

Model for monitoring the psychological safety of young people based on automated analysis of queries in search engines

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Abstract. The paper considers the method of parsing and processing information in combination with classical psychological science. The result of the synthesis of the two directions was a predictive model of the mood and psychological state of city residents. The analysis of information about self-destructive practices and the need for psychological assistance based on search engine statistics is one of the most objective analysis tools, since it allows you to evaluate large amounts of information without the influence of social desirability and socio-cultural stereotypes about psychological assistance. The study showed that the analysis of queries in a search engine can serve as an important source of information about psychological security, self-destructive practices and the dynamics of demand for the services of specialists in helping professions. The results of the work can be used to visualize and track the seasonal dynamics of requests for psychological help and monitoring the quality of life of the population. In the course of the work, 30 topics in the field of psychology were analyzed, a database and a predictive model of the psychological state of urban residents based on big data from search engines were developed.

1 Introduction

An important stage in the development of the mental health monitoring system of the population is the creation of new interactive diagnostic systems capable of assessing on a large scale the presence of mental problems and requests for help from specialists in the population. According to many researchers, more than a quarter of the population needs the help of a psychologist and at the same time the same number do not satisfy their need for quality care (17.8%) [1].

The number of self-destructive practices is increasing, especially among young people, which is associated with a high risk of mortality and is one of the main problems that the world health currently faces. In our study, we define self-destructive behavior as a destructive form of defensive behavior that is used by a person as an avoidant coping strategy aimed at complacency and reacting emotions in non-constructive ways associated with alcohol, drug use, risky, deviant behavior, self-harm and suicidal attempts [2]. Such forms of behavior can be life-threatening, harmful to spiritual and moral development or social status.

Self-destructive behavior is a dynamic phenomenon that is influenced by many factors. Adhering to the ecological approach, it is important to take into account the peculiarities of the micro- and macro-environment: the peculiarities of society, in communication with which the development of pathological symptoms occurs [3]. The main social environment for the majority of the active population is cyberspace, which provides access to any information. All spheres of life (communication, development, opportunities to study and work) are connected with the information that a person consumes in a digital environment.

Classical forms of self-destructive behavior are transferred to the virtual space - gaming and chemical addictions, Internet pornography, autodestructive and extremist groups, bullying [4], as well as specific ones are formed – dependence on social networks, excessive use of the Internet, dependence on gadgets, etc. All this suggests that the Internet environment appears to be a convenient platform for monitoring all forms of destructive behavior. At the same time, excessive Internet use is also considered by many authors as a form of risky behavior, the predictors of which are other forms of self-destructive behavior and psychopathological diseases [5].

Based on one of the leading theories of self-destructive behavior - the interpersonal psychological theory of suicide (IPTS), it is possible to consider three factors of the emergence of self-destructive thoughts in the context of the digital environment. The first factor is related to the perception of oneself as a burden to others (family, friends, society) [6]. In the context of modern digital culture, which is aimed at accelerated perception and demonstration of a positive lifestyle, emotional costs increase and can increase the feeling of self-hatred, which will manifest itself in self-destructive thoughts and actions and self-isolation. The second factor is associated with the disappearance of a sense of belonging to a social environment [7]. Excessive immersion in the virtual environment increases the distance in social interaction in real life and can lead to the manifestation of destructive loneliness. The third factor is related to fearlessness before death [8]. Hyperstimulation of all perception systems in interaction with the digital environment leads to increased tolerance to provocative stimuli and reduces the fear of death.

Due to the importance of digital technologies for the psychological well-being of modern man, there is a growing number of studies on how artificial intelligence and machine learning can help in detecting and predicting self-destructive behavior. N. Nordin et al. in their cross-sectional study of various empirical approaches to automated analysis, they indicate that single prediction models are not yet accurate enough, however, when using ensemble prediction, it is possible to describe a fairly accurate range of possible future psychological states and predict the risks of autoaggression [9].

