

Lexical, Morphological and Semantic Correlates of the Dark Triad Personality 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 the Dark Triad personality traits, comprising non-clinical Narcissism, Machiavellianism and Psychopathy. 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 computational stylometry and text-based author profiling. The measures for these psychological phenomena are provided by recognized self-report psychological surveys adapted to Russian. Morphological and semantic analysis are applied to investigate the relationship between the Dark traits and their linguistic manifestation in social network texts. Significant morphological and semantic correlates of Narcissism, Machiavellianism and Psychopathy are identified and compared to respective advances in English author profiling. In order to deepen our understanding of the relation between these psychological characteristics and natural language use, the identified linguistic features are interpreted in terms of the fine-grained factor structure of the Dark traits. Identifying correlated features is a step towards automatic Dark trait prediction and early detection of the potentially harmful mental states.

I. INTRODUCTION

Internet provides a vast amount of data, including data on verbal behaviour of individuals and groups of users. Data on verbal and social network usage patterns can provide insight into numerous sociological and psychological characteristics [1]. Text mining can assist in uncovering the potential of the online verbal data, with the latest works in the field describing psychological profiling in a multilingual setting [2].

The empirical study in question is a part of a larger research project aimed to explore the relations among online and offline stressful experience, psychological well-being, negative personality traits and the language a person uses in online communication ("A cross-cultural study of the markers of stress, health and well-being in social networks"). To measure the negatively oriented personality traits and thus the general possibility of a person's misbehavior, two questionnaires were chosen: the Short Dark Triad scale [3], [4] and the Propensity for Moral Disengagement scale [5]. These two scales have already been used to study the predictors of unethical behavior in English [6]. Moreover, the three traits - Narcissism, Machiavellianism and Psychopathy - having the lack of empathy as their core characteristic, are considered very fruitful in the studies of malevolence, which is the primary goal of

the larger research project [7], [8]. The negatively-marked personality characteristics have been successfully studied in English language data [9], [10]. Besides, the Short Dark Triad scale has been recently translated and adapted to Russian [11].

We present a linguistic approach to investigation of the Dark Triad personality traits using natural language processing. We have launched a Facebook app which gathers textual data and asks the participants to fill in a survey, thus annotating texts with levels of Narcissism, Machiavellianism and Psychopathy of the authors provided by the survey results. We propose a number of morphological and semantic features, identify significant correlates of the Dark traits among them, provide interpretation of the results and relate them to similar findings in different languages.

The paper is organized as follows: Section II contains an overview of similar approaches to author profiling and the Dark Triad research; Section III describes our dataset; Section IV is a description of the statistical analysis procedure; Sections V and VI contain the results obtained, their detailed interpretation, and overall conclusions.

II. RELATED WORK

A. Linguistic Inquiry and Word Count approach

A widely known approach known as Linguistic Inquiry and Word Count (LIWC) [12] has been developed for English and other languages [13], [14]. The main idea of the approach is that words are grouped into psychologically meaningful categories, and specific counts of the categories in a person's text can be interpreted in psychological terms and linked to their psychological profile. Lexical items are first divided into function words and content words, where the former are considered as meta-behavioural information on *how* the author thinks and communicates, and the latter providing information on *what* the topics of concern are in their texts [15]. Content and function words are manually grouped to obtain predefined top-down categories, which are accounted for in texts and used for author profiling. Content categories include psychological - social, cognitive, biological, affective - processes, positive and negative sentiment, topics of personal concern (work, leisure, home, money); function words include auxiliary parts of speech like pronouns, quantifiers, articles, and a number of verb categories - tense, person, number; the total number of categories reaches 80.

B. Russian author profiling

There has been a significant body of work on the LIWC approach to word psychometrics, including eastern [13] and slavic [14] languages. LIWC for Russian [16] has been developed, but has not undergone specific validation by the authors.

In the Russian language the work on linguistic author profiling has been mostly confined to the clinical scope of mental disorders and a manual descriptive framework, with the focus on interpretative diagnostic power [17], [18]. Recent exception is a work involving written text samples by 500 Russian participants [19]. The Russian version of LIWC was applied in this work: it was tested for author-specific word count stability and applied to author profiling with gender and Big Five personality characteristics [19], not involving social media texts.

C. Russian LIWC approach revisited

Despite the altogether relevant and fruitful LIWC approach giving indispensable insights from different languages, there is an issue with the LIWC approach in Russian: it has been developed as a direct translation from English, preserving English-specific category and algorithm structure.

First of all, a division of features into function and content words, while basically reflecting the state of affairs in English, can be misleading for Russian: functional categories are largely represented in Russian by morphological properties of content words, i.e. number, person categories of verbs. Second, the LIWC algorithm is word-base oriented: a word is assigned a certain category if its base matches a dictionary word. Such an approach is reasonable for languages with low syntheticity, where a word base often equals the word. Russian language lies at the opposite end of the spectrum with high syntheticity and high fusion, which means that words are formed using a high number of affixes, and they are often fused, making word form and meaning non-additive (see [20] and later development, i.e. [21], [22]). High syntheticity and fusion result in the fact that a single lexical or grammatical meaning is not as often represented by a single word base, as in English. A word-base dictionary approach would thus fail to account for a lot of functional and content phenomena. It is necessary to introduce an additional feature category containing morphological and some lexical features in order to represent the phenomena which cannot be accounted for in a simple dictionary structure.

