**Mental Distress and Language Use: Linguistic Analysis of Discussion Forum Posts**

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Online peer support groups have become a popular arena for interacting with others who experience similar types of distress. Previous studies have identified distinctive linguistic patterns displayed by those experiencing a wide range of physical or mental health difficulties, especially in terms of increased use of first-person singular pronouns and negative words. We used the Linguistic Inquiry and Word Count program (LIWC; Pennebaker, Boyd, Jordan, & Blackburn, 2015) in comparing the linguistic content of individuals in online communities for different types of mental distress (Generalized Anxiety Disorder, Borderline Personality Disorder, Major Depressive Disorder, Obsessive-Compulsive Disorder, and Schizophrenia) and controls (a finance discussion forum). Compared to the control group, people who experience any form of distress displayed a higher frequency of singular personal pronouns and higher frequency of negative emotion word use. Those who participated in schizophrenia discussion forums had the highest use of third person plural pronouns (e.g., they, them), which could reflect persecutory ideas associated with the diagnosis. Borderline Personality Disorder discussion forums had the highest incidence of using third person singular pronouns (e.g., he, hers), which could be due to excessive focus on significant others, possibly because of insecure attachment patterns. Findings highlight important similarities between those identifying with different forms of mental distress.

Keywords: language use; linguistic analysis; mental distress; mental health; online forum

**1. Introduction**

Words convey important information about thoughts, feelings, and the way in which a person experiences the world (e.g., Pennebaker & Lay, 2002). This applies whether the words are spoken in person or written online. In particular, linguistic analyses have been employed to identify the social, emotional, and cognitive difficulties associated with different forms of mental distress; including schizophrenia (Minor et al., 2015), depression (Fineberg et al., 2016), social anxiety disorder (Anderson, Goldin, Kurita, & Gross, 2008), anorexia nervosa (Lyons, Mehl, & Pennebaker, 2006), obsessive-compulsive disorder (Oren, Friedmann, & Dar, 2016), and borderline personality disorder (Carter & Grenyer, 2012). Understanding the linguistic patterns displayed by those experiencing mental distress can identify the difficulties people have and inform the development of appropriate treatments and interventions.

One important aspect of language that reveals information about mental states is the use of personal pronouns. Pronouns indicate whether an individual’s focus is on the self (first-person singular pronouns such as “I”, “me”, “my”), on others (second-person pronouns such as “s/he”, “you”, “they”, “others”), or on the self as part of a social group (first-person plural pronouns such as “we”, “our”). The inward-focus, manifested in increased use of first-person singular pronouns, is evident across multiple forms of mental distress (Anderson, et al., 2008; Buck & Penn, 2015; Edwards & Holtzman, 2017; Wolf, Sedway, Bulik, & Kordy, 2007; Zimmermann, Brockmeyer, Hunn, Schauenburg, & Wolf, 2016), as well as in physical illnesses (Finberg et al., 2016). However, studies have not yet compared the pronoun use between specific categories of distress, which is important in terms of deepening our understanding of the types of difficulties people with different mental illness diagnoses might be experiencing.

Although many forms of distress are characterised by self-focussed attention and rumination, this is especially typical to depression (Mor & Winquist, 2002). A study that compared online personal pronoun use found that people who were depressed used significantly more first-person singular pronouns than people who had a breast cancer diagnosis (Ramirez-Esparza, Chung, Kacewicz, & Pennebaker, 2008). Another study found that Twitter users with a depression or bi-polar disorder diagnosis used the first-person singular more than individuals without a diagnosis (Coppersmith, Dredze, & Harman, 2014). To our knowledge, previous studies have not compared the personal pronoun use of those who suffer from depression to people who suffer from other forms of distress. It would be expected that in comparison to other forms of distress, depression relates to elevated use of first-person singular pronouns.

Although most studies have focused on first-person singular pronouns as an indicator of distress, there are reasons to expect that differences exist in the use of third person pronouns too. For instance, individuals who have received a diagnosis of schizophrenia/psychosis may suffer from persecutory delusions, and attribute responsibility of persecution to a number of different entities (e.g., neighbours, governments, scientists, family members, spirits; Pugh, Luzon, & Ellett, 2018). Indeed, a study that analysed Twitter posts found that schizophrenia was related to increased use of personal pronouns, especially the third-person plurals (Birnbaum, Ernala, Rizvi, De Choudhury, & Kane, 2017). Thus, we would expect that those who suffer from schizophrenia-related distress also use more third person pronouns (e.g., “s/he”, “they”, “them”) than people who suffer from other forms of distress.

