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Negative Emotion Differentiation and Long-Term Physical Health—The Moderating Role of Neuroticism

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Objective: Negative emotion differentiation refers to the ability to make complex distinctions between specific negative emotions. However, little research has examined its associations with long-term physical health and its potential limitations. The present study aims to investigate whether negative emotion differentiation would predict long-term health outcomes and whether neuroticism would moderate this relationship. ***Methods:*** Adult participants (N = 1,010; 433 men, 577 women; M_{age} = 55.53) were studied in the present research. Negative emotion differentiation was computed based on a daily diary procedure, whereas neuroticism was measured using a validated 4-item scale. Physical health was assessed at baseline as well as an average of 7 years later using a combination of subjective (3-item self-report scale) and objective (number of chronic conditions and number of prescription medications) measures. Demographical variables (age, gender, income, education, household size, ethnicity) were controlled for. ***Results:*** Negative emotion differentiation did not uniquely predict later health (β = .02) upon controlling for baseline health and demographical covariates. However, neuroticism significantly moderated this relationship, such that negative emotion differentiation significantly predicted better health (β = .12) an average of 7 years later after accounting for baseline health, but only for those low on neuroticism. ***Conclusion:*** For individuals low on neuroticism, negative emotion differentiation is a beneficial regulatory capacity that has substantial positive associations with later health outcomes. However, these health benefits did not generalize to individuals higher on neuroticism, suggesting that there are limits to the regulatory benefits afforded by negative emotion differentiation. Theoretical and practical implications are discussed.

Keywords: negative emotion differentiation, physical health, neuroticism, emotion regulation

Supplemental materials: http://dx.doi.org/10.1037/hea0000809.supp

Researchers have increasingly recognized the theoretical and practical importance of studying how affective dynamics may influence physical health outcomes (DeSteno, Gross, & Kubzansky, 2013). Whereas early work such as the dynamic model of affect has focused on the dynamics between positive emotions and negative emotions (e.g., Zautra, Smith, Affleck, & Tennen, 2001), researchers have increasingly also recognized the importance of studying whether individuals make distinctions between same-valenced emotional states such as anger and fear or gratitude and pride. Such individual differences have been termed *emotion differentiation* or *emotional granularity* (Smidt & Suvak, 2015), though many unanswered questions remain pertaining to this phenomenon. The present research attempts to address some of the questions pertaining to negative emotion differentiation, specifically in (a) whether it may be related to physical health, as well as (b) whether the benefits of negative emotion differentiation may be bounded by trait neuroticism.

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Early conceptualizations of emotion differentiation have suggested that labeling one's emotions in a discrete and well-differentiated manner would provide complex and nuanced information regarding one's emotional states, thereby promoting effective regulation (Barrett, Gross, Christensen, & Benvenuto, 2001). Although researchers have discussed both the differentiation of positive as well as negative emotions (e.g., Starr, Hershenberg, Li, & Shaw, 2017), negative emotion differentiation is likely to have special relevance to psychosocial outcomes, given that the regulatory costs of negative affect are generally higher (Kashdan, Barrett, & McKnight, 2015). Indeed, research has largely supported associations between negative emotion differentiation and positive outcomes such as emotional well-being, self-esteem, and reduced depressive symptoms (Erbas et al., 2018; Lennarz, Lichtwarck-Aschoff, Timmerman, & Granic, 2018). These lines of research are also consistent with findings linking negative emotion differentiation positively to adaptive psychological processes such as mindfulness (Tong & Keng, 2017), but negatively with maladaptive psychological processes such as those implicated in psychopathology (Demiralp et al., 2012).

However, no research to our knowledge has directly examined associations between negative emotion differentiation and physical health, making this a crucial gap in the empirical literature on how such affective dynamics may be linked to health (DeSteno et al., 2013). Moreover, a major limitation of research on negative emo-

tion differentiation is that it has mostly focused on short-term associations, and many studies have been limited to relatively small undergraduate samples due to logistical difficulties in running daily diary or experience sampling studies. Given the growing centrality of health expenditures to government spending (Keehan et al., 2015) and given the criticality of one's health to general quality of life (Bowling, 1995), we believe that an empirical investigation of how negative emotion differentiation would relate to long-term physical health among a large and more generalizable sample of participants is both timely and practically important.

Generally, the existing evidence suggests the hypothesis that negative emotion differentiation should be linked to long-term health benefits. A recent review suggested that negative emotion differentiation allows detailed emotional representation, such that one's negative emotions would either be effectively downregulated or utilized to facilitate adaptive strivings toward positive behaviors and outcomes (Kashdan et al., 2015). Indeed, there is mounting evidence that negative emotion differentiation enables better control of impulses to express aggression (Pond et al., 2012), to consume alcohol (Kashdan, Ferssizidis, Collins, & Muraven, 2010), as well as to smoke (Sheets, Bujarski, Leventhal, & Ray, 2015). These lines of research imply that negative emotion differentiation should promote adaptive regulatory processes and reduce maladaptive impulses that may be destructive to health. Over time, the use of healthy coping strategies and the effective regulation of negative emotions by differentiating them should accumulate and lead to positive health outcomes (Gross, 2013).