We apply a bottom-up approach to content and functional categories: the former are automatically bootstrapped from corpus data using distributional semantic techniques; the latter are based on the vast morphological information in Russian. The outlined bottom-up approach allows to omit time- and resource-consuming procedure of manual classification, while retaining the Russian-specific semantic and morphological category structure.

D. Facebook language data

A similar data-driven approach to word, phrase and content topic features correlated with age, gender and the Big Five personality traits of Facebook users is presented in [23]. Current work explores the same consideration that an open-vocabulary approach to lexical features could be more revealing than a pre-set top-down category list. We also follow [23] in generating

content categories automatically to include most of the vocabulary. However, there is a number of significant differences: first, analysing texts in Russian requires scrupulous normalization or morphological analysis. Second, in the current work content categories are generated based on large balanced Russian corpora, and not on the social network data obtained, as the latter dataset is too small and too specific to represent general semantic categories.

There has been a considerable amount of work done using Facebook data in Russian, where a large amount of data (3M+ users, 550M+ posts) was gathered from Facebook and applied to the primarily linguistic tasks of Sentiment Analysis and semi-automatic identification of neologisms [24], [25]. However, it is important to notice the difference of our work in terms of research goals and respective data domains: while covering a much smaller number of authors, we are concerned with very fine-grained data containing personal psychological questionnaire results. The latter data is considerably more complicated to obtain both technically and from the point of view of ethical issues, which currently prevents the resulting corpus from being freely distributed as open access data.

To conclude, the current work presents the first attempt to gather and explore psychological and linguistic data in Russian Facebook. To our knowledge, it is the first attempt of using word-embeddings semantic models to generate meaningful categories for author profiling. It is also the first work to approach semantic and morphological correlates of the Dark traits in the Russian language.

E. The Dark Triad personality traits

Our analysis is focused on the Dark Triad personal characteristics. These are related but distinct sub-clinical categories, where Narcissism is primarily associated with self-focus and grandiosity, Psychopathy with impulsiveness, aggression and asocial behaviour, and Machiavellianism with manipulating. Lack of empathy is reported to be the common feature of the Dark Triad [4]. The following factor structure is ascribed to the Dark traits:

- Narcissism is described as a combination of Exploitativeness/Entitlement and Leadership/Authority [4].
- Machiavellianism is a multi-dimensional but controversial construction; the factors accepted in [4] are Machiavellian Tactics and Cynical Worldview.
- Psychopathy is reported to incorporate Manipulation, Callous Affect, Erratic Lifestyle, Antisocial Behaviour [4].

The Dark Triad questionnaire has been recently adapted to Russian and has undergone language-specific validation [11].

Linguistic correlates of Psychopathy have been effectively analysed on English-language data in a clinical context [10]. It involved crime narratives around 2500 words each by 14 psychopaths and 52 controls. Authors of [26] describe LIWC-based analysis of Twitter texts by 5700 control group participants and 150-450 individuals labelled with a diagnosis, each participant being associated with 25 to 3,200 Tweets. An important contribution of this work is interpretable analytics combining the users' verbal and non-verbal online behaviour.

A study of the Dark Triad correlates in English has been performed with 2,500 authors of Twitter texts [9]. The positive content correlates included anger, swear and negative emotion words for Psychopathy and Machiavellianism, sex-related words for Narcissism. Narcissism was also positively correlated with function symbols (@, #) used in Twitter to denote relations between users and between users and topics, thus modelling a meta-category of social relation symbols in Twitter. Negative correlates included positive emotion and 'we' for Machiavellianism.

III. DATA COLLECTION

1972 Facebook users participated in the study by completing the Dark Triad Scale [11] and providing consent to share their publicly available posts. This questionnaire is a validated self-report measure of the so called dark personality traits: Narcissism, Machiavellianism and subclinical Psychopathy. Each trait is assessed by 9 questions about the users' attitude and behaviour towards themselves and others. The answers are situated on a 5-point Likert scale representing the degree of agreement or disagreement with the statements in question. The total score for each subscale is divided by 9 (the number of questions) resulting in a score range for each scale from 1 to 5.

The application with the questionnaire had been advertised on Facebook (<https://apps.facebook.com/psytest/>). The public posts have been gathered, with text cited or written by the users themselves, repost information being out of scope of the current work. The obtained dataset consists of **7.67** posts on average for each participant, standard deviation = 5.69. This is on average **24.77** sentences (std = 38.13) or **311.99** tokens (std = 565.56) per participant. The volume of posts by each author was technically restricted by Facebook API (<https://developers.facebook.com/docs/javascript/reference/v2.6>), which only allowed for a definite number of latest posts to be downloaded. Only the posts containing personal comments by the participant, no repost texts, were included in the study.

