



# The Effects of Problematic Internet Use and Emotional Connotation on Internet Slang Processing: Evidence from a Lexical Decision Task

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## Abstract

Young people use slang for identifying themselves with a particular social group, gaining social recognition and respect from that group, and expressing their emotional state. One feature of Internet slang is its active use by youth in online communication, which, under certain conditions, may cause problematic Internet use (PIU). We conducted two studies in young Russian speakers ( $n_1 = 115$ ,  $n_2 = 106$ ). In study 1, participants were asked to rate a set of slang and common words using Self-Assessment Manikin. The study revealed that the most reliable predictor of higher emotional ratings was word familiarity. There were no significant effects of slang vs. common words or word frequency. In study 2, we used a dual lexical decision task to reveal the effects of word characteristics and propensity for PIU on reaction time (RT) for Internet slang words in pairs with semantically related vs. unrelated common words. Study 2 did not reveal any significant semantic priming effect. Word frequency was a significant predictor of lexical decision facilitation. Common, but not slang, word valence and dominance significantly affected RT in the opposite direction. Individuals with higher cognitive preoccupation with the Internet responded significantly faster, while those more likely to use online communication for mood regulation responded significantly slower to the stimuli. Apparently, on explicit and implicit levels, in-depth knowledge of Internet slang can be one the PIU markers. The results are discussed in line with Davis' approach to determining the general pathological Internet use.

**Keywords** Problematic internet use · Internet slang processing · Loanwords · Emotion-laden words perception · Youth · Lexical decision task

## Introduction

Slang is an international phenomenon of modern youth culture, which can be observed in many languages of the world. Adolescents and young adults are believed to use slang for identifying themselves with a particular social group, gaining social recognition and respect from that group, and, most importantly, to express their emotional state (Zhou & Fan, 2013).

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The main purpose of slang usage, as Jonathon Green, the author of the largest historical dictionary of English slang, rightly noted, is “to playfully disguise true meaning in a way that determines who is in the know and who is out” (Steinmetz, 2018). Green noted the motivational nature of slang usage: “slang, at least figuratively, remains the language of that true-and-trusted youthful triumvirate: drugs, sex, and rock’ n’ roll” (Green, 2016, p. 56). It is also “a rebellion against the mainstream” (Adams, 2009, p.2). Slang usage reflects how much young people can be rebels and how unchanging they are at the change of generations. Green summarizes: “while the words may change, the thematic areas (sex, drugs, crime, insults, etc.) have remained unwavering for half a millennium” (Steinmetz, 2018).

Youth uses slang for *group identification*. Connie Eble (1996) considers the *promotion of sociability* as the most important function of youth slang. Its informal and often playful features reflect the function of sociability development while mitigating the effects of social distance and formal hierarchy. Not all slang words have this function but slang is particularly well suited to support egalitarianism (Eble, 1996).

Specifically, modern youth may use slang and more specialist jargon in different communities to satisfy their psychological needs, including *the need for affiliation*. Several researchers argue that Internet resources serve as a potential domain for satisfying basic psychological needs (e.g., Greitemeyer et al., 2014; Nadkarni & Hofmann, 2012; Sheldon et al., 2011) and certain motivational predictors of Internet addiction (or problematic Internet use) are discussed by scholars according to the self-determination theory (Deci & Ryan, 2008). For instance, Arpaci et al. (2018) found negative effects of dominance, achievement and autonomy but a positive effect of affiliation on the likelihood of Internet addiction.

*Emotional disclosure* is the other potential psychological prerequisite of slang use, including Internet slang use. Lin et al. (2014) found that the density of a Facebook user’s personal networks was positively correlated with both positive and negative emotional disclosures and this relation was mediated by a stronger need for emotional expression. Additionally, the need for impression management led to a greater disclosure of positive emotions. These findings reveal not only *binding (community-specific)* but also *emotional* motivational foundations of Internet slang use.

In the current study, we try to integrate the cognitive (Kazanas & Altarriba, 2015; Meyer & Schvaneveldt, 1971; Scott et al., 2014; Zhang et al., 2017) and motivational theoretical basis (Baker et al., 2004; Lin, 2016; Mazer & Hunt, 2008; McEown & Oga-Baldwin, 2019) for predicting Internet slang processing by young Russian speakers while measuring their propensity for problematic Internet use (PIU). In a dual lexical decision task we use a set of Russian slang words related to social networking, as well as semantically related and unrelated common words. The effects of participants’ problematic Internet use and the effects of words’ characteristics (word frequency, word familiarity, semantic congruity and emotional connotations) on reaction time are analysed.

## Modern Internet Slang: The Case of Russia

The Internet is the most important modern source of novel youth slang. “The Internet provides a seeming infinity of material, and the slang gatherer must look beyond books, and beyond narratives, to lyrics, scripts, blogs, tweets, and so on” (Green, 2016, p. 126). Internet slang (or Internet jargon) is mostly used in written e-communication (Kalita, 2013). A certain stability in orthographic and semantic representations should be followed by Internet slang users in order to be understood by other users.

Due to the rather rapid growth of the Russian-speaking segment of the Internet (Runet), modern Internet slang words are widely used by Russian youth in various social networks, video games, and blogs. Currently, there is a decrease in the age of the Runet users, which means that many slang words become familiar to users from early childhood (Abdarakhmanova et al., 2022).

Frequently, the lexicon of Russian youth's Internet slang consists of both common and slang English loanwords: *mood*—*муд*; *thread*—*мред*; *tomboy*—*томбой*, etc. (Bucholtz, 2000; Limarova & Son, 2018). Internet slang interacts with various socio-lects (the jargons of programmers, advanced users, gamers, bloggers, and youth slang in general). It is constantly updated with new words, but some words become obsolete; for instance, borrowed from English (*floppy*, *floppy disk*) the Russian slang word *флон* is not actively used by modern programmers or advanced users. Some slang words become common words. For instance, the Russian word *геймер* (*gamer*) was recorded in the dictionary of youth slang (Nikitina., 2013, p. 200) in 2008. Currently, this word has appeared in many dictionaries of the modern Russian language as a common word with the mark “colloquial”. There are also slang words that “moved” into the category of common words but then acquired new jargon lexical meanings, that is, they became ambiguous. For instance, in 2004, the word *спам* (*spam*, which means “intrusive advertising on the Internet”) acquired a new meaning in the Russian jargon of soccer fans: the word *спам* is abbreviation of the football club name “Spartak-Moscow” (Nikitina., 2013, p. 541).

Each thematic group of Internet slang words is endorsed by a specific audience, sub-culture or a network community (in-group) (Vlasov et al., 2020). For instance, the jargon of Russian-speaking gamers and the jargon of anime fans differ in their passive vocabulary. Video gamers' jargon mostly includes English loanwords: the word *заметать* (*to game*) means “to play video games”; the word *ганкать* (*to gunk*) means “to kill obviously the weakest (or lower level) enemy in a video game; moreover, often and consistently for pleasure, punishment of an foe”; *ГГ* (the Russian abbreviation of *GG*) means “a good game, usually used by a gamer with a fair amount of cynicism and casual grace, the winner rushing into the chat, reveling in superiority over the enemy, and enjoying the insults of the losers”; the word *чумеп* (*cheater*) means “a swindler, a deceiver, a person who plays dishonestly using hidden commands and techniques”. The jargon of anime fans principally consists of Japanese loanwords: for instance, the verb *кавайиться* (*kawaii*) means “to be in a state of delight and tenderness which is often accompanied by a slight squeal and waving of the arms”; the noun *омаке* (*omake*) means “various kinds of anime bonuses attached to the video, for example, funny Chibi scenes with anime characters, interviews with the creators, etc., as well as any additional material that comes with the manga volume”; the noun *ватакы* means “an ardent activist of the anti-anime movement or the movement itself, and the word, apparently, comes from the phrase *On the attack!*”; the word *ватакы* is an antonym of the word *отакы* (a person who is addicted to anime, a passionate fan of this culture) with the Russian prefix *в*. These words are likely to be unfamiliar to most native speakers of the Russian language, but well known to a specific in-group or active Internet users.

Hence, to some extent Internet slang is familiar to social network website users. This social group is very large and numbers about 99,000,000 Russian users in 2021, while the degree of familiarity with the new lexicon may vary depending on the amount of screen time, the specifics of perceived content, the degree of immersion in social networking, the

nature of social connections on the Internet, age and many other behavioural and psychological traits of users.<sup>1</sup>

Surprisingly, the acquisition of novel words by native speakers does not require much cognitive effort. Recent studies have shown that new word forms are acquired rapidly even in the absence of semantic reference (Bermúdez-Margaretto et al., 2020). This rapid acquisition may be involved in learning new Internet slang words; as a rule, the meanings of these words are not explained to new users, but are directly extracted from the context.

Lexical processing of slang words can be tested via a lexical decision task (LDT) while controlling word frequency (objective and subjective). LDT may provide the data of their rapid processing in individuals with different degrees of familiarity with this specific vocabulary. In this study we investigate the lexical processing of Internet slang in relation to participants' problematic Internet use while controlling a set of variables that characterize the stimulus and the individuals.

