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The association of language style matching in text messages with mood and anxiety symptoms

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Abstract

Context: Impairment in social functioning is a feature and consequence of depression and anxiety disorders. For example, in depression, anhedonia and negative feelings about the self may impact relationships; in anxiety, fear of negative evaluation may interfere with getting close to others. It is unknown whether social impairment associated with depression and anxiety symptoms is reflected in day-to-day language exchanges with others, such as through reduced language style matching (LSM).

Methods: Over 16 weeks, we collected text message data from 458 adults and evaluated differences in LSM between people with average scores above/below the clinical cutoff for depression, generalized anxiety, and social anxiety in text message conversations. Text message sentiment scores were computed across 73 Linguistic Inquiry and Word Count (LIWC) categories for each participant. T-tests were used to compare LSM across two groups (average scores above/below clinical cutoff) for each of the 3 diagnostic categories (depression, generalized anxiety, social anxiety), and each of the 73 LIWC categories, with correction for multiple comparisons.

Results: We found reduced LSM of function words (namely, prepositions [t=−2.82, p=.032], articles [t=−5.26, p<.001], and auxiliary verbs [t=−2.64, p=.046]) in people with average scores above the clinical cutoff for generalized anxiety, and reduced LSM of prepositions (t=−4.26, p<.001) and articles (t=−3.39, p=.010) in people with average scores above the clinical cutoff for social anxiety. There were no significant differences in LSM of function words between people with average scores above and below the clinical cutoff for depression. Across all symptom categories, elevated affective psychopathology was associated with being more likely to style

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match on formality, including netspeak (generalized anxiety, t=5.77, p<.001; social anxiety, t=4.14, p<.001; depression, t=3.13, p=.021) and informal language (generalized anxiety, t=6.65, p<.001; social anxiety, t=5.14, p>.001; depression, t=3.20, p=.020).We also observed content-specific LSM differences across the three groups.

Conclusions: Reduced LSM of function words among patients reporting elevated anxiety symptoms suggests that anxiety-related psychosocial difficulties may be perceptible in subtle cues from day-to-day language. Conversely, the absence of differences in the LSM of function words among people with average scores above and below the clinical cutoff for depression indicates a potentially distinct mechanism of social impairment.

Implications: Results point to potential markers of psychosocial difficulties in daily conversations, particularly among those experiencing heightened anxiety symptoms. Future studies may consider the degree to which LSM is associated with self-reported psychosocial impairment, with the promise of informing cognitive-behavioral mechanisms and tailoring digital interventions for social skills.

Keywords

personal sensing; depression; anxiety; sentiment analysis

1. Introduction

Depression and anxiety disorders are common psychiatric conditions, with an increasing prevalence and public health burden in recent years [1-3]. Improving our understanding of how depression and anxiety symptoms are reflected in patients' day-to-day interactions may enhance our ability to develop precision treatments.

Both depression and anxiety disorders are associated with social impairments; however, most prior studies on social impairments in depression and anxiety rely on self-report information about relationships. Social relationships are frequently impacted in patients with depression, with social skills deficits representing one manifestation or consequence of depressive symptoms [4]. While researchers have theorized about the mechanisms of social deficits in depression (e.g., reduced eye contact and muted facial expressions; response latency) [5], examining the everyday language of people experiencing depressive symptoms may provide greater specificity about the nature of disruptions in relationships related to depression.

Similarly, social relationships are impaired across anxiety disorders. Patients with generalized anxiety are 2.5 times more likely to report social difficulties [6], which research indicates may be due to anxiety-related interpersonal styles (e.g., being overly accommodating, self-sacrificing, and seeking reassurance; lacking assertiveness) [7,8]. According to the cognitive model of social anxiety, patients experience a core fear of negative evaluation by others [9], which influences social behavior (e.g., by interfering with a patient being vulnerable with others, thereby precluding the formation of a close social bond) in such a way that social impairment is a common functional outcome despite a desire for social connection [10,11]. However, as with depressive symptoms, few studies on social

interaction associated with anxiety symptoms have considered *in-vivo* measures of social dynamics.

Given the evidence for social issues in depression and anxiety, an important but unanswered question is whether social impairment can be reflected in the day-to-day language exchanges of people experiencing elevated affective symptoms. One way in which symptoms of affective psychopathologies may present is by moderating the degree to which individuals mirror the language of others, aligning with evidence that suggests that social behavior may differ when people are experiencing affective conditions [5].