However, researchers have increasingly begun to question whether there may be limits to the benefits of negative emotion differentiation (Kashdan et al., 2015). For example, Smidt and Suvak (2015) suggested that fast and straightforward decision-making may be better facilitated by undifferentiated valence-based emotional representations. More recently, Erbas et al. (2018) also speculated that reduced differentiation may be more efficient for managing highly stressful adversities. Although fine-grained distinctions between negative emotions typically enable healthy coping, it is questionable whether individuals who experience such negative emotions very frequently would still benefit from differentiating these emotions. More specifically, individuals high on trait neuroticism tend to experience substantial as well as frequent negative affectivity (Tackett & Lahey, 2017), and it is not clear whether negative emotion differentiation would still enable positive outcomes even in such cases. In other words, it is theoretically pertinent to question whether neuroticism would moderate the long-term benefits of negative emotion differentiation in predicting physical health.

Given this scenario, two competing hypotheses can be suggested. The first possibility, which we term the *unbounded differentiation hypothesis*, is that traditional perspectives pertaining to negative emotion differentiation would remain valid regardless of trait neuroticism. Thus, despite frequent and intense episodes of negative affectivity, individuals high on neuroticism can nevertheless effectively regulate them by making complex affective distinctions, thereby facilitating healthy coping and long-term outcomes (e.g., Barrett et al., 2001). This perspective is also broadly consistent with findings linking negative emotion differentiation to positive psychosocial and regulatory outcomes (e.g., Kashdan et al., 2010), and it would suggest that negative emotion differentiation is indeed a highly beneficial capacity that promotes adaptive outcomes even for those with high dispositional levels of negative affect. Were this to be the case, one would expect negative emotion differentiation to predict long-term physical health outcomes without significant interactions with neuroticism.

An alternative possibility, which we term the *differentiation threshold hypothesis*, is that negative emotion differentiation may be beneficial only up to a certain threshold of negative affectivity. The first consideration in support of this hypothesis is that individuals high on neuroticism regularly experience many negative emotions (Miller, Vachon, & Lynam, 2009) and have elevated levels of stress (Ebstrup, Eplov, Pisinger, & Jørgensen, 2011). Thus, given the sheer frequency of negative affectivity, simply being able to represent their negative emotions in a complex manner may no longer be sufficient. A second consideration comes from Erbas et al. (2018), who suggested that under stressful conditions, detailed differentiation of negative emotions may be less adaptive than simply processing the valence of the negative emotions. Because individuals with high neuroticism regularly experience many different negative emotions, making detailed appraisal-based distinctions (Erbas, Ceulemans, Koval, & Kuppens, 2015) between all these negative emotions is likely to be overwhelming. In contrast, simply labeling them in a generalized, valence-based manner may ironically enable easier regulation, because simply having one overall negative affect may be less regulatorily taxing than frequently having multiple unique negative emotions.

A third and final consideration comes from findings suggesting that trait-consistent ways of self-regulation may produce unexpectedly positive results. For example, individuals high on neuroticism have been found to actively increase their worry, which paradoxically increased performance on various tasks (Leung et al., 2014; Tamir, 2005), and psychological processes which enact avoidance-related behaviors may produce better regulatory outcomes for individuals high on neuroticism (Robinson, Ode, Wilkowski, & Amodio, 2007). Negative emotion differentiation may thus be fundamentally incompatible with neuroticism because of its tendency to reduce emotional avoidance (Erbas, Ceulemans, Lee Pe, Koval, & Kuppens, 2014), which suggests that negative emotion differentiation may be a trait-inconsistent form of self-regulation that could have limited benefits for individuals high on neuroticism. In sum, this hypothesis implies that negative emotion differentiation would be moderated by trait neuroticism, such that positive long-term associations between negative emotion differentiation and physical health would not be found for individuals high on neuroticism.

Thus, the present study has two primary aims: (a) to test whether long-term associations may be found between negative emotion differentiation and physical health and (b) to test the unbounded differentiation hypothesis against the differentiation threshold hypothesis and determine whether the benefits of negative emotion differentiation would be moderated by trait neuroticism. As these two competing hypotheses have equally strong theoretical foundations, we made no a priori assumptions as to which one is more likely to be supported, and instead we focused on examining which would be empirically supported by our analyses. To accomplish these aims, we examined long-term associations between negative emotion differentiation and subjective as well as objective health outcomes an average of 7 years later, controlling for baseline health to allow a strong test of whether negative emotion differ-

entiation would uniquely explain variance in later health outcomes. Demographical covariates were adjusted for, including age, gender, household income, household size, education level, and ethnicity. In addition, as recent work has emphasized the theoretical importance of distinguishing complex emotion dynamics from mean levels of affect (Dejonckheere et al., 2019), we also controlled for mean levels of negative affect to test the unique predictive contributions of negative emotion differentiation to health outcomes.

