thus were subject to recall biases and may have been influenced by diurnal mood variation (Murray, 2007).

Several open questions remain regarding the well-being and clinical implications of the present findings. First, the present study was conducted in a non-clinical community sample. The nature of the associations between depressive symptoms and emotion differentiation in patients with clinical depression may differ. Although the present sample included a wide range of depressive symptoms, the subsample of participants with clinical levels of depression based on BDI cut-off scores (Beck et al., 1996) ($N = 58$) was not large enough to test this question. Second, the present study does not provide evidence for the directional association between depressive symptoms and emotion differentiation. Future studies should use longitudinal and intervention methods to better understand the directionality of this relationship. This is particularly important given that emotion differentiation may be amenable to intervention (Kircanski, Lieberman, & Craske, 2012). Future research should also explore the possibility that differentiation within individual emotion categories may be associated with other clinical symptomatology and disorders. For example, anxiety symptoms may be associated with lower anxiety-differentiation and hypomanic symptoms may be associated with impaired differentiation within individual categories of positive emotions.

Conclusion

Depressive symptoms are associated with the tendency to report feeling all negative emotions simultaneously, rather than feeling specific emotions such as sadness. The present study addressed several key open questions concerning this link. Results showed that the association between depressive symptoms and negative emotion differentiation holds above and beyond mean emotion intensity and is generalizable across men and women and younger and middle adulthood. Furthermore, the association between greater depressive symptoms and lower negative emotion differentiation appears to be specific to and driven by lower differentiation among sadness-related emotions.

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Table 1

Studies of the Association between Depressive Symptoms and Emotion Differentiation

Study	<i>N</i>	Participants (Mean Age, % Female)	Measure of ED	Controlled for Emotion Intensity	Examined Within-Category ED	Summary of Findings
The Present Study	212	Community 41, 57%	Daily diary	Yes	Yes	Negative ED: ↓ Positive ED: ↔
Erbas et al. (2018)	1,074	Students and community 19, 70%	Ratings of standardized stimuli ^b	Yes	Yes	Negative ED: ↓ Positive ED: -
Lennarz et al. (2018)	72	Adolescents 14, 71%	Experience sampling	No	No	Negative ED: ↔ Positive ED: ↔
Santorelli et al. (2018)	83	Students and community 18–92 years old	Similarity ratings of emotion terms ^c	No	No	Negative ED: ↓ Positive ED: ↓
Plonkser et al. (2017)	55	Community 27, 51%	Ratings of standardized stimuli ^b	Yes ^e	No	Negative ED: ↓ Positive ED: -
Starr et al. (2017) Study 1	157	Students 20, 81%	Experience sampling	No ^d	No	Negative ED: ↓ [†] Positive ED: ↔
Starr et al. (2017) Study 2	50	Veterans 57, 12%	Experience sampling	No ^d	No	Negative ED: ↓ Positive ED: ↔
Erbas et al. (2014) Study 2	131	Students 19, 85%	Ratings of other people ^a	No	No	Negative ED: ↓ Positive ED: -
Erbas et al. (2014) Study 3	170	Students 19, 81%	Ratings of standardized stimuli ^b	No	No	Negative ED: ↓ Positive ED: -
Demiralp et al. (2012)	106	MDD patients and controls 28, 70%	Experience sampling	Yes	No	Negative ED: ↓ Positive ED: ↔
Goldston et al. (1992)	25	MDD patients 42, 56%	Ratings of other people ^a	No	No	Negative ED: ↓ Positive ED: -

Note. ED = emotion differentiation.

↓ negative association with depressive symptoms

↔ no association with depressive symptoms

- not assessed.

† marginally significant.

^a Participants rated other people's emotions (e.g., three close friends, their mother).

^b Participants rated their own emotional responses to standardized stimuli.

^c Participants rated the similarity of 16 emotion terms.

^d Mean emotion intensity was not included as a covariate when estimating the association between depressive symptoms and emotion differentiation.

^e Only intensity of the target emotion was included as a covariate.

Table 2
Descriptive Statistics and Correlations (Pearson's r) Among Key Study Variables

	2.	3.	4.	5.	6.	7.	8.	Mean (SD)
1. Depressive Symptoms (BDI)	.07	-.26*	-.33*	-.29*	-.11	-.19*	--	10.98 (9.64)
2. Positive emotion differentiation		.02	.13	.02	.06	.01	-.15 [†]	0.49 (0.44)
3. Negative emotion differentiation			.27*	.23*	.45*	.39*	-.18*	0.46 (0.35)
4. Sadness-related emotion differentiation				.10	.15 [†]	.10	-.19*	0.67 (0.52)
5. Guilt-related emotion differentiation					.12	.19*	-.35*	0.56 (0.46)
6. Anxiety-related emotion differentiation						.23*	-.14 [†]	0.36 (0.30)
7. Anger-related emotion differentiation							-.31*	0.44 (0.40)
8. Matched mean emotion intensity								--

* *Note.* $p < .008$

[†] $p < .05$.

Table 3

Multiple Regression Predicting Depressive Symptoms from the Five Negative Emotion Differentiation Scores and Mean Negative Emotion Intensity

Predicting depressive symptoms fro...	β	t	p
Negative emotion differentiation	-.08	1.27	.21
Sadness-related emotion differentiation *	-.19	3.54	< .001
Guilt-related emotion differentiation †	-.11	2.06	.04
Anxiety-related emotion differentiation	.04	0.69	.49
Anger-related emotion differentiation	-.06	1.13	.26
Mean intensity of all negative emotions *	.51	9.19	< .001

* *Note.* $p < .008$

† $p < .05$. Model $R^2 = .43$.

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