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Natural Emotion Vocabularies as Windows on Distress and Well-being

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Abstract

To date we know little about natural emotion word repertoires, and whether or how they are associated with emotional functioning. Principles from linguistics suggest that the richness or diversity of individuals' actively used emotion vocabularies may correspond with their typical emotion experiences. The current investigation measures active emotion vocabularies in participant-generated natural speech and examined their relationships to individual differences in mood, personality, and physical and emotional well-being. Study 1 analyzes stream-of-consciousness essays by 1,567 college students. Study 2 analyzes public blogs written by over 35,000 individuals. The studies yield consistent findings that emotion vocabulary richness corresponds broadly with experience. Larger negative emotion vocabularies correlate with more psychological distress and poorer physical health. Larger positive emotion vocabularies correlate with higher well-being and better physical health. Findings support theories linking language use and development with lived experience and may have future clinical implications pending further research.

Keywords: emotion, emotion vocabulary, emotion language, affect labeling, emotion awareness

34 **Natural Emotion Vocabularies as Windows on Distress and Well-being**

35 **Introduction**

36 In today's age of hyper-self-awareness, the ability to name emotions is often celebrated.
37 It is often assumed that people who use rich emotional vocabularies are emotionally and
38 physically healthier than those who express themselves using a narrower range of emotion
39 words. Self-styled emotion experts publish lengthy lists of emotion words to help people
40 articulate feelings as precisely as possible¹⁻⁴. In popular and scholarly press, it is proposed that
41 naming emotions can promote mental and physical health⁵⁻⁷. To capitalize on this effect, readers
42 are advised to "beef up your emotion concepts" and "learn as many new words as possible," to
43 be equipped to categorize difficult emotions when they arise more flexibly and precisely⁵.
44 Mobile applications ensure that the most precise emotion label is only a finger-click away⁸.

45 Despite this interest in naming emotions, we still know little about natural emotion word
46 repertoires, and whether or how natural emotion vocabularies are associated with emotional
47 functioning. Most research on benefits of identifying emotions has measured self-perception of
48 emotional abilities instead of emotion language itself^{9,10}. The studies more concerned with
49 emotion language have relied on passive presentation of experimenter-generated emotion words,
50 capturing constructs other than natural emotion vocabularies. For example, emotional
51 intelligence, the ability to recognize and reason using emotions, is measured using multiple
52 choice formats¹¹. Emotion differentiation, the ability to distinguish same-valenced emotions
53 conceptually, which is correlated with positive mental health, is inferred from the structure of
54 Likert emotion ratings¹². Faster responding on such Likert-type emotion scales is also associated
55 with helpful emotion regulation¹³. And compared to viewing unlabeled images, viewing
56 upsetting images paired with a matching emotion word activates frontal lobe structures that

57 dampen emotional intensity¹⁴. Such studies point compellingly to benefits related to recognizing
58 common emotion concepts and labels, but they have unclear relevance to natural, spontaneous
59 emotion word use in everyday life.

60 Linguistic approaches contribute a useful distinction to the study of emotion language:
61 degrees of verbal knowledge fall into one of two nested domains. An active vocabulary is the set
62 of words an individual produces spontaneously, which constitutes only a subset of one's passive
63 vocabulary, or the full body of words the person can recognize¹⁵⁻¹⁷. Importantly, sizes of active
64 and passive vocabularies are not correlated; passive vocabularies increase through schooling,
65 whereas active vocabularies tend to plateau, suggesting that people re-use the words with which
66 they are most comfortable¹⁶. Studies presenting participants with emotion labels reveal processes
67 involving passive emotion knowledge. However, as others have pointed out^{12,18-20}, to fully
68 understand the role of emotion language in well-being, we must also extend research into active
69 emotion vocabularies.

70 At their most basic level, words are symbols that correspond to concepts and
71 experiences²¹. From this perspective, there should be a broad alignment between active
72 vocabularies and experience. At this stage, we are agnostic about the causality in this
73 relationship, which could be bidirectional. Specifically, active vocabularies could correspond
74 with experiences for at least three, non-mutually-exclusive reasons. First, active vocabularies
75 provide a window into mental habits. According to Zipf's²² principle of least effort, speakers are
76 naturally economical in their use of language, with active vocabularies driven by utility. Like
77 carpenters who keep their most useful tools within arm's reach, speakers use most frequently the
78 words that perform their most common mental operations. This linguistic principle has become a
79 central premise of personality research: active vocabularies can tell us about the concepts people

80 use in their thinking most²²⁻²⁵. By this logic, an individual may simply have developed a wider
81 variety of labels for certain emotions via more frequent experiences of them.

82 Second, active vocabularies may reflect expertise or interest. The psychologist uses a rich
83 vocabulary of psychology words, the sommelier a rich vocabulary of wine words. Lévi-Strauss²⁶
84 famously recorded that indigenous hunter-gatherers in the Philippines easily named over 450
85 plants, 75 birds, and 20 varieties of ants. Lévi-Strauss reasoned that utility alone could not
86 explain such staggering vocabularies, as there would be diminishing practical returns on such
87 fine-grained classifications. Instead, he speculated that interest may have motivated these
88 exceedingly diverse taxonomies. In addition to well-established determinants of vocabulary
89 acquisition and maintenance^{27,28}, we similarly suggest that preoccupation with or interest in
90 one's own affective states could contribute to the development of increasingly diverse affective
91 taxonomies and lexica.