### Word Frequency and Word Familiarity

Typically, to assess the objective frequency of word occurrence in a language extracted from a representative corpus, the *instances per million words* (ipmw) measure is used. In general, the words with high corpus-based word frequency are more familiar to most native speakers than words with low word frequency. Simultaneously, the words with high familiarity to a small amount of individuals do not necessarily have high frequency in the corpus. Also, the larger the corpus size is, the higher the positive correlation between corpus-based word frequency and word familiarity is observed. This correlation is higher for the spoken lexicon (Tanaka-Ishii & Terada, 2011). Thus, when studying the perception and understanding of a specific lexicon (e.g., Internet slang vocabulary), it is crucial to take into account both objective (corpus-based) word frequency and word familiarity to the representatives of the social group. If many social groups start to use a particular slang word more frequently, then this word may transfer to a common lexicon, and most likely its objective frequency will begin to increase.

### Emotion-Laden Words Perception

Despite the fact that most researchers postulate that slang and jargon are used to express emotions, to our knowledge there are no empirical studies of assessing emotional connotations of this specific vocabulary. Nevertheless, the issues of cognitive processing of emotion-laden words are represented by a wide range of psycholinguistic and neurocognitive studies (Bernat et al., 2001; Citron et al., 2014a, 2014b; Hofmann et al., 2009; Pavlenko, 2008; Yap & Seow, 2014; Zhang et al., 2017).

The importance and relevance of this kind of research is evinced by the emergence of *affective neurolinguistics* (Hinojosa et al., 2020). In this area there is a lack of research that brings together disparate empirical data on linguistic, pragmatic, social and emotional factors in the word recognition process, while controlling the various personal characteristics of native speakers.

<sup>1</sup> The data were retrieved from: <https://exlibris.ru/news/digital-2021-glavnaya-statistika-po-rossii-i-vsemu-miru/>.

In studies of emotion-laden words processing, Lyusin and Sysoeva's (2016, 2017) presume that there might be significant effects of the emotional content of stimuli, as well as the emotional state of participants during processing these stimuli.

Several normative databases of the emotional characteristics of stimuli provide the necessary information for controlling emotional content in different behavioral experiments. For instance, the most widely used database in studies of emotion-laden words is ANEW (Affective Norms for English Words) created by Bradley and Lang (1999). ANEW presents a set of common words in English rated on three emotional scales (valence, arousal and dominance) which were also used in other studies of emotionally charged pictures (IAPS) (Lang et al., 2005) and emotionally charged sounds (IADS) (Bradley & Lang, 2007). In the studies mentioned, participants assessed their emotional state during the presentation of one stimulus using the Self-Assessment Manikin (SAM) (Bradley & Lang, 1994) with 9-point Likert scales of valence, arousal and dominance. These scales represent visual sets with schematic images of a man with facial expressions, posture and size corresponding to different emotional states. SAM allows evaluation of individuals' non-discrete emotional reactions to various stimuli in contrast to discrete reactions, for instance, when participants should mark some specific emotions to evaluate the emotional content of stimuli: joy, sadness, anger, etc. We consider that the advantage of the SAM method lies in the fact that since the name of a specific emotion (for example, sadness) can be associated with some semantically related common words, then in order to assess low-frequency or novel words and jargon a native speaker should ignore the existing semantic associates of the word *sadness*. Thus, for each word, non-verbalized emotional ratings can be obtained on three main ANEW scales: valence, arousal, and dominance.

The emotional connotation has an independent effect on the speed of word recognition, regardless of other lexicosemantic properties (Citron et al., 2014b). The results of earlier studies of lexical decisions using emotion-laden words do not lead to an unambiguous answer to the question of whether the speed of recognition of an individually significant (more familiar) lexicon is related to the individual characteristics of native speakers. Thus, in the study by Clark et al. (1983), lexical decision time to congruent emotion-laden words (with positive or negative connotation) did not differ significantly in the induced elated mood of the participants compared to the induced depressive mood, while the efficiency of incongruent words memorizing turned out to be higher in an elated mood. In another study, Challis and Krane (1988) found faster recognition of positively coloured adjectives (names of personality traits) in induced elated moods compared to responses to neutral and negatively coloured stimuli. However, individuals with an induced depressive mood did not show significantly faster reactions to adjectives with a negative emotional connotation compared to words with a positive emotional connotation. At the same time, these groups of participants did not show significant differences in the effectiveness of memorizing words with different emotional connotations.

There is still a lack of studies on specific lexicon processing in individuals with various behavioural characteristics and pathologies. Thus, in the lexical decision task, words associated with sexual and romantic behaviour are recognized more slowly than words with a neutral connotation, while women have faster reactions to lexemes with a romantic connotation compared to lexemes denoting sexual behaviour (Geer & Bellard, 1996). Campos-Melady and Smith (2012) found a consistent effect of affective and semantic priming in women with alcohol addiction using a lexical decision task: negative words elicited faster responses to alcohol-related words. Expectations from alcohol consumption were positively correlated with faster reactions to prime words with negative connotation. Comparing these results with explicit measures, Campos-Meladi and Smith concluded that the

lexical decision process is more sensitive to associations of negative emotional reinforcement than other methods for measuring explicit alcohol expectancies.

Concerning the aspect of cognitive mechanisms of expectations from interpersonal interaction (including interaction on the Internet), Baldwin et al. (1993) suggested self-report and lexical decision approaches in exploration of the relational schemata underlying attachment styles. Using a lexical decision task and stimulus words with different contextual meanings, the authors found that individuals with an identified secure attachment style responded faster to words denoting positive interpersonal outcomes, and individuals diagnosed with an insecure attachment style responded faster to words denoting negative interpersonal outcomes.

Thus, lexical decisions tend to be influenced by both the denotative and connotative semantics of words, while individual and group characteristics of a sample are also significant.

### Problematic Internet Use and Internet Slang Processing

The emotional context of Internet slang usage could be accompanied by a person's desire to use Internet communication for satisfying basic psychological needs for autonomy, competence and relatedness according to the *self-determination theory*. Users whose satisfaction of these needs suffers in face-to-face communication try to satisfy them in social networking (Wong et al., 2015). In Internet communication, the use and understanding of a specific lexicon demonstrates personal identification with one or several network communities. In this regard, users may have a craving or obsessive thoughts about going online, a preference for online communication over face-to-face. Some individuals use online communication to improve their emotional state, but for others online communication can cause negative consequences (insomnia, loss of productivity at work, problems in interpersonal relationships, etc.). Thus, individuals with these behavioral characteristics may experience problematic Internet use, or PIU, that can be diagnosed with the Generalized Problematic Internet Use Scale, or GPIUS (Caplan, 2002, 2010).

The effects of personal traits on lexical decision time and on emotion-label and emotion-laden words have been tested in many studies (Borkenau et al., 2010; Challis & Krane, 1988; Clark et al., 1983; Estes & Adelman, 2008; Lorenz & Newman, 2002; Reidy et al., 2008; Scott et al., 2014; Siakaluk et al., 2016). However, the results of a great number of studies often showed only general effects of words' valence on reaction time, and only a few of them took into account the semantic and connotative features of a special lexicon in individuals with different traits and addictions (Campos-Melady & Smith, 2012; Geer & Bellard, 1996; Reidy et al., 2008). To summarize, it is necessary to figure out two main groups of predictors of Internet slang processing in a lexical decision task: (a) linguistic (what characteristics of a particular group's lexicon can be identified, and how to measure them?) and (b) individual (what traits do individuals have, those who use, perceive and interpret this lexicon?).

### Experimental Study

We conducted two studies in two samples of Russian speakers. In study 1, participants were asked to rate a set of Russian slang and common words from the Russian youth slang database (Vlasov et al., 2020) on three scales (valence, arousal and dominance) using

SAM. Participants' emotional states were also measured with the Russian language version of the Positive and Negative Affect Scale (PANAS) (Osin, 2012). In study 2, we used the dual LDT (Meyer & Schvaneveldt, 1971) to reveal linguistic (word frequency, word familiarity, semantic priming, emotional connotation of words) and individual (the propensity for PIU) effects on reaction time for Internet slang words in pairs with common words.

## Hypothesis

We hypothesized that.

1. Higher emotional ratings of words are determined not only by their linguistic characteristics, but also by their subjective significance for our participants measured by word familiarity (Study 1).
2. Participants' emotional state (as measured by the PANAS) may contribute to emotional ratings of words (Study 1).
3. Emotional connotation of words may be the important predictor of RT reduction for pairs of words in which one of them is a slang word after controlling for the influence of cognitive preoccupation in social networking (i.e., constant mental return to online communication) (study 2). This hypothesis is based on the previous study of Russian nouns processing (Vlasov & Sychev, 2018) where the effect of RT reduction was observed for common words with positive valence (compared to words with negative or neutral valence) in an unprimed lexical decision task.