Further, individuals who have a Borderline Personality Disorder (BPD) diagnosis often have insecure attachment patterns, stemming from trauma experienced earlier in life (Badoud et al., 2018). It is possible that insecure attachment to significant others relates to increased use of third-personal singular pronouns (e.g., “him”, “he”, “hers”). Indeed, a previous study found that in comparison to a control group, patients with BPD diagnosis used more third person singular pronouns (Carter & Grenyer, 2012). In the present study, we aim to add to the literature by comparing the pronoun use across several categories of distress to determine if the specific difficulties associated with them are also reflected in language use.

In addition to the use of personal pronouns, the valence of words can indicate the emotional processes a person experiences. Negative emotionality characterises a range of different forms of distress (Krueger, McGue, & Iacono, 2001). It is not surprising, therefore, that different types of mental distress have been related to more frequent use of words that are negative, angry, or anxious (e.g., Anderson et al., 2008; Carter & Grenver, 2012; Fineberg et al., 2016; Fung, Moore, Karcher, Kerns, & Martin, 2017). However, previous studies have not compared the valence of language between different types of distress, something we aim to achieve in the present study.

Overlap in the word use between different, supposedly distinct forms of mental distress is interesting, and may suggest that the inward focus (i.e., first-person singular pronoun use) and negative valence of language is typical to those suffering from any distress, regardless of the condition. There has been little investigation of commonalities in online language use across different categories of distress. Fineberg, et al. (2016) analysed personal blogs of those who identified as having a host of physical and mental problems (including psychosis and depression), and compared them to control groups. They found that those who suffered from any kind of distress (whether mental or physical) used more first-person singular pronouns, and had more negative and less positive emotion words in their writing. However, another study found that those who were using an online discussion forum to discuss depression had significantly more use of first person singular pronouns than those who entered a discussion forum on breast cancer, suggesting that mental distress relates to more inward focus than physical distress (Ramirez-Esparza et al., 2008). It is likely that the context in which language is used has a major influence in how distress is expressed. For example, in personal blogs, the writers are creating mini-essays about their topic, and there is less of an expectation of reciprocal communication with the readers. In online discussion forums, the communication is interactive (Kummervold et al., 2002), mimicking more the discussions that people have in an offline environment.

Indeed, computer-mediated online communication had become a rich source of data in recent decades, with a mushrooming of studies using content and linguistic analyses in examining language use in mental distress (e.g., Cavazos-Rehg, et al. 2016; Coppersmith et al., 2014; DeChoudhury, Counts, & Horvitz, 2013).The online environment provides opportunities for investigating language use in peer-to-peer support discussion forums (Kramer, Fussell, & Setlock, 2004). Online mental health communities consist of people who are united by similar experiences / diagnoses, and who can provide each other support and advice under the guise of a pseudonym. Online support groups are characterised by interactions that have a high degree of reciprocal self-disclosure (Barak & Gluck-Ofri, 2007). In particular, those who are concerned with stigma are more likely to benefit from participation in online communities (DeAndrea, 2014; Pendry & Salvatore, 2014), suggesting that individuals who use this media for communication may be able express themselves freely (Kummervold et al., 2002). Overall, peer-to-peer online support networks increase social connectedness and sense of belonging (Naslund, Aschbrenner, Marsch, & Bartels, 2016). Communication in online discussion forums is more likely to reflect naturalistic language use than often-used diary-writing/clinical interviews/blogging methods, and provides a valuable opportunity for investigating the linguistic characteristic of those who experience mental distress.

The present study aims to add to the existing literature by (i) researching language use in a wide range of mental distress categories (Generalized Anxiety Disorder, Borderline Personality Disorder, Major Depressive Disorder, Obsessive-Compulsive Disorder, and Schizophrenia) by (ii) using communication in online peer-to-peer support networks. We address the research questions “to what extent do the interactive online posts written by those experiencing mental distress differ from those who do not experience mental distress” and “is the language used by those experiencing mental distress a reflection of generalised suffering or more specific symptomology”. We expect that those experiencing mental distress, (especially depression), will display more use of singular personal pronouns and negative emotion than those who do not experience mental distress. We also expect that those who participate in schizophrenia (as opposed to the control, or other types of mental distress) forums, display an increased use of third person pronouns as a function of the persecutory ideology assigned to third parties. Finally, due to insecure attachment patterns and pervasive inter-personal problems, we expect that those who participate in the Borderline Personality Discussion forum have a heightened emphasis on using third person singular pronouns.

