

Towards a Psychologically Grounded Emotion Dictionary for Russian

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Abstract—In Natural Language Processing, there is currently a trend towards analyzing subjective language, one of the important topics being emotion detection from text. There have been a number of successful attempts of developing emotion dictionaries in the English language based on emotion theories well established in psychology. However, such resources in Russian are lacking. In the current work, we propose a roadmap for developing a psychologically grounded emotion dictionary in Russian. Based on the related work overview, we propose an emotion classification theory by Carroll Izard including ten basic emotions as a framework for building emotion dictionary. We outline a number of lexical resources for compiling word candidates for the dictionary. Finally, we describe the annotation procedure by volunteers and experts, and psychometric evaluation to measure internal consistency and external validity of the dictionary. The dictionary will be used in emotion detection tasks, compared to other available lexical resources, and supplemented with context-dependent statistical algorithms.

Keywords—*Emotion dictionary; Russian language; affective language; subjectivity analysis; basic emotions.*

I. INTRODUCTION

In recent Natural Language Processing (NLP) applications subjectivity analysis, e.g., identification and interpretation of information related to personal private states, has become extremely popular. Resources and algorithms of subjectivity, sentiment and emotion detection in text are numerous. They are applied to analyze the ever-growing body of texts in the World Wide Web, including social networks, news, political debates and product reviews.

The first line of research in this field stems from psychology, with the seminal work by authors of Linguistic Inquiry and Word Count [1]. This body of research adheres to the framework of psychological science, with lexicons compiled and annotated manually in a top-down manner, and dictionary categories originating from well-established research on psychology of emotions and appraisal [2]. Moreover, the resulting dictionaries are thoroughly tested in terms of their psychometric properties. The other research line is linguistically oriented: a word is supposed to fall into a sentiment or emotion category if there holds a certain formal relation between the word meaning and the category. Sometimes, the word should include a certain emotion or sentiment in its connotation [3][4], or imply an affective response as a result of common-sense logical operations [5]. Such linguistically motivated dictionaries are often developed (semi-)automatically by analyzing word usage

in context [4], or rely on existing world knowledge thesauri [6][7].

Although there exist a number of sentiment and emotion dictionaries in Russian, they are mostly linguistically grounded. Some attempts have been made to translate English psychologically grounded emotion dictionaries to Russian, however, with no psychometric evaluation. In the current work, we set out to fill this gap by creating a psychologically grounded emotion dictionary of Russian. The psychological orientation of the dictionary implies the following:

- The dictionary categories are based on emotion categorization well established in the literature;
- The words belonging to emotion categories explicitly and objectively mean the expression of emotion in question, e.g., *неожиданность* - *surprise*, *шокированный* - *shocked*, *удивлять* - *to amaze*, *чудесно* - *wonderful*, ruling out the connotation-based, context-dependent and common-sense-derived lexica, e.g., *война* - *war*, *ужасно* - *awfully*, *ложь* - *lie*;
- The dictionary must be evaluated for internal consistency and external validity.

The paper is organized as follows. In Section 2, existing emotion dictionaries in Russian are described, and their limitations are discussed. In Section 3, a framework for building a psychologically grounded emotion dictionary in Russian is presented. Section 4 contains our conclusions and future work on annotation and experimental validation of the suggested dictionary.

II. RELATED APPROACHES TO EMOTION DICTIONARIES IN RUSSIAN

A. Linguistic Inquiry and Word Count

The first widely known linguistic approach to representing emotions is Linguistic Inquiry and Word Count (LIWC) [1]. Work on this tool has been going on since 1993, with the latest version released in 2015. The original idea behind LIWC was to compile a dictionary of words denoting basic emotional and cognitive dimensions, which are often studied in sociology and psychology.