## Study 1. Emotional Assessment of Internet Slang in the Russian language.

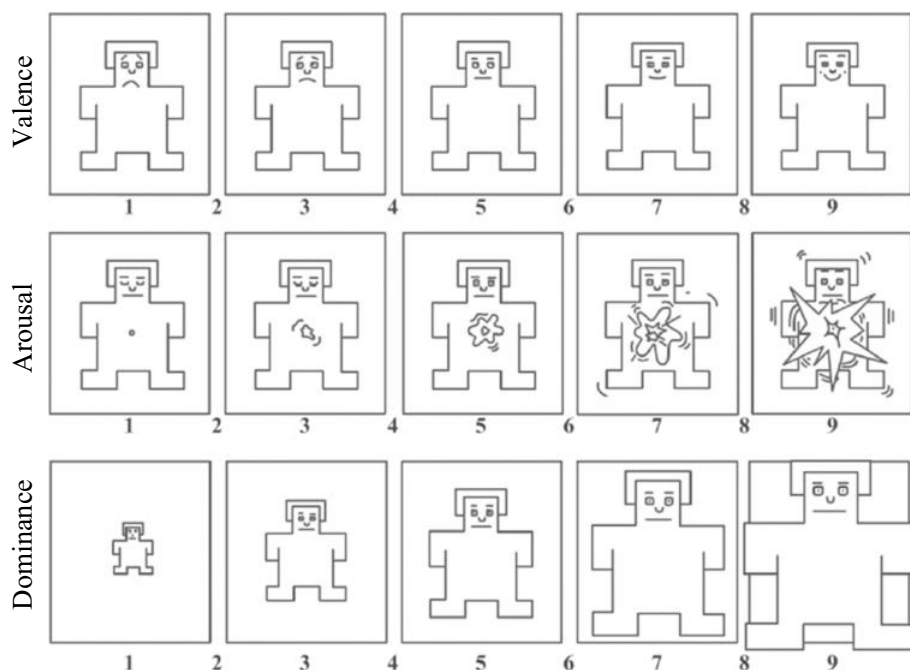
The purpose of this study was to collect data on the emotional ratings of Internet slang, as well as semantically related and unrelated common Russian words in three SAM-scales (valence, arousal and dominance). The effects of the psychological and demographic characteristics of the participants, as well as the linguistic characteristics of stimuli (word frequency and word familiarity) on emotional ratings were analysed as well.

## Methods

### Participants

The sample comprised 115 participants (Russian speaking students from the Altai Territory, Russia,  $N_{\text{female}} = 73$  (63%),  $N_{\text{male}} = 42$  (37%), aged 17–47,  $M_{\text{age}} = 22.26$ ,  $SD = 5.65$ ).

**Materials** For this study, we selected 24 Russian words related to Internet youth slang from a psycholinguistics database (Vlasov et al., 2020). Then to each of a slang word, we added a common word (a synonym or a word defining the essence of the slang word core meaning, sema), i.e., a semantically related word (*аппнуть* (rus. “to up”)—*приподнять* (rus. to raise), *рофл* (rus. rofl)—*хохот* (rus. laughter). Also, to our list of these words we added common words that were unrelated with slang words and had no common sema (e.g., *аппнуть* (rus. to up)—*испечь* (rus. to bake), *рофл* (rus. rofl)—*тетрадь* (rus. a notebook). Both common



**Fig. 1** Self-assessment manikins (SAMs) for valence, arousal, and dominance

and slang words were low-frequency lexical units of the Russian language. According to the General Internet Corpus of the Russian Language, the frequency for each of slang and common word did not exceed 10 ipm, hence they supposed to be low-frequent items according to the “rule of thumb” (Laurinavichyute, et al., 2019). Additionally, we tested another standardized measure of word frequency called the Zipf-value, according to which words with 10 ipm have  $\text{Zipf} = 4 (\log_{10}(\text{fpmw}) + 3)$  and they supposed to be low-frequency words (Brysbaert et al., 2018). Non-words (*клизхит*—*klight*), *зхерпце* (nonword—*ghverse*) were constructed as unpronounceable set of Russian letters according to the procedure described in Vlasov and Sychev (2018). Complete experimental materials are available in the OSF repository ([https://osf.io/fwgqn/?view\\_only=fdc243b7b9164e1cbe5a6b5a8afae4d0](https://osf.io/fwgqn/?view_only=fdc243b7b9164e1cbe5a6b5a8afae4d0)).

## Instruments

For assessing participants’ emotional states, the Russian version (Osin, 2012) of PANAS (Watson, et al., 1988) was used. PANAS consists of 20 adjectives reflecting various emotional states. The relevance of each of the adjectives to the participants’ condition (during the past few weeks) was assessed using a five-point scale. By averaging the responses in accordance with the key, final scores were calculated on two scales: positive affect (Cronbach’s  $\alpha = 0.87$  in our study) and negative affect (Cronbach’s  $\alpha = 0.87$ ).

To assess the emotional ratings of stimulus Self-Assessment Manikin Scales (SAM-scales) were used (Bradley & Lang, 1994; Soares et al., 2013). SAM-scales include three 9-point Likert scales: valence, arousal and dominance (see Fig. 1).

## Procedure

Data collection was approved by the Ethical Committee of Shukshin Altai State University for Humanities and Pedagogy and implemented through the *Yandex.Forms* online service without any limitation of time. All participants provided informed consent prior to the survey. Participants completed PANAS and then they were sequentially presented with 119 verbal stimuli, including 24 Internet slang words, 48 common words and 47 non-words to rate on three SAM-scales (valence, arousal and dominance). The ratings for non-words were not analysed, since they are not of interest in the context of the current study.

Each word from the dataset was assessed as familiar or unfamiliar to participants. The decimal proportion of familiar words was calculated for slang and common word categories separately. This proportion was used as a measure of word familiarity. The mean familiarity of slang words was equal to  $M=0.73$  ( $SD=0.21$ ), with a range of variation from 0.13 to 1, that indicated quite significant individual differences in familiarity with the slang lexicon. After excluding two outliers (less than 0.5), the mean familiarity of common words was high ( $M=0.98$ ,  $SD=0.04$ ) with a rather weak variation of this measure.

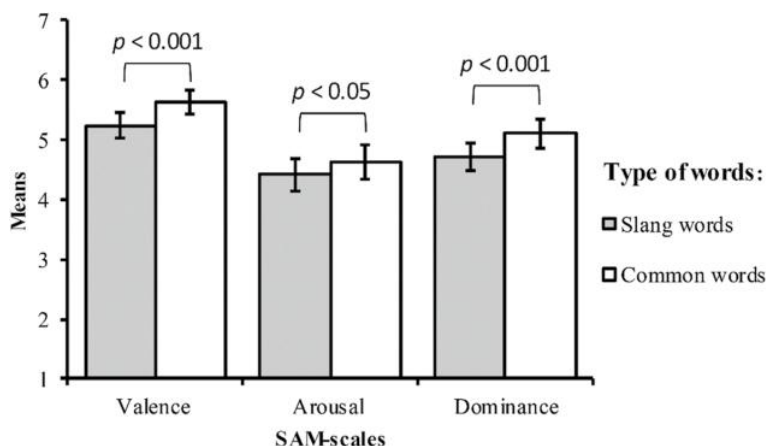
## Data Analysis

For data analysis, *psych*, *mlmhelp* and *afex* packages for R were used, including descriptive statistics, *t*-test and linear mixed effects models that allow us to take into account fixed effects (positive and negative affect, gender, age, Zipf coefficient (a measure of word frequency), word familiarity and word type (slang or common word), and random effects (variation of words emotional ratings by participants and by stimuli). To simplify data analysis and interpretation of models, the dependent variables (word ratings on valence, arousal and dominance) were standardized. The need to use a mixed effects model is confirmed by the values of intraclass correlation (ICC) by participant and stimulus for valence (ICC=0,17 and 0,12 respectively), arousal (ICC=0,33 and 0,05), and dominance (ICC=0,24 and 0,04). We consider here only the random intercept model, because more complicated random slope models demonstrated convergence problems. Statistical significance of fixed effects was estimated using Satterthwaite's approximation of the degrees of freedom for *t*-statistic and likelihood ratio tests ( $\chi^2$ ). Complete analysis code and data are available in the OSF repository ([https://osf.io/fwgqn/?view\\_only=fdc243b7b9164e1cbe5a6b5a8afae4d0](https://osf.io/fwgqn/?view_only=fdc243b7b9164e1cbe5a6b5a8afae4d0)).

## Results and Discussion

To summarize the results, word ratings on valence, arousal and dominance were averaged over all the stimulus words for each participant. Correlations of average emotional ratings for all participants ranged from moderate to high and had high statistical significance. The strongest was observed between arousal and dominance ( $r=0.73$ ;  $p \leq 0.001$ ), the weaker correlation was observed between valence and dominance ( $r=0.54$ ;  $p \leq 0.001$ ). Moderate correlation was found between valence and arousal ( $r=0.40$ ;  $p \leq 0.001$ ). The fact that all three SAM-scales positively correlate with each other indicates the presence of a common factor which can be called the *emotional connotation* of word meaning.

Average scores on SAM-scales for slang and common words as shown in Fig. 2 were compared using the student's *t*-test for dependent samples. It was found that the emotional



**Fig. 2** Mean values and statistical significance of differences in emotional ratings of slang and common words (vertical bars reflect the 95% confidence interval for the mean)

ratings of common words are statistically significantly higher for each of the SAM-scales: valence ( $t(114)=3.75$ ;  $p \leq 0.001$ ), arousal ( $t(114)=2.49$ ;  $p \leq 0.05$ ) and dominance ( $t(114)=4.46$ ;  $p \leq 0.001$ ).