Burke T.A. et al in their review study indicate that the use of machine learning in forecasting can help not only to find and classify existing risk factors for self-destructive behavior, but also can identify and describe new digital variables that can predict the risk of even subthreshold non-clinical forms of self-harm, as well as taking into account nonlinear analysis models [10].

Kusuma K. et al point out that artificial prediction models predict suicide risk better than traditional clinical diagnostics, since they are able to take into account a wide range of socio-demographic and behavioral factors that are not always possible to track in clinical conversation and observation [11].

Macally M. et al in their work indicate that with the help of machine learning it is possible to track the occurrence of suicidal thoughts in dynamics, as well as changes in the emotional-volitional sphere and fluctuations in self-esteem [12].

Bernert R.A. et al point out that users often disclose information about their self-destructive behavior and intentions on social networks even while hiding them from relatives and doctors, which makes the study of digital traces even more relevant. A cross-sectional

analysis of information in a digital environment can help trace the population dynamics of interest in destructive content and develop an effective prevention system [13].

It becomes important to study the information about health and professional help that the user faces on the network. To modernize the system of professional psychological assistance, it is necessary to create an effective system for monitoring the needs of the population, taking into account the use of new sources of information. Traditional socio-psychological studies of the prevalence of self-destructive practices, as well as studies devoted to the analysis of the needs of the population for psychological assistance, are quite time-consuming and often have a number of limitations: 1) the possibility of selecting large samples of subjects; 2) taking into account all socio-demographic indicators; 3) the complexity of tracking the dynamics of processes; 4) the inability to correlate research results with different diagnostic models.

In this regard, the purpose of this study was to study the dynamics of requests for self-destructive behavior and the search for help by users of the Yandex search engine to create a model for monitoring psychological security.

2 Materials and methods

The methodological model of the study was built on the combination of traditional socio-psychological methods and the possibilities of automated analysis of information in search engines to create a system for monitoring psychological security.

To achieve this goal, we have set the following tasks:

- 1) to analyze the main approaches to the study of self-destructive behavior, as well as the use of information technology for the analysis and monitoring of psychological safety;
- 2) set up an automated complex for uploading information about search queries on the Internet;
- 3) develop a database for storing information;
- 4) to conduct a survey of users to create marker dictionaries for automated analysis of query dynamics;
- 5) to identify the dynamics of queries about self-destructive behavior and search for help by search engine users.

We have hypothesized that:

- 1) there is an annual dynamics of requests for self-destructive behavior and search for psychological help in the search engine;
- 2) requests for self-destructive behavior and self-help can be predictors of requests for professional help from a psychologist.

The sample for the survey consisted of 218 people aged 16 to 35 years (Mean=19.9, SD=3.3), of which 67% (147) were women and 33% (70) men. The study was conducted in 2022 in Russia, in the city of St. Petersburg.

The study used survey methods, the corpus method of creating dictionaries, automated methods of downloading and analyzing information from search engines, statistical methods of data analysis (analysis of changes in the level of dynamics of query growth, regression analysis).

To create a dictionary of markers for automated analysis of query dynamics, a user survey was conducted on the following questions:

- 1) Analysis of ideas about what self-destructive behavior is: "Self-destructive behavior is...", "People practicing self-destructive behavior ...";
- 2) Analysis of ideas about ways to help people with self-destructive behavior: "If someone from my family practices self-destructive behavior, then I...", "When it's difficult for me to cope with my experiences, I ...".

In our work, an analysis of the search activity of Internet users was carried out to identify trends and seasonality of certain topics. The search activity of users was collected using the Yandex Wordstat tool.

Wordstat is a free online tool provided by the Yandex search engine. With Wordstat, users can find the most popular search queries in a certain region and in a certain language and understand the search behavior of their target audience. This information can be used for SEO and advertising purposes, such as optimizing website content and selecting the best search queries for advertising campaigns. However, the useful functions of this service are also suitable for scientific research. So, in their work [14], the authors study the problems associated with the increase in antibiotic resistance in the conditions of the pandemic spread of COVID-19 by assessing the dynamics of the frequency of a specific request for "antibiotics" in the pharmacy and hospital segments based on open data from the Wordstat search engines. In the conditions of a rapidly changing society and the environment of its existence, timely identification of the main trends in the dynamics of socio-economic conflictogenicity of society is becoming more and more urgent. In the article [15], an attempt is made to perform such an analysis based on the data of the population's requests on the Internet. The analysis of search queries of the population using the Wordstat search engine allows us to establish the intra-annual dynamics of virtual, subjective and socio-economic conflictogenicity of society as a whole. The approbation of the proposed methodology confirmed its suitability for the express analysis of the socio-economic conflictogenicity of society.