The volume of text by each author is modest comparing to previous studies; however, the numbers of authors are comparable [26], [9]. Preliminary experiments on automatic classification and regression have confirmed that a larger dataset is necessary for significant Machine Learning results, which we proceed to obtaining in future work. On the other hand, the number of Facebook users in the study allows to make exploratory conclusions based on statistical analysis, allowing for fruitful psychological interpretation.

Text volume by each author in tokens and sentences is significantly negatively correlated with Machiavellianism ($p < 0.01$) and positively with Narcissism ($p < 0.05$). Text volume characteristics can't be directly interpreted, as they depend on the technical restriction on the number of downloadable posts; however, they will affect further results interpretation.

IV. STATISTICAL ANALYSIS

All the data have been processed with PyMorphy2 morphological package [27] using the default morphological disambiguation option, unigram statistics. We apply Spearman's correlation coefficient, as we are primarily interested in finding monotonous relationship between linguistic items and the Dark

Triad measure, not limited to the linear correlation identified by Pearson's r .

A. Statistical significance correction

An important issue addressed in this work is the significance of the statistical results. Spearman's correlation reflects r , the correlation value ranging from -1 to 1, with 0 indicating no correlation, and p , indicating the degree to which the current r value could be obtained by chance in a random sample. It has been shown in previous linguistic profiling works with different sample sizes [9], [23] that the values of r do not usually exceed 0.2 in absolute value. This supports the consideration that word categories tend to be sparse in multi-purpose social network texts, with very high correlation values between word counts and personal characteristics appearing a very superficial case.

However, there is another strong correlation significance filter which applies to the p-value. It is a well-known issue that in multiple-hypothesis testing the p-values must be adapted [28]. The intuition behind multiple-testing correction is that when evaluating correlation with a large number of features, a small portion of random features obtain statistically significant correlation by chance. In order to eliminate the random effects of numerous hypotheses, various statistical filters are suggested. E.g., the Bonferonni correction procedure requires the resulting p-values in multiple-hypothesis testing to be multiplied by the hypothesis number, thus allowing a much lower number of p-values to pass the level of $p < 0.01/0.05$ [23].

A surprising number of state-of-the-art works in author profiling do not mention applying multiple-hypothesis correction procedures ([12], [9], [13], [19]). We find it necessary to apply a filtering procedure to our results, as the number of lexical features exceeds 19K, and content and morphological features reach 184 and 64 respectively. As the Bonferonni correction is reported to be too stringent, resulting in a portion of false rejections [23], we apply the Benjamini-Hochberg false discovery rate procedure for multiple hypothesis testing (FDR) [28]. This allows to control for statistically significant results in the current setting of a modest dataset size with a large number of correlated features.

B. Numeric characteristics

Spearman's correlation ($r(1,972)$) was applied to self-reported Dark Triad measures and text-length, lexical and morphological features. Average sentence length and post length in sentences and tokens reveal some significant correlations with the Dark Triad measures, see Table 1: significant correlations are highlighted in italics ($p < 0.05$) and bold ($p < 0.01$).

TABLE I. SPEARMAN'S CORRELATIONS BETWEEN AVERAGE POST LENGTH FEATURES AND PERSONALITY SCORES

Text feature	Na	Ma	Ps
Sentence length	0.022	<i>-0.057</i>	0.006
Post length, sentences	<i>0.054</i>	-0.109	-0.04
Post length, tokens	<i>0.045</i>	-0.101	-0.02

C. Lexical features

Normal forms of words constitute lexical features. Out of 19K lexemes occurring in the texts there are around 150 correlated words for every Dark Trait; these are exemplified in Table II. However, the FDR correction procedure rejects their significance based on the current dataset.

D. Morphological features

Morphological features are based on Py-Morphy tagset [27], list of tags is available at <http://opencorpora.org/dict.php?act=gram>. Along the lines of LIWC parameters [15], the features include the following:

- All parts of speech;
 - auxiliary parts of speech - preposition, conjunction, particle, interjection - are also grouped together;
- Person and number, standalone and grouped with POS;
- Verb modality features:
 - voice: active, passive;
 - mood: indicative, imperative;
 - tense: present, past;
 - reflexivity;
- Named entity features:
 - name, surname, patronymic;
 - organization, trademark, geographical location, abbreviation;
- Adjective features:
 - short, full;
 - qualitative;
 - superlative;
- Possessive pronouns;
- Style characteristics:
 - vernacular, slang words.

Morphological correlates are illustrated in Table IV.

E. Generalized content features

In order to obtain semantically interpretable features and reduce the number of testing hypotheses, we apply clustering based on word-embeddings semantic modelling.