92 Third, it appears that experience can grow into gradual alignment with words. The strong
93 causal view—that language fully determines experience²⁹—has been dismissed³⁰, but subtler
94 versions of this hypothesis are compelling. Dewey³¹ has described the function of words as “a
95 fence, a label, and a vehicle—all in one”³¹, meaning that words not only divide our continuous
96 stream of experiences into discrete units, but also catalog experiences in memory for future use,
97 and conceptually scaffold our interpretations of future events. Several others have articulated
98 similar roles for language in shaping experience (see language-as-context³²; the mangrove
99 effect³³; essence placeholders³⁴). Initial experiments seem to confirm that verbal concepts help
100 construct perceptions of reality, including the experience and interpretation of emotional states⁵,
101 ³⁴⁻³⁷.

102 In the present project, two studies examine the characteristics of active emotion

103 vocabularies and their relationships to individual differences in mood, personality, and physical
104 and emotional well-being. We expect a broad cross-sectional correspondence between words and
105 experience, such that large vocabularies for negative emotions would signal low well-being,
106 while large positive emotion vocabularies would signal high well-being.

107 **Results**

108 **Study 1**

109 Stream-of-consciousness writing, with its unstructured nature, presents an ideal
110 opportunity to investigate linguistic markers of individual differences²⁴. Study 1 investigated
111 emotion vocabularies (EVs) in stream-of-consciousness writings (final N = 1,567) by: (1)
112 identifying basic properties of positive and negative EVs, including their size and test-retest
113 reliability; (2) examining the link between EVs and broad individual differences in demographic
114 characteristics, personality, and physical and emotional health; and (3) examining the
115 relationships between EVs for specific emotion families (i.e., anger, sadness, anxiety/fear,
116 happiness) and the intensity of corresponding state-level moods. Relationships are expressed
117 with standardized errors and 95% bias-corrected and accelerated confidence intervals, generated
118 using 2000 bootstrapped replicates with replacement.

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Overall, 6.11% ($SD = 1.66$) of words used in essays were emotionally toned, based on the positive emotion ($M = 3.62$, $SD = 1.28$) and negative emotion ($M = 2.40$, $SD = 1.15$) categories computed using Linguistic Inquiry and Word Count (LIWC)³⁸. The actual number of unique emotion words was far smaller. Average EV was 0.55 for negative emotions ($SD = 0.36$, range = 0 to 5.71, 95% CI [.53, .57]), and 0.52 for positive emotions ($SD = 0.34$, range = 0 to 3.75, 95% CI [.29, .34]). Based on the EV algorithm, these average rates correspond to approximately one unique positive and one unique negative emotion word per 200 words of text. Test-retest correlations were modest ($r_{NegEV} = .18$, 95% CI [.10, .27], $p < .001$; $r_{PosEV} = .28$, 95% CI [.19, .38], $p < .001$), but in line with previous findings of temporal stability for traits manifested in verbal behavior ($r = .24$)³⁹. Positive and negative EV indices were modestly correlated with each other in a positive direction, suggesting that to some extent they may reflect a unitary tendency toward greater diversity in emotion language (Table 1). As shown in Table 1, negative EV was associated with female gender, while positive EV was not. Neither negative nor positive EV were related to age.

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152 Insert Table 1 about here
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154 Indicating convergent validity, negative and positive EV were related to cognitive
155 processing words (see Table 1). Both positive and negative EV were also associated with general
156 vocabulary, and each index was associated with the corresponding emotional tone. These
157 convergences support our general conceptualization of EV; they are also further relevant to our
158 examination of incremental validity, below.

159 As seen in Table 1, negative EV was generally associated with prevalence of linguistic
160 markers related to poor well-being, namely, lower frequency of *we*-words and leisure words, and
161 higher use of I-words and illness words. Positive EV was generally associated with markers
162 related to positive well-being: high frequency of achievement, affiliation, and leisure words. A
163 few findings were not expected. Positive EV was unexpectedly related to higher mention of
164 physical illness words. Achievement words did not show the expected inverse correlation with
165 negative EV, perhaps because these concerns are common to most students in a university
166 setting.

167 As shown in Table 1, negative EV was related to higher neuroticism and depression and
168 lower overall health. Conversely, positive EV corresponded with indicators of more positive
169 experiences and higher psychosocial functioning: higher extraversion, agreeableness, and overall
170 health, and lower self-reported neuroticism and depression. For scatterplots of key relationships
171 see Supplementary Figure 2. Although not the focus of these analyses, Study 1 data were also
172 used to examine criterion validity of the text-derived indices. Correlations between text-derived
173 and self-reported indicators of well-being, reported in Supplementary Table 2, consistently
174 indicate the associations suggestive of validity (i.e., I-words and illness words with low well-
175 being; *we*-words, affiliation, achievement, and leisure words with high well-being).

176 Given the possibility that EV is partly a product of emotional tone of texts and/or
177 individuals' general verbal ability, the analyses reported in Table 1 were repeated using partial
178 correlations controlling for general vocabulary, negative emotional tone, and positive emotional
179 tone. As indicated in the footnotes to Table 1, many key relationships between emotion EV and
180 psychological variables remained or became significant. EV appears to be capable of explaining
181 unique variance in health and adjustment indices, above and beyond the effects of overall verbal
182 development and emotional tone. Readers interested in an exploration of the interaction between
183 negative and positive EV are directed to Supplementary Note 1.

184 Students used more diverse negative EV when they felt negatively before writing ($r =$
185 $.19$, $SE = .02$, $95\% CI [.14, .24]$, $p < .001$), and larger negative EV was also related to feeling
186 negatively after writing ($r = .21$, $SE = .02$, $95\% CI [.17, .26]$, $p < .001$). Similarly, the positive
187 EV and was related to positive self-reported mood before writing ($r = .19$, $SE = .02$, $95\% CI$
188 $[.14, .23]$, $p < .001$). and after writing ($r = .22$, $SE = .02$, $95\% CI [.18, .27]$, $p < .001$).

