

Towards a Linguistic Model of Stress, Well-being and Dark Traits in Russian Facebook Texts

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Abstract—The presented project is intended to make use of growing amounts of textual data in social networks in the Russian language, in order to find linguistic correlates of stress, subjective well-being, moral disengagement and dark personality traits. The background for the investigation includes, on the one hand, psychological research on these phenomena and their measurement instruments, and on the other hand, recent advances in automatic text-based author profiling. The measures for these psychological phenomena are provided by recognized psychological surveys adapted to Russian. Morphological and semantic analysis, as well as statistical techniques of feature selection and automatic classification are used to investigate the relationship between the psychological states and their linguistic manifestation in social network texts. The results of the current experiments will be evaluated and compared to respective advances in English author profiling, deepening our understanding of the interconnection between these psychological characteristics and natural language use and aiding in early detection of potentially harmful mental states.

I. INTRODUCTION

Internet provides a vast amount of data, including data on verbal behaviour of individual users and groups of users. Linguistic analysis, i.e. algorithms of subjectivity analysis and, more general, text mining, can assist in uncovering the potential of the online verbal data. The negatively-marked personality characteristics are of particular interest, and have been successfully studied in English language data [1], [2]. They are also closely connected to the experience of stressful events and subjective well-being [3].

We present a linguistic approach to investigation of these psychological scales using natural language processing. The psychological scope of the investigation consists of subjective psychological well-being, stress experience, and "dark" personality characteristics. We have launched a Facebook app which gathers textual data and asks the participants to fill in a survey, thus relating texts with the marks in the four psychological dimensions. We propose an automated classification approach to investigate the resulting corpus data.

II. BACKGROUND

Various individual and psychological characteristics have been studied from the viewpoint of their verbal manifestation, from age and gender differences in language [4], to psychological profiling [5], [6].

Text-based psychological profiling implies revealing significant linguistic features and using them to model and

predict texts by authors representing certain psychological characteristics. This task is closely related to and recruited in forensic linguistics and development of NLP tools for medical psychology [7]. The procedure of text-based psychological profiling requires an additional stage compared to objective characteristics profiling, as textual data in the latter usually includes natural annotation with respective characteristics (e.g., age and gender in social networks), whereas manually completed surveys are necessary to obtain gold-standard annotation for psychological phenomena.

Recently there has been a vast volume of successful research on linguistic prediction of a variety of psychological phenomena, including clinical psychopathy in self-reports [2], subclinical dark personality traits and mental health problems in twitter texts [1], [8].

In the Russian language the work on linguistic psychological profiling has been confined to the clinical scope of mental disorders and a manual descriptive framework. Authors of recent research in medical psychology [9] make an attempt to interpret the results of some linguistically-based psychodiagnostic techniques in terms of "sense understanding adequacy" in impaired vs unimpaired groups of individuals, suggesting that a formal linguistic interpretation of the results would be fruitful.

The research presented in [10] presents a descriptive approach to investigation of the peculiarities in speech produced by patients diagnosed with schizophrenia. Using component analysis technique and manual analysis of semantic features, the authors analyze main topics of essays and self-descriptions of patients with clinical states of autism, paranoid schizophrenia and depersonalization, comparing them against a control group of medical college students.

III. MOTIVATION

We are exploring the opportunity to apply various text mining methodologies for Russian to modelling verbal correlates of psychological phenomena.

Most of the research endeavours in the field of automatic linguistic prediction and classification of psychological characteristics have by now been applied to the English language data. However, recent advances in morphosyntactic analysis of Russian [11], [12] and data in Russian available in social networks provide a technical basis for further research in psychological profiling using Russian texts. The authors of [13], [3] have adapted to Russian and evaluated psychological

surveys on dark traits, traumatic symptoms and subjective well-being, providing a psychological framework for verbal models of post-traumatic conditions and aggressive personality traits, formulating textual interconnections between previous traumatic events and subjective well-being and a possibility of using social networks for early subclinical condition prediction.

IV. METHOD

A. Data collection

We have designed a Facebook app, which is going to be spread via Facebook ads service covered by the ongoing project budget (see Acknowledgement). The app, on the one hand, suggests to participate in a survey on subjective well-being, stressful events, dark personality traits and moral disengagement, thus collecting the psychological data. The app then gathers the publicly available Facebook texts of the Russian informants which have completed the survey. It thus annotates every facebook author’s texts with their characteristics on the four psychological scales.

After answering the survey in the app, the informants are provided with feedback which describes their level of Facebook activity (in terms of wall posts publishing frequency compared to average, as to the Facebook data), their psychological state in terms of subjective well-being level and level of possible traumatic experience, and also their usual behavior and beliefs in the social context, according to their Dark Triad and Moral Disengagement scores. All scores are stratified in terms of "high, "medium" and "low" values.

The effective numbers of participants reported in the previous studies range from 14 psychopaths and 52 controls respectively [2] to 5700 control group participants and 150-450 individuals labelled with a diagnosis [8]. The former contains an analysis of self reports around 2500 words by each participant, while the latter has to do with tweets, their numbers ranging from 25 to 3200 per participant. Both works report a number of significant features identified, although the more extensive data naturally allows to reveal more specific and not semantically predefined features.