Method

Participants

Analyses for the present research were performed on a subset of participants from the Midlife Development in the United States (MIDUS) study, a multiphase longitudinal study which drew from a nationally representative random-digit-dial sample of participants from the United States. Specifically, participants completed the MIDUS2 Daily Stress Project, which consists of a representative subsample of 2,022 participants from the original MIDUS2. The MIDUS2 Daily Stress Project, conducted between 2004 and 2009, used a daily diary procedure in which participants provided information about their daily emotional experiences via phone interviews which were conducted by trained interviewers across eight consecutive days. Overall compliance to the daily diary procedures was high, with a 92% retention rate. Data from the MIDUS2 Main Survey, conducted between 2004 and 2006, was used to provide information about demographical characteristics and baseline variables which were analyzed as covariates. Participants who took part in MIDUS2 Main Survey completed a phone interview, followed by a questionnaire that was sent via mail. In sum, data from MIDUS 2 served as the first time point (T1) for the present analyses. Finally, data from the MIDUS3 Main Survey, conducted between 2013 and 2014, served as the second time point (T2) and provided information on the outcome variables of interest. Similar to MIDUS2, participants completed a phone interview and a mailed questionnaire. The temporal order of the variables is presented in Figure 1. On average, the gap in time between the MIDUS2 Daily Stress Project and the MIDUS3 Main Survey was approximately 7.35 years (SD = 1.25) with a range from between 5 to 10 years. As variables were sampled across three different measurement points, substantial attrition was present, such that complete data was available for 1,010 participants (433 men, 577 women; 939 Whites, 27 African Americans, 17 Native Americans, five Asians, 22 others; M_{age} = 55.53, SD_{age} = 11.20, age range = 34–83 years). Power analyses indicated that the present sample size would enable even small effect sizes to be detected with the conventional alpha of .05 and power of .85. Included participants generally did not differ from the larger sample on the key predictors and outcomes (ps ≥ .20), while differences on several control variables were small in magnitude (rs ≤ .07) and have been controlled for. We report these comparisons in the online supplemental materials.

Measures

Negative emotion differentiation. Across eight consecutive days during the daily diary procedure, participants were asked to indicate how much of the time during each day they felt various

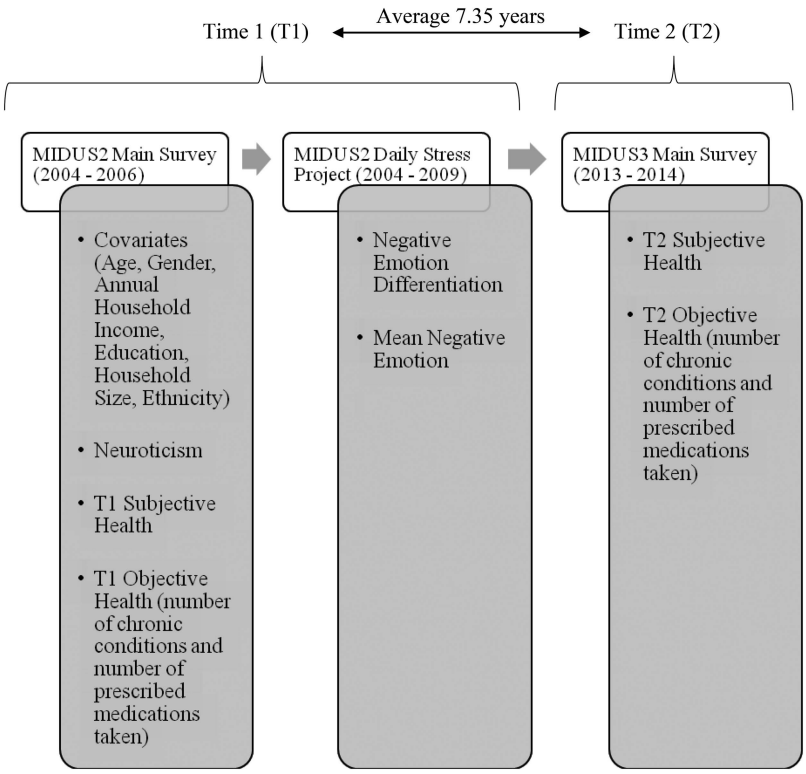

Figure 1. The temporal order of all variables.

state negative emotions ("so sad no one could cheer you up," "nervous," "restless," "everything was an effort," "hopeless," "worthless," "lonely," "afraid," "jittery," "irritable," "ashamed," "upset," "angry," and "frustrated") on a 5-point Likert scale from 0 (*none of the time*) to 4 (*all of the time*). Negative emotion differentiation was computed using the average intraclass correlation (ICC) of the 14 items for each participant across the eight days. In line with past research, negative values of the ICC are not interpretable and were hence treated as missing values (Erbas et al., 2018). In addition, the computed ICC was transformed using Fisher's Z-transformation and reverse-coded using a multiplication factor of −1 to facilitate more straightforward interpretations, such that higher scores represented better differentiation. This procedure for computing emotion differentiation is widely used in past work (e.g., Pond et al., 2012), and the average level of negative emotion differentiation in this study ($M = 0.54$, $SD = 0.27$) is also similar to those reported in past studies. In addition, an overall mean level of negative affect across the 8 days was also computed by averaging overall negative affect for each day across the eight days ($\alpha = .88$).