For the purpose of an in-depth analysis of the factors that determine the emotional ratings of words, three linear mixed effects models were built for three SAM-scales as dependent variables: valence, arousal, and dominance.

Participants' gender and age, positive affect and negative affect, as well as stimulus characteristics: Zipf coefficient<sup>2</sup> (Van Heuven et al., 2014; Zipf, 1949), word familiarity (familiar or unfamiliar), and word type (slang or common word) were used as predictors of emotional ratings. Analysis of the residual plots for all three models showed a symmetrical shape of the distribution, close to normal, and low heteroscedasticity. This allows us to conclude that the basic assumptions necessary for the linear mixed effects modelling are met.

The first model considered predictors of word valence. The analysis of the statistical significance of random effects in alternative models, that included one or both random effects by comparing these models with each other, showed that both the effect of a participant and the effect of a stimulus are statistically significant (both random effects are significant,  $p \leq 0.001$ ).

The results of the analysis of fixed effects (see Table 1) indicate the presence of a statistically significant effect of word familiarity only. In particular, familiar words were rated 0.92 standard deviations higher than unfamiliar ones on valence scale.

In the second model, the arousal scale was used as the dependent variable. As in the previous model, both the random effects of participants and stimuli showed high statistical significance ( $p \leq 0.001$ ). The results of the fixed effects analysis (see Table 2) revealed a statistically significant positive effect of word familiarity ( $p \leq 0.001$ ) and a

<sup>2</sup> The Zipf coefficient makes it possible to compare word frequencies extracted from different corpora and databases, regardless of the corpora size. Zipf coefficient =  $\log_{10}(\text{fpmw}) + 3$  or  $\log_{10}(\text{fpmw} * 1000)$ , where fpmw is the frequency of a particular word per million words. Fpmw was retrieved from the *General Internet Corpus of the Russian Language*: <http://www.webcorpora.ru/> (Belikov et al., 2013a, 2013b).

**Table 1** The results of the analysis of fixed effects on valence ratings of words in a linear mixed effects model

| Fixed effects                               | Estimate | SE   | df      | <i>t</i> | <i>p</i> (Satt) | $\chi^2$ ( <i>df</i> =1) | <i>p</i> ( $\chi^2$ ) |
|---------------------------------------------|----------|------|---------|----------|-----------------|--------------------------|-----------------------|
| Intercept                                   | -0,99    | 0,26 | 347,63  | -3,84    | <0,001          | —                        | —                     |
| Positive affect                             | 0,03     | 0,03 | 2035,01 | 1,01     | 0,312           | 1,04                     | 0,307                 |
| Negative affect                             | -0,04    | 0,03 | 986,14  | -1,26    | 0,209           | 1,53                     | 0,216                 |
| Gender (0—female, 1—male)                   | -0,02    | 0,07 | 372,50  | -0,30    | 0,764           | 0,10                     | 0,749                 |
| Age                                         | 0,01     | 0,01 | 204,21  | 0,93     | 0,356           | 0,85                     | 0,356                 |
| Zipf coefficient                            | 0,02     | 0,06 | 68,99   | 0,40     | 0,694           | 0,16                     | 0,688                 |
| Word familiarity (0—unfamiliar, 1—familiar) | 0,92     | 0,04 | 8731,68 | 24,79    | <0,001          | 594,21                   | <0,001                |
| Word type (0—slang, 1—common)               | 0,04     | 0,06 | 69,77   | 0,66     | 0,509           | 0,45                     | 0,500                 |

**Table 2** The results of the analysis of fixed effects on arousal ratings of words in a linear mixed effects model

| Fixed effects                               | Estimate | SE   | df      | <i>t</i> | <i>p</i> (Satt) | $\chi^2$ ( <i>df</i> =1) | <i>p</i> ( $\chi^2$ ) |
|---------------------------------------------|----------|------|---------|----------|-----------------|--------------------------|-----------------------|
| Intercept                                   | -0,96    | 0,26 | 658,95  | -3,74    | <0,001          | —                        | —                     |
| Positive Affect                             | 0,03     | 0,03 | 4334,37 | 1,06     | 0,289           | 1,14                     | 0,286                 |
| Negative Affect                             | -0,11    | 0,03 | 2664,73 | -3,06    | 0,002           | 9,04                     | 0,003                 |
| Gender (0—female, 1—male)                   | 0,09     | 0,07 | 899,45  | 1,22     | 0,223           | 1,45                     | 0,228                 |
| Age                                         | 0,02     | 0,01 | 390,23  | 2,09     | 0,037           | 4,39                     | 0,036                 |
| Zipf coefficient                            | 0,03     | 0,04 | 69,01   | 0,75     | 0,454           | 0,58                     | 0,446                 |
| Word familiarity (0—unfamiliar, 1—familiar) | 0,70     | 0,04 | 8007,74 | 20,05    | <0,001          | 392,87                   | <0,001                |
| Word type (0—slang, 1—common)               | 0,06     | 0,04 | 70,57   | 1,62     | 0,111           | 2,64                     | 0,104                 |

**Table 3** The results of the analysis of fixed effects on dominance ratings of words in a linear mixed effects model

| Fixed effects                               | Estimate | SE   | df      | <i>t</i> | <i>p</i> (Satt) | $\chi^2$ ( <i>df</i> =1) | <i>p</i> ( $\chi^2$ ) |
|---------------------------------------------|----------|------|---------|----------|-----------------|--------------------------|-----------------------|
| Intercept                                   | -2,03    | 0,23 | 507,27  | -8,76    | <0,001          | —                        | —                     |
| Positive Affect                             | 0,12     | 0,03 | 2475,88 | 3,96     | <0,001          | 15,46                    | <0,001                |
| Negative Affect                             | 0,09     | 0,04 | 1247,32 | 2,70     | 0,007           | 7,29                     | 0,007                 |
| Gender (0—female, 1—male)                   | 0,24     | 0,07 | 449,86  | 3,37     | <0,001          | 11,17                    | <0,001                |
| Age                                         | 0,02     | 0,01 | 232,89  | 3,55     | <0,001          | 12,59                    | <0,001                |
| Zipf coefficient                            | 0,03     | 0,03 | 71,15   | 1,13     | 0,260           | 1,28                     | 0,259                 |
| Word familiarity (0—unfamiliar, 1—familiar) | 0,80     | 0,04 | 5273,20 | 21,94    | <0,001          | 459,66                   | <0,001                |
| Word type (0—slang, 1—common)               | 0,03     | 0,03 | 74,68   | 1,21     | 0,229           | 1,21                     | 0,229                 |

weak reverse effect of negative affect ( $p \leq 0.01$ ). The effect of word familiarity is similar to that identified in the previous model. The effect of negative affect is manifested in a slightly lower rating of arousal when perceiving words by persons experiencing

negative affect (by 0.11 standard deviation on arousal scale with an increase in negative affect per 1). In addition, a weak effect of the participants' age on stimulus arousal score was found: an increase in age by 1 year leads to an increase in the arousal score by 0.02 standard deviation ( $p \leq 0.05$ ).

In the third model, as in the two previous models, both random effects of participants and stimuli on dominance scale showed a high statistical significance ( $p \leq 0.001$ ). The analysis of fixed effects (see Table 3) revealed a statistically significant effect of word familiarity ( $p \leq 0.001$ ), gender ( $p \leq 0.001$ ), age ( $p \leq 0.01$ ), positive affect ( $p \leq 0.001$ ) and negative affect ( $p \leq 0.01$ ) on the dominance scale. The dominance of familiar words is estimated to be significantly higher (by 0.80 standard deviation). Higher estimates of dominance are given by men (by 0.24 standard deviation) and more mature individuals (by 0.02 standard deviation). At the same time, both positive and negative affect of participants have a positive effect on dominance ratings of the words.

None of the three models showed a statistically significant effect of the Zipf coefficient (a measure of corpus based word frequency) or word type (slang vs. common words). Apparently, the higher emotional ratings of common words (see Fig. 2) are explained by their higher familiarity to the participants, and not by objective word frequency.