Linguistic mirroring can be captured with estimates of language style matching (LSM), which measures the subtle similarity of dyadic language use across different language categories [12]. Prior literature has focused specifically on LSM of function words such as articles and pronouns, since the mirroring of function words is thought to reflect shared social knowledge in a context-independent manner [13]. While reduced LSM of function words is associated with negative interpersonal outcomes (e.g., less success in romantic relationships) [12], no study to date has examined whether the presence of depression and anxiety symptoms is linked with differences in LSM, which could elucidate one potential mechanism of social difficulties in these disorders.

Text messages constitute an ideal medium through which to examine LSM during everyday communication in depression and anxiety, because they are personal, reflective of typical interactions, and can be evaluated unobtrusively [14,15]. By analyzing text messaging data, researchers can test whether social impairment associated with depression and anxiety symptoms is reflected in day-to-day language exchanges, such as by showing reduced LSM.

In the present study, we aimed to assess the degree to which people with average scores above and below the clinical cutoffs for depression, generalized anxiety, and social anxiety exhibit LSM in text messages. While our aims were largely exploratory given that this is a novel area of research, we expected to observe reduced LSM of function words among those experiencing affective symptoms, in line with behavioral indicators such as reduced eye contact [5] and past evidence linking LSM with lower quality relationships more broadly [12]. Although LSM has traditionally been defined in the context of function words [12], we took a broader definition and examined LSM across both function words and language content categories (see 2.2, “Analytic methods” for more detail).

2. Methods

2.1 Participants and procedures

Study recruitment sources included social media and online advertisements, Focus Pointe Global, and an internally maintained registry of people who previously indicated an interest in participating in digital mental health research. We enrolled 458 participants from across the U.S. over two periods: February 1-5, 2021 (n=251), and April 5-9, 2021 (n=207). We oversampled for participants with elevated depression symptoms, defined as having at least moderate depressive symptom severity (⩾10) on the Patient Health Questionnaire-8 (PHQ-8) [16].

Participants were eligible to take part in the present study if they met the following criteria: lived in the U.S.; had an Android smartphone with a data plan; and were able to speak and read in English. Participants were excluded if they indicated via self-report a prior diagnosis of bipolar disorder, schizophrenia, or other psychotic disorder; shared a smartphone with another person; or were not willing to share smartphone data necessary for sensor analyses.

All participants provided electronic informed consent prior to beginning study procedures, which were approved by Northwestern University's Institutional Review Board (IRB). Participants were informed of the option not to provide consent or to withdraw from study at any point should privacy concerns arise. Compensation involved up to $142 for completing ecological momentary assessment (EMA) check-ins and online self-report assessments.

Data were collected over 16 weeks in each wave. After a baseline assessment, participants completed online symptom assessments every 3 weeks through the end of the study (i.e., weeks 4, 7, 10, 13, and 16; note, depression symptoms were measured via EMA at the beginning and end of each assessment week). Assessments included measures of depression symptoms (PHQ-8) [16], generalized anxiety symptoms (Generalized Anxiety Disorder 7-item scale [GAD-7]) [17], and social anxiety symptoms (Social Phobia Inventory [SPIN]) [18]. We continuously and passively collected text message sentiment data using the LifeSense app, which was built on the Passive Data Kit (PDK) platform [19]. We conducted on-device processing of text message language data, allowing us to protect participant privacy by only transmitting data summarized according to Linguistic Inquiry and Word Count (LIWC) 2015 categories [20]. For example, for the prepositions category, the total count of prepositions for a message was transmitted, but not the actual word counts (e.g., the count for "to" or the count for "with"). Sentiment scores were computed for all messages sent and received using a weighted word count sum for LIWC lexica categories [20].

2.2 Analytic methods

We begin the analysis of mirroring by first defining a conversation: a conversation is a pair of messages that consists of an incoming message received by a participant and one or more outgoing messages sent by the same participant. Therefore, building conversations is the process of pairing incoming messages and relevant outgoing messages into conversations. More details about how such pairing is done are provided below (see 2.2.2, "Conversation building").

2.2.1 Normalization—Before building conversations, we must account for the fact that messages have differing lengths. To avoid giving long messages greater weight for having higher LIWC category counts, we normalize each message based on the sum of LIWC top-level category values. To do so, all LIWC category values in a message are divided by the sum of the top-level category values in that same message. The resulting message would have the LIWC top-level category values sum to 1. We thus ensure that short and long sentences have the same scale of LIWC category values.