Trait neuroticism. Participants were instructed to indicate how well four items ("moody," "worrying," "nervous," "calm") described them on a 4-point Likert scale from 1 (*not at all*) to 4 (*a lot*) in the MIDUS2 Main Survey (T1). One item was reverse-coded so that higher scores reflected higher neuroticism. The four items were averaged to determine participants' trait neuroticism ($\alpha = .74$). Previous research has provided evidence for the psychometric validity of this scale (Lachman & Weaver, 1997).

Health. Two variables were used to assess subjective and objective levels of health. Given that subjective and objective levels of health correlate positively but only moderately ($r < .50$ at both time points), the two variables allow assessments of distinct aspects of health.

Subjective health. Three items ("How would you rate your health these days?," "Looking ahead ten years into the future, what do you expect your health will be like at that time?," "How would you rate the amount of control you have over your health these days?") were used to assess participants' subjective health on an 11-point Likert scale from 0 (*worst*) to 10 (*best*). The three items were averaged to calculate subjective health in both MIDUS2 Main Survey (used as a baseline measure; $\alpha = .82$) and MIDUS3 Main Survey (used as an outcome measure; $\alpha = .84$). The three items provide assessments of key latent aspects of self-evaluated health, including current health status, expected developments in health, as well as perceived behavioral control over health (Jylhä, 2009). Confirmatory factor analyses provided further evidence that all three items loaded strongly into the latent factor of subjective health (standardized λs $> .60$).

Objective health. Complementing the previous self-reported measure of subjective health, a relatively more objective indicator of participants' health was also obtained using two items. Specifically, participants were given a list of 30 chronic conditions and indicated (1 = *yes*, 0 = *no*) whether they have experienced or been treated for each of these conditions in the past 12 months. Participants also indicated (1 = *yes*, 0 = *no*) whether they have taken 11 prescription medications in the past 30 days. The lists of conditions and medications participants were given are provided in Supplemental Table S1 in the online supplemental materials.[1] At each time point, the total number of diagnosed chronic conditions and the total number of prescription medications were then computed by summing the number of items participants checked from each respective list. Both of these variables have been found to be practically important indicators of objective physical health which have critical downstream implications for individuals (Masnoon, Shakib, Kalisch-Ellett, & Caughey, 2017; Schneider, O'Donnell, & Dean, 2009). The two variables were first standardized to be comparable, and since having more chronic health conditions and taking more medications would indicate poorer health, the two variables were multiplied by −1 so that higher values would reflect better objective health, facilitating more straightforward interpretations. An overall indication of objective health was then calculated by averaging these two items at both T1 (used as a baseline measure; $\alpha = .69$) and T2 (used as an outcome measure; $\alpha = .74$). Confirmatory factor analyses also indicated that the two items loaded strongly into the latent factor of objective health (standardized λs $> .60$).

Covariates. Age, gender (1 = *male*, 0 = *female*), education level (from 1 [*no education or some grade school*] to 12 [*PhD or other comparable qualifications*]), annual household income, household size (excluding the participant), and ethnicity (due to the small number of participants of non-White ethnicities, we dichotomized this variable as 1 = *White*, 0 = *non-White*) were assessed in the MIDUS2 Main Survey and included as demographical covariates. Because of their large numerical values, age and annual household income were standardized prior to analyses to improve the interpretability of the regression coefficients. Because there is substantial variability between participants in the amount of time that passed between the completion of the MIDUS2 Daily Stress Project and the MIDUS3 Main Survey, we also controlled for the number of years between the two measurements for each participant to reduce methodological heterogeneity.

Analyses

We used both observed variable as well as latent variable approaches in the present analyses. Although the use of observed variables to model interactions is more well-established and provides higher-powered tests (Hayes, Montoya, & Rockwood, 2017), the latent variable approach offers other key advantages (e.g., Ledgerwood & Shrout, 2011), such as allowing measurement errors to be accounted for to provide more accurate tests (Kline, 2016). In addition, the latent variable approach allows health to be modeled as a higher-order latent factor comprised of the lower-order latent factors of subjective health and objective health, which enables an overall test of whether the interaction between negative emotion differentiation and neuroticism would predict the underlying latent factor of health.

Specifically, regression analyses were performed to test whether negative emotion differentiation would uniquely explain variance in T2 subjective health as well as T2 objective health after accounting for baseline indicators of health as well as all covariates.

[1] Participants were also asked to indicate whether they had taken birth control pills, but these were excluded from analyses because birth control pills do not appear to have direct relevance to health outcomes. In addition, at Time 2, participants were given 9 additional chronic conditions (e.g., sweating, hair loss, itch) to select from. These were excluded from analyses to ensure standardization in the measures at Time 1 and Time 2. All key findings remained significant even when these were included into analyses.

We then tested regression models including the interaction term between negative emotion differentiation and neuroticism to determine whether the hypothesized moderation was supported. Finally, in the latent variable approach, structural equation modeling was performed to verify these results. Across all analyses, we uniformly applied the same sets of covariates: age, gender, household income, education level, household size, ethnicity, mean negative affect, time difference between MIDUS2 Daily Stress Project and MIDUS3 Main Survey, as well as T1 subjective health and T1 objective health.