189 Emotion-specific EV scores were used to examine the relationship between variability in
190 emotion language with change in corresponding mood states. Sadness vocabularies were used to
191 predict post-writing levels of self-reported sadness, fear vocabularies to predict post-writing
192 worry, anger vocabularies to predict post-writing anger, and undifferentiated negative
193 vocabularies to predict self-reported levels of post-writing stress. To provide a stringent test of
194 the effects of sheer emotion vocabulary size, apart from overall vocabulary richness or the
195 emotionality of the writing, partial correlations controlled for general vocabulary and negative
196 and positive emotional tone. To isolate change in self-reported moods over time, each partial
197 correlation also controlled for pre-writing levels of the target mood. As shown in Table 2, as a

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Insert Table 2 about here

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201 function of variability in specific emotion vocabularies, the corresponding subjective feelings
202 grew stronger over the course of writing, and these subjective mood effects were highly specific
203 to the target mood. People who used more names for sadness grew sadder over the course of the
204 stream of consciousness exercise, but did not grow more worried, angry, or stressed. People who
205 used more names for fear grew more worried, but did not feel sadder, angrier, or more stressed.
206 People who used more names for anger in their writing grew angrier, but actually grew less
207 worried, and reported no change in stress. The people who grew more stressed over the course of
208 the writing exercise were those who used high rates of unique undifferentiated negative words.
209 Positive EV showed a similar correspondence with increases in positive mood.

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211 **Study 2**

212 Study 2 analyzed a large collection of public blogs (final N = 35, 385). Bloggers wrote
213 often over several years, producing text samples spanning an unrestricted range of topics—some
214 personal and emotional, others dry and factual. Relationships in Study 2 are expressed with
215 standardized errors and 95% bias-corrected and accelerated confidence intervals, generated using
216 500 bootstrapped replicates with replacement.

217

218 The average blogger used approximately 6.55 unique negative emotion words and 5.99
219 unique positive emotion words. The negative EV rate averaged 0.29 (SD = 0.21, range = 0 to
220 2.66), and the positive EV rate averaged 0.33 (SD = 0.21, range = 0 to 2.49), or just less than one
221 unique positive and one unique negative emotion word per 300 words of text. To assess EV
222 stability, each blog was split in half, and separate EV statistics were computed for each half.
223 Reliabilities ($r_{\text{NegEV}} = .27$, SE = .01, 95% CI [.26, .29], $p < .001$; $r_{\text{PosEV}} = .28$, SE = .01, 95% CI

224 [.27, .29], $p < .001$) exceeded both the test-retest reliability in Study 1 and rates found previously
225 for psychological linguistic variables³⁹. As in Study 1, positive and negative EV were positively
226 correlated ($r = .22$, $SE = .01$, 95% CI [.20, .23], $p < .001$). Examples of emotion words captured
227 appear in Supplementary Methods.

228 As in Study 1, negative EV was associated with female gender; positive EV was also
229 associated with female gender (see Table 3). Replicating Study 1, negative and positive EV were
230 related to cognitive processing words. Both positive and negative EV were associated with
231 general vocabulary, and each index was associated with the corresponding emotional tone.

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233 Insert Table 3 about here
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235 Negative EV was again associated with linguistic markers of low well-being. As in Study
236 1, negative EV was correlated with higher use of illness and *I*-words, and lower use of *we*- and
237 leisure words. Exceeding effects of Study 1, negative EV was further related to lower rates of
238 achievement words. Results involving positive EV were similar to Study 1. Positive EV was
239 again related to higher rates of achievement, leisure, and affiliation words. Unexpectedly,
240 correlations with illness and *I*-words, which had been positive but nonsignificant in Study 1,
241 were larger and reaching significance in Study 2. For scatterplots of key relationships see
242 Supplementary Figure 2.

243 Almost all relationships between negative emotion EV and psychological variables
244 remained significant after controlling for other factors (and in the same direction), as did several
245 of the relationships involving positive emotion EV. In other words, EV again appeared to be
246 capable of explaining unique variance in health and adjustment indices.

247 Discussion

248 These studies examined whether emotion vocabularies in natural language are associated

249 with psychosocial functioning. Study 1 indicated that EV indices are psychometrically
250 acceptable. Regarding construct validity, EVs were correlated with cognitive processing
251 tendency, general vocabulary, and emotional tone in logically consistent directions. Most
252 markers of well-being were associated with use of sparser negative and more expansive positive
253 EVs. At the state level, using a wider array of emotion words was associated with intensification
254 of the corresponding mood. These effects were strikingly emotion-specific: people with varied
255 vocabularies for sadness grew sadder, people with varied anger vocabularies grew angrier, and
256 so on—even when controlling for pre-writing levels of these specific moods. These effects
257 remained above and beyond effects of potential confounds. It appears that people use larger EVs
258 to describe states they are likely to intensify. However, the student sample and stream-of-
259 consciousness exercise limit generalizability. Although the topic was not constrained, the
260 exercise required some minimal degree of introspection, which could have inflated EVs. Study 2
261 addressed these concerns by analyzing a larger and more heterogeneous sample of natural
262 language.