We expect to obtain at least one thousand participants, collecting all their public texts for the last two years, since September 2013. The minimum threshold of words per participant is estimated around 1000 and will be further tuned according to the quantity and quality of the obtained data. Assuming a normal distribution of the measures in question [3], for every measure around 68% of the sample falls into the one-standard-deviation confidence interval, leaving 15% in the left and right tails of the distribution. Thus we hope to obtain at least 150 authors for every scale extreme, i.e. every "positive" and "negative" class.

B. Experiment setting

We formulate the task of prediction as a classification problem in the resulting text corpus, with the annotation provided by the survey results. First, correlation analysis and feature selection methods will be applied in order to identify significant features, which will be analysed in terms of theoretical considerations on the mental states in question and

compared to the corresponding linguistic features reported in English-language literature [2], [1], [8]. Secondly, the identified features will be used for the classification task per se. The obtained numeric measures of the psychological phenomena will be applied to split the data into "positive" and "negative" classes in two ways: first, a natural 3-class stratification used for feedback, including only the "high" and "low" extremes; second, a distribution-based stratification will be applied, with the authors who qualify far enough from the mean value on certain dimensions constituting the "high" and "low" classes. The resulting models are intended to classify the authors in terms of extreme measures on specific dimensions.

C. Tests

Annotation for our statistical inference will be provided by the following psychological surveys:

- 1) The short moral disengagement survey form [14]. It contains 8 questions, each representing a trend towards a certain mechanism of moral disengagement, as described in [15].
- 2) The Post-Traumatic Stress Disorder (PTSD) screening procedure described in [16], containing four questions. The first and the second surveys have been translated and adapted to Russian in [3].
- 3) The short "Dark Triad" personality traits survey [17], adapted to Russian by [13]. The survey consists of 27 questions resulting in values on three subclinical scales: Machiavellianism, narcissism, and psychopathy.
- 4) The World Health Organization (WHO) Well-being Index (WHO-5), adapted to Russian by WHO and freely available at https://www.psykiatri-regionh.dk/who-5/Documents/WHO5_Russian.pdf.

Table I contains statistics of the scales and sub-scales in the survey. Every scale is associated with a resulting numeric value range and are stratified for feedback and classification.

TABLE I. RESULTING VALUE RANGES FOR THE PSYCHOLOGICAL SURVEY SCALES

Id	Scale	Sub-scale	Questions	Result values
1	Moral disengagement	-	8	8 - 56
2	PTSD	-	4	0 - 4
3	Dark Triad	Machiavellianism	9	9 - 45
4	Dark Triad	Narcissism	9	9 - 45
5	Dark Triad	Psychopathy	9	9 - 45
6	WHO-5	-	5	0 - 100

D. Linguistic features

Linguistic features for statistical analysis will include lexical and semantic tokens and ngrams, syntactic, sentiment and negation characteristics, word and sentence length indicators. These features are reported to be effective in similar English-language tasks (i.e., [1], [5], [8]). We find it important to make use of the Russian rich morphology by including morphological characteristics as linguistic features. We will apply morphological analysis based on [11] pursuing two goals: first, we need normalized lexical items; second, we expect some morphological tags on their own to be meaningful for

the applied psychological categories. To overcome sparseness, some Russian and adapted thesauri will be applied [18], [19], [20].

E. Statistical and evaluation methods

Feature selection methods ((relative) information gain, relief measure, recursive elimination), dimensionality reduction (PCA, ICA, factor analysis), inferential statistics (correlation analysis, ANOVA) and machine learning techniques of different level of complexity (linear and logistic regression, SVM, Naive Bayes, neural networks) will be applied to identify linguistic features containing information about the psychological characteristics.

A computational model of interrelations between psychological phenomena and linguistic behaviour will be proposed. Evaluation will include measuring Accuracy, Recall, Precision, F1 and Area Under The Curve in cross-validation prediction experiments.

V. EXPECTED RESULTS

In accordance with the previously reported results [1], [2], we anticipate to find significant lexical and grammatical indicators of the discussed psychological characteristics. To be more specific, we expect the prevalence of different semantic classes corresponding to motivational, affective, cognitive and topical trends depending on specific psychological traits. Special attention will be dedicated to words bearing grammatical function (pronouns, conjunctions) and also to the purely morphological characteristics, such as verb tense and person.

English language-based results ([1], [5]) indicate that the scope of narcissism-related states, including illness and depression on the one hand and the Dark Triad on the other hand, is characterized by extensive usage of first person singular pronoun 'I', 'me', while first person plural forms correlate negatively with narcissism. However, in English the resources expressing such grammatical meaning are limited to pronouns and auxiliary verb 'be', while Russian verb morphology regularly expresses these grammatical combinations. Thus combined verb person and number features are anticipated to be especially significant in the models of narcissism and related self-focused characteristics.

We expect these Russian-specific linguistic phenomena along with the widely used lexical, semantic and ngram features to become a sufficient foundation for a model with reasonably high performance in the prediction task. By making use of the rich morphology of Russian, we hope to perform equally or higher than the reported English results [1].

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