Results

Associations Between Negative Emotion Differentiation, Neuroticism, and Health

Descriptive statistics are summarized in Table 1, and intercorrelations between all variables are reported in Supplemental Table S2 in the online supplemental materials. Bivariate correlations indicated that negative emotion differentiation was correlated with better T2 subjective health, $r = .10$, $p = .002$ as well as T2 objective health, $r = .11$, $p = .001$. However, in linear regression analyses adjusting for all covariates as well as baseline indicators of health, negative emotion differentiation was no longer a significant predictor of either T2 subjective health ($b = 0.09$, $SE = 0.10$, $p = .37$, 95% confidence interval [CI] [−0.10, 0.28], $\beta = 0.02$) or T2 objective health ($b = 0.02$, $SE = 0.05$, $p = .69$, 95% CI [−0.08, 0.12], $\beta = 0.01$), thus indicating that negative emotion differentiation did not uniquely explain additional variance in physical health at T2.

Interaction Between Negative Emotion Differentiation and Neuroticism

We next investigated whether negative emotion differentiation would interact with neuroticism in predicting later health outcomes.[2] Negative emotion differentiation and neuroticism were centered prior to computing the interaction term, and these terms were included in the regression equations predicting T2 subjective health and T2 objective health. Controlling for all the aforementioned covariates, the interaction term was significant in predicting both T2 subjective health ($p = .003$) and T2 objective health ($p = .003$).[3] The regression coefficients for each of these analyses are summarized in Table 2. Follow-up analyses of the simple slopes indicated that when neuroticism was 1 *SD* below the mean, there was a significant and positive conditional effect of negative emotion differentiation on T2 subjective health ($b = 0.34$, $SE = 0.13$, $p = .008$, 95% CI [0.09, 0.60], $\beta = 0.10$) as well as T2 objective health ($b = 0.15$, $SE = 0.07$, $p = .022$, 95% CI [0.02, 0.29], $\beta = 0.08$). However, when neuroticism was at mean levels, the conditional effect of negative emotion differentiation was not significant for both T2 subjective health ($b = 0.09$, $SE = 0.10$, $p = .38$, 95% CI [−0.11, 0.28], $\beta = 0.02$) and T2 objective health ($b = 0.02$, $SE = 0.05$, $p = .71$, 95% CI [−0.08, 0.12], $\beta = 0.01$). When neuroticism was 1 *SD* above the mean, the conditional effect of negative emotion differentiation on T1 subjective health ($b = -0.17$, $SE = 0.13$, $p = .18$, 95% CI [−0.43, 0.08], $\beta = -0.05$) and T2 objective health ($b = -0.12$, $SE = 0.07$, $p = .085$, 95% CI [−0.25, 0.02], $\beta = -0.06$) was also nonsignificant.

Latent Variable Structural Equation Modeling

Finally, we verified our findings using structural equation modeling to perform a latent variable interaction. Analyses were performed using the *lavaan* package on *R*. We first specified and tested the measurement model using confirmatory factor analyses. Neuroticism was specified as a latent variable indicated by four items, whereas negative emotion differentiation was indicated by the single item calculated based on the ICC. The latent variable interaction was specified based on recommendations by Marsh, Wen, & Hau (2004), such that four product terms were created using the centered terms for negative emotion differentiation and each of the four items of neuroticism. These four product terms were specified as indicators of the latent variable interaction term between negative emotion differentiation and neuroticism. Subjective health at both T1 and T2 was specified as a latent variable indicated by three items, whereas objective health at both T1 and T2 was specified as a latent variable indicated by the reverse-coded and standardized terms for number of chronic conditions and number of prescription medications. Covariances between the indicators of T1 health and their corresponding indicators at T2 were also specified to account for their shared error variances. Finally, the higher-order latent variable of overall health was specified at both T1 and T2 as being indicated by the latent variables of subjective health and objective health. The results of the confirmatory factor analysis indicated that the measurement model fit the data well, $\chi^2(143) = 234.53$, $p < .001$, comparative fit index (CFI) = 0.99, root mean square error of approximation (RMSEA) = 0.026, standardized root mean residual (SRMR) = 0.031.

Having established model fit for the measurement model, we proceeded to test the overall structural equation model. The higher-order latent factor of T2 health was specified as the key outcome variable. Negative emotion differentiation, neuroticism, and their latent variable interaction term were specified as predictors, controlling for the higher-order latent variable of T1 Health and the observed variables for age, gender, household income, education level, household size, ethnicity, time differences between measurements, and mean negative affect. We addressed missing data using full-information maximum likelihood estimation, which is widely considered the gold standard for handling missing data (Enders & Bandalos, 2001). In addition, we applied bootstrap resampling with 10,000 resamples to obtain more accurate standard errors. Results showed that the structural model fit the data well, $\chi^2(279) = 1098.96$, $p < .001$, CFI = 0.92, RMSEA = 0.045, SRMR = 0.050.