Originally, the LIWC dictionary is compiled for English. The latest version includes around 90 variables, covering almost 6,400 words. The LIWC dictionary is organized hierarchically and contains, among other dimensions, 21 linguistic categories (mostly parts of speech) and 41 categories tapping psychological constructs. The former include, for example,

function words, pronouns, typed personal pronouns, articles, prepositions, auxiliary, common verbs, etc. The latter include affective, social, cognitive, perceptual, biological processes, time orientations, relativity, personal concerns and informal language. The affective processes contain positive and negative emotions, the latter being divided into anxiety, anger and sadness. Unfortunately, other emotions are not included in LIWC, and the choice of these emotions is not grounded by the authors. Probably, the reason for this is that LIWC is not specifically aimed at covering emotion vocabulary. The dictionary has been composed following an elaborate procedure involving 2-8 judges and recourse to common emotion rating scales and English dictionaries. Thereafter, internal consistency and external validity have been assessed for every category.

Internal consistency of a word category is a measure of all the words belonging to a category actually meaning the same thing psychologically. It is calculated with the Cronbach's alpha [8], showing to what degree words of the same category tend to co-occur in the same texts. *External validity* of a word category shows how much the words in question are actually related to the underlying psychological phenomena. It is measured by correlating word usage with manual ratings by judges on the underlying dimensions [1].

The 2007-version dictionary was translated in Russian [9]. The Russian dictionary includes 61 categories and around 5,900 words organized in a flat category structure. The categories include positive and negative affects, as well as anxiety, anger and sadness. The Russian LIWC dictionary has never been validated for internal consistency or external validity. However, Russian LIWC has been used in a few recent studies [10][11], where some dictionary categories were additionally populated.

B. Emotive Lexicon

In Russian language studies, an attempt to categorize emotional lexica was made as early as 1989 [3]. The key feature of the resulting dictionary is a purely linguistic approach to its development: the author draws a distinction between emotion words, emotional words and emotive lexica, with the dictionary capturing the latter. Emotive meaning refers to a meaning containing an emotive seme, whether in its lexical, connotative or logical meaning.

The main idea behind the Emotive Lexicon is to identify words which contain a reference to emotion in their description in a standard Russian dictionary, e.g., *рай* - *paradise*, *баловать* - *to indulge*. Thus, around 8,500 words were included in the lexicon, divided into 37 categories corresponding to basic emotive meanings identified in the dictionary, e.g., *беспокойство* - *anxiety*, *вдохновение* - *inspiration*, *вера* - *faith*, *надежда* - *hope*, *недовольство* - *discontent*, *неприязнь* - *dislike*, *одиночество* - *loneliness*, *одобрение* - *approval*, *протест* - *protest*, *радость* - *joy*, *страх* - *fear*, *удивление* - *surprise*. Every category was further divided into 6 functional classes: emotional state, state development, influence, attitude, expression, characterization; for example, category *стыд* - *shame* includes the following words: *конфуз* - *embarrassment*, *смутиться* - *to be embarrassed*, *клевета* - *slander*, *закраснеться* - *to blush*, *застенчивый* - *shy*, *совестливость* - *conscientiousness*, respectively.

C. WordNet Affect

WordNet Affect was developed as an extension of WordNet Domains in [6]. It is based entirely on the WordNet original

structure, with one or more affective labels assigned to some synsets. The core of WordNet Affect was developed manually with the help of dictionaries. Then it was further expanded using WordNet relations. The original WordNet Affect contains 2,874 synsets and 4,787 words, annotated with a complex hierarchy of mental states and other affect-related phenomena. The affective label hierarchy provides a reference to one or more of the three main kinds of theories on emotion representation: discrete theories (based on the concept of cognitive evaluation), basic emotion theories and dimensional theories; see [12] for discussion.

A successful attempt at translating WordNet Affect into Russian and Romanian is described in [7]. It is based on the part of WordNet Affect annotation capturing 6 basic emotions: joy, fear, anger, sadness, disgust, surprise [13]. First, all the words in the English synsets denoting one of the six emotions were automatically translated in Romanian and Russian with an electronic English-Romanian and English-Russian dictionary. Second, irrelevant and duplicate translations were removed manually. Finally, the Russian and Romanian synsets were formed manually by three independent translators using Russian and Romanian thesauri and bilingual dictionaries. In the absence of Russian WordNet, the synsets in Russian were handcrafted so as to closely resemble the meaning of the original English synsets, based on the glosses of the latter. Some words were added to or deleted from the Russian synsets at this stage. The final dictionary contains 2,199 Russian affective words. The average pairwise inter-translator agreement for the Russian synsets ranged between 0.57 and 0.61, with the three-translator agreement reaching 0.29.