According to the results of study 1, the most reliable predictor of higher emotional ratings of words was word familiarity: the effect size for familiar words ranged from 0.70 to 0.92 standard deviations. There was no significant effect of word type (slang vs. common words), as well as the effect of corpus based word frequency (Zipf coefficient). A number of Internet slang words were rated as positive, that is, the ratings above the median ( $Md = 5.67$ ) for all words on the valence SAM-scale received such slang words as: гуглить (rus. to google), чилить (rus. to chill), директ (rus. direct message service in Instagram), ава (rus. avatar), сторис (rus. stories in Instagram), краш (rus. crush), олды (rus. olds, or elders), рофл (rus. rofl), апнуть (rus. to up). Several slang words were rated as negative (with scores below the median on valence scale): флуд (rus. flooding in social networks), хейтер (rus. hater), томбой (rus. tomboy), флейм (rus. flaming in social networks), стэн (rus. stan), лонгрид (rus. longread), забанить (rus. to ban), дисконнект (rus. disconnect), ливнуть (rus. to leave chat, game etc.), фид (rus. feed on the Web), панч (rus. punch), муд (rus. mood), донатить (rus. to donate), постить (rus. to post). Ratings above the median ( $Md = 4.52$ ) on the arousal scale received such slang words as забанить (rus. to ban), краш (rus. crush), хейтер (rus. hater), рофл (rus. rofl), чилить (rus. to chill), сторис (rus. stories in Instagram), дисконнект (rus. disconnect), гуглить (rus. to google), донатить (rus. to donate), постить (rus. to post). The scores below the median received the words: флейм (rus. flaming in social networks), лонгрид (rus. longread), тред (rus. thread on the Web), фид (rus. feed on the Web), стэн (rus. stan), ава (rus. avatar), томбой (rus. tomboy), флуд (rus. flooding in social networks), апнуть (rus. to up), муд (rus. mood), директ (rus. direct message service in Instagram), олды (rus. olds, or elders), панч (rus. punch), ливнуть (rus. to leave chat, game etc.). The scores on the dominance scale were distributed as follows: the slang words гуглить (rus. to google), забанить (rus. to ban), краш (rus. crush), чилить (rus. to chill), директ (rus. direct message service in Instagram), донатить (rus. to donate), олды (rus. olds, or elders), рофл (rus. rofl), сторис (rus. stories in Instagram) were rated as more dominant, or above the median value ( $Md = 5.0$ ), and the following ones: лонгрид (rus. longread), флейм (rus. flaming in social networks), флуд (rus. flooding in social networks), стэн (rus. stan), тред (rus. thread on the Web), фид (rus. feed on the Web), томбой (rus. tomboy), панч (rus. punch), муд (rus. mood), ливнуть (rus. to leave chat, game etc.), хейтер (rus. hater), дисконнект (rus. disconnect), ава (rus. avatar), постить (rus. to post), апнуть (rus. to up)—were rated below the median as less dominant.

The following translations of common words semantically related to the above mentioned slang words (congruent words) were rated with scores above the median on valence scales (falling in love, laughter, fan, update, business card, Instagram, harmony, publish, request, elders, raise), arousal (falling in love, attack, dispute, block, hater, fan, laugh, Instagram, discussion, disable, update, post, a girl with masculine behaviour (patsanka), mailing, leave, request, exposition), dominance (falling in love, attack, argument, update, elders, laughing, Instagram, business card, block, fan, publish, mailing, harmony, contribute, to up, discussion). The following words were rated below the median values: on valence scale, that is, closer to the negative pole of the scale (disconnect, hater, block, leave, mailing, a girl with masculine behaviour (patsanka), argument, mess around, attack, exposition, contribute, discussion), arousal (laze, business card, harmony, elders, deposit, lift, stress), dominance (laze, leave, hater, turn off, expression, stress, a girl with masculine behaviour (patsanka), request).

The interpretation of these SAM-ratings cannot be based entirely on the emotional connotations of these words since study 1 showed significant effects of word familiarity and individual emotional state as well as random effects on the emotional ratings. Also, we did not use verbal scales for ratings, which excluded the possibility of an associative connection between stimulus emotion-laden and emotion-label words. The results of study 1 showed that emotional ratings on the arousal scale were influenced by negative affect: a more depressed, negative emotional state of the participant significantly reduces word ratings on this scale. On dominance scores, a positive effect of both positive and negative affect was found: that is, individuals with more pronounced affectivity in recent weeks rate the words higher on the dominance scale on average. Interestingly, there were no significant effects of participants' affectivity on word valence. Apparently, valence (with polar scales "negative"—"positive") acts as a relatively stable emotional connotative characteristic of word meaning, in contrast to arousal and dominance.

## Study 2. Implicit recognition of Internet slang in a dual lexical decision task and problematic Internet use

The aim of this study was to test the effects of emotional connotation of slang and common words rated in study 1 on the reaction time in a dual lexical decision task while controlling the propensity to problematic Internet use of the participants and linguistic factors (semantically related vs. unrelated word pairs, Zipf coefficient and emotional connotation of words).

### Methods

#### Participants

The sample comprised 106 young Russian speakers from Altai Territory, Russia ( $N_{\text{female}} = 76$  (72%),  $N_{\text{male}} = 30$  (28%),  $M_{\text{age}} = 19.44$ ,  $SD = 1.54$ ) as the most active users of social networks.

**Instruments** To assess the cognitive preoccupation in social networking we implemented the *Generalized Problematic Internet Use Scale* (GPIUS3) (Gerasimova & Kholmogorova, 2018) based on the second version of the original English-language scale (GPIUS2, Caplan,

2010). The scale includes five subscales: *Preference for Online Social Interaction*, *Mood Regulation*, *Cognitive Preoccupation*, *Compulsive Internet Use*, *Negative Outcomes*. Specifically, this technique is focused more on assessing the addiction to communication in social networks, and not on pathological Internet use in general.

Additionally, participants were asked to indicate their gender, age, region of residence, the average number of minutes or hours per day spent on the Internet.

**Procedure and Materials** Data collection was approved by the Ethical Committee of Shukshin Altai State University for Humanities and Pedagogy. *Dual lexical decision task* was implemented through the *PsyToolkit* online service for behavioral experiments (Stoet, 2010, 2017). All participants provided informed consent before the task. Participants were asked to complete a dual lexical decision task (dual LDT) via browser with the following instruction: “In this task, you will be asked to quickly recognize words and meaningless sets of letters (“non-words”) in pairs of stimuli presented simultaneously. If there are only real words in the pair (for example, *аннунть* (rus. “to up”)—*приподнять* (rus. “to raise”), then press the “A” key, if there is at least one non-word in the pair (for example, *приподнять* (rus. “to raise”)—*клигхнт* (non-word “*klight*”), then press the “L” key. Two seconds are given to respond to each stimulus. First there will be a practice test and then the main test. Please, press the spacebar to continue”.

The training session consisted of 12 stimulus blocks. Reaction times (RTs) from this session were not further analyzed. If the participant did not correctly respond to any of the training trials (for example, all the responses of one student were incorrect or exceeded 2000 ms), then that participant’s data were subsequently excluded from the analysis.

The main session consisted of 96 pairs of printed verbal stimuli, including semantically related slang and common words (i.e., simultaneous prime words). For instance, *аннунть* (rus. “to up”)—*приподнять* (rus. to raise), *рофл* (rus. rofl)—*хохот* (rus. *laughter*) etc.,  $n=24$ ); semantically unrelated slang and common words (e.g., *аннунть* (rus. to up)—*испечь* (rus. to bake), *рофл* (rus. rofl)—*тетрадь* (rus. a notebook),  $n=24$ ), common words and non-words (e.g., *приподнять* (rus. to raise)—*клигхнт* (nonword *klight*), *хохот* (rus. laughter)—*эхверсе* (nonword *ghverse*),  $n=48$ ). Complete experimental materials are available in the OSF repository ([https://osf.io/fwgqn/?view\\_only=fdc243b7b9164e1cbe5a6b5a8afae4d0](https://osf.io/fwgqn/?view_only=fdc243b7b9164e1cbe5a6b5a8afae4d0)).

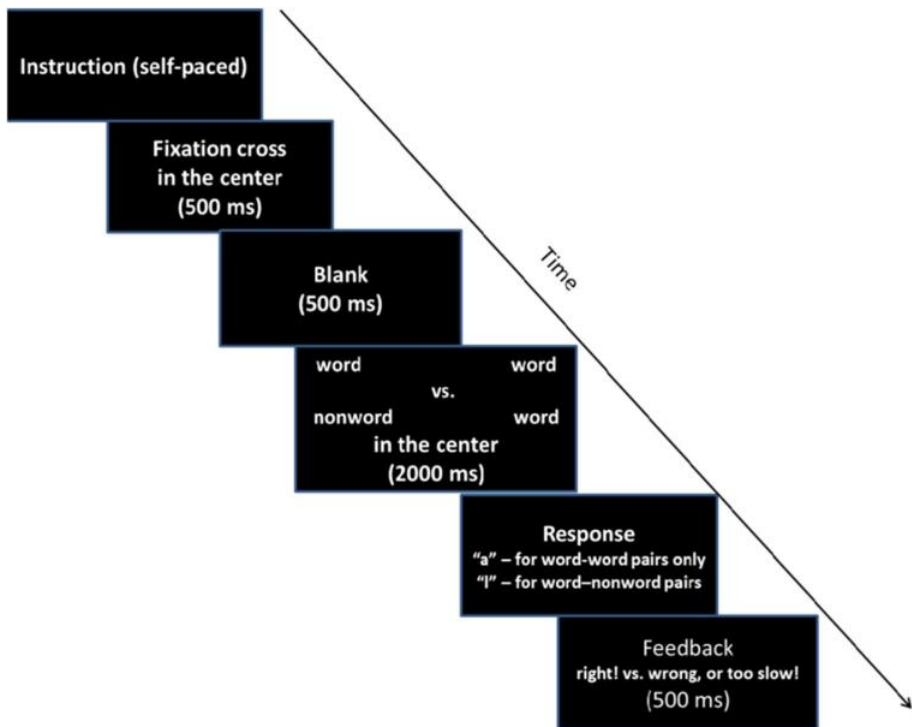
Both common and slang words were low-frequency<sup>3</sup> lexical units of the Russian language: the instances per million words (ipm) were 0.002–3.035 ipm for slang words and 0.152–9.6 ipm for common words. For each of the stimulus words, mean scores of valence, arousal, dominance, and word familiarity were obtained from the study 1. The experimental design of the dual lexical decision task is presented in Fig. 3.