To reduce clustering evaluation and leave out obscure and rare items we only cluster the words which occur in at least 10 authors' texts. Thus we obtain a set of 3,700 lexical items to be clustered. We use a Skip-Gram Word2Vec model trained with the Russian National Corpus data. We intentionally apply RNC and not a web-trained model, as the goal is to capture established semantic regularities interpretable in terms of general semantic categories, while describing web language peculiarities is a different task.

The clustering techniques applied in this task have been compared in [29]. The optimal algorithm for the current task is K-means with Euclidean distance, yielding the most homogeneous and precise clusters. The optimal number of

clusters for manual labelling, evaluation and interpretation of the current data is 20 words per cluster, i.e. 184 clusters. Other clustering algorithms and parameters have been applied in preliminary experiments; resulting in various cluster sizes and slightly different cluster contents, different algorithms maintain the basic significant topics unchanged.

The clusters have been manually labelled with a concept comprising their members. Function words, numerals and unknown words are out of scope of the semantic model and out of the clusters.

The generalized semantic correlates are illustrated in Table III. Table V (see Appendix) contains contents of the significantly correlated clusters.

V. RESULTS AND INTERPRETATION

A. General considerations

Russian-speaking Facebook users with higher scores on the scale of Machiavellianism are less likely to produce posts; the length of their posts and sentences is shorter in comparison with users characterized by lower scores of Machiavellianism. The posts and sentences of Facebook users scoring high on Narcissism are significantly longer than those of users scoring low on Narcissism. This is consistent with psychological models of Machiavellianism and Narcissism, wherein individuals with prominent machiavellianistic traits would be more likely to closely guard their personal image and avoid oversharing as a result of careful strategic planning [30], [4], and individuals with high Narcissism would tend to be more 'ego-promoting', i.e. expansive and needing to attract attention to their actions and personality [31], [4].

Because of the modest amount of textual data, lexical correlates of the Dark traits and morphological correlates of Narcissism and Psychopathy have been filtered out by the statistical significance correction procedure. However, by presenting a number of significant semantic correlates for every Dark trait we have shown that semantic clustering is a useful, intuitive and interpretable approach to reducing feature dimensionality in case of a limited dataset, high lexical diversity and sparsity.

B. Narcissism

High Narcissism values are characterized by the following correlated items:

- 1) **Social involvement** and communication importance is present in clusters denoting social interaction as Appeal, Take_give. These features replicate the findings reported in [9], where high Narcissism was characterized by social involvement in terms of high correlations with 'Friends' category and with punctuation symbols (@, #) denoting social interaction in Twitter.
- 2) Importance of **self-image and status** is present in High_low word cluster.
- 3) **Goal-focus**, achievement, competency are stressed by the Reasoning cluster.

With regard to the accepted factor structure of Narcissism [4], goal focus applies to Leadership/Authority, the status features are related to Exploitativeness/Entitlement, while social

TABLE II. LEXICAL CORRELATES OF THE DARK PERSONALITY TRAITS

Language	Narcissism		Machiavellianism		Psychopathy	
	Positive, 129	Negative, 10	Positive, 16	Negative, 160	Positive, 136	Negative, 13
Russian	масса, мой, одновременно, сокращение, важный, целый, слово, благодарность, решение, смс, я, президент, собственный, спасибо, дурной, править, забытый, ...	дохлый, посвящаться, доставать, подмосковье, снизу, мент, 1993, nice, ерунда, la	russia, оригинал, стройный, игил, новороссийск, инвестиция, жарко, замуж, бродить, беспомощный, выход, фотка, новыйгод, президент, провайдер, трое	и, себя, очень, любить, чтобы, сердце, друг, каждый, мы, понять, много, физический, господь, чувство, война, ...	сша, российский, путин, нация, президент, пользователь, привязать, нормальный, славянский, заканчиваться, деньга, масса, институт, давно, состав, признать, рубль, ...	порадоваться, даровать, предновогодний, подводить, задуматься, друг, вдохновлять, крыло, мел, раздавать, nice, наделить, внимательный
English translation	mass, my, simultaneously, reduction, important, whole, word, gratitude, decision, sms, I, president, own, thank you, silly, rule, forgotten, ...	dead, dedicated, reach, Moscow suburbs, below, policeman(derogatory), 1993, nice, nonsense, la	russia, original, slim, isis, Novorossiysk city, investment, hot, married, wander, helpless, exit, photo, newyear, president, provider, three	and, self, much, love(verb), in order to, heart, friend, every, we, understand, a lot, physical, god, feeling, war, ...	usa, russian, Putin, nation, president, user, tie(verb), normal, slavic, be over, money, mass, institute, long ago, content, acknowledge, ruble, ...	be glad, grant, new year eve's, betray, think, friend, inspire, wing, chalk, hand out, nice, endow, attentive