263 In Study 2, Psychometrics of EVs generally replicated Study 1. Although people used
264 positively valenced words more frequently than negative words, EVs were again slightly larger
265 for negative emotions. Split-half reliability exceeded test-retest reliability found in Study 1,
266 suggesting stability. EVs again correlated with established markers of attention to internal
267 experience (cognitive processing), general vocabulary breadth, and emotional tone, suggesting
268 construct validity. Notably, most people tended to have small EVs, averaging about seven unique
269 emotion words per 1,000 words in their blog entries. This low rate is consistent with the limited
270 nature of active vocabularies relative to other knowledge levels¹⁶. Negative EV was again
271 correlated with virtually all markers of lower adjustment. Bloggers with a larger negative EV

272 used language in ways consistent with people who are depressed, socially and behaviorally
273 withdrawn, and in poorer physical health. Similarly, and even more consistently than in Study 1,
274 negative EV demonstrated incremental validity in predicting well-being indices above and
275 beyond effects of general vocabulary and emotional tone. Relationships of positive EV with
276 well-being indicators were more mixed and only partially replicated Study 1.

277 Across both studies, then, people who used a wider variety of negative emotion words
278 appeared to be faring less well; they used linguistic markers of lower well-being and reported
279 greater depression, neuroticism, and poorer physical health. Conversely, people who used a
280 variety of positive emotion words appeared to be faring well; positive EV was associated with
281 linguistic markers of well-being and, in the student sample, self-reports of higher
282 conscientiousness, extraversion, agreeableness, and overall health, and lower depression and
283 neuroticism. Most relationships could not be attributed to the emotional tone of the texts, nor to
284 the size of individuals' general vocabularies, recommending EV as a unique psychological
285 marker in its own right. The stability of EV indices, acceptable for measures of its kind³⁹,
286 underscores this potential.

287 To interpret these findings, the relationship of EV to mood (Study 1) is instructive.
288 Larger EVs corresponded with state mood and its intensification, suggesting that emotion
289 vocabularies not only provide insight into frequently experienced emotions, but perhaps also
290 indicate a sort of emotional expertise: the tendency to use reflective thought to intensify already-
291 present feeling states. If vocabulary size indicates interest²⁶, larger EVs may further reveal
292 emotional states preoccupying the individual. Future studies incorporating trait preoccupation
293 with moods (e.g., rumination) may be fruitful. EV's correspondence with mood is noteworthy
294 given possible difficulties inferring momentary well-being from emotion word frequencies^{40,41}.

295 The EV approach bypasses this issue by relying not on frequency but rather on the diversity of
296 emotion word categories. Future research could explore whether EVs develop over time in
297 parallel with the frequency of felt experiences, which would help confirm whether EVs serve as
298 observable markers of familiar emotional states.

299 The current pattern of findings suggests that the relative proliferation of emotion words in
300 individuals' active vocabularies may correspond to emotional experiences, but it does not speak
301 to whether EVs were instrumental (helpful or harmful) in bringing emotional experiences about.
302 Even though moods intensified during the stream of consciousness writing (Study 1)
303 corresponding to diversity in emotion word use, the absence of experimental manipulation makes
304 it impossible to conclude that broader EVs *caused* this intensification. At the same time, it is also
305 not possible to rule out such a causal effect. Language facilitates mental processes and subtly
306 alters experience^{31,33}. For instance, verbalizing taste sensations aids later memory retrieval⁴²,
307 suggesting words may sustain fleeting subjective states. Emotion labels, in particular, may
308 influence which emotions individuals perceive in others and experience themselves^{32,34,36,43}.
309 Future research should investigate experimentally whether the state mood intensification such as
310 we observed could have been constructed in part by more elaborative use of emotion synonyms.
311 If so, this could be interpreted in line with constructivist emotion theories: while finding a
312 precise emotion labels is presumed to aid in emotion regulation because it creates access to
313 relevant emotion knowledge^{5,44}, applying more than one relevant label may be counterproductive
314 for down-regulating negative states, given that the labels may also reify the perception and felt
315 experience of the state being named³⁴.

316 It is tempting to use the current findings to speculate about whether and how broad
317 emotion vocabularies may be psychologically adaptive (i.e., functions causally to increase

318 individuals' well-being). While we believe the current findings are a small part of a larger puzzle
319 on this topic, we caution readers against interpreting current findings strongly in terms of the
320 psychological adaptiveness of large emotion vocabularies. We take as given the existing larger
321 framework, at the intersection of evolutionary psychology and appraisal theories, holding that the
322 existence of language is advantageous because of its ability to segment and categorize
323 experience into cognitively manageable units⁴⁵⁻⁴⁷. Recent discovery of cross-cultural universals
324 in the structure of emotion semantics underscores the species-wide advantageousness of lexical
325 systems containing names for both positive and negative states⁴⁸. That said, evolutionarily
326 advantageous behaviors do not necessarily confer advantage in social-emotional life at individual
327 difference level⁴⁹. A true test of psychological adaptiveness of large emotion vocabularies still
328 requires experimental evidence that this study does not provide.

329 Importantly, our findings are not incompatible with evidence of regulatory neurological
330 effects of labeling vs. not labeling negative states¹⁴. Perhaps unhappy people use larger
331 vocabularies for negative emotions as attempts to down-regulate those states—maybe even
332 somewhat successfully. Negative mood intensified as a function of negative EVs (Study 1);
333 however, mood increases might have been even more pronounced had unhappy individuals not
334 deployed an arsenal of emotion words. The findings presented here are silent on the possible
335 coping function of emotion labels; rather, they complement existing literature by advancing the
336 possibility that EVs serve as trait-like indicators of familiar states. Additionally, note that
337 individual people likely rely on active and passive EV for different purposes in their everyday
338 lives. Passive EVs are likely important for recognizing and interpreting day-to-day social
339 behaviors in the social environment⁵⁰. Active EVs may be more important for decoding one's
340 own mental state and communicating it to oneself and others, to address one's own needs and

341 inform new behavior^{51,52}.