After completion of the dual LDT, participants were asked to fill out the GPIUS3.

## Data Analysis

During data analysis we implemented mixed-effects models, using *afex* and *mlmhelp* packages for R, descriptive statistics were estimated using *psych* package. To simplify data analysis and interpretation of models, the dependent variable (RT) was standardized.

<sup>3</sup> According to the General Internet Corpus of the Russian Language, word frequency for the stimulus words did not exceed 10 ipm.



**Fig. 3** Experimental design of the dual lexical decision task (on the PsyToolkit online platform)

Practical significance of random effects is confirmed by intraclass correlation values for RTs by participant and stimulus, that constitute 0,42 and 0,04 respectively. We considered here only the random intercept model, because more complicated random slope models had demonstrated convergence problems. Again, we used Satterthwaite's approximation and likelihood ratio tests ( $\chi^2$ ) to assess significance of fixed effects. Complete analysis code and data are available in the OSF repository ([https://osf.io/fwgqn/?view\\_only=fdc243b7b9164e1cbe5a6b5a8afae4d0](https://osf.io/fwgqn/?view_only=fdc243b7b9164e1cbe5a6b5a8afae4d0)).

## Results and Discussion

For data analysis we used a linear mixed-effects model with standardized RT as a dependent variable (4,660 reactions were analysed). To clean the data, responses to trials with non-words, incorrect and too slow (over 2000 ms) responses were removed as irrelevant to the tasks of this study. The current model includes several RTs predictors: GPIUS3, time that participants spend on the Internet, gender, average Zipf coefficient for a pair of words, type of word pairs (semantically related or unrelated), emotional connotation (including valence, arousal, and dominance) of common and slang words obtained in Study 1. Random effects of the participant and the stimulus on RT are also used in the model.

Residual analysis showed a symmetrical distribution close to normal and low heteroscedasticity, indicating that the basic assumptions needed to apply linear mixed effects models were met. When testing the statistical significance of random effects in alternative models

**Table 4** Results of fixed effects analysis on reaction time in a linear mixed effects model

| Fixed effects                               | Estimate | SE   | df     | t     | p(Satt) | $\chi^2$ (df=1) | $p(\chi^2)$ |
|---------------------------------------------|----------|------|--------|-------|---------|-----------------|-------------|
| Intercept                                   | 2,15     | 0,65 | 129,77 | 3,34  | 0,001   |                 |             |
| Preference for online social interaction    | 0,00     | 0,06 | 96,67  | 0,01  | 0,993   | 0,00            | 0,992       |
| Mood regulation                             | 0,14     | 0,05 | 96,70  | 2,68  | 0,009   | 7,48            | 0,006       |
| Cognitive preoccupation                     | -0,21    | 0,07 | 96,74  | -2,92 | 0,004   | 8,86            | 0,003       |
| Compulsive internet use                     | 0,04     | 0,06 | 96,94  | 0,60  | 0,549   | 0,39            | 0,531       |
| Negative Outcomes                           | -0,01    | 0,08 | 97,11  | -0,09 | 0,929   | 0,01            | 0,928       |
| Time spent online (hours per day)           | -0,03    | 0,02 | 96,81  | -1,39 | 0,169   | 2,05            | 0,152       |
| Gender (male)                               | 0,00     | 0,07 | 96,66  | 0,06  | 0,956   | 0,00            | 0,954       |
| Average Zipf coefficient                    | -0,22    | 0,05 | 38,56  | -4,00 | <0,001  | 16,22           | <0,001      |
| Type of word pairs (semantically unrelated) | -0,03    | 0,03 | 38,55  | -1,25 | 0,219   | 1,84            | 0,175       |
| Valence (common words)                      | 0,12     | 0,05 | 38,40  | 2,38  | 0,022   | 6,40            | 0,011       |
| Valence (slang words)                       | -0,06    | 0,07 | 38,57  | -0,86 | 0,396   | 0,89            | 0,346       |
| Arousal (common words)                      | 0,13     | 0,07 | 38,35  | 1,72  | 0,094   | 3,45            | 0,063       |
| Arousal (slang words)                       | -0,13    | 0,11 | 38,75  | -1,20 | 0,239   | 1,69            | 0,193       |
| Dominance (common words)                    | -0,30    | 0,12 | 38,56  | -2,40 | 0,021   | 6,51            | 0,011       |
| Dominance (slang words)                     | 0,02     | 0,16 | 38,85  | 0,11  | 0,909   | 0,02            | 0,899       |

that included only one or both random effects (by comparing these models), we revealed that both random effects are statistically significant ( $p \leq 0.001$ ).

The results of the analysis of fixed effects on word pairs RT are given in Table 4, which indicates the presence of statistically significant effects of a number of factors.

Several significant effects were found, including the RT facilitation effects of cognitive preoccupation ( $-0.21$  SD with an increase in cognitive preoccupation per 1,  $p \leq 0.01$ ) and average Zipf coefficient ( $-0.22$  SD,  $p \leq 0.001$ ), as well as the RT inhibitory effect of mood regulation ( $0.14$  SD,  $p \leq 0.01$ ). The significant, but opposite, effects of emotional connotation of common words were found, including the RT inhibitory effect of valence ( $0.12$  SD,  $p \leq 0.05$ ) and facilitation effect of dominance ( $-0.3$  SD,  $p \leq 0.05$ ). In addition, a slight tendency of the RT inhibitory effect of arousal ( $0.13$  SD,  $p = 0.063$ ) was found as well. At the same time, no statistically significant effects of slang words' emotional connotation on RT were found.

## General Discussion and Conclusion

The problem of specific lexicon processing in individuals with different group identities or personal traits faces many theoretical and methodological obstacles. Affective neurolinguistics, as a field of study of language's emotional content effects on cognitive processing, needs a more detailed analysis of linguistic and psychological predictors of word recognition, including units of a specific lexicon.

In this study, we focused on two main objectives.

The first one was to analyze the effect of word familiarity and emotional state of participants on the three SAM-scales (valence, arousal and dominance) of words. In the first study we also sought to obtain normative ratings of Internet slang and common

words (both semantically related and unrelated) on the three SAM-scales. The second objective was to test the hypothesis about the RT facilitation effect of the emotional connotation of common and slang words in a dual lexical decision task, while controlling other linguistic factors and participants' propensity for PIU. So, we tested three empirical hypotheses in two studies.

The first hypothesis about significant effect of word familiarity on emotional ratings was fully confirmed: word familiarity was the strongest predictor of higher emotional ratings of words by the all three SAM-scales (with the effect size ranged from 0.70 to 0.92 SD). At the same time, there was no significant effect of word type (slang vs. common words), as well as no effect of corpus-based word frequency (Zipf coefficient) on word emotional ratings.

The second hypothesis about the contribution of participant's emotional state was partially confirmed. Emotional ratings on the arousal scale were influenced by negative affect: a more depressed, negative emotional state of the participant significantly reduces word ratings on this scale. On dominance scores, an effect of both positive and negative affect was revealed: that is, individuals with more pronounced affectivity in recent weeks rate the words higher on the dominance scale on average. At the same time, there were no significant effects of participants' affectivity on word valence. Apparently, valence (with polar scales "negative"—"positive") acts as a relatively stable emotional connotative characteristic of word meaning, in contrast to arousal and dominance.

The third hypothesis that emotional connotation of words may be the important predictor of RT reduction for pairs of words in which one of them is a slang word after controlling for the influence of cognitive preoccupation in social networking was tested in study 2. One feature of Internet slang is its active use by young people in online communication, which, under certain conditions, can cause problematic Internet use (PIU). On an explicit and implicit level, in-depth knowledge of Internet slang can be a marker of such an addiction. Our study 2 does not reveal any significant semantic priming effect (Fischler, 1977) on RT to pairs of slang and common words when the prime of a less-familiar slang word is a commonly used (albeit low-frequency) word. At the same time, corpus-based word frequency (average Zipf coefficient for word pairs) turned out to be a significant predictor of lexical decision facilitation. Common words with a more positive emotional connotation (valence) were recognized slower. This fact is not in line with the results of recent studies which have shown a facilitation effect on lexical decisions for positive words compared to negative and neutral words (Barriga-Paulino et al., 2022; Estes & Adelman, 2008; Scott et al., 2014; Vlasov & Sychev, 2018). As a tendency ( $p=0.063$ ), a similar effect was also observed for common words with a higher arousal. Surprisingly, dominance for common words affected RT in the opposite direction: there was a statistically significant facilitation in recognition of word pairs. Hence, emotional connotation of common words showed significant but sometimes unexpected effects on RT.