**2. Method**

*2.1 Sample and Procedure*

An internet search was conducted using keywords (e.g., ‘schizophrenia discussion forum’) to identify the most popular discussion forums for each form of mental distress investigated (Generalized Anxiety Disorder (GAD), Borderline Personality Disorder (BPD), Major Depressive Disorder (MDD), Obsessive-Compulsive Disorder (OCD), and Schizophrenia (SZ)). All forums were public and did not require registration to view forum posts. For each mental distress category the first 100 suitable entries were identified. Only entries from authors clearly disclosing that they suffered from one of the five types of mental distress were included in the analysis. Only one text per pseudonym was used for the study. A maximum of 500 words were analysed for each entry. As the program we used adjusts the length of the text, the slight differences in the word count between different entries was not an issue. Control group posts were selected from an online personal finance discussion forum. Control entries were excluded if the author disclosed that they currently or previously suffered from mental distress or if they disclosed therapist / psychologist expenses.

In terms of choosing the forums, we used Reddit as the first point of call for all the categories. Research has shown that individuals who contribute to different mental health forums in Reddit are likely to be suffering from the type of distress indicated by the forum (Gkotsis et al., 2017). We were able to identify 463 entries with unique pseudonyms using Reddit. The remaining posts were from several forums (e.g., www.mentalhealthforum.net, www.psychforums.com, www.beyondblue.org).

*2.2 Data Analysis*

The Linguistic Inquiry and Word Count (LIWC; Pennebaker, Boyd, Jordan, & Blackburn, 2015) programme was used to analyse the discussion forum entries. The programme assesses the emotional, cognitive, and structural components of the text based on a psychometrically validated dictionary of over 6400 words, word stems, and emoticons assigned to a range of categories. In the present study, we report the use of personal pronoun words (e.g., “I”, “we”), and emotion words (positive emotion, negative emotion, anxiety, anger, sadness, and affective process words). All statistical analyses were conducted using SPSS.

**3. Results**

Levene’s test identified a lack of homogeneity of variance in personal pronouns (except first person singular), negative emotion, anxiety, anger, and sadness. Hence, *F* values were calculated using Welch’s *F* test. Post-hoc analyses were conducted using pairwise comparisons. A more stringent (*p* = .001) significance level was adopted for post-hoc comparisons due to the number of analyses conducted.

*3.1**Personal Pronoun Use*

 There was a significant main effect of mental distress on first person singular, first person plural, second person plural, third person singular, third person plural but not on second person singular personal pronoun categories (See Table 1). Post-hoc analyses demonstrate that overall personal pronoun usage was significantly lower in the control group compared to the BPD, GAD, MDD, OCD, and SZ groups. First person singular pronoun usage was significantly lower in the control group compared to the BPD, GAD, MDD, OCD, and SZ groups. First person plural pronoun usage was significantly higher in the control group compared to the GAD, MDD, OCD, and SZ groups. Third person singular pronoun usage was significantly higher in the BPD group compared to the GAD, OCD, SZ, and control groups. Third person plural pronoun usage was significantly higher in the SZ group compared to the GAD group.

*3.2 Emotional Word Use*

 There was a significant main effect of mental distress on the positive emotion, negative emotion, anxiety, anger, sadness, and affective process categories (See Table 2). Post-hoc analyses indicate that overall affective process words use was significantly lower in the control group compared to the BPD, GAD, MDD, OCD, and SZ groups. Affective process word use was lower in the SZ group compared to the BPD, GAD, and MDD groups.

Use of words indicating negative emotion was significantly lower in the control group compared to the BPD, GAD, MDD, OCD, and SZ groups. Negative emotion word use was significantly higher in the GAD group compared to the BPD group and significantly lower in the SZ compared to the GAD, MDD, and OCD groups. Anxiety word usage was significantly lower in the control group compared to the BPD, GAD, OCD, and SZ groups, and higher in the GAD group compared to the BPD, MDD, OCD, and control groups. Anxiety word use was significantly higher in the OCD group compared to the BPD, MDD, and the control groups.

The usage of anger words was significantly lower in the control group compared to the BPD, GAD, OCD, and SZ groups. Sadness word use was significantly lower in the control group compared to the BPD and GAD groups. The usage of words that indicate sadness was significantly higher in the MDD group compared to the BPD, GAD, OCD, SZ, and control groups.

**4. Discussion**

The present study analysed linguistic components (use of personal pronouns and words indicating emotional processes) of discussion forum posts in people who have been diagnosed as having specific forms of mental distress. Overall, findings suggest marked differences between the posts written by those experiencing mental distress and control participants (i.e., people who post on a personal financial discussion forum), but fewer differences between specific mental distress groups. Hence, the linguistic differences identified for those who experience or do not experience mental distress when investigating offline and non-interactive online language appear to extend to more naturalistic interactive online communication, suggesting that those factors which predict offline communication patterns also influence communication online.