TABLE III. MORPHOLOGICAL CORRELATES OF THE DARK PERSONALITY TRAITS, * $p < 0.05$, FDR-CORRECTED

Narcissism		Machiavellianism		Psychopathy	
Cluster	Correlation	Cluster	Correlation	Cluster	Correlation
		Patronymic*	-0.083		
		1person_plural*	-0.074		
		Verb_1person_plural*	-0.073		
		3person_plural*	-0.071		
		Pronoun_1person_plural*	-0.071		
		3person_singular*	-0.069		
		Adjective_short*	-0.068		
		Pronoun_3person_plural*	-0.066		
		Verb_3person_plural*	-0.066		
Verb_imperative	0.073	Pronoun_2person_plural*	-0.064		
Interjection	0.065	Verb_3person_singular*	-0.062		
Pronoun_2person_plural	0.065	Adjective_full*	-0.062	Vernacular	0.049
Pronoun_1person_singular	0.062	Participle_full*	-0.060	Slang	0.049
2per_plural	0.059	Adverbial_participle*	-0.060	Organization	0.047
Possessive	0.050	2person_plural*	-0.059	Adjective_short	-0.045
Punctuation	0.047	Pronoun_3person_singular*	-0.058		
Verb_2person_plural	0.046	Surname	-0.056		
		Qualitative	-0.054		
		Active	-0.053		
		Participle_active	-0.053		
		Participle_passive	-0.052		
		Name	-0.050		
		Verb_2person_plural	-0.048		
		Conjunction	-0.046		
		Pronoun	-0.045		
		Possessive	-0.045		

involvement can be related to both Leadership and Exploitativeness.

C. Machiavellianism

Lexical, semantic and morphological features correlated with Machiavellianism follow a single pattern of mostly negative correlation. The significant topics include the following:

- 1) **Social involvement**, communication and relationship issues are particularly **rare** in high Machiavellianism:
 - clusters Affirm, Friend, Feeling_vb, Tender_adj, male and female names;
 - numerous morphological features: first person plural verbs and pronouns, some names (patronymics), reference to other people with third and second person verbs and pronouns.

The negative social communication feature was also reported as prominent in Machiavellianism in [9], represented by negative correlations with first person plural pronoun, family and social processes word categories.

- 2) **Positive affect** is less likely to occur with high Machiavellianism according to the **negatively correlated** clusters Wellbeing, Impress, confirming the findings by [9] of negatively correlated affective processes and positive emotion words.
- 3) Issues of **mental processing** are **negatively represented** by the clusters Faith, Religion, Perception, Sensation, Appearance.
- 4) Negatively correlated pronouns and verbs indicate **personal detachment** and formality in speech ([15]).
- 5) A number of **negatively correlated** cluster categories of **common, casual topics** (Verbs, Neg_action, Trouble, face- and body-related words, Citizen, Age,

TABLE IV. SEMANTIC CLUSTER CORRELATES OF THE DARK PERSONALITY TRAITS, * $p < 0.05$, ** $p < 0.01$, FDR-CORRECTED

Narcissism		Machiavellianism		Psychopathy	
Cluster	Correlation	Cluster	Correlation	Cluster	Correlation
		Faith**	-0.101		
		Wellbeing**	-0.094		
		Friend**	-0.094		
		Verbs**	-0.085		
		Sensation**	-0.084		
		Difficult**	-0.083		
		Affirm**	-0.083		
		Appearance**	-0.083		
Appeal*	0.080	Material**	-0.083		
Take_give*	0.076	Tender_adj**	-0.083		
High_low*	0.073	Space**	-0.081	Money**	0.110
Reasoning*	0.073	Neg_action*	-0.076	Food*	0.08
Authority	0.068	Female_name*	-0.076	Money_affair*	0.075
Monument	0.068	Male_name*	-0.076	Political*	0.074
Goal	0.068	Trouble*	-0.070	Authority	0.071
Passion	0.066	Perception*	-0.070	Virtual	0.069
Pos_quality	0.066	Feeling_vb*	-0.070	Sky	-0.068
Event	0.064	Impress*	-0.064	Friend	-0.068
Feeling	0.061	Religion*	-0.063	Powerful_male	0.066
Want	0.059	Face_part*	-0.062	Money_operation	0.064
Casual	0.059	Water_object*	-0.062		
Perfection	0.058	Body_situation*	-0.062		
Regulations	0.058	Furniture_object*	-0.062		
		Number*	-0.062		
		Being*	-0.062		
		Wild*	-0.062		
		Citizen*	-0.061		
		Anniversary*	-0.061		
		Clothing*	-0.060		
		Age*	-0.059		

Being) suggest an overall decrease in general, daily issues-related speech. This goes in line with an overall decrease in post number and volume, as Machiavellianism increases.

Based on the accepted factors of Machiavellianism described in [4], negatively correlated general topics and an overall lack of positive correlates are in line with the Machiavellian cynical views on the world and people, leading to lack of self-disclosure. The same is true for lacking positive emotional expressions, mental processing features and social involvement. Personal detachment and formality in speech may apply to Cynical Worldview and to Machiavellian tactics, as they can represent deceptive speech.