The Russian WordNet Affect was used in dataset filtering for sentiment analysis in [14]. However, no evaluation or validation of the resource has been performed to date.

D. RuSentiLex

RuSentiLex is a recently created sentiment lexicon in Russian [4]. It was created in three stages. First, sentiment words were extracted and manually filtered from a list of domain-specific sentiment words. Second, 55 lexico-syntactic patterns were applied to a text collection of 2 million news articles, to extract words with sentiment connotations. Finally, a supervised model of sentiment word extraction was applied to 1 million Tweets to infer Twitter-specific sentiment words.

The resulting database contains information on the sentiment orientation (positive, negative, neutral, or positive/negative, the latter meaning highly context-dependent) and the source of the sentiment. The source of the sentiment can be explicit *opinion*, negative or positive connotation (*fact*) or *feeling* (private state). The current version contains sentiment ratings for over 12,000 words and expressions. It has been successfully used in a number of NLP applications [15][16].

E. Limitations of the Existing Emotion Dictionaries in Russian

There has been a number of emotion lexicons developed for Russian, or sentiment lexicons containing additional useful information. There have also been reports on translating English-based emotion lexicons [15][17]. However, the translated parts only contain sentiment ratings for Russian words.

These are the main reasons why we have rejected the existing available Russian lexicons in our work:

- Most of the lexicons are based on purely linguistic, rather than psychological, grounds:

- Sentiment scores instead of emotion ratings.
- The emotive lexicon is based on emotive lexica concept, appealing to the semantic structure of words.
- WordNet Affect and some other resources are a direct translation of an English dictionary, preserving the English-based structure.
- None of the emotion lexicons in Russian have been validated for internal consistency or external validity.

Some examples of the listed issues are the following:

- Russian LIWC linguistic categories only contain parts of speech and a few pronoun types. However, the rich morphology in Russian allows to identify other grammatical categories, such as tense, voice, gender, number, etc. These are commonly identified with morphological parsers [18][19].
- In LIWC, lemmatization is accounted for by only listing word stems in the dictionary. Morphological parsing allows to lemmatize words more accurately.
- The Emotive Lexicon contains 37 linguistically grounded emotive categories. Some of them are hard to differentiate from the psychological point of view. For example, there are two distinct categories for *грусть* - *sadness* and *зope* - *grief*, which are hardly distinguishable psychologically.
- The concepts of emotive, affective and sentiment lexicons clearly include words which do not express emotion explicitly, e.g.:
 - *жар* - *heat*, *жить* - *to live*, *чувство* - *feeling* (Emotive Lexicon, *love* category);
 - *застенчивый* - *shy*, *скромный* - *modest*, *бесчувственный* - *heartless* (Russian WordNet Affect, *fear* category);
 - *уверовать* - *to believe*, *увлекаться* - *to be fond of* (RuSentiLex, *positive*, *feeling* category).

As a result, application of the existing emotion resources for Russian appears ineffective from the linguistic point of view and difficult to interpret psychologically.

III. EMOTION DICTIONARY IN RUSSIAN

A. Framework

The goal of the current work is to create a psychologically motivated dictionary of emotion words in Russian.

In psychology, numerous theories have been proposed to explain and describe emotions. Discrete emotions theories are a subgroup of these theories postulating that there are several *basic* emotions, which are distinct from one another, and that these core emotions reflect biologically determined affective responses, observable across cultures. The number of these basic emotions varies from 6 to 10, depending on the particular theory of discrete emotions. The most well-known discrete emotions theories were proposed by Ekman [20], Plutchik [21], and Izard [22]. While discrete emotions approach has been criticized, it remains the most popular and intuitively clear approach to classifying emotions. In Human-Computer Interaction research (HCI) and NLP it has been widely used for constructing emotion lexicons [6][7][2].