 Consistent with previous research (e.g., Anderson et al., 2008; Buck & Penn, 2015; Edwards & Holtzman, 2017; Wolf et al., 2007) those with each form of mental distress were more likely to use first-person singular pronouns (e.g., “I”, “me”) than those in the control group. Findings reflect the more inward focus associated with personal difficulties (Fineberg et al., 2016), which seems to be at the core of many forms of mental distress. Indeed, extensive self-focus and rumination is a common factor in different forms of distress, and could explain high rates of co-morbidity between diagnostic categories (McLaughlin & Nolen-Hoeksema, 2011). With regards to real life implications, this suggests that interventions that target reducing self-focus and rumination (e.g., Hofmann, 2014; Park et al., 2016) could be used to alleviate the suffering of people regardless of their diagnosis.

Some interesting patterns emerged with regards to the use of second (i.e., “you”) and third (i.e., “s/he”, “they”) person pronouns. Not only did mental distress groups differ significantly from the control group, demonstrating a higher usage of these pronouns, there were also some differences between the groups. Third person singular pronoun usage (e.g., “s/he”, “hers”, “his”) was significantly higher in the BPD group compared to the control group and the other mental distress groups. Those who have received a diagnosis of BPD have higher sensitivity to rejection (Gutz, Roepke, & Renneberg, 2016), possibly due to maltreatment in childhood (Chesin, Fertuck, Goodman, Lichenstein, & Stanley, 2015), and think that their earlier experiences are still highly relevant in the present life (Rosenbach & Renneberg, 2015). It is possible that distressing experiences with others, coupled with rejection sensitivity, are reflected in higher use of third person singular pronouns.

Another interesting finding was that people in the schizophrenia discussion group had the highest frequency of third person plural pronoun use (i.e., “they”), although the difference was statistically significant only compared to the lowest scoring group, Generalised Anxiety Disorder discussion forum users. Some features of schizophrenia, such as paranoia, are related to lack of social identity and group membership (McIntyre, Wickham, Barr, & Bentall, 2017), as well as persecutory delusions (Pugh et al., 2018). The increased use of words related to “them” could be a reflection of experiencing out-group membership in a wider social context, resulting in an increased attention on groups of “others”.

Consistent with previous research, negative emotion words were particularly common amongst those with mental distress (e.g., Carter & Grenver, 2012; Minor et al., 2015). Though some variation occurred between mental distress types (e.g., increased use of anxiety and sadness words amongst those with Generalised Anxiety Disorder and Major Depressive Disorder respectively) which reflects specific symptomology, differences between mental distress types were less marked than differences between the mental distress and control group posts. Overall, the linguistic patters indicate that diverse categories of mental distress are related to increased negative emotions (e.g., Krueger et al., 2001).

Our findings provide some support for the recent criticism for the utility of present diagnostic categories (e.g., Hofmann, 2014; Parnas, 2015), and concerns regarding whether the categories represent “real” distinctive entities of illness (e.g., Fried & Nesse, 2015; Van Os, 2016). It is possible that these categories exist on a continuum reflecting the extent to which the difficulties experienced stem from problems with significant others (i.e., BPD), out-group and persecution experiences (i.e., schizophrenia), or self-focussed rumination (i.e., depression). The similarities between different mental distress forums, and differences between the mental distress and control discussion forums indicate that the difficulties that people experience are not necessarily specific to a mental disorder diagnostic category. Rather than categorising people into distinctive disorder groups it may be more useful to focus on the behaviours, emotions, and cognitions that unify the distress categories. It would also be useful to investigate the experiences of distress as a continuum rather than as a qualitative difference between different categories.

A substantial number of those diagnosed with a mental health condition are diagnosed with one or more additional mental or physical health conditions (Jacobi et al. 2014; Scott et al. 2016). In the present study, we collected data from those posting on specific mental health online forums and disclosing the related condition. We cannot, however, exclude the possibility that those identifying with one mental health community were also diagnosed with other conditions. Hence, comorbidity may be problematic. Future research may obtain more detailed clinical assessments including both current and prior experience of each form of mental distress. This approach would allow researchers to exclude those diagnosed with further conditions or to compare the language of those with one or more than one diagnosis.