The results of our study revealed a significant effect of two facets of PIU on word pairs recognition, but they had the opposite directions. Individuals with a higher cognitive preoccupation with online communication responded to Internet slang words paired with common words significantly faster, while those more likely to use online communication for mood regulation responded for word pairs significantly slower.

The results obtained can be interpreted in line with Richard Davis' approach to determining general pathological Internet use (Davis, 2001). Individuals with a more pronounced immersion in Internet communication are more likely to have a tendency to implicitly recognize Internet slang without a clear effect of semantic priming (in our study,

slang words with semantically related primes did not show a significant facilitation in a lexical decision).

In a lexical decision task with emotion-laden online slang words, individual emotional experience associated with online communication, probably elicit faster reactions to the meanings of words with higher emotional experience scores, as confirmed by a number of studies (Siakaluk et al., 2016; Vinson et al., 2013). Apparently, cognitive preoccupation with social networking is associated not only with greater awareness of a specific lexicon, but also with a richer emotional experience of using this lexicon. Also according to Davis, depressive symptoms and loneliness can cause negative perceptions of social competence in individuals suffering from general pathological Internet use. Depressive symptoms are often associated with a decrease in overall productivity in solving various cognitive tasks, including lexical decision tasks (Stip et al., 1994). Our results of study 2 showed a significant increase in RT to pairs of words in individuals who demonstrated higher scores on the GPIUS-3 mood regulation subscale. These findings seem reasonable in terms of a general pathological Internet use model (Davis, 2001).

One of limitations of the study is that we used self-report scales for assessing PIU instead of medical diagnosis. This was due to the fact that clinical diagnosing Internet addiction is not yet widespread enough in Russia. Another limitation of the study is that the procedure of participants' recruiting for this study did not assure inclusion of highly addicted people. Hence, most of participants showed low or moderate level of PIU.

In general, the results of the study showed that cognitive, emotional processing of lexical information and some individual characteristics of behavior made sense in lexical decision. This was confirmed by our earlier studies on the material of the Russian language (Vlasov & Sychev, 2018). The emotional connotation of slang words obtained using the rating method in Study 1 did not cause any facilitation in LDT in Study 2. This finding may be explained by the lack of emotional connotation for slang words. Apparently, a higher emotional connotation is attached to those lexical representations that are more familiar to a native speaker, and this is typical for words with low frequency according to Zipf-value (since all stimulus words were considered low frequency). In Study 2, we hypothesize that correctly recognized pairs of Internet slang words with common words were recognized significantly faster by individuals with greater cognitive preoccupation with Internet communication due to the fact that this lexicon is part of their active vocabulary. This result can shed light on the current social stratification of the Russian language based on the studied material of Internet slang.

The studies of Internet slang processing and other youth sociolects can contribute to cognitive research on social identity, value orientations, emotional experiences of native speakers of a particular language, as well as for implicit diagnosing addictive behaviour.

## Appendix 1

Stimuli and their characteristics used in Study 2.

| No | Stimulus 1 | Stimulus 2   | Type | Word frequency of slang word, ipm | Word frequency of common word, ipm | Zipf coeff. of slang word | Zipf coeff. of common word | average Zipf coeff |
|----|------------|--------------|------|-----------------------------------|------------------------------------|---------------------------|----------------------------|--------------------|
| 1  | Забанить   | замариновать | 2    | 0,33                              | 0,30                               | 2,52                      | 2,48                       | 2,50               |

| No | Stimulus 1  | Stimulus 2  | Type | Word frequency of slang word, ipm | Word frequency of common word, ipm | Zipf coeff. of slang word | Zipf coeff. of common word | average Zipf coeff |
|----|-------------|-------------|------|-----------------------------------|------------------------------------|---------------------------|----------------------------|--------------------|
| 2  | пиджак      | сцквaйтч    | 3    | 0,00                              | 3,83                               | -                         | 3,58                       | 3,58               |
| 3  | Макушка     | aвa         | 2    | 1,00                              | 0,28                               | 3,00                      | 2,45                       | 2,72               |
| 4  | лонгрид     | вычитание   | 2    | 0,01                              | 0,31                               | 0,85                      | 2,49                       | 1,67               |
| 5  | гхвaсцк     | пaркeт      | 3    | 0,00                              | 1,89                               | -                         | 3,28                       | 3,28               |
| 6  | испeчь      | сцвиeнн     | 3    | 0,00                              | 2,10                               | -                         | 3,32                       | 3,32               |
| 7  | фид         | мex         | 2    | 0,13                              | 2,59                               | 2,12                      | 3,41                       | 2,76               |
| 8  | сцвoпe      | гpузoвик    | 3    | 0,00                              | 2,25                               | -                         | 3,35                       | 3,35               |
| 9  | дoнaтить    | уничтoжaть  | 2    | 0,04                              | 2,09                               | 1,57                      | 3,32                       | 2,44               |
| 10 | рaсписaтьcя | ливнуть     | 2    | 0,01                              | 0,75                               | 0,70                      | 2,87                       | 1,79               |
| 11 | шуруп       | сцвaисe     | 3    | 0,00                              | 0,26                               | -                         | 2,42                       | 2,42               |
| 12 | сцвaич      | тeтpадь     | 3    | 0,00                              | 3,85                               | -                         | 3,59                       | 3,59               |
| 13 | муд         | фeн         | 2    | 0,09                              | 2,71                               | 1,97                      | 3,43                       | 2,70               |
| 14 | кaпкaн      | пaнч        | 2    | 0,07                              | 1,77                               | 1,83                      | 3,25                       | 2,54               |
| 15 | свepлo      | стэн        | 2    | 0,90                              | 0,26                               | 2,96                      | 2,41                       | 2,68               |
| 16 | пocтить     | взбивaть    | 2    | 3,04                              | 1,99                               | 3,48                      | 3,30                       | 3,39               |
| 17 | выpeзaть    | чилить      | 2    | 0,00                              | 3,31                               | 0,30                      | 3,52                       | 1,91               |
| 18 | свeтильник  | сцкpилб     | 3    | 0,00                              | 1,68                               | -                         | 3,23                       | 3,23               |
| 19 | гхлуилт     | дpoвa       | 3    | 0,00                              | 5,75                               | -                         | 3,76                       | 3,76               |
| 20 | чинить      | гхвиeгт     | 3    | 0,00                              | 1,24                               | -                         | 3,09                       | 3,09               |
| 21 | рукaв       | сквuitxе    | 3    | 0,00                              | 4,64                               | -                         | 3,67                       | 3,67               |
| 22 | чacовня     | тoмбoй      | 2    | 0,00                              | 1,07                               | 0,30                      | 3,03                       | 1,67               |
| 23 | пылeсoc     | гхлуркe     | 3    | 0,00                              | 3,73                               | -                         | 3,57                       | 3,57               |
| 24 | бaлкoн      | сцквигхтxе  | 3    | 0,00                              | 9,60                               | -                         | 3,98                       | 3,98               |
| 25 | oбсуждeниe  | тpeд        | 1    | 0,59                              | 7,27                               | 2,77                      | 3,86                       | 3,32               |
| 26 | oтключeниe  | дискoнкeкт  | 1    | 0,02                              | 2,05                               | 1,38                      | 3,31                       | 2,35               |
| 27 | пpипoднять  | aпнуть      | 1    | 0,02                              | 0,73                               | 1,34                      | 2,86                       | 2,10               |
| 28 | стopис      | oбнoвлeниe  | 1    | 0,03                              | 5,68                               | 1,51                      | 3,75                       | 2,63               |
| 29 | oбсуждeниe  | гхвигхб     | 3    | 0,00                              | 7,27                               | -                         | 3,86                       | 3,86               |
| 30 | сцвиce      | oтключeниe  | 3    | 0,00                              | 2,05                               | -                         | 3,31                       | 3,31               |
| 31 | дирeкт      | инcтaгpaм   | 1    | 0,39                              | 3,59                               | 2,59                      | 3,55                       | 3,07               |
| 32 | пpипoднять  | клигхнт     | 3    | 0,00                              | 0,73                               | -                         | 2,86                       | 2,86               |
| 33 | poфл        | xoхoт       | 1    | 0,03                              | 1,02                               | 1,41                      | 3,01                       | 2,21               |
| 34 | oбнoвлeниe  | гхвoилл     | 3    | 0,00                              | 5,68                               | -                         | 3,75                       | 3,75               |
| 35 | флeйм       | cпop        | 1    | 0,18                              | 7,51                               | 2,26                      | 3,88                       | 3,07               |
| 36 | cтapшe      | oлды        | 1    | 0,00                              | 2,13                               | 0,48                      | 3,33                       | 1,90               |
| 37 | зaпpaшивaть | гyглитъ     | 1    | 0,48                              | 0,22                               | 2,68                      | 2,34                       | 2,51               |
| 38 | инcтaгpaм   | сцвyгг      | 3    | 0,00                              | 3,59                               | -                         | 3,55                       | 3,55               |
| 39 | гхвepce     | xoхoт       | 3    | 0,00                              | 1,02                               | -                         | 3,01                       | 3,01               |
| 40 | cпop        | гхвap       | 3    | 0,00                              | 7,51                               | -                         | 3,88                       | 3,88               |
| 41 | cтapшe      | сцкpesp     | 3    | 0,00                              | 2,13                               | -                         | 3,33                       | 3,33               |
| 42 | хeйтep      | нeнaвистник | 1    | 0,15                              | 0,15                               | 2,16                      | 2,18                       | 2,17               |
| 43 | квyич       | зaпpaшивaть | 3    | 0,00                              | 0,22                               | -                         | 2,34                       | 2,34               |
| 44 | нeнaвистник | сцкыcцк     | 3    | 0,00                              | 0,15                               | -                         | 2,18                       | 2,18               |