2.2.2 Conversation building—As the first step, we must "select" incoming messages in order to keep each conversation semantically independent from others. This helps ensure the content in the replying message is due to the incoming message and not any previous

messages. We therefore keep only the first incoming messages sent to a participant after a minimum one-hour gap. In other words, if the same participant has either received or sent a message within the preceding one hour of an incoming message, that incoming message would not be considered the start of a conversation.

As the second step, we find valid outgoing messages to be paired with the selected incoming messages. By default, every valid incoming message and the immediate message following it would form an incoming-outgoing message pair. We then filter those message pairs as follows: (1) We keep only message pairs in which the message following the incoming message is an outgoing message; (2) Based on the assumption that LSM should happen within a certain period of time, we keep only message pairs in which the message following the incoming message is sent within 30 minutes; (3) We further mine the message data by aggregating all outgoing messages within 5 minutes of the initial outgoing messages; for example, given a message pair (M_i, M_o1) that satisfies all the criteria above, we add the LIWC term counts from all **outgoing** messages within 5 minutes of M_o1 together. Note that for the outgoing message(s), the receiver(s) do not have to be the same person (or people) that initiated the conversation. This is because we hypothesize that mirroring of emotional states transfers across conversations.

2.2.3 Language style matching—We follow Ireland et al. (2011) to define the LSM score comparing the amount of LIWC 2015 category usage by each side of a conversation [12]. The LSM score is defined as:

$$\mathrm{LSM\_cat} = 1 - (\,|\,\mathrm{LIWC\_cat\_in} - \mathrm{LIWC\_cat\_out}\,|\,) \;/\; (\mathrm{LIWC\_cat\_in} + \mathrm{LIWC\_cat\_out} + 0.0001) \quad (1)$$

Formula (1) measures the co-occurrence of a given category in a conversation. A higher score means a higher degree of matching, i.e., greater similarity of word categories, between both parties. LIWC_cat_in is the normalized frequency of the LIWC category in incoming messages, and LIWC_cat_ out is the same for outgoing messages. The 0.0001 term prevents division by zero when neither party uses the LIWC category; however, we set the LSM score to zero in these cases, as we do not consider the mutual absence of a category to indicate active style matching.

While Ireland et al. investigated the style matching of function words specifically, our interest is in the mirroring of emotional, as well as syntactic, language. For this reason, we compute LSM scores for *all* LIWC categories. Another difference between our LSM calculation and that of Ireland et al. is the granularity of calculation. Ireland et al. investigated LSM of romantic partners, wherein LSM is considered to be symmetric and constructed by both parties through all conversations between them [12]. We consider LSM as an attribute of a single conversation in which a given participant took part. Each single conversation produces one style matching score for each language category, which contributes to the list of style matching scores for this category for this person. That design choice influences our strict constraints on conversation building, as we must ensure that each conversation is semantically independent.

To compare mirroring between two groups (e.g., people with average scores above vs. below the clinical cutoff for depression), we first calculate style matching scores for each conversation and attain an average score per person per category. We test the hypothesis that there is no difference between mean LSM scores for a given category for people with average scores above vs. below the clinical cutoff (e.g., for depression) using an independent samples t-test. We report the following parameters: the *t* statistic reflects the difference in mean LSM scores across groups; the standard error (*SE*) is the mean difference divided by the *t* statistic, or the standard deviation of the sample mean; and the *p*-value indicates the probability of observing the mean difference if the null hypothesis is true. We set an *a priori* alpha level of .05 and apply a Benjamini-Hochberg correction for multiple comparisons.

3. Results

3.1 Demographic information

See Table 1 for participant demographics. Grouping people according to whether their average symptom scores* across the 16 weeks were above or below the clinical cutoff resulted in the following splits: 191 (41.7%) above the clinical cutoff for depressive symptoms (PHQ-8⩾10), 184 (40.2%) above the clinical cutoff for generalized anxiety symptoms (GAD-7⩾10), and 230 (50.2%) above the clinical cutoff for social anxiety symptoms (SPIN⩾21).

3.2 Primary LSM results

Primary associations between symptoms and LSM are described below; for results across all LIWC categories, see Table 2.