Therapy and information based intervention programs may be delivered to those experiencing mental distress online (Alleman, 2002) and provide cost-effective support, particularly for rural or difficult to reach populations (Barak & Grohol, 2011). Both therapist led and self-directed applications have successfully reduced mental distress symptomology (Griffiths & Christensen, 2007; Ybarra & Eaton, 2005). Future research could employ similar linguistic analysis to consider responses to mental health interventions and treatment. Linguistic analysis may allow researchers or practitioners to assess symptom severity or evaluate treatment effectiveness. Indeed, linguistic analysis has been successfully employed to assess recovery oriented concepts (Bonfils et al., 2016). Previous studies suggest that linguistic analysis predicts post-treatment functioning (Alvarez-Conrad, Zoellner, & Foa, 2001) and enables identification of effective counselling conversations (Althoff, Clark, & Leskovec, 2016). Additional research is required to investigate the manner in which those experiencing different forms of mental distress respond to therapy, and in particular indicators of treatment success and reductions in symptom severity. Further, tools may be developed to identify those contributing to online forums who may benefit from such specialist support. It is important to note that previous studies have documented important sex and cultural differences in the experience and understanding of mental health (e.g., Finlay, et al., 2015; Sheikh & Furnham, 2000) and in language use (Holtgraves, 1997; Newman, Groom, Handelman, & Pennebaker, 2008). Future research should consider the extent to which these factors influence the written or verbal expression of mental health difficulties.

To conclude, the present study investigated the language used by those experiencing five forms of mental distress (Generalized Anxiety Disorder, Borderline Personality Disorder, Major Depressive Disorder, Obsessive-Compulsive Disorder, and Schizophrenia) and controls when posting in online discussion forums. Findings suggest that the distinctive linguistic patterns displayed by those experiencing mental health difficulties extends to interactive online communication. Findings are consistent with previous research focusing on offline language or online non-interactive posts. Further, the supposedly distinctive mental distress groups had similar kinds of linguistic expressions in terms of increased use of first-person singular pronouns and negative emotion words. This suggests implies a similar self-focus amongst those identifying with specific mental disorder categories. Future research should further consider the utility of linguistic analysis for the monitoring of mental distress experiences and evaluation of treatment effectiveness.

**5. References**

Alleman, J. R. (2002). Online counselling: The internet and mental health treatment. *Psychotherapy: Theory, Research, Practice, Training, 39*, 199-209.

Althoff, T., Clark, K., & Leskovec, J. (2016). Large-scale analysis of counselling conversations: An application of natural language processing to mental health. *Transactions of the Association for Computational Linguistics, 4*, 463-476.

Alvarez-Conrad, J., Zoellner, L. A., & Foa, E. B. (2001). Linguistic predictors of trauma pathology and physical health. *Applied Cognitive Psychology, 15*, S159-S170.

Anderson, B., Goldin, P. R., Kurita, K., & Gross, J. J. (2008). Self-representation in social anxiety disorder: Linguistic analysis of autobiographical narratives. *Behaviour Research and Therapy*, *46*, 1119-1125.

Badoud, D., Prada, P., Nicastro, R., Germond, C., Luyten, P., Perroud, N., & Debbané, M. (2018). Attachment and reflective functioning in women with borderline personality disorder. *Journal of Personality Disorders*, *32*, 17-30.

Barak, A., & Gluck-Ofri, O. (2007). Degree and reciprocity of self-disclosure in online forums. *CyberPsychology & Behavior*, *10*, 407-417.

Barak, A., & Grohol, J.M. (2011). Current and future trends in Internet-supported mental health interventions. *Journal of Technology in Human Services, 29*, 155-196.

Birnbaum, M. L., Ernala, S. K., Rizvi, A. F., De Choudhury, M., & Kane, J. M. (2017). A collaborative approach to identifying social media markers of schizophrenia by employing machine learning and clinical appraisals. *Journal of Medical Internet Research*, *19*, E289.

Bonfils, K. A., Luther, L., Firmin, R. L., Lysaker, P. H., Minor, K. S., & Salyers, M. P. (2016). Language and hope in schizophrenia-spectrum disorders. *Psychiatry Research*, *245*, 8-14.

Buck, B., & Penn, D. L. (2015). Lexical characteristics of emotional narratives in Schizophrenia: Relationships with symptoms, functioning, and social cognition. *Journal of Nervous and Mental Disease*, *203*, 702-708.

Carter, P. E., & Grenyer, B. F. S. (2012). Expressive language disturbance in Borderline Personality Disorder in response to emotional autobiographical stimuli. *Journal of Personality Disorders*, *26*, 305-321.

Cavazos-Rehg, P. A., Krauss, M. J., Sowles, S., Connolly, S., Rosas, C., Bharadwaj, M., & Bierut, L. J. (2016). A content analysis of depression-related tweets. *Computers in Human Behavior, 54*,351-357.