In order to start working with the service, you need to log in through your account. Next, you need to enter the query of interest. The system makes it possible to conduct an analysis in several directions:

- 1) By words. The results of the selection will show statistics of Yandex queries that include the word or phrase you specified (on the left), and similar queries (on the right). The numbers next to each query in the keyword search results give a preliminary forecast of the number of impressions per month that you will receive by selecting this query as a keyword. So, the number next to the word "car" indicates the number of impressions for all queries with the word "phone": "buy a car", "passenger car", etc.
- 2) By region. In this section, you can view a regional cross-section of the statistics of the display of a given request. "Impressions per month" is the absolute value of the number of page impressions for queries from a given region. "Regional popularity" is the share that a region occupies in impressions for a given word, divided by the share of all search results impressions that fell on that region. The popularity of a word/phrase equal to 100% means that this word is not highlighted in this region. If the popularity is more than 100%, it means that there is an increased interest in this word in this region, if less than 100%, it is reduced.
- 3) Query history. This tool provides a monthly or weekly slice of impression statistics for a given query. Statistics can be viewed both in absolute and relative values. To get a relative value, the absolute figure is normalized by the number of impressions of Yandex search results for the corresponding month. After that, you need to go to the wordstat website.yandex.ru

In our work, the Query History tool was used to analyze the dynamics of Internet users' interest in the subject of our research. The general scheme of work is shown in Figure 1.

The choice of the Wordstat tool is due to the popularity of the Yandex search engine. This company has local experience and knowledge, it provides services in Russian, adapted to the needs and interests of its users. It is important to note that there are analogues of this system, for example Google Trends. Work with this system is planned for the next stage, to collect complete statistics.

Google Trends is a free web service provided by Google that allows users to see how often Google has searched for certain keywords, topics and phrases over time. This provides

valuable information about search patterns and interests of Internet users in different regions and in different languages. This information can also be useful for marketers, researchers and journalists to stay up to date on current topics and help plan marketing campaigns or write timely articles (fig. 1).

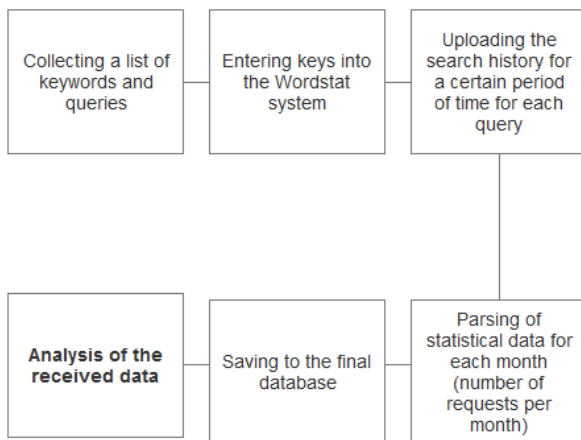


Fig. 1. The general scheme of work on collecting statistics of search activity.

3 Research results

At the first stage, with the help of a survey, we identified the main components (markers) of the concept of self-destructive behavior in the minds of users, as well as the main ways of helping them in difficult situations for themselves and loved ones. Based on the selected categories, using the corpus method, dictionaries of markers were compiled for automated analysis of query dynamics (Table 1).

Table 1. Components (markers) of the concept of self-destructive behavior and the main ways of helping in the minds of users.