[2] Although the moderator was significantly correlated with the predictor as well as the outcomes, the magnitudes were reasonably modest and no evidence of multicollinearity was present in any analyses (VIFs < 1.5). Given these values and given the large sample size with substantial variability among participants, tests of interactions remain appropriate and statistical artefacts are extremely unlikely.

[3] Given that trait neuroticism has strong theoretical links to trait negative affect (e.g., Miller et al., 2009), we explored the possible conceptual replication of our main analyses using a 14-item measure of trait negative affect in the MIDUS2 Main Survey. Indeed, trait negative affect had the same interaction patterns with negative emotion differentiation in predicting T2 subjective health and T2 objective health ($ps < .01$) after accounting for baselines and other covariates.

Table 1
Descriptive Statistics for All Key Variables

Variable	*M*	*SD*	Range
Negative emotion differentiation	−.54	.27	−.99 to 0
Neuroticism	2.07	.61	1 to 4
T1 subjective health	7.41	1.46	1 to 10
T1 objective health	0	.87	−4.77 to .95
T1 number of chronic conditions	2.38	2.35	0 to 17
T1 number of medicines taken	1.41	1.59	0 to 11
T2 subjective health	7.18	1.57	.33 to 10
T2 objective health	0	.89	−4.21 to 1.12
T2 number of chronic conditions	2.87	2.53	0 to 16
T2 number of medicines taken	2.04	1.84	0 to 9
Age	55.53	11.86	34 to 83
Gender	.43	.50	433 male, 577 female
Ethnicity	.93	.26	939 White, 71 Non-White
Annual household income	73308	58140	0 to 300,000
Household size	.9	.66	0 to 7
Education level	7.53	2.50	1 to 12
Mean negative affect	.19	.20	.01 to 1.68
Time difference between measures	7.35	1.25	5 to 10

Note. Descriptive statistics for negative emotion differentiation are calculated prior to Fisher's Z-transformation. Objective health was calculated by standardizing the number of chronic conditions and the number of medicines taken, reverse-coding these variables, and then averaging them. Hence, in addition to reporting the mean aggregated objective health, we also reported the raw descriptive statistics of the number of chronic conditions and number of medicines taken. Gender was coded as 1 = Male, 0 = Female, whereas ethnicity was coded as 1 = White, 0 = Non-White; the means reported for gender and ethnicity hence represent the average proportion of males and Whites in the sample, respectively.

Results indicated that the latent variable interaction term was statistically significant ($p = .003$). Further analyses of the simple slopes provided converging evidence with those found in the observed variable analyses, such that controlling for baseline health and all other covariates, negative emotion differentiation had a significant and positive conditional effect on T2 health when neuroticism was 1 *SD* below the mean ($b = 0.24$, $SE = 0.09$, $p = .006$, 95% CI [0.08, 0.43], $\beta = 0.12$). However, the conditional effect of negative emotion differentiation on T2 health was nonsignificant when neuroticism was at mean levels ($b = 0.04$, $SE = 0.07$, $p = .57$, 95% CI [−0.09, 0.17], $\beta = 0.02$) or at 1 *SD* above the mean ($b = -0.17$, $SE = 0.10$, $p = .096$, 95% CI [−0.36, 0.03], $\beta = -0.09$). The structural and measurement models are presented in Figure 2, whereas the full path coefficients are summarized in Supplemental Table S3 in the online supplemental materials.

Discussion

Across both observed variable and latent variable analyses, our findings suggest that negative emotion differentiation is associated with long-term physical health outcomes approximately 7 years later even after baseline levels of health were accounted for, but

Table 2
Regression Coefficients Predicting T2 Subjective Health and T2 Objective Health

	T2 subjective health				T2 objective health			
Variable	*b*	*SE*	β	95% CI	*b*	*SE*	β	95% CI
Age	−.18***	.04	−.12	[−.27, −.10]	−.04	.02	−.05	[−.08, .002]
Gender	−.24**	.08	−.08	[−.40, −.08]	.03	.04	.02	[−.05, .12]
Annual household income	.12**	.04	.08	[.04, .20]	.03	.02	.04	[−.01, .08]
Household size	−.09	.06	−.04	[−.21, .02]	<.001	.02	<.001	[−.06, .06]
Education level	.02	.02	.03	[−.01, .05]	.02	.01	.04	[−.001, .03]
Ethnicity	−.07	.15	−.01	[−.37, .22]	.13	.08	.04	[−.02, .29]
Mean negative affect	−.33	.23	−.04	[−.78, .11]	−.21	.12	−.05	[−.44, .02]
Time difference	.01	.03	.01	[−.05, .07]	.01	.02	.02	[−.02, .05]
T1 subjective health	.57***	.03	.53	[.51, .63]	.07***	.02	.12	[.04, .10]
T1 objective health	.11*	.05	.06	[.01, .21]	.62***	.03	.60	[.56, .67]
Negative emotion differentiation (NED)	.09	.10	.02	[−.11, .27]	.02	.05	.01	[−.08, .12]
Neuroticism	−.12	.07	−.05	[−.26, .02]	−.03	.03	−.02	[−.10, .04]
Interaction term of NED × Neuroticism	−.42**	.14	−.07	[−.70, −.15]	−.22**	.07	−.07	[−.36, −.08]

Note. Time Difference denotes the gap in time between participation in MIDUS2 Daily Stress Project and MIDUS3 Main Survey. MIDUS = Midlife Development in the United States.
* $p < .05$. ** $p < .01$. *** $p < .001$.