3.2.1 Function words—Both generalized anxiety and social anxiety were associated with reduced style matching of several function word categories. In particular, participants with average scores above the clinical cutoff for social anxiety exhibited less style matching in the use of articles ($t=-3.3881$, $SE=0.0027$, $p=0.0103$), verbs ($t=-3.007$, $SE=0.0049$, $p=0.0321$), and prepositions ($t=-4.2622$, $SE=0.0042$, $p=0.0007$); participants with average scores above the clinical cutoff for generalized anxiety showed less style matching in the use of auxiliary verbs ($t=-2.6443$, $SE=0.0045$, $p=0.046$), articles ($t=-5.2565$, $SE=0.0028$, $p<0.0001$), prepositions ($t=-2.8193$, $SE=0.0042$, $p=0.032$), and function words overall ($t=-3.4228$, $SE=0.0047$, $p=0.0076$). There were no significant differences in LSM between participants with average scores above and below the clinical cutoff for depression for any of the function word categories.

3.2.2 Other grammar—Only generalized anxiety was associated with reduced style matching of some of the “Other Grammar” categories. People with average generalized

*We examined average symptom scores because symptoms were relatively stable over time. There was minimal within-person variability, as measured by the average within-person standard deviation for the symptom measures (PHQ-8: 2.44; GAD-7: 2.42; SPIN: 4.62). In terms of symptom trajectories, 280 (61.14%) of participants entered the study above the clinical cutoff for depressive symptoms (PHQ-8⩾10), and 81 of these scored in the clinical range at all study weeks; 221 (48.25%) of participants entered the study above the clinical cutoff for generalized anxiety symptoms (GAD-7⩾10), and 116 of these scored in the clinical range at all study weeks; 256 (55.9%) of participants entered the study above the clinical cutoff for social anxiety symptoms (SPIN⩾21), and 173 of these scored in the clinical range at all study weeks.

anxiety scores above the clinical cutoff exhibited less style matching in the language categories of common verbs (t=−3.0709, SE=0.0049, p=0.0173) and comparisons (t=−2.6949, SE=0.0013, p=0.0429). Neither depression nor social anxiety was significantly associated with differences in LSM.

3.2.3 Psychological processes

Affective processes: Both generalized anxiety and depression were associated with reduced style matching of several affective process word categories. People with average generalized anxiety scores above the clinical cutoff exhibited less style matching in the use of POSEMO (positive emotion words; t=−3.5517, SE=0.0030, p=0.0056) and in the use of AFFECT (affective process words as a whole; t=−3.2348, SE=0.0033, p=0.0111). People with average depression scores above the clinical cutoff also exhibited less style matching in the same two categories (POSEMO: t=−4.9743, SE=0.0030, p<0.0001; AFFECT: t=−4.2512, SE=0.0033, p=0.0004). There were no significant differences in LSM between people with average scores above and below the clinical cutoff for social anxiety for any of the affective process word categories.

Informal language: All three psychological conditions were associated with increased style matching for informal language. People with average scores above the clinical cutoff exhibited higher style matching in the NETSPEAK word category (generalized anxiety: t=5.7725, SE=0.0014, p<0.0001; social anxiety: 4.1400, SE=0.0013, p=0.0008; depression: t=3.1302, SE=0.0013, p=0.0213) and informal language as a whole (generalized anxiety: t=6.6516, SE=0.0025, p<0.0001; social anxiety: t=5.1364, SE=0.0024, p<0.0001; depression: t=3.2017, SE=0.0025, p=0.0200).

Other psychological processes: There were several other LIWC psychological process word categories associated with LSM differences. Participants with average scores above the clinical cutoff for generalized anxiety showed less style matching on future-focused words (e.g., may, will, soon; t=−4.0828, SE=0.0020, p=0.0008) and reward (e.g., take, prize, benefit; t=−3.2698, SE=0.0021, p=0.0111). They also showed more style matching on words that focus on causal language (e.g., because, effect; t=3.0039, SE=0.0015, p=0.0195). On the other hand, participants with average scores above the clinical cutoff for social anxiety exhibited less style matching in the relative word category (e.g., area, bend, exit; t=−3.5643, SE=0.0042, p=0.0067). Participants with average scores above the clinical cutoff for depression showed less language style matching in words related to biological process (e.g., eat, blood, pain; t=−5.5550, SE=0.0017, p<0.0001) and affiliation (e.g., ally, friend, social; t=−4.6967, SE=0.0021, p=0.0001)