Concepts	Markers
Forms of self-destructive behavior	self-harm, autoaggression, self-destruction, suicide, self-harm, suicide methods
Symptoms of self-destructive behavior	Experiencing pain, suffering, psychological trauma, inability to solve a problem, inability to find a way out, feeling helpless, feeling like a burden
Consequences of self-destructive behavior	negative impact on health, destructive behavior, mental harm, physical harm, degradation of personality, low self-esteem
Psychologist's help and self-help	Help from a psychologist, Talk about problems, share experiences, seek support, look for a solution on your own, pay attention to a loved one
Appeal to relatives and family for help	meet with loved ones, share with loved ones, find friends, talk to parents, try to distract from difficult experiences

At the second stage, automated collection of query statistics for 2021 and 2022 was carried out.

The analysis of statistics showed the following (Figure 2,3).

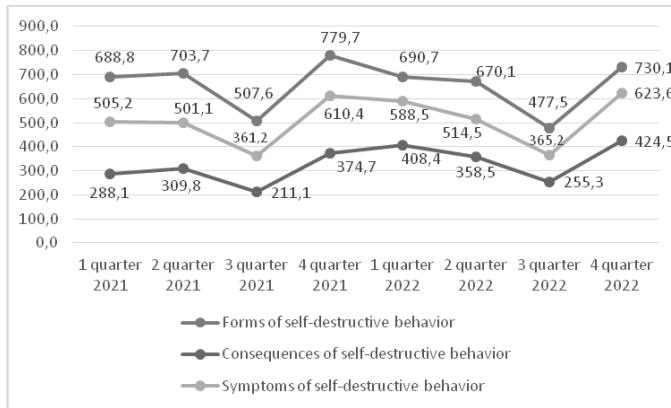


Fig. 2. Dynamics of requests for self-destructive behavior (units of measurement of 1000 requests).

Analysis of the dynamics of requests for self-destructive behavior showed that there is a seasonal variability in the growth of interest in this topic.

The greatest interest in this topic is manifested in the 4th quarter in the autumn-winter time, and the decline in interest in the 3rd quarter in the summer.

This picture correlates with clinical observations of the dynamics of the development of seasonal affective disorders, which are one of the main risks of developing self-destructive behavior [16]. It is worth noting that at the moment clinical research in this area is primarily devoted to the study of pathological affective states, and the dynamics of mass affective states remains unexplored.

Analysis of the dynamics of queries in search engines will allow you to track fluctuations in affective states in the community as a whole and build a clearer model of prevention and psychological assistance. Let's look at the dynamics of requests for help and self-help methods (Figure 3).

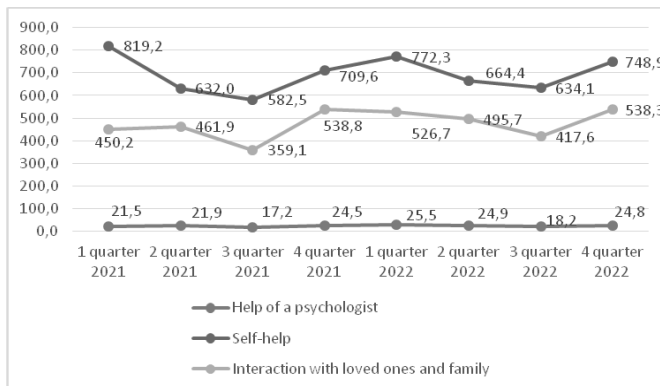


Fig. 3. Dynamics of requests for ways to help with self-destructive behavior (units of measurement of 1000 requests).

The analysis shows that the search for information about ways to help also has seasonal dynamics and increases in autumn and winter. It is worth noting that there are significantly fewer requests for help than requests for self-destructive behavior.

In particular, requests for professional help from a psychologist are 20 times less than requests for self-help, which indicates a low psychological literacy of the population. The growth of self-destructive practices in society leads to an increase in the demand for such information. Netizens are faced with the need to understand and help themselves and their

loved ones in difficult life situations. However, the understanding of the importance of professional psychological assistance has not yet been integrated into the everyday socio-cultural environment. Such a mismatch leads to a decrease in the effectiveness of the prevention of psychological safety.