Chesin, M., Fertuck, E., Goodman, J., Lichenstein, S., & Stanley, B. (2015). The interaction between rejection sensitivity and emotional maltreatment in borderline personality disorder. *Psychopathology*, *48*, 31-35.

Coppersmith, G., Dredze, M., & Harman, C. (2014). Quantifying mental health signals in Twitter. *Proceedings of the Workshop on Computational Linguistics and Clinical Psychology: From Linguistic Signal to Clinical Reality* (pp. 51-60).

DeAndrea, D. C. (2015). Testing the proclaimed affordances of online support groups in a nationally representative sample of adults seeking mental health assistance. *Journal of Health Communication*, *20*, 147-156.

DeChoudhury, M., Counts, S., & Horvitz, E. (2013, April). Predicting postpartum changes in emotion and behavior via social media. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 3267-3276). ACM.

Edwards, T. & Holtzman, N. S. (2017). A meta-analysis of correlations between depression and first person singular pronoun use. Journal of Research in Personality, 68, 63-68.

Finlay, A. K., Binswanger, I. A., Smelson, D., Sawh, L., McGuire, J., Rosenthal, J., Blue-Howells, J., Timko, C., Blodgett, J. C., Harris, A. H., Asch, S. M., & Frayne, S. (2015). Sex differences in mental health and substance use disorders and treatment entry among justice-involved veterans health administration. *Medical Care, 53*, S105-S111.

Fineberg, S. K., Leavitt, J., Deutsch-Link, S., Dealy, S., Landry, C. D., Pirruccio, K., Shea, S., Trent, S., Cecchi, G., & Corlett, P. R. (2016). Self-reference in psychosis and depression: A language marker of illness. *Psychological Medicine*, *46*, 2605-2615.

Fried, E. I., & Nesse, R. M. (2015). Depression is not a consistent syndrome: An investigation of unique symptom patterns in the STAR\* D study. *Journal of Affective Disorders*, *172*, 96-102.

Fung, C. K., Moore, M. M., Karcher, N. R., Kerns, J. G., & Martin, E. A. (2017). Emotional word usage in groups at risk for schizophrenia-spectrum disorders: An objective investigation of attention to emotion. *Psychiatry Research*, *252*, 29-37.

Griffiths, K.M., & Christensen, H. (2007). Internet-based mental health programs: A powerful tool in the rural medical kit. *The Australian Journal of Rural Health, 15*, 81-87.

 Gkotsis, G., Oellrich, A., Velupillai, S., Liakata, M., Hubbard, T. J., Dobson, R. J., & Dutta, R. (2017). Characterisation of mental health conditions in social media using Informed Deep Learning. *Scientific Reports*, *7*, 45141.

Gutz, L., Roepke, S., & Renneberg, B. (2016). Cognitive and affective processing of social exclusion in borderline personality disorder and social anxiety disorder. *Behaviour Research and Therapy*, *87*, 70-75.

Hofmann, S. G. (2014). Toward a cognitive-behavioral classification system for mental disorders. *Behavior Therapy*, *45*, 576-587.

Holtgraves, T. (1997). Styles of language use: Individual and cultural variability in conversational indirectness. *Journal of Personality and Social Psychology, 73*, 624-637.

Jacobi, F., Hofler, M., Siegert, J., Mach, S., Gerschler, A., Scholl, L., Busch, M. A., Hapke, U., Maske, U., Seiffert, I., Gaebel, W., Maier, W., Wagner, M., Zielasek, J., & Wittchen, H. U. (2014). Twelve-month prevalence, comorbidity and correlates of mental disorders in Germany: The mental health module of the German Health Interview and Examination Survey for Adults (DEGSS1-MH). *Psychiatric Research, 23*, 304-319.

Jarrold, W., Javitz, H. S., Krasnow, R., Peintner, B., Yeh, E., Swan, G. E., & Mehl, M. (2011). Depression and self-focused language in structured interviews with older men. *Psychological Reports*, *109*, 686-700.

Kramer, A. D., Fussell, S. R.,& Setlock, L. D. (2004, April). Text analysis as a tool for analysing conversation in online support groups. In *CHI’04 Extended Abstracts on Human Factors in Computing Systems* (pp. 1485-1488). ACM.

Krueger, R. F., McGue, M., & Iacono, W. G. (2001). The higher-order structure of common DSM mental disorders: Internalization, externalization, and their connections to personality. *Personality and Individual Differences*, *30*, 1245-1259.