4. Discussion

In the present study, we aimed to test whether people experiencing elevated affective symptoms exhibit different levels of LSM in day-to-day interactions. In partial support of hypotheses, we found reduced LSM of function words (namely, prepositions, articles, and auxiliary verbs) in people with average scores above the clinical cutoff for generalized anxiety and reduced LSM of prepositions and articles in people with average scores above

the clinical cutoff for social anxiety; however, there was no difference in LSM of function words for people with average scores above and below the clinical cutoff for depression. Our results also indicated reduced LSM of several content-specific language categories, particularly for people experiencing higher depression and generalized anxiety symptoms.

Our finding that people reporting anxiety are less likely to style match function words may point to one mechanism of social difficulties across the anxiety spectrum. Prior literature suggests that LSM of function words is predictive of romantic relationship interest and satisfaction [12]. That people experiencing high levels of anxiety exhibit lower LSM suggests that they may struggle with nonconscious verbal coordination or the interpersonal coordination of psychological states [21]. It will be important for future studies to consider associations between LSM and behavioral indicators of social difficulties in anxiety, as LSM of function words and relationship engagement are thought to be mutually reinforcing in support of relationship satisfaction [22]. Notably, we did not find support for reduced LSM of function words as a potential indicator of depression symptoms; if future studies replicate these findings, results may point to a way in which social functioning differs among people reporting depression versus anxiety symptoms.

Across all three symptom categories, we observed that people experiencing elevated levels of psychopathology were in sync with their conversational partner on the level of formality, as indicated by higher LSM of netspeak and informal language categories among people with average affective symptom scores above the clinical cutoff. This may reflect attempts toward impression management, which is a common safety behavior in anxiety disorders [23] and practice in depression [24]. Conversely, people who are not generally experiencing clinical levels of depression or anxiety may be less concerned with a mismatch in the level of formality with their conversational partner.

We also found several differences between people with average scores above versus below the clinical cutoffs for affective symptoms when it came to content-specific LSM. First, people experiencing elevated depression and generalized anxiety symptoms were less likely to mirror positive emotion and general affect words. As is the case with all LSM findings, we cannot ascertain the direction of this mismatch (e.g., whether people reporting high depression and anxiety tend to use more positive emotion words when their conversational partners use fewer positive emotion words, or vice versa); however, the misalignment on these categories is notable given evidence of lower positive emotion as a core indicator of depression [25] and the mixed evidence for blunted positive emotion in generalized anxiety [26]. Second, reduced LSM of affiliation and biological words was specific to depression symptoms. While again, the direction of mismatch is unknown, prior literature on language and depression would suggest that people reporting elevated depressive symptomatology might be more likely to discuss biological processes and less likely to discuss social ties when their conversational partners bring up these topics [27-30]. At the same time, it is important to consider potential gender effects in the association between LSM of affiliation words and depression, as there was also lower LSM of affiliation words among participants identifying as female. Finally, there was reduced LSM of reward, comparisons (e.g., “greatef’, “best”), and future-focused language among people experiencing elevated generalized anxiety symptoms, suggesting that when people feel anxiety, they may be less

flexible or able to adapt their conversation about these topics to match their partner's language content. Previous studies point to aberrant reward processing of social stimuli in generalized anxiety [31], and the cognitive model of generalized anxiety implicates both a heightened focus on the future (i.e., worry) and cognitive distortions involving comparison as contributing factors [32], potentially explaining these results.

The present study had several limitations, pointing to areas for future study. For one, in order to examine high-level patterns, we aggregated data over time, such that all findings are correlational in nature and reflect a given individual's average experience of psychopathology over the course of the study. For another, our construction of a conversation is one of many ways that a conversation could be operationalized, raising a question for future studies as to how best to capture and analyze the back-and-forth between two people via text messages. Future studies could also employ natural language processing techniques in analyzing text messaging data, and they could consider how language varies across more severe levels of psychopathology (e.g., examining different clinical cutoffs).

Overall, findings from the present study support the notion that text-message-based LSM may inform our understanding of social functioning associated with affective symptoms. As in less successful romantic relationships [12], people experiencing anxiety symptoms exhibit reduced LSM of function words, indicating one potential mechanism of social difficulties on the anxiety spectrum.

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Table 1.

Demographic characteristics of sample.