Let's consider the dynamics of statistical indicators for 2021-2022, to analyze the increase in interest in the topics of self-destructive behavior and psychological assistance (Table 2).

Table 2. Statistical indicators of changes in the dynamics of reserves growth for 2021-2022.

Indicators	Help of a psychologist	Self-help	Appealing to loved ones for help	Ways to escape from difficult experiences
Absolute increase	2060	-64308	68749	6790
Growth rate	9,7	-8,3	15,7	16,6
Middle level of the row	22322,6	695367,6	473536,8	43128,5
Median	22906,5	698371	483235	44577,5
Indicators	Forms of self-destructive behavior	Consequences of self-destructive behavior	Symptoms of self-destructive behavior	Methods of suicide
Absolute increase	184889	142639	154807	2300
Growth rate	33,1	52,4	32,3	26,4
Middle level of the row	656014,5	328807,5	508716,3	10255,5
Median	686205,5	329860,5	554314	10136,5

The table shows that over the past two years there has been an absolute increase in interest in the topics of self-destructive behavior (184889), symptoms of self-destructive behavior (154807), consequences of self-destructive behavior (142639), as well as the study of suicide methods (2300)

An increase in interest in this topic can manifest itself in various forms, such as fascination with dangerous or radical ideas, experimentation with drugs and alcohol, participation in dangerous games or suicide attempts. The growing interest in self-destruction can be caused by many factors, some of them may include high levels of stress, lack of social support, encouragement of dangerous and destructive behavioral patterns in the media, distorted body images, drug addiction or alcoholism. Due to the growth of such interest, it is necessary to carry out measures for the prevention and treatment of mental disorders, as well as to expand research aimed at analyzing the dynamics and causes of such conditions.

The analysis of requests for help shows an increase in interest in professional help from a psychologist (2060), in interaction with loved ones (68749), attempts to distract from problems (6790) and a decline in interest in self-help (-64308). At the level of statistical analysis, we can say that people lose interest in opportunities to improve their mental or physical condition using their own strength and knowledge. This can occur because of various factors, for example, lack of motivation, preoccupation with other things, unsuccessful experience of earlier attempts at self-help, as well as an abundance of contradictory information in the information space. A decline in interest in self-help can lead to a deterioration in health. Therefore, it is important to continue studying this phenomenon of decline to maintain healthy habits to cope with a number of psychological difficulties on their own.

The analysis of the growth rate indicates that the topic of the consequences of self-destructive behavior is of the greatest interest (52.4%), and the topic of self-help is the least (-8.3%). The consequences of self-destructive behavior can be different and have serious consequences for human health and life. Some of them include physical injuries, mental disorders, loss of trust of close associates, financial losses, damage to relationships, damage to professional life. However, there are many ways to treat this phenomenon, including professional psychological assistance, medical treatment and rehabilitation programs that help to avoid or reduce the consequences of such behavior and restore mental health. It is worth noting that the appeal to professional help is not yet so common in Russian practice. The reasons for the low interest in professional assistance also need further study.

The issue of indirect diagnosis of the need for professional help through popular requests for self-destructive behavior and self-help becomes relevant. We have chosen regression analysis, which allows us to build a statistical model used to predict the value of a dependent variable based on the value of one or more independent variables. It can be used to determine which factors have the greatest impact on the change in the dependent variable, as well as to predict its value in specific conditions. In this regard, at the third stage, we built a regression model in order to determine the statistical significance of the presence of different requests for the actual determination of the increase in requests for professional help from a psychologist (Table 3).

Table 3. Regression analysis results.

Independent variables	Request: "psychologist's help"		
	b	Std.Err.	p-value
Request: «how to share experiences?»	2,936	1,158	0,019704
Request: «how to find friends?»	0,031	0,015	0,048292
Request: «self-harm»	0,034	0,015	0,030484
R ²	0,8434		
Intercept	6383,357		

As a result of regression analysis, the following predictors of an increase in the number of requests for professional help from a psychologist were identified: requests for how to share experiences, how to find friends and requests for self-harm.