D. Psychopathy

- 1) High concern for **basic needs** in Psychopathy is demonstrated by a number of money and food-related clusters (Money, Money_affair, Food). This confirms strong 'Sex' and 'Body' correlates of Psychopathy reported in [9].
- 2) Prevailing **political** and authority issues are represented by the Political word cluster.

According to the factor structure of Psychopathy [4], political and authority focus displays Manipulation, while Callous Affect and Antisocial Behavior are represented in high concern for basic needs.

Statistically identified linguistic features show modest correlation measures, however, both statistical significance and correlation levels replicate those identified in an English-speaking sample of comparable and larger sizes [9], [23]. Statistical significance procedures have shown that larger text samples are necessary in future research to add to lexical

and morphological findings and confirm the list of significant semantic features.

VI. CONCLUSIONS AND FUTURE WORK

We have developed semantic and morphological psychometric categories based specifically on Russian language and a statistical processing tool based on PyMorphy analyser [27]. The psychometric tool has been applied to texts of Russian Facebook users, who also filled a self-report questionnaire on the levels of the Dark Triad personality traits. We have identified significant morphological and semantic correlates of the Dark traits, and interpreted them in terms of larger linguistic categories. The most prominent categories have replicated the findings reported in previous work on the Dark Triad in English language. Finally, most of the revealed linguistic features are related to psychological factors of the Dark traits.

The statistical bottom-up approach has proven to be a plausible and fruitful research method. The developed morphological and semantic categories represent Russian language peculiarities and give informative results comparable to English-language LIWC-based research.

The described significant morphological and semantic patterns will supply a deeper understanding of the psychological characteristics of individuals with prominent Dark traits. To our knowledge there have been no previous studies of the language of the Dark traits in Russian samples. We may assume that the increased understanding of the linguistic characteristics of Narcissism, subclinical Psychopathy and Machiavellianism in Russian samples will enhance the theoretical psychological model of the Dark Triad. The local cultural and national features mirrored in the language will bring more detailed descriptions of these individuals, which may be used to identify Dark trait patterns in counselling, psychotherapy, forensic assessments and negotiation procedures.

In order to enhance the list of significant linguistic features, the following research step will involve larger amounts of textual data. The proposed categories are subject to refinement: the semantic categories are to be associated with LIWC-based categories, specifically those denoting psychological processes and sentiment; the morphological and lexical categories should be enhanced by applying a dataset with larger text sample per participant.

Our next research steps involve expanding the dataset to allow automatic personality identification, i.e. regression and classification of the Dark trait levels based on the Facebook text collection.

ACKNOWLEDGMENTS

The reported study is supported by Saint-Petersburg State University research grant 8.38.351.2015 "A cross-cultural study of the markers of stress, health and well-being in social networks".

REFERENCES

[1] M. Kosinski, S. C. Matz, S. D. Gosling, V. Popov, and D. Stillwell, "Facebook as a research tool for the social sciences: Opportunities, challenges, ethical considerations, and practical guidelines." *American Psychologist*, vol. 70, no. 6, p. 543, 2015.

[2] B. Verhoeven, B. Plank, and W. Daelemans, "Multilingual personality profiling on twitter;" *To be presented at DHBenelux 2016, Belval, Luxembourg*, 09/06/2016 In Press.

[3] D. L. Paulhus and K. M. Williams, "The dark triad of personality: Narcissism, machiavellianism, and psychopathy." *Journal of research in personality*, vol. 36, no. 6, p. 556–563, 2002.

[4] D. N. Jones and D. L. Paulhus, "Introducing the short dark triad (sd3) a brief measure of dark personality traits." *Assessment*, vol. 21, no. 1, pp. 28–41, 2014.

[5] C. Moore, J. R. Detert, L. KLEBE TREVIÑO, V. L. Baker, and D. M. Mayer, "Why employees do bad things: Moral disengagement and unethical organizational behavior," vol. 65, no. 1, pp. 1–48. [Online]. Available: <http://onlinelibrary.wiley.com/doi/10.1111/j.1744-6570.2011.01237.x/full>

[6] V. Egan, N. Hughes, and E. J. Palmer, "Moral disengagement, the dark triad, and unethical consumer attitudes," vol. 76, pp. 123–128. [Online]. Available: <http://www.sciencedirect.com/science/article/pii/S019188691400703X>

[7] A. Book, B. A. Visser, and A. A. Volk, "Unpacking "evil": Claiming the core of the dark triad," vol. 73, pp. 29–38. [Online]. Available: <http://www.sciencedirect.com/science/article/pii/S0191886914005182>

[8] A. Furnham, S. Richards, L. Rangel, and D. N. Jones, "Measuring malevolence: Quantitative issues surrounding the dark triad of personality," vol. 67, pp. 114–121. [Online]. Available: <http://www.sciencedirect.com/science/article/pii/S0191886914000932>

[9] C. Sumner, A. Byers, R. Boochever, and G. Park, "Predicting dark triad personality traits from twitter usage and a linguistic analysis of tweets," in *Machine Learning and Applications (ICMLA), 2012 11th International Conference on*, vol. 2. IEEE, 2012, pp. 386–393.