342 Limitations of this study include the use of a one-item question to assess self-reported
343 physical health and the absence of a direct measure of writers' education levels. A possible proxy
344 for education, the general vocabulary index, was correlated with the breadth of emotion
345 vocabularies, especially positive EV. However, many associations between EV and well-being
346 indicators survived the inclusion of general vocabulary size as a covariate. Future replications
347 with nuanced measures of individual differences in both well-being outcomes and intellectual
348 functioning are needed. Our current findings also suggest several new research questions that the
349 present study was not equipped to answer fully. For one, supplemental analyses using
350 complementary text analysis methods suggest that emotion vocabularies may have interesting
351 relationships with more sophisticated topic modeling approaches (Supplementary Note 2,
352 Supplementary Table 4). Relationships between EV and conceptually related traits, such as
353 emotional intelligence, also need to be articulated, as do relationships of EV dimensions to one
354 another. Post hoc moderation analyses were suggestive of a possible buffering effect of rich
355 positive emotion vocabularies, such that they may protect against maladaptive correlates of rich
356 negative emotion vocabularies with depression (Supplementary Note 1). This initial cross-
357 sectional effect requires replication and extension before it can be substantively interpreted.

358 Several features of the EV method require comment. It is important to note that the words
359 captured by the EV index are not applied to mental or emotional life exclusively; for instance,
360 the word "alone" does not always refer to the feeling state. This is a natural feature of word-
361 counting approaches to text analysis. Because words correspond to mental content imperfectly,
362 text-derived signals are necessarily noisy; even robust, meaningful effects are necessarily
363 small⁵³. Given the explicit instruction in the stream-of-consciousness essays to focus on internal

364 experience, it is likelier that words with multiple meanings were used for their emotional
365 meaning more in this sample than in the blogs. As with other word counting approaches, the
366 multiple meanings of words do not invalidate the EV approach, but instead simply constrain the
367 inferences it can support. As argued elsewhere, spontaneously used words should be considered
368 not explicit, but rather semi-implicit indices of thematic content, concerns, and frequent mental
369 operations^{54,55}. Moreover, the reliability of inferences from such data is proportional to sample
370 size—this approach is best suited to revealing sample-wide patterns; inferences about any
371 individual or small group should be treated with skepticism. See Supplementary Note 3 for
372 additional nuance regarding the negligible impact of imbalance and length in EV word lists.

373 Future longitudinal research can ultimately determine whether and how changes in
374 emotion vocabularies and changes in well-being are related. Intensive multilevel studies of
375 emotion language are needed that would be capable of unpacking the complex relationship of
376 emotion words to moods at contrasting temporal resolutions. Perhaps rich vocabularies for
377 negative emotions are co-activated during distressed states so as to appear correlated in the short
378 term, while in the long term these rich vocabularies could nevertheless be helpful. Future large-
379 scale studies could further characterize the relationship of EVs to clinical presentations and
380 changes in clinical functioning over time. Given the distinct conceptual viewpoints afforded by
381 different measures, it would be interesting to include in such studies other measures related to
382 emotion awareness, including traits⁵⁶, emotional abilities^{11,57}, and passive emotion word
383 knowledge and recognition^{12,13,44}. Understanding patterning of EV development within a multi-
384 method, multivariate context will be essential to improve theoretical models of emotion language
385 and support emerging emotion labeling-based interventions. To complement these observational
386 methods for emotion language research, there is also a clear need for experimental manipulations

387 of EV and other aspects of naturalistic, active emotion language generation. For example, a
388 recent experimental manipulation of emotion labeling suggests preliminarily that leading
389 individuals to generate excessive numbers of emotion labels in the context of a simulated stressor
390 could undermine problem solving and emotion regulation efforts²⁰. Many more experiments are
391 needed before we can answer causal questions on the effects of emotion language on emotion
392 experience and psychological adaptation.

393 At this juncture clinical application of the present methods and present findings is
394 premature. Assessments of EV could potentially merit consideration as the basis for a future tool
395 for planning treatment and predicting patient responses to affect labeling and other emotion-
396 focused interventions. However, given the current method's more appropriate use for describing
397 sample-wide patterns, the use of EV for diagnostic and intervention purposes would require
398 further validation. While cross-sectional, our findings would be consistent with the possibility
399 that distressed people may not need to increase vocabulary size, per se, for articulating their
400 unhappiness—their negative EVs appear larger already. Perhaps other features of emotion
401 language, or coordinated habits or skills, are needed instead of—or in addition to—emotion
402 language diversity. Instead of or in addition to EVs, psychological effects of emotion language
403 may hinge on several other factors, including perhaps: context-specificity/precision of emotion
404 language selections^{18,44}, deep conceptual emotion knowledge³⁴, cognitive efficiency of emotion
405 naming processes^{13,20}, and/or accompanying mental stance (e.g., nonreactiveness⁵⁸;
406 nonjudgmentalness⁵⁹; perceived clarity of emotions and/or ambiguity tolerance^{10,60}). Because
407 words may help construct experience³⁴, we cautiously speculate, based on our positive EV
408 findings, that positive EV may be an especially fruitful target for mechanistic and applied study.

409 Overall, the current project highlights the potential value of big data in the multi-method

410 study of emotion language, because it can reveal broad patterning of naturally-occurring social
411 and clinical processes. Large data sets make visible relatively small effects that are difficult to
412 capture in lab samples. Our initial replication suggests that we are detecting small, but reliable,
413 phenomena at the intersection of emotion vocabularies, distress, and well-being. This project
414 also offers up a computerized tool for the quantification of active emotion vocabularies in
415 participant-generated natural speech/text, which can aid the efficiency and generalizability of
416 future efforts to understand the link between active emotion vocabularies and experience.