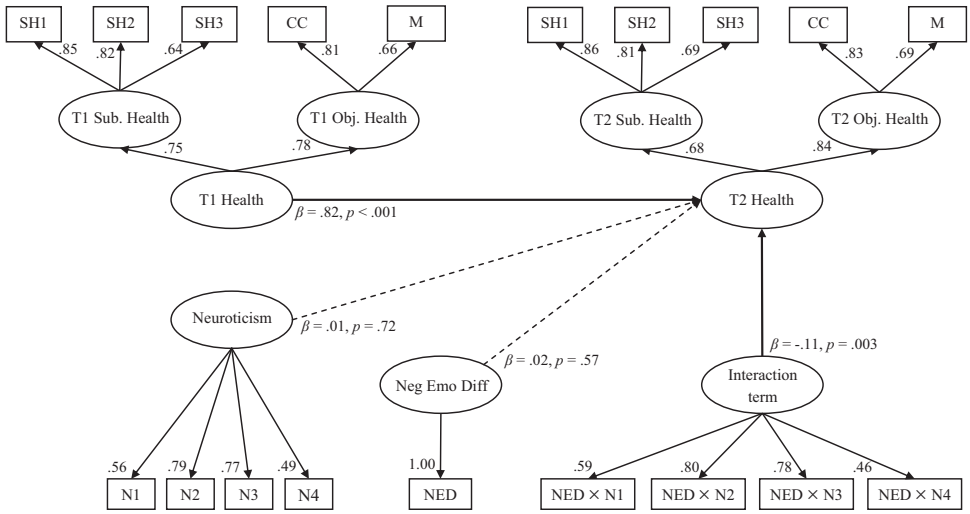

Figure 2. Measurement and path model for structural equation modeling with full-information maximum likelihood estimation and 10,000 bootstrap resamples, $\chi^2(279) = 1098.96$, $p < .001$, comparative fit index = 0.92, root mean square error of approximation = 0.045, standardized root mean residual = 0.050. SH = items for subjective health; CC = number of chronic conditions; M = number of prescription medications; *N* = items for neuroticism; NED = Negative Emotion Differentiation. Age, gender, household income, household size, education level, ethnicity, time difference between measurements and mean negative affect were adjusted for in pathways predicting T2 health. Simple slope analyses of the interaction found that negative emotion differentiation significantly predicted T2 health only when neuroticism was one *SD* below the mean, $b = 0.24$, $SE = 0.09$, $p = .006$, 95% confidence interval [0.08, 0.43], $\beta = 0.12$.

this was the case only for individuals low in neuroticism. Thus, our results support the differentiation threshold hypothesis over the unbounded differentiation hypothesis, which is consistent with the theorizing of several researchers who have suggested that there may be limits to the benefits of negative emotion differentiation (e.g., Kashdan et al., 2015). To the best of our knowledge, our work is the first to empirically investigate the association between negative emotion differentiation and long-term physical health, and this is also one of the first empirical studies to provide evidence that the benefits of negative emotion differentiation may not be universal but may instead be moderated by trait neuroticism.

Earlier conceptualizations and findings regarding negative emotion differentiation have generally focused on the benefits of making nuanced distinctions between different negative emotions. Indeed, for individuals low on neuroticism, being able to differentiate their negative emotions would likely allow them to regulate specific episodes of negative affect more adaptively. For example, when faced with adversities, negative emotion differentiation would allow these individuals to more clearly delineate the specific negative emotions they may be experiencing, which provides in-depth emotional information and enables more effective regulation strategies for managing negative affect (Smidt & Suvak, 2015). In turn, negative emotion differentiation should reduce maladaptive coping behaviors, for example in the form of alcohol use (Emery, Simons, Clarke, & Gaher, 2014), as well as promote adaptive forms of emotion regulation, which should be beneficial for long-term health outcomes (Appleton, Buka, Loucks, Gilman, & Kubzansky, 2013).

However, the above was no longer the case for individuals at mean or higher levels of neuroticism, which suggests that there are limits to the regulatory benefits of negative emotion differentiation. Although most individuals inevitably experience negative affect occasionally, individuals higher on neuroticism are more susceptible to such episodes (Larsen & Ketelaar, 1991). Thus, given the sheer frequency of such negative emotions, negative emotion differentiation may be insufficient for promoting healthy regulatory strategies and long-term health outcomes. However, our findings held despite statistical adjustments for mean levels of state negative affect, which suggests that fundamental aspects of trait neuroticism may also be critical to its moderating role independently of state negative affect. One possibility is that the tendency of neuroticism to induce avoidance (Robinson et al., 2007) makes it fundamentally incompatible with the detailed, appraisal-specific style of processing associated with negative emotion differentiation (Erbas et al., 2015). Thus, as would also be predicted by the trait-consistent self-regulatory perspective (Tamir, 2005), behavioral and psychological properties of neuroticism beyond just heightened negative affect may also play important roles in limiting the benefits of negative emotion differentiation.