[10] J. T. Hancock, M. T. Woodworth, and S. Porter, "Hungry like the wolf: A word-pattern analysis of the language of psychopaths," *Legal and Criminological Psychology*, vol. 18, pp. 102–114, 2013.

[11] M. Egorova and M. Sitnikova, "The dark triad," *Psikhologicheskie Issledovaniya*, vol. 7(38), p. 12, 2014. [Online]. Available: <http://psystudy.ru/index.php/num/2014v7n38/1071-egorova38.html>

[12] J. W. Pennebaker, M. E. Francis, and R. J. Booth, "Linguistic inquiry

and word count: Liwc 2001," *Mahway: Lawrence Erlbaum Associates*, vol. 71, 2001.

[13] C. H. Lee, K. Kim, Y. S. Seo, and C. K. Chung, "The relations between personality and language use," *The Journal of general psychology*, vol. 134, no. 4, pp. 405–413, 2007.

[14] J. Bjekić, L. B. Lazarević, M. Živanović, and G. Knežević, "Psychometric evaluation of the serbian dictionary for automatic text analysis—liwceser," *Psihologija*, vol. 47, no. 1, 2014.

[15] Y. R. Tausczik and J. W. Pennebaker, "The psychological meaning of words: Liwc and computerized text analysis methods," *Journal of language and social psychology*, vol. 29, no. 1, pp. 24–54, 2010.

[16] A. Kailer and C. K. Chung, "The russian liwc2007 dictionary," *LIWC.net*, 2011.

[17] N. Zvereva, E. Mikhaleva, S. Nosov, and Y. Y. Nikitina, "Eksperimental'noe issledovanie osobennosti rechevoi deyatel'nosti u muzhchin, bol'nykh shizofreniei.[elektronnyi resurs][experimental research of features of speech activity in men with schizophrenia]," *Meditsinskaya psikhologiya v Rossii [Medical psychology in Russia]*, no. 4, 2011.

[18] P. Y. Zavitaev, "Autism: a clinical-semantic and experimental-psychological investigation, [autism: kliniko-semanticheskoe i eksperimental'no-psichologicheskoe issledovanie], in russian," *Russian Journal of Psychiatry, [Rossiyskiy Psikhiatricheskii Zhurnal]*, vol. 5, pp. 44–48, 2007.

[19] T. Litvinova, O. Litvinova, Y. Ryzhkova, Y. Biryukova, P. Seredin, and O. Zagorovskaya, "Studying influence of author's gender and psychological characteristics on quantitative parameters of text using "linguistic inquiry and word count" program," *Naučnyj dialog (Scientific dialogue)*, in Russian, p. 101, 2015.

[20] J. H. Greenberg, "A quantitative approach to the morphological typology of language," *International journal of American linguistics*, vol. 26, no. 3, pp. 178–194, 1960.

[21] A. Pirkola, "Morphological typology of languages for ir," *Journal of Documentation*, vol. 57, no. 3, pp. 330–348, 2001.

[22] J. Siegel, B. Szmrecsanyi, and B. Kortmann, "Measuring analyticity and syntheticity in creoles," *Journal of Pidgin and Creole Languages*, vol. 29, no. 1, pp. 49–85, 2014.

[23] H. A. Schwartz, J. C. Eichstaedt, M. L. Kern, L. Dziurzynski, S. M. Ramones, M. Agrawal, A. Shah, M. Kosinski, D. Stillwell, M. E. Seligman *et al.*, "Personality, gender, and age in the language of social media: The open-vocabulary approach," *PloS one*, vol. 8, no. 9, p. e73791, 2013.

[24] A. Panchenko and others, "Sentiment index of the russian speaking facebook," pp. 506–517. [Online]. Available: <http://dial.uclouvain.be/handle/boreal:160359>

[25] N. Muravyev, A. Panchenko, S. Obiedkov, and others, "Neologisms on facebook," pp. 440–454. [Online]. Available: <http://dial.uclouvain.be/handle/boreal:160352>

[26] G. Harman, M. Coppersmith, and C. Dredze, "Quantifying mental health signals in twitter," *ACL 2014*, p. 51, 2014.

[27] M. Korobov, "Morphological analyzer and generator for russian and ukrainian languages," in *Analysis of Images, Social Networks and Texts*. Springer, 2015, pp. 320–332.

[28] Y. Benjamini and Y. Hochberg, "Controlling the false discovery rate: a practical and powerful approach to multiple testing," *Journal of the royal statistical society. Series B (Methodological)*, pp. 289–300, 1995.

[29] P. Panicheva, Y. Ledovaya, and O. Bogoliubova, "Revealing interpretable content correlates of the dark triad personality traits," in *Russian Summer School in Information Retrieval*, 2016, accepted for publication.