417 **Methods**

418 **Study 1**

419 **Participants and procedure.** Undergraduates enrolled in a large online introductory
420 psychology class completed identical writing assignments in mid-September (Time 1) and, for
421 test-retest reliability analysis, again in early December (Time 2). Most essays met criteria for
422 inclusion: of the 1,579 students who wrote the first essay, 1,567 produced analyzable texts (i.e.,
423 at least 100 words; at least 70% of words identifiable by the default LIWC³⁸ lexicon); 1,360 of
424 those produced analyzable essays at Time 2. Given the novelty of our research question, effect
425 sizes were not available a priori for a power analysis. However, this sample size is sufficient to
426 detect even very small-to-moderate correlations with adequate (.80) power. Students completing
427 the Time 1 essay had a mean age of 18.8 (SD = 2.0), and 60.7% identified as female. Time 2
428 essay completers differed from non-completers by sex (females more likely to complete the
429 second essay) and by reporting higher conscientiousness (independent *t*-tests, $p < .01$). The
430 procedure was approved by the Institutional Review Board at the University of Texas at Austin.
431 Informed consent was obtained from all participants at the start of the semester.

432 **Stream of consciousness essays.** Participants recorded their thoughts in writing as they

433 occurred for 20 minutes. Students completed the exercises on personal computers outside of
434 class. The instructions read:

435 During this 20-minute task, your goal is to track your thoughts, perceptions,
436 and feelings as they occur to you. Simply write continuously for the entire time
437 and type out your thoughts, perceptions, and feelings without censoring them.
438 There are no right or wrong things to write. Just track what is going on in your
439 mind for the full 20 minutes.

440
441 When 20 minutes had elapsed, students were given the option to stop or continue writing. Essays
442 averaged 665 words (SD = 241) at Time 1 and 631 words (SD = 254) at Time 2. Sample essays
443 representative of the tone/content of essays and range of EV scores appear in Supplementary
444 Methods.

445 **Emotion Vocabulary (EV).** Linguistic Inquiry and Word Count (LIWC)³⁸ is frequency-
446 based, meaning that it counts the number of occurrences of over 4,500 words and word stems in
447 over 70 categories. However, in its typical application, LIWC would produce the same score for
448 texts containing ten different emotion words as it would for texts repeating the same emotion
449 word ten times. We created an approach that quantifies the size of EVs by counting the rate of
450 unique, or non-repeated, emotion words. By emotion words, we mean words that are used
451 primarily for naming emotional states or feelings (e.g., happy, disheartened, embarrassed), rather
452 than referring to affectively tinged or themed content (e.g., victory, idiotic, fight). While there is
453 disagreement about the number of distinct emotional states⁶¹, this approach is flexible and can be
454 modified to include words of interest to each researcher. For the current project, the words
455 naming positive and negative emotions were identified from the initial set of 406 positive and
456 499 negative affectively tinged words in the LIWC2007 emotion dictionaries. The final list of
457 emotion words included 92 negative emotion and 53 positive emotion words (Supplementary
458 Table 1). Normative data on age-of-acquisition (AoA) drawn from Kuperman and colleagues⁶²

459 show comparable AoA for positive (8.21yrs, SD=2.63) and negative words (8.9yrs, SD=2.79;
460 Supplementary Table 3). Note that the length and balance of final word lists can be expected to
461 impact results negligibly, thanks to properties of count-based text analyses (Supplementary Note
462 3). By unique and non-repeated, we mean that the emotion vocabulary approach is concerned
463 with the diversity—not frequency, quality, or other dimension—of emotion word use.
464 Importantly, various inflections of the same word (e.g., sad, sadness, sadly) were counted as the
465 same emotion word.

466 To eliminate the confounding effect of text length, all EV scores controlled for word
467 count using the following formula:

$$Emotion\ Vocabulary\ (EV) = \left(\frac{\# \text{ unique emotion words}}{\text{total word count}} \right) \times 100$$

468
469 Thus, EV scores represent the number of unique emotion words as a percentage rate of total
470 word count. For example, the text, “he was so angry at me, but sadly there was nothing I could
471 do” would receive an EV score of $2/14 \times 100$, or 14.29. Scores were computed separately for
472 negative and positive emotion words (in the numerator position). To anticipate more fine-grained
473 questions related to state mood, EV rates were also computed separately for names of sadness-
474 related emotions (e.g., disappointed, bitter, hopeless), anxiety- or fear-related emotions (e.g.,
475 nervous, afraid, alarmed), and anger-related emotions (e.g., mad, furious, aggravated). To
476 correspond to state mood ratings for a stressed mood, which is generally considered an
477 undifferentiated negative emotional state, the EV rate was also computed for general, negatively
478 valenced words that could easily refer to an affective state (e.g., awful, terrible, bad).
479 We have developed a free, open-source software program called Vocabulate, which
480 automatically performs the text processing method described here. The software itself and

481 dictionary file from the Supplemental Online Materials are available at <https://osf.io/8ckyp/>. This
482 open source repository also contains the data supporting the findings of both studies reported in
483 this manuscript.

484 **Individual difference indicators—text-derived.** Several other language markers were
485 computed in order to better understand the EV construct. The first of these was computed using
486 our open-source software for computing EV (Vocabulate; see Code Availability). The rest were
487 computed using LIWC, which counts words in approximately 80 categories that have been
488 extensively validated in psychological research²⁵. Categories are grammatical (e.g. articles,
489 pronouns), thematic (e.g., social, religion), and psychological (e.g. positive and negative affect
490 words). LIWC produces scores reflecting the presence of words in each category as a percentage
491 of each individual's total word count.