Kummervold, P. E., Gammon, D., Bergvik, S., Johnsen, J. A. K., Hasvold, T., & Rosenvinge, J. H. (2002). Social support in a wired world: use of online mental health forums in Norway. *Nordic Journal of Psychiatry*, *56*, 59-65

Lyons, E. J., Mehl, M. R., & Pennebaker, J. W. (2006). Pro-anorexics and recovering anorexics differ in their linguistic Internet self-presentation. *Journal of Psychosomatic Research*, *60*, 253-256.

McIntyre, J. C., Wickham, S., Barr, B., & Bentall, R. P. (2017). Social identity and psychosis: Associations and psychological mechanisms. *Schizophrenia Bulletin*, sbx110.

McLaughlin, K. A., & Nolen-Hoeksema, S. (2011). Rumination as a transdiagnostic factor in depression and anxiety. *Behaviour Research and Therapy*, *49*, 186-193.

Minor, K. S., Bonfils, K. A., Luther, L., Firmin, R. L., Kukla, M., MacLain, V. R., Buck, B., Lysaker, P. H., & Salyers, M. P. (2015). Lexical analysis in schizophrenia: How emotion and social word use informs our understanding of clinical presentation. *Journal of Psychiatric Research*, *64*, 74-78.

Molendijk, M. L., Bamelis, L., van Emmerik, A. A., Arntz, A., Haringsma, R., & Spinhoven, P. (2010). Word use of outpatients with a personality disorder and concurrent or previous major depressive disorder. *Behaviour Research and Therapy*, *48*, 44-51.

Mor, N., & Winquist, J. (2002). Self-focused attention and negative affect: a meta-analysis. *Psychological Bulletin*, *128*, 638-662.

Naslund, J. A., Aschbrenner, K. A., Marsch, L. A., & Bartels, S. J. (2016). The future of mental health care: peer-to-peer support and social media. *Epidemiology and Psychiatric Sciences*, *25*, 113-122.

Newman, M. L., Groom, C. J., Handelman, L. D., & Pennebaker, J. W. (2008). Gender differences in language use: An analysis of 14,000 text samples. *Discourse Processes, 45*, 211-236.

Oren, E., Friedmann, N., & Dar, R. (2016). Things happen: Individuals with high obsessive-compulsive tendencies omit agency in their spoken language. *Consciousness and Cognition*, *42*, 125-134.

Parnas, J. (2015). Differential diagnosis and current polythetic classification. *World Psychiatry*, *14*, 284-287.

Pendry, L. F., & Salvatore, J. (2015). Individual and social benefits of online discussion forums. *Computers in Human Behavior*, *50*, 211-220.

Pennebaker, J. W., Boyd, R. L., Jordan, K., & Blackburn, K. (2015). *The development and psychometric properties of LIWC2015*. Austin, TX: University of Texas at Austin.

Pennebaker, J. W., & Lay, T. C. (2002). Language use and personality during crises: Analyses of Mayor Rudolph Giuliani’s press conferences. *Journal of Research in Personality, 36*, 271-282.

Pugh, K., Luzon, O., & Ellett, L. (2018). Responsibility beliefs and persecutory delusions. *Psychiatry Research*, *259*, 340-344.

Ramirez-Esparza, N., Chung, C. K., Kacewicz, E., & Pennebaker, J. W. (2008). The psychology of word use in depression forums in English and in Spanish: Texting two text analytic approaches. In *ICWSM*.

Rodriguez, A. J., Holleran, S. E., & Mehl, M. R. (2010). Reading between the lines: The lay assessment of subclinical depression from written self‐descriptions. *Journal of Personality*, *78*, 575-598.

Rosenbach, C., & Renneberg, B. (2015). Remembering rejection: Specificity and linguistic styles of autobiographical memories in borderline personality disorder and depression. *Journal of Behavior Therapy and Experimental Psychiatry*, *46*, 85-92.

Scott, K.M., Lim, C., Al-Hamzawi, A., Alonso, J., Bruffaerts, R., Caldas-deAlmeida, J.M., Florescu, S., de Girolamo, G., Hu, C., de Jonge, P., Kawakami, N., Medina-Mora, M.E., Moskalewicz, J., Navarro-Mateu, F., O’Neill, S., Piazza, M., Posada-Villa, J., Torres, Y., & Kessler, R.C. (2016). Association of mental disorders with subsequent chronic physical conditions: World Mental Health Surveys from 17 countries. *JAMA Psychiatry, 73*, 150-158.

Sheikh, S., & Furnham, A. (2000). A cross-cultural study of mental health beliefs and attitudes towards seeking professional help. *Social Psychiatry and Psychiatric Epidemiology, 35*, 326-334.