| No | Stimulus 1    | Stimulus 2    | Type | Word frequency of slang word, ipm | Word frequency of common word, ipm | Zipf coeff. of slang word | Zipf coeff. of common word | average Zipf coeff |
|----|---------------|---------------|------|-----------------------------------|------------------------------------|---------------------------|----------------------------|--------------------|
| 45 | влюбленность  | клигхлт       | 3    | 0,00                              | 9,07                               | -                         | 3,96                       | 3,96               |
| 46 | атака         | гхлоряуе      | 3    | 0,00                              | 3,14                               | -                         | 3,50                       | 3,50               |
| 47 | влюбленность  | краш          | 1    | 0,11                              | 9,07                               | 2,04                      | 3,96                       | 3,00               |
| 48 | флуд          | атака         | 1    | 0,46                              | 3,14                               | 2,66                      | 3,50                       | 3,08               |
| 49 | забанить      | заблокировать | 1    | 0,33                              | 2,03                               | 2,52                      | 3,31                       | 2,91               |
| 50 | визитка       | ава           | 1    | 1,00                              | 0,69                               | 3,00                      | 2,84                       | 2,92               |
| 51 | изложение     | лонгрид       | 1    | 0,01                              | 1,60                               | 0,85                      | 3,20                       | 2,02               |
| 52 | фид           | рассылка      | 1    | 0,13                              | 1,84                               | 2,12                      | 3,26                       | 2,69               |
| 53 | донатить      | вносить       | 1    | 0,04                              | 2,68                               | 1,57                      | 3,43                       | 2,50               |
| 54 | заблокировать | гхвоисе       | 3    | 0,00                              | 2,03                               | -                         | 3,31                       | 3,31               |
| 55 | визитка       | сцваигуе      | 3    | 0,00                              | 0,69                               | -                         | 2,84                       | 2,84               |
| 56 | изложение     | гхрелце       | 3    | 0,00                              | 1,60                               | -                         | 3,20                       | 3,20               |
| 57 | гхавце        | рассылка      | 3    | 0,00                              | 1,84                               | -                         | 3,26                       | 3,26               |
| 58 | ливнуть       | покинуть      | 1    | 0,01                              | 7,23                               | 0,70                      | 3,86                       | 2,28               |
| 59 | муд           | лад           | 1    | 0,09                              | 2,93                               | 1,97                      | 3,47                       | 2,72               |
| 60 | ударение      | панч          | 1    | 0,07                              | 2,28                               | 1,83                      | 3,36                       | 2,59               |
| 61 | стэн          | фанат         | 1    | 0,90                              | 2,71                               | 2,96                      | 3,43                       | 3,19               |
| 62 | вносить       | сцквуиф       | 3    | 0,00                              | 2,68                               | -                         | 3,43                       | 3,43               |
| 63 | покинуть      | гхлелц        | 3    | 0,00                              | 7,23                               | -                         | 3,86                       | 3,86               |
| 64 | публиковать   | постить       | 1    | 3,04                              | 1,82                               | 3,48                      | 3,26                       | 3,37               |
| 65 | лад           | сцквалте      | 3    | 0,00                              | 2,93                               | -                         | 3,47                       | 3,47               |
| 66 | бездельничать | чилить        | 1    | 0,00                              | 0,50                               | 0,30                      | 2,70                       | 1,50               |
| 67 | сцвеиф        | ударение      | 3    | 0,00                              | 2,28                               | -                         | 3,36                       | 3,36               |
| 68 | фанат         | гхвауш        | 3    | 0,00                              | 2,71                               | -                         | 3,43                       | 3,43               |
| 69 | сцкрулм       | публиковать   | 3    | 0,00                              | 1,82                               | -                         | 3,26                       | 3,26               |
| 70 | бездельничать | гхвисп        | 3    | 0,00                              | 0,50                               | -                         | 2,70                       | 2,70               |
| 71 | пацанка       | томбой        | 1    | 0,00                              | 0,29                               | 0,30                      | 2,46                       | 1,38               |
| 72 | пацанка       | сцкрурк       | 3    | 0,00                              | 0,29                               | -                         | 2,46                       | 2,46               |
| 73 | тред          | пиджак        | 2    | 0,59                              | 3,83                               | 2,77                      | 3,58                       | 3,18               |
| 74 | замариновать  | гхрултх       | 3    | 0,00                              | 0,30                               | -                         | 2,48                       | 2,48               |
| 75 | дисконнект    | паркет        | 2    | 0,02                              | 1,89                               | 1,38                      | 3,28                       | 2,33               |
| 76 | макушка       | квеуе         | 3    | 0,00                              | 0,28                               | -                         | 2,45                       | 2,45               |
| 77 | испечь        | апнуть        | 2    | 0,02                              | 2,10                               | 1,34                      | 3,32                       | 2,33               |
| 78 | вычитание     | гхвилтч       | 3    | 0,00                              | 0,31                               | -                         | 2,49                       | 2,49               |
| 79 | сторис        | грузовик      | 2    | 0,03                              | 2,25                               | 1,51                      | 3,35                       | 2,43               |
| 80 | гхвеитх       | мех           | 3    | 0,00                              | 2,59                               | -                         | 3,41                       | 3,41               |
| 81 | шуруп         | директ        | 2    | 0,39                              | 0,26                               | 2,59                      | 2,42                       | 2,51               |
| 82 | уничтожать    | сцвоафф       | 3    | 0,00                              | 2,09                               | -                         | 3,32                       | 3,32               |
| 83 | расписаться   | сцкреняуе     | 3    | 0,00                              | 0,75                               | -                         | 2,87                       | 2,87               |
| 84 | фен           | гхвалце       | 3    | 0,00                              | 2,71                               | -                         | 3,43                       | 3,43               |
| 85 | капкан        | сцкрарв       | 3    | 0,00                              | 1,77                               | -                         | 3,25                       | 3,25               |
| 86 | тетрадь       | рофл          | 2    | 0,03                              | 3,85                               | 1,41                      | 3,59                       | 2,50               |
| 87 | светильник    | флейм         | 2    | 0,18                              | 1,68                               | 2,26                      | 3,23                       | 2,74               |

| No | Stimulus 1 | Stimulus 2 | Type | Word frequency of slang word, ipm | Word frequency of common word, ipm | Zipf coeff. of slang word | Zipf coeff. of common word | average Zipf coeff |
|----|------------|------------|------|-----------------------------------|------------------------------------|---------------------------|----------------------------|--------------------|
| 88 | сверло     | гхлелмб    | 3    | 0,00                              | 0,26                               | -                         | 2,41                       | 2,41               |
| 89 | взбивать   | гхвемф     | 3    | 0,00                              | 1,99                               | -                         | 3,30                       | 3,30               |
| 90 | олды       | дрова      | 2    | 0,00                              | 5,75                               | 0,48                      | 3,76                       | 2,12               |
| 91 | чинить     | гуглить    | 2    | 0,48                              | 1,24                               | 2,68                      | 3,09                       | 2,88               |
| 92 | хейтер     | рукав      | 2    | 0,15                              | 4,64                               | 2,16                      | 3,67                       | 2,91               |
| 93 | пылесос    | краш       | 2    | 0,11                              | 3,73                               | 2,04                      | 3,57                       | 2,80               |
| 94 | вырезать   | гхвеиг     | 3    | 0,00                              | 3,31                               | -                         | 3,52                       | 3,52               |
| 95 | часовня    | гхлаутхе   | 3    | 0,00                              | 1,07                               | -                         | 3,03                       | 3,03               |
| 96 | флуд       | балкон     | 2    | 0,46                              | 9,60                               | 2,66                      | 3,98                       | 3,32               |

Note. The *Type* column uses the following stimulus type coding: 1—for semantically related stimuli, 2—for semantically unrelated stimuli, 3—for nonwords. The abbreviation "coeff." means coefficient

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**Data Availability Statement** The data and materials from Study 1 and Study 2 are publicly available at the Open Science Framework website: [https://osf.io/fwgqn/?view\\_only=fdc243b7b9164e1cbe5a6b5a8afae4d0](https://osf.io/fwgqn/?view_only=fdc243b7b9164e1cbe5a6b5a8afae4d0).

## Declarations

**Conflict of interest** The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Informed Consent** Data collection was approved by the Ethical Committee of Shukshin Altai State University for Humanities and Pedagogy, the informed consent was read and acknowledged by participants (or legal representatives) prior to their tasks. Since the studies were conducted on the *Yandex.Forms* and *PsyToolkit* platforms in a computer lab, participants had to verify their age themselves or through their legal representative. Legal representatives also attended the study at the prior invitation of the supervisor. Students over 18 completed the surveys on their own.

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