492 **General vocabulary size (via Vocabulate).** Emotion vocabulary size might be an artifact
493 of general verbal ability or educational background. To address this possibility, we estimated
494 each writer's general vocabulary size, which is a commonly used proxy for education level⁶³, as
495 a type/token ratio (TTR). In calculating TTR, the number of unique words (types) is divided by
496 the number of total words (tokens) used in the text. Like EV, TTR is expressed as a percentage,
497 with higher values representing higher diversity in vocabulary. In this context, a unique word
498 refers to any word that appears at least once in a given text. For example, the exclamation "A
499 horse! A horse! My Kingdom for a horse!" contains 5 unique words out of 9 total words (a,
500 horse, my, kingdom, for). In order to capture the most relevant index of general vocabulary, only
501 open-class, or content, words were counted (i.e., excluding function words such as pronouns,
502 prepositions, articles, and other short and common words which are used frequently but are not
503 clearly linked with verbal ability). To avoid redundancy, all emotion words used to compute EV

504 were excluded. The average TTR for general vocabularies was 71.01, ($SD = 7.25$; range = 30.73
505 to 96.38).

506 ***Cognitive processing (via LIWC).*** Given that people may develop more expansive
507 vocabularies to describe topics they find interesting, EV size was expected to converge with the
508 tendency to reflect on internal experience. The LIWC cognitive process index, which captures
509 the frequency of words such as think, question, and because. This index is believed to indicate
510 individuals' efforts to analyze or mentally organize experience⁶⁴.

511 ***Emotional tone (via LIWC).*** One would assume that negative emotion vocabulary size
512 might be highly correlated with the overall emotional tone of the text. To explore this possibility,
513 negative and positive emotional tone was calculated for all texts using the LIWC negemo and
514 posemo variables, which have been demonstrated in many studies to accurately reflect affective
515 traits and states^{65,66}.

516 ***Language diagnostic of well-being (via LIWC).*** LIWC includes several non-emotion
517 language dimensions that have been related to mental and physical health²⁵. The category health
518 includes 294 health-related words (e.g., clinic, flu, pill). People who use more words in this
519 category tend to report being less healthy than people who do not. Several studies have found
520 that the use of first-person singular pronouns, or I-words, is correlated with depression, physical
521 illness, anxiety, and even suicide⁵⁴. Conversely, consistent with the social support literature, the
522 more people use words suggesting engagement with others, such as first-person plural, or we-
523 words, the fewer health problems they report^{24,25}. Additionally, words related to affiliation (e.g.,
524 ally, friend, social), achievement (e.g., win, success, better), and leisure (e.g., cook, chat, movie)
525 were presumed to be related to higher psychosocial adjustment.

526 **Individual difference indicators—self-reported.** Self-report measures administered

527 over the course of the semester were used to examine the individual differences associated with
528 EV and confirm the utility of linguistic proxies for well-being.

529 **Personality.** Students completed the 44-item Five Factor Inventory (FFI)⁶⁷ midway
530 through the semester. The five factors include extraversion, neuroticism, agreeableness,
531 conscientiousness, and openness. For the current sample, the internal reliability was good (α
532 range from .78 for conscientiousness to .85 for extraversion).

533 **Physical health.** During the second week of the semester, participants responded to the
534 question, "Overall, how would you rate your health?" Responses ranged from 1 (poor) to 5
535 (excellent). The mean response was 3.69 (SD = 0.84).

536 **Emotional health.** Three weeks before the semester ended and the Time 2 essay was
537 completed, students completed the short form of the Center for Epidemiological Studies
538 Depression Scale, which was developed for use in the general population (CESD-10)⁶⁸.
539 Participants rate the frequency with which they experienced 10 depression symptoms in past
540 week on a scale ranging from 0 (rarely or none of the time/less than 1 day) to 3 (most or all of
541 the time/5-7 days). In our sample internal consistency was good ($\alpha = 0.85$). The mean depression
542 score was 10.00 (SD = 5.91).

543 **State-level mood ratings.** Immediately before and after the 20-minute writing exercise,
544 students rated how much they felt four negative moods (sad, worried, angry, stressed) and four
545 positive moods (happy, enthusiastic, optimistic, calm) on a Likert scale ranging from 1 (not at
546 all) to 5 (a great deal). Ratings of the same valence were averaged to create negative and positive
547 mood scores at both pre- and post-writing with acceptable-to-good internal consistency (α .75 to
548 .83).

549 **Study 2**

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741

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755

Author Contributions

756 V.V. and J.W.P. developed the concept and approach for these studies using archival data
757 collected by J.W.P. V.V., R.L.B., and J.W.P. developed the emotion vocabulary dictionary.
758 R.L.B. parsed text samples to generate linguistic data, and V.V. conducted statistical analyses.
759 V.V. drafted the manuscript, with critical revisions provided by R.L.B. and J.W.P.

760

Conflict of Interest Statement

761 The text analysis program LIWC is a commercial product co-owned by J.W.P. Proceeds
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764 Table 1

765 *Pearson and Partial Correlations of Emotion Vocabulary (EV) with Other Study Variables for*
766 *Study 1 (N = 1,567 unless marked otherwise)*