Variable	Categories	Statistic
Age in years, mean (sd)		41.21 (12.58)
Sex (assigned at birth), n (%)	Female	344 (75.1%)
	Male	114 (24.9%)
Race, n (%)	White	373 (81.4%)
	Black/African American	51 (11.1%)
	Asian	10 (2.2%)
	Native American/Alaskan Native	4 (0.9%)
	More than one Race	17 (3.7%)
	Prefer not to answer	3 (0.7%)
Ethnicity, n (%)	Hispanic/Latinx	29 (6.3%)
	Non-Hispanic/Non-Latinx	428 (93.4%)
	Unknown/Prefer not to answer	1 (0.3%)
Highest level education completed, n (%)	Some high school, no diploma	7 (1.5%)
	High school/GED	37 (8.1%)
	Some college, no degree	119 (26.0%)
	Associate's degree	84 (18.3%)
	Bachelor's degree	131 (28.6%)
	Graduate degree	80 (17.5%)
Marital status, n (%)	Single/never married	147 (32.1%)
	Domestic partnership	6 (1.3%)
	Married	147 (32.1%)
	Separated	17 (3.7%)
	Divorced	75 (16.4%)
	Unknown/Prefer not to answer	2 (0.4%)
	Living with Partner	64 (14.0%)
Household income, n (%)	<$10,000	41 (9.0%)
	$10,000-19,999	47 (10.3%)
	$20,000-39,999	101 (22.1%)
	$40,000-59,999	89 (19.4%)
	$60,000-99,999	94 (20.5%)
	>$100,000	74 (16.2%)
	Unknown/Prefer not to answer	12 (2.6%)
Employment, n (%)	Employed	276 (60.3%)
	Unemployed	70 (15.3%)
	Disability	51 (11.1%)
	Retired	17 (3.7%)
	Other	42 (9.2%)
	Prefer not to answer	2 (0.4%)

Variable	Categories	Statistic
Average PHQ-8	Overall mean (sd)	9.25 (5.04)
	Minimal (0-4), n (%)	69 (15.1%)
	Mild (5-9), n (%)	167 (36.5%)
	Moderate (10-14), n (%)	141 (30.8%)
	Moderate-Severe (15-19), n (%)	62 (13.5%)
	Severe (20-24), n (%)	19 (4.1%)
Average GAD-7	Overall mean (sd)	8.92 (5.41)
	Minimal (0-4), n (%)	104 (22.7%)
	Mild (5-9), n (%)	148 (32.3%)
	Moderate (10-14), n (%)	109 (23.8%)
	Moderate-Severe (15-19), n (%)	83 (18.1%)
	Severe (20-24), n (%)	14 (3.1%)
Average SPIN	Overall mean (sd)	23.88 (16.80)
	Minimal (0-20), n (%)	228 (49.8%)
	Mild (21-30), n(%)	76 (16.6%)
	Moderate (31-40), n (%)	63 (13.8%)
	Severe (41-50), n (%)	50 (10.9%)
	Very Severe (>50), n (%)	41 (9.0%)

Table 2.

T-tests comparing LSM of people with average scores above/below clinical cutoffs for PHQ-8, GAD-7, and SPIN.