[30] J. F. Rauthmann and G. P. Kolar, "How "dark" are the dark triad traits? examining the perceived darkness of narcissism, machiavellianism, and psychopathy," *Personality and Individual Differences*, vol. 53, no. 7, pp. 884–889, 2012.

[31] R. Raskin and H. Terry, "A principal-components analysis of the narcissistic personality inventory and further evidence of its construct validity," *Journal of personality and social psychology*, vol. 54, no. 5, p. 890, 1988.

TABLE V. SIGNIFICANT CLUSTER CONTENTS (IN ALPHABETICAL ORDER)

Cluster	Typical contents	
	Russian	English translation
Affirm	зарегистрировать называть составлять утверждать	register call constitute affirm
Age	возраст детство здоровье молодость прошлое ранний старость	age childhood health youth past early
Anniversary	поздравлять праздник рождение рождество свадьба юбилей	congratulate holiday birth christmas marriage jubilee
Appeal	вызов жалоба задание заказ заявление обещание обращение ответ	call complaint task order statement promise appeal answer
Appearance	внешность выглядеть гордый красавец красивый худой шикарный	appearance look proud beauty beautiful slim chic
Being	бытие вселенная духовность истина мир природа реальность	being universe spirituality truth world nature reality
Body_situation	висеть вставать держаться лежать посадить сидеть ставить стоять	hang stand up hold lie sit down sit put stand
Citizen	американец гражданин еврей китаец немец россиянин француз	american citizen jew chinese german russian french
Clothing	ботинок костюм куртка носок обувь одежда платье шляпа штаны	boot costume jacket sock shoes clothes dress hat trousers
Difficult	важный необходимый полезный сложный трудный успешный	important inevitable useful difficult hard successful
Face_part	бровь веко взгляд глаз лицо рожа рот улыбка	eyebrow eyelid look eye face face(derogatory) mouth smile
Faith	ангел благодать бог господний дар дух дьявол молитва откровение	angel grace god godly gift spirit devil prayer revelation
Feeling_yb	верить восхищаться гордиться доверять дружить любить ненавидеть	believe admire be proud trust be friends love hate
Female_name	анна вера виктория екатерина елена мария надежда natalya	anna vera victoria ekaterina elena maria nadezhda natalia
Food	блин борщ вкусный картошка каша масло молоко пицца салат суп	pancake tasty potato porridge butter milk food salad soup
Friend	друг забытый знакомый приятель родные сосед чужой	friend forgotten familiar friend relative neighbour stranger
Furniture_object	дверь доска дыра замок крыша портал потолок стена табличка труба	door board hole lock roof portal ceiling wall sign pipe
High_low	вершина высокий выше ниже низкий повышение средний	peak high higher lower low advancement medium
Impress	вдохновлять великолепный впечатлять выдающийся удивительный	inspire magnificent impress outstanding amazing
Male_name	андрей борис валерий василий виктор владимир дмитрий иван	andrey boris valeriy vasily viktor vladimir dmitriy ivan
Material	асфальт зеркало камень металл окно посуда разбитый стекло	asphalt mirror stone metal window dishes broken glass
Money	валюта деньга доллар дорого евро копейка марка рубль	currency money dollar expensive euro kopeck mark ruble
Money_affair	бюджет вклад доход зарплата кредит налог оплата расход	budget deposit income salary credit tax payment expense
Neg_action	жестокость измена коррупция ложь месть нарушение насилие обман	cruelty treason bribery lie revenge violation violence fraud
Number	восемь двадцать девять десять пара пятнадцать пять тридцать четыре	eight twenty nine ten pair fifteen five thirty four
Perception	влиять воспринимать касаться осознавать относиться ощущать	influence perceive regard recognize relate feel
Political	власть вождь государство демократия партия политика правительство	power leader state democracy party politics government
Reasoning	вывод заключение мнение осознание понимание решение	inference conclusion opinion awareness understanding decision
Religion	возлюбить господь иисус милость молиться прощать сотворить	love god jesus mercy pray forgive create
Sensation	вспоминание впечатление иллюзия мысль ощущение шок эмоция	memory impression illusion thought sensation shock emotion
Space	близко вне внизу внутри возле вокруг позади посреди соседний	close outside below inside near around behind amid next
Take_give	брать взять давать держать забирать нести отдавать хватать	take take give hold take away carry give away grasp
Tender_adj	вежливый внимательный добрый ласковый любящий нежный	polite attentive kind tender affectionate loving
Trouble	беда война несчастье неудача перемена подвиг разрушение	trouble war disaster failure change achievement destruction
Verbs	бывать видеть познакомиться помнить сделать случаться создать	be see meet remember do happen create
Water_object	берег болото вода канал море озеро океан остров пруд река	bank marsh water channel sea lake ocean island pond river
Wellbeing	благополучие комфорт отдых покой равновесие спокойствие уют	wellbeing comfort rest peace balance tranquillity cosiness
Wild	агрессивный быстрый крутой мощный острый сильный смелый	aggressive fast hard mighty sharp strong courageous