The more requests there are about how to share experiences, how to find friends and about self-harm, the more likely it is to increase requests for psychological help. It is worth noting that the linear determination coefficient (R²) is 0.84, which indicates a high level of approximation, adequate selection of predictors and effective predictive power of this model.

4 Discussion

The results obtained allow us to conclude that the research hypotheses have found support. There is a year-long dynamic in search queries, with an increase in interest in self-destructive behavior and the search for psychological help in the 4th quarter and a decline in interest in the 3rd quarter of the year.

Over the past two years, there has been an absolute increase in interest in the topics of self-destructive behavior and professional help from a psychologist and a decline in interest in self-help. These results correlate with the clinical observations of specialists, which objectifies their use for mass monitoring.

Analysis of the growth rate indicates that the greatest increase in interest is caused by the topic of the consequences of self-destructive behavior. It is worth noting that there are an order of magnitude fewer requests for help than requests for self-destructive behavior, which

correlates with the results of previous studies that indicate a link between the statistics of requests for psychological help and psychological culture [17].

In connection with the above, there is an important task of building monitoring models related to the analysis of a wide range of requests that do not directly affect the sphere of psychological assistance.

A comprehensive model of psychological safety prevention should include a set of measures aimed at preventing the occurrence and development of possible problems caused by self-destructive behavior. A number of components of this model can be implemented in the information space by analyzing large databases:

- 1) Raising awareness of the problem: Spreading information about the negative consequences of self-destructive behavior can help reduce the attractiveness of such behavior to people.
- 2) Prevention of risk factors: risk dynamics analysis and creation of educational and informational programs based on them that can help people understand which factors in their lives can lead to self-destruction.
- 3) Digital online support system based on the analysis of current requests for professional assistance.
- 4) Modernization of diagnostics and treatment based on the analysis of requests for forms and types of self-destructive practices.

The second hypothesis was confirmed about the possibility of constructing a predictive model of increasing requests for psychological help through the analysis of requests for self-destructive behavior (requests for self-harm) and the search for ways of self-help (how to share experiences, how to find friends). This result correlates with studies that indicate a low percentage of requests for psychological help among young people (W. Shi, Z. Shen) and the need to find new ways to educate and help (P. Petrelli, M. Enter, A.) [18;19].

It is important to note the limitations of this approach for constructing a predictive model for monitoring psychological security. The analysis of the general dynamics of requests is important for predicting seasonal exacerbations and periods of activation of the psychological support system. However, this system does not make it possible to take into account the socio-demographic specifics of requests and set up personalized monitoring taking into account age, gender and economic factors. It is also necessary to constantly update monitoring data and test the model in different search engines to clarify the specifics of local search. It is worth noting that in order to analyze the results of such monitoring, it is necessary to involve experts in the field of psychology, psychiatry and information technology. An important stage in the implementation of the system is the training of qualified personnel to integrate the model into the work of the prevention system, as well as the experimental study of the requests of people with diagnosed self-destructive symptoms for iterative analysis and refinement of the model.

5 Conclusions

Based on the results obtained, it is possible to describe the methodological grounds for building a psychological security monitoring model based on automated query analysis in search engines:

- 1) systematic analysis of requests to track bursts of interest in self-destructive behavior for preventive work during periods of exacerbation;
- 2) analysis of the growth rate of the request for individual topics to identify the targets of assistance;
- 3) qualitative analysis of requests for the creation of support programs covering issues of psychological education, diagnostics of affective tension in society;

4) development of behavioral models of assistance based on requests for psychological support.

In the continuation of this study, we plan to study the semantic field of query markers to expand the possibilities of digital diagnostics of the affective state of users and clarify the directions of monitoring and prevention of psychological safety. Also, an important area of development of this work will be the clarification of the regional specifics of requests, taking into account various socio-demographic factors.

The second stage of the study will be the study of platforms with questionnaires of psychologists. Using parsing methods, it is planned to upload descriptions of specialists' questionnaires, then using mathematical modeling based on the LDA method or others to determine the main topics that specialists describe in their profiles.

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