LIWC Category	PHQ-8		GAD-7		SPIN	
	t (SE)	*p*-value	*t (SE)*	*p*-value	*t (SE)*	*p*-value
LINGUISTIC DIMENSIONS						
FUNCTION	−2.3164 (.0047)	.1500	−3.4228 (.0047)**	.0076	−1.7247 (.0046)	.2807
PRONOUN	−.8214 (.0048)	.6750	.7711 (.0048)	.6702	.9462 (.0047)	.6126
PPRON	−.8374 (.0047)	.6750	1.0241 (.0047)	.5657	1.3368 (.0046)	.4412
I	−.5334 (.0034)	.8162	.5843 (.0034)	.7311	.6831 (.0033)	.7264
WE	−1.859 (.001)	.3211	−1.1969 (.001)	.5117	−1.3009 (.001)	.4442
YOU	−.4564 (.0032)	.8162	.9492 (.0033)	.5657	2.6181 (.0032)	.0643
SHEHE	−2.3541 (.0014)	.1500	.0057 (.0014)	.9955	.5042 (.0014)	.7264
THEY	−1.559 (.0008)	.3949	−1.8685 (.0008)	.1958	−.5328 (.0008)	.7264
IPRON	1.333 (.0028)	.4442	−1.0777 (.0028)	.5657	−1.2275 (.0027)	.4581
ARTICLE	−1.6958 (.0028)	.3436	−5.2565 (.0028)***	.0000	−3.3881 (.0027)*	.0103
PREP	−.4039 (.0042)	.8427	−2.8193 (.0042)*	.0320	−4.2622 (.0042)***	.0007
AUXVERB	−.1406 (.0045)	.9149	−2.6443 (.0045)*	.0460	−.5975 (.0045)	.7264
ADVERB	.8792 (.0035)	.6750	.1347 (.0035)	.9281	−1.2699 (.0034)	.4473
CONJ	.8693 (.0032)	.6750	−.985 (.0032)	.5657	−.9778 (.0032)	.5990
NEGATE	−.2396 (.0016)	.8858	−.8925 (.0016)	.5780	−2.4362 (.0016)	.0834
OTHER GRAMMAR						
VERB	−1.2296 (.0049)	.4841	−3.0709 (.0049)*	.0173	−3.007 (.0049)*	.0321
ADJ	1.3421 (.0026)	.4442	−.1936 (.0026)	.9112	−.8179 (.0026)	.6706
COMPARE	−.1386 (.0013)	.9149	−2.6949 (.0013)*	.0429	−2.4778 (.0013)	.0805
INTERROG	2.6492 (.0017)	.0842	1.6023 (.0017)	.2844	.7032 (.0016)	.7264
NUMBER	.6228 (.0006)	.8113	−.6464 (.0006)	.7273	−.1796 (.0005)	.9012
QUANT	.3797 (.0015)	.8427	−2.0553 (.0015)	.1386	−.5277 (.0015)	.7264
PSYCHOLOGICAL PROCESSES						
AFFECT	−4.2512 (.0033)***	.0004	−3.2348 (.0033)*	.0111	−.9028 (.0033)	.6373
POSEMO	−4.9743 (.003)***	.0000	−3.5517 (.003)**	.0056	−1.2582 (.003)	.4473
NEGEMO	1.733 (.0012)	.3436	.4783 (.0012)	.7627	.4328 (.0012)	.7506
ANX	−.2096 (.0002)	.8858	−.6131 (.0002)	.7297	−1.4201 (.0002)	.4057
ANGER	.5474 (.0003)	.8162	−.4424 (.0003)	.7627	−2.587 (.0003)	.0643
SAD	1.4424 (.0007)	.4442	−.5207 (.0007)	.7455	1.2968 (.0007)	.4442
SOCIAL	−2.4594 (.0043)	.1271	−.9032 (.0043)	.5780	−1.0167 (.0042)	.5790
FAMILY	.8807 (.0006)	.6750	1.0454 (.0006)	.5657	.1451 (.0006)	.9096
FRIEND	−.2828 (.0003)	.8858	−1.7963 (.0003)	.2204	−2.1764 (.0003)	.1437
FEMALE	−1.3094 (.0011)	.4484	.6307 (.0011)	.7276	.6199 (.0011)	.7264
MALE	−.5718 (.0012)	.8162	−.2068 (.0012)	.9112	.4285 (.0012)	.7506
COGPROC	1.6741 (.0039)	.3436	−.4494 (.0039)	.7627	−2.1786 (.0038)	.1437
INSIGHT	−.207 (.0016)	.8858	−2.136 (.0015)	.1277	−.6668 (.0015)	.7264