Van Os, J. (2016). "Schizophrenia" does not exist. *British Medical Journal (Online)*, *352*.

Wolf, M., Sedway, J., Bulik, C. M., & Kordy, H. (2007). Linguistic analyses of natural written language: Unobtrusive assessment of cognitive style in eating disorders. *International Journal of Eating Disorders*, *40*, 711-717.

Ybarra, M.L., & Eaton, W.W. (2005). Internet-based mental interventions. *Mental Health Services Research, 7*, 75-87.

Zimmermann, J., Brockmeyer, T., Hunn, M., Schauenburg, H., & Wolf, M. (2016). First‐person pronoun use in spoken language as a predictor of future depressive symptoms: Preliminary evidence from a clinical sample of depressed patients. *Clinical Psychology & Psychotherapy, 24*, 384-391.

**Table 1. LIWC Analysis for the Use of Personal Pronouns**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | BPD | GAD | MDD | OCD | SZ | Ctrl | Main Effect |  |
|  | M (S.D.) | M (S.D.) | M (S.D) | M (S.D) | M (S.D) | M (S.D) | *F* | *p* | *np2* |  |
| PER | 12.53 (3.63) | 12.83 (2.57) | 13.52 (3.01) | 12.95 (2.89) | 13.43 (3.83) | 10.27 (2.51) | 25.99 | <.01 | .15 |  |
| FPS | 11.15 (3.01) | 11.02 (2.58) | 11.34 (3.18) | 11.06 (2.87) | 10.95 (3.74) | 8.18 (2.83) | 15.41 | <.01 | .12 |  |
| FPP | 0.46 (0.81) | 0.15 (0.39) | 0.20 (0.51) | 0.12 (0.29) | 0.12 (0.36) | 0.74 (1.74) | 5.73 | <.01 | .07 |  |
| SPS | 0.59 (1.28) | 0.61 (1.18) | 0.54 (1.06) | 0.63 (1.62) | 0.75 (1.79) | 0.31 (0.61) | 2.51 | .031 | .01 |  |
| TPS | 1.76 (2.26) | 0.67 (1.26) | 0.95 (1.83) | 0.45 (0.94) | 0.64 (1.21) | 0.41 (1.28) | 6.82 | <.01 | .08 |  |
| TPP | 0.58 (0.80) | 0.38 (0.47) | 0.49 (0.62) | 0.69 (0.94) | 0.96 (1.43) | 0.62 (1.02) | 4.60 | <.01 | .04 |  |

*Note.* PER = Personal pronouns. FPS = First person singular. FPP = First person plural. SPS = Second person singular. TPS = Third person singular. TPP = Third person plural. Ctrl = Control group. M = Mean. S.D. = Standard Deviation. np2 = partial eta square.

**Table 2. LIWC Analysis for the Use of Emotion Words**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | BPD | GAD | MDD | OCD | SZ | Ctrl | Main Effect |  |
|  | M (S.D.) | M (S.D.) | M (S.D) | M (S.D) | M (S.D) | M (S.D) | *F* | *p* | *np2* |  |
| AFF | 6.93 (2.49) | 7.35 (2.02) | 7.41 (2.33) | 6.60 (2.14) | 5.56 (2.82) | 3.53 (2.09) | 47.53 | <.01 | .26 |  |
| POS | 2.90 (1.70) | 2.29 (1.36) | 2.72 (1.61) | 2.11 (1.36) | 2.33 (1.69) | 2.56 (1.81) | 3.70 | .003 | .03 |  |
| NEG | 3.87 (2.19) | 4.97 (1.79) | 4.56 (1.92) | 4.40 (1.88) | 3.14 (2.27) | 0.91 (0.89) | 152.47 | <.01 | .34 |  |
| ANX | 0.94 (0.85) | 2.24 (1.26) | 0.65 (0.71) | 1.63 (1.15) | 0.78 (1.06) | 0.17 (0.31) | 87.37 | <.01 | .34 |  |
| ANG | 0.97 (0.87) | 0.72 (0.68) | 1.01 (1.09) | 0.73 (0.68) | 0.70 (1.56) | 0.13 (0.29) | 38.00 | <.01 | .08 |  |
| SAD | 0.91 (0.95) | 0.78 (0.69) | 1.69 (1.13) | 0.57 (0.62) | 0.55 (0.67) | 0.26 (0.45) | 33.34 | <.01 | .25 |  |

*Note.* AFF = Affective processes. POS = Positive emotion. NEG = Negative emotion. ANX = Anxiety. ANG = Anger. SAD = Sadness. Ctrl = Control group. M = Mean. S.D. = Standard Deviation. np2 = partial eta square.