	Pearson Correlations with Negative EV	Partial Correlations with Negative EV	Pearson Correlations with Positive EV	Partial Correlations with Positive EV
Negative EV	--	--	--	--
Positive EV	.16 (.06)***	.18 (.04)***	--	--
Demographic variables				
Age	-.02 (.02)	-.05 (.03) [±]	-.06 (.02)*	-.04 (.02)
Gender ^a	.20 (.02)***	.15 (.03)***	-.00 (.03)	.06 (.03)*
Individual differences—text-derived				
Cognitive processing	.08 (.03)**	--	-.07 (.03)**	--
Negative emotional tone	.61 (.04)***	--	.01 (.06)	--
Positive emotional tone	-.03 (.04)	--	.50 (.03)***	--
General vocabulary size	.11 (.04)***	--	.21 (.03)***	--
Illness words	.11 (.05)***	.01 (.03)	.06 (.04)*	.06 (.03)*
I-words	.25 (.06)***	.23 (.04)***	.05 (.04) [±]	.10 (.04)***
We-words	-.11 (.02)***	-.06 (.02)*	-.05 (.02)*	-.06 (.03)*
Affiliation words	.05 (.03) [±]	.09 (.03)***	.14 (.04)***	.06 (.03)*
Achievement words	.06 (.06)*	.04 (.04) [±]	.11 (.04)***	.00 (.03)
Leisure words	-.07 (.06)**	-.02 (.04)	.20 (.06)***	.08 (.05)**
Individual differences—self-reported				
Openness ^b	-.03 (.03)	-.02 (.03)	.04 (.03)	.01 (.03)
Conscientiousness ^b	-.01 (.03)	.06 (.03)*	.06 (.03)*	.07 (.03)*
Extraversion ^b	-.04 (.03)	-.03 (.03)	.06 (.03)*	.03 (.03)
Agreeableness ^b	.01 (.03)	.05 (.03) [±]	.09 (.03)**	.06 (.03) [±]
Neuroticism ^b	.17 (.03)***	.08 (.03)**	-.09 (.03)**	-.02 (.03)
Depression symptoms ^c	.11 (.03)***	-.01 (.03)	-.07 (.03)*	-.01 (.03)
Overall health ^d	-.13 (.03)***	-.05 (.03) [±]	.06 (.03)*	.05 (.03)

767 *Note.* Partial correlations control for general vocabulary, negative, and positive emotional tone.
768 All tests are two-tailed. Coefficients are expressed as *r* (SE). For 95% confidence intervals and
769 exact significance values, see Supplementary Table 5.770 ****p* < .001, ** *p* < .01, **p* < .05. [±] *p* < .10771 ^a Coded 0 = male, 1 = female.772 ^b *n* = 1,341 participants based on available data.773 ^c *n* = 1,256 participants based on available data.774 ^d *n* = 1,545 participants based on available data.

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779 Table 2

780

781 *Partial Correlations between Emotion Vocabulary (EV) for Distinct Emotion Types and Changes*
782 *in Self-Rated Moods in Study 1 (N = 1,546)*

Emotion Vocabulary	Sadness mood change	Worry mood change	Anger mood change	Stressed mood change	Positive mood change
Sadness	.09 (.03)***	.02 (.03)	-.08 (.02)**	.01 (.03)	-.01 (.03)
Fear	-.03 (.02)	.09 (.03)***	-.12 (.02)***	.02 (.03)	.06 (.03)*
Anger	.01 (.03)	.05 (.03) [±]	.10 (.03)***	.05 (.03) [±]	-.10 (.03)***
Undifferentiated negative	.00 (.03)	.06 (.03)*	-.01 (.03)	.09 (.03)**	-.02 (.03)
Positive	-.04 (.02)	.02 (.03)	-.07 (.02)**	-.02 (.03)	.04 (.02) [±]

784 *Note.* Values are partial correlation coefficients between EV indices and post-writing ratings of
785 subjective mood. Each correlation controls for pre-writing levels of the target mood, as well as
786 general vocabulary, and negative and positive emotional tone. Sample size is based on
787 availability of state mood ratings. All tests were two-tailed. Coefficients are expressed as *r* (SE).

788 For 95% confidence intervals and exact significance values, see Supplementary Table 6.

789 *** $p < .001$. ** $p < .01$. * $p < .05$. [±] $p < .10$

790

791

792 Table 3

793 *Pearson Correlations of Emotion Vocabulary (EV) with Other Study Variables for Study 2 (N =*
794 *35,385)*

	Pearson Correlations with Negative EV	Partial Correlations with Negative EV	Pearson Correlations with Positive EV	Partial Correlations with Positive EV
Negative EV	--	--	--	--
Positive EV	.22 (.01)***	.12 (.01)***	--	--
Demographic variables				
Age ^a	-.09 (.01)***	.01 (.01)	.05 (.01)***	-.07 (.01)***
Gender ^b	.15 (.01)***	.15 (.01)***	.07 (.01)***	.07 (.01)***
Individual differences—text-derived				
Cognitive processing	.21 (.01)***	--	.08 (.01)***	--
Negative emotional tone	.51 (.01)***	--	-.03 (.01)***	--
Positive emotional tone	.09 (.01)***	--	.35 (.01)***	--
General vocabulary size	.24 (.01)***	--	.46 (.00)***	--
Illness words	.16 (.01)***	.07 (.01)***	.07 (.01)***	.06 (.01)***
I-words	.28 (.01)***	.20 (.01)***	.13 (.01)***	.10 (.01)***
We-words	-.08 (.01)***	.00 (.01)	-.02 (.01)**	.00 (.01)
Affiliation words	-.01 (.01)	.06 (.01)***	.08 (.01)***	.03 (.01)***
Achievement words	-.10 (.01)***	-.07 (.01)***	.06 (.01)***	-.01 (.01)
Leisure words	-.14 (.01)***	-.09 (.01)***	.06 (.01)***	-.05 (.01)***

796 *Note.* Partial correlations control for general vocabulary, negative, and positive emotional tone.797 All tests are two-tailed. Coefficients are expressed as **r** (SE). For 95% confidence intervals and
798 exact significance values, see Supplementary Table 5.799 *** $p < .001$, ** $p < .01$, * $p < .05$. [±] $p < .10$ 800 ^a For analyses involving age, $n = 9,805$ authors' blogs.801 ^b Coded 0=male, 1=female.

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