LIWC Category	PHQ-8		GAD-7		SPIN	
	t (SE)	*p*-value	*t (SE)*	*p*-value	*t (SE)*	*p*-value
CAUSE	2.1948 (.0015)	.1654	3.0039 (.0015)*	.0195	1.6065 (.0014)	.3159
DISCREP	.8549 (.0018)	.6750	−1.4134 (.0018)	.3710	−2.0437 (.0017)	.1722
TENTAT	2.1775 (.002)	.1654	−.7019 (.002)	.7048	.0104 (.002)	.9917
CERTAIN	−1.5681 (.0009)	.3949	−2.4959 (.0009)	.0612	−.513 (.0009)	.7264
DIFFER	−.0672 (.0021)	.9523	−.9371 (.0021)	.5657	−1.5379 (.0021)	.3355
PERCEPT	−1.3401 (.0018)	.4442	−1.7145 (.0017)	.2427	.5786 (.0017)	.7264
SEE	−.5735 (.0011)	.8162	−1.1503 (.0011)	.5334	.692 (.0011)	.7264
HEAR	−.4978 (.0006)	.8162	−.3134 (.0006)	.8468	−.6136 (.0006)	.7264
FEEL	−1.2431 (.0007)	.4841	−.9721 (.0007)	.5657	−.5223 (.0007)	.7264
BIO	−5.555 (.0017)***	.0000	−.1787 (.0017)	.9112	.3709 (.0017)	.7861
BODY	1.7412 (.0006)	.3436	.404 (.0006)	.7827	−.5891 (.0006)	.7264
HEALTH	−.8914 (.0005)	.6750	−1.3078 (.0005)	.4356	−.5002 (.0005)	.7264
SEXUAL	.3036 (.0002)	.8823	.5607 (.0002)	.7311	−1.0909 (.0002)	.5289
INGEST	−1.7172 (.0005)	.3436	−2.0655 (.0005)	.1386	−.8698 (.0005)	.6377
DRIVES	−2.208 (.0038)	.1654	−.1747 (.0039)	.9112	−1.6411 (.0038)	.3066
AFFILIATION	−4.6967 (.0021)***	.0001	−.4636 (.0022)	.7627	−1.7598 (.0021)	.2727
ACHIEVE	1.1627 (.0012)	.5110	−.6523 (.0012)	.7273	.4335 (.0011)	.7506
POWER	.9563 (.0015)	.6687	−.0321 (.0015)	.9880	.5899 (.0015)	.7264
REWARD	−1.4015 (.0021)	.4442	−3.2698 (.0021)*	.0111	−2.029 (.0021)	.1722
RISK	.0598 (.0005)	.9523	−.7346 (.0005)	.6891	2.7932 (.0005)	.0545
TIME ORIENTATIONS						
FOCUSPAST	1.1872 (.0028)	.5049	−1.4842 (.0028)	.3352	−2.6878 (.0027)	.0584
FOCUSPRESENT	−.3889 (.0047)	.8427	−2.1292 (.0047)	.1277	−1.7905 (.0046)	.2679
FOCUSFUTURE	−.771 (.002)	.6994	−4.0828 (.002)***	.0008	−1.3738 (.002)	.4267
RELATIV	−.3178 (.0043)	.8823	−1.9699 (.0043)	.1621	−3.5643 (.0042)**	.0067
MOTION	1.4492 (.0022)	.4442	−1.0506 (.0021)	.5657	−.626 (.0021)	.7264
SPACE	−.4626 (.0034)	.8162	−1.6707 (.0033)	.2563	−1.5752 (.0033)	.3235
TIME	.4558 (.0028)	.8162	−2.1678 (.0028)	.1277	−1.9216 (.0028)	.2101
PERSONAL CONCERNS						
WORK	.5119 (.001)	.8162	−.9446 (.0009)	.5657	−.1711 (.0009)	.9012
LEISURE	−.6595 (.0005)	.7915	−2.5509 (.0005)	.0561	−.8713 (.0005)	.6377
HOME	−1.3742 (.0008)	.4442	−.5522 (.0008)	.7311	1.184 (.0008)	.4665
MONEY	.8132 (.0006)	.6750	.5689 (.0006)	.7311	−.1026 (.0006)	.9310
RELIG	−1.3898 (.0002)	.4442	−1.7551 (.0002)	.2314	.2816 (.0002)	.8355
DEATH	−1.0547 (.0001)	.5913	−.1223 (.0001)	.9281	−.3538 (.0001)	.7883
INFORMAL	3.2017 (.0025)*	.0200	6.6516 (.0025)***	.0000	5.1364 (.0024)***	.0000
SWEAR	.4585 (.0002)	.8162	1.4927 (.0002)	.3352	−2.1077 (.0002)	.1600
NETSPEAK	3.1302 (.0013)*	.0213	5.7725 (.0014)***	.0000	4.14 (.0013)***	.0008
ASSENT	1.8386 (.0011)	.3211	2.3152 (.0011)	.0940	2.7065 (.001)	.0584
NONFLU	.2054 (.0005)	.8858	−.9841 (.0005)	.5657	−1.2102 (.0005)	.4587
FILLER	.2179 (.0001)	.8858	1.1365 (.0001)	.5334	1.6988 (.0001)	.2837