The first step in creating an emotion lexicon that fits within the framework of psychological science is the selection of a theoretical model of emotion classification. Within the general

framework of discrete emotions theories and their existing applications to NLP and HCI, we will follow the classification of emotions proposed by Carroll Izard, which includes *anger*, *contempt*, *disgust*, *fear*, *guilt*, *interest*, *joy*, *sadness*, *shame*, and *surprise* [22]. We have chosen this classification, because it includes *shame* and *guilt*, which we find essential for further research.

We will be focusing on overt expression of emotions only. Ascribing emotional meaning to words and phrases outside of explicit expression of emotion is wrought with difficulties, as it is highly subjective and context-dependent. At the current stage, we aim at building the core of emotional expression words in Russian, which is fully motivated psychologically. However, the following steps will include identifying various linguistic ways of emotional expression, including connotation and neutral facts in view of common-sense knowledge.

For this reason, we are only concerned with lexical information, containing words and multi-word expressions. Interaction with context, including negation, is an essential step in subjective language analysis, which will be addressed in our future work.

B. Development

1) *Dictionary Sources*: The next step would be to identify the sources of words and phrases to annotate. Sources of words and expressions for annotation include existing Russian thesauri.

- 1) Words in the Russian LIWC dictionary [9] tapping the following psychological constructs:
 - Affective processes;
 - Informal language.
- 2) Russian WordNet Affect words [7] in the *emotion* category.
- 3) RuSentiLex words with the *feeling* source [4].
- 4) Emotional expressions in the Russian phraseology dictionary [23].

The resulting list of words will be filtered by frequency [24]: very infrequent words will be excluded from the annotation process. Thus, a set of around 5,000 words and expressions is expected to be compiled from the above thesauri.

An important question is whether to take slang words into consideration. On the one hand, slang is often related to expressing emotions. On the other hand, there are no dictionaries of emotional slang available. Also, existing Russian slang dictionaries contain over 30,000 words and expressions [25], which is a too large number to annotate manually.

2) *Annotation*: We will employ a two-step manual annotation by lay volunteers and experts.

- 1) A large group of volunteers will manually annotate the set of words and expressions pulled from the existing resources. The annotation procedure will be carried out using the Yandex.Toloka service [26] (a Russian counterpart of Mechanical Turk). Yandex.Toloka has been effectively used for crowdsourcing annotation of various semantic tasks in Russian [27][28]. The annotators will first be provided with the definitions of ten basic emotions by Izard [29]. Then, they will answer questions on whether a particular word denotes expression of every basic emotion, similar to [30]. Every word-emotion pair should be annotated by at least three annotators.

- 2) A small group of experts will review the annotation results, decide on the points of contradictions and make corrections, where necessary.

3) *Psychometric Evaluation*: As pointed out by Pennebaker et al. [1], reliability and validity testing of natural language instruments poses a number of challenges. In line with the procedures described by these authors, we will test reliability of the dictionary categories by representing each word within the category as a percentage score (words per text in selected corpora, such as blog posts, online forum entries, etc.) and conducting Cronbach's alpha calculations with Spearman-Brown prediction formula correction [1]. Validity testing will be achieved by correlating data from self-report questionnaire, targeted emotional writing tasks, and dictionary-based automated analysis in a series of studies.

IV. CONCLUSIONS AND FUTURE WORK

We have outlined a framework for developing a psychologically grounded Russian emotion dictionary. First, existing approaches to emotion and sentiment dictionaries in Russian have been reviewed, and their limitations discussed. Second, we have identified the basic emotion classification by Izard, which will be used to define the dictionary categories. We have chosen a number of existing lexical resources to compile word candidates for emotion annotation. Finally, we have outlined the annotation procedure for volunteers and experts to classify words into emotion categories.

Our immediate future work includes carrying out the annotation experiment and evaluating the consistency and validity of the resulting word categories.

More distant future work will focus on real-world emotion expression in texts: narratives and social network posts will be analyzed in terms of the dictionary words attested against the ground truth provided by human judgments. The developed emotion dictionary will be compared to other emotion lexicons in Russian. Context-dependent features, such as negation and implicit emotion, will be added in order to develop a statistical emotion identification algorithm.

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