Given that researchers, individuals, as well as policymakers have reason to be highly invested in physical health outcomes, the present findings have strong theoretical and practical implications. One key theoretical implication pertaining to the study of complex affective dynamics (Dejonckheere et al., 2019) is that there may be a need to look beyond simple associations and examine dispositional or situational moderators that may influence associations between these dynamics and various outcomes. Practically, our findings suggest that for individuals with lower levels of neuroticism, negative emotion differentiation can have substantial associations with long-term health outcomes about 7 years later even

after accounting for preexisting levels of health. Although the standardized effect size of the simple slope for negative emotion differentiation may prima facie appear small, small effect sizes in time-based designs that rule out baseline levels of the outcome variable are common and often practically meaningful (Adachi & Willoughby, 2015). Indeed, for individuals low on neuroticism, negative emotion differentiation had comparable or larger effect sizes relative to other life variables such as age and income, which have been well-established as practically important predictors of one's health outcomes (e.g., Larrimore, 2011; McCullough & Laurenceau, 2004). Thus, for a significant portion of the population, the association between negative emotion differentiation and later health is likely to be sizable, substantive, and comparable to key demographic variables such as age and income.

However, our findings also caution against a one-size-fits-all approach to negative emotion differentiation for individuals high on neuroticism, which is critical to informing interventions as well as health practitioners. Specifically, empirical research on the efficacy of interventions based on negative emotion differentiation (Kashdan et al., 2015) should include examinations of whether their benefits are uniformly applicable even to individuals high on neuroticism prior to the potentially costly rollout of such interventions to the general population. Health practitioners should also be mindful of trait-consistency when advising patients on emotion regulation strategies that promote negative emotion differentiation such as affective labeling. Although we as well as other researchers have speculated that valence-based regulation may be more adaptive than fine-grained distinctions in cases of high stress or neuroticism, further research is required to test whether specific forms of trait-consistent regulation would be more beneficial for high-neuroticism individuals.

An important question for further study concerns the possible mediational mechanisms by which negative emotion differentiation can be linked to health outcomes for individuals low on neuroticism. Previous work (e.g., Emery et al., 2014) has suggested that adaptive coping behaviors may be one possible pathway. We further speculate that biological aspects of health such as markers of inflammation (e.g., Appleton et al., 2013) or excessive physiological activation (e.g., Brosschot, Gerin, & Thayer, 2006) offer promising mechanisms—for example, individuals low on neuroticism may be less likely to suffer prolonged sympathetic arousal and may also exhibit fewer signs of biological inflammation if they habitually make fine-grained distinctions between their negative emotions. Indeed, a recent study found that differentiating emotions may allow individuals to disrupt maladaptive psychological processes such as ruminative thought patterns (Liu, Gilbert, & Thompson, 2019), which could alleviate biological signs of maladaptive regulation and lead to better health over time. Some researchers have also found that negative emotion differentiation may have state-based fluctuations (Erbas et al., 2018), and a ripe area for further investigation is whether such state-related fluctuations in negative emotion differentiation would be related to state-fluctuations in biological inflammation or cardiovascular arousal.

Several limitations to the present analyses should be noted. One such limitation is that causality cannot be fully determined, given the absence of controlled experimental manipulations. However, because negative emotion differentiation and physical health are both inherently naturalistic constructs, it is difficult to imagine a valid experimental study of their associations. Second, as negative emotion differentiation was not measured at Time 2, lagged analyses to determine bidirectionality were not possible—we see this as a key future direction for further research. Despite these limitations, the use of a large sample of adult participants who were assessed naturalistically permitted high-powered tests with strong ecological validity. Third, daily frequency measures were used to compute emotion differentiation in the present study, whereas intensity measures are more common in previous work (Dejonckheere et al., 2019). Although the present measures still tap on the specificity with which individuals experience different negative emotions on a daily basis, there may be important conceptual differences to the differentiation of emotions based on intensity versus frequency measures. This cannot be examined in the present research and thus remains open to empirical investigation. Finally, external clinical information was not available, which would have allowed even more objective assessments of health. Nevertheless, external assessments of health are not always superior in predicting psychosocial outcomes (Robinski, Strich, Mau, & Girndt, 2016), and the present measures provide convenient sources of valuable health information, especially in large-sample research.

Overall, the present research is the first to demonstrate that negative emotion differentiation can be linked to long-term physical health, but only for individuals low on neuroticism. Thus, our findings advance both theoretical and practical conceptualizations pertaining to negative emotion differentiation and provide one of the first empirical studies supporting speculations that negative emotion differentiation may have its limits. Although it remains the case that negative emotion differentiation can be a highly beneficial regulatory capacity, our findings suggest the need for a more nuanced perspective that acknowledges both the utility and the potential pitfalls of making complex affective distinctions.

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