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## **Application of Social Engineering Elements to Marketing of Public Science-Promoting Educational Products in Biomedicine**

**Abstract.** In order to overcome the low level of literacy of the population in the issues of modern innovative technologies, the paper suggests a technological approach, which combines methods of classical marketing with elements of social engineering on the basis of a neuro-evolutionary paradigm. The essence of this approach is to organize social communications in the target group by analogy with neuron connections in mathematical neural networks, thus ensuring the group's high efficiency in making collective decisions. At the stage of testing of this campaign, over 3 thousand people were involved in scientific and educational activities of a biomedical orientation.

**Keywords:** marketing, scientific and educational lectures, social engineering, neuro-evolutionary methodology.

**JEL Codes:** I18, M31, L31, I29

### **Introduction**

Over the past few decades, modern science has undergone such a high rate of discovery of new phenomena and revision of existing concepts that its condition is often characterized as a scientific revolution. An example is the biomedical field, which gave rise to revolutionary technological transformations in medicine [Biomedicine 2040, 2017]. Some results are visible in the statistics, for example, the average life expectancy at birth in the world increased by more than 7 years in 25 years (1990-2015) [World Health..., 2017]. However, a significant part of the results and consequences of the ongoing scientific revolution is still beyond the field of view of statisticians. Because of the high level of bureaucratization and inadequate efficiency of state regulation of the healthcare system, the

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implementation of scientific developments into medical practice is extremely slow. Medications and technologies, the effectiveness of which has already been discovered and proved at the level of laboratory experiments, can go into mass use no earlier than in 7-10 years [Public analytical report..., 2015]. This means that the significant potential for growth in the quality of life level remains concealed. The very fact of whether this potential is realized, for whom and on what terms, is currently the subject of active discussion both in Russian society and throughout the world. Against this background, the problem of a low level of public awareness in modern technologies, understanding of threats and the ability to assess risks, becomes especially relevant. The purpose of this article is to propose and test methodological approaches to increase the level of awareness of mass youth audiences in the area of achievements of modern biomedical science.

### **Scientific and educational lectures, as an object of social marketing**

One of the tools that historically proved its effectiveness in educational activities for the general public is scientific and educational lecturing (SEL). In 2017, employees of the Department of Marketing of the Faculty of Economics of the Lomonosov Moscow State University conducted a marketing analysis of SEL formats existing in the Russian educational environment as a possible commercial product [Gerasimenko, 2017].

The research of the existing competitive space of the leading SEL providers shows:

- there is an increasing trend in a demand to spend leisure on self-education - “edutainment”;
- the leading actors of the market lecture on a broad variety of topics and have an established audience;
- strong players have a high image and attendance;
- there is the development of online formats, it requires the formation of a comprehensive information infrastructure.

As shown by the study of Russian providers of educational content, the following tools are used in SEL marketing:

- leaders of opinions in each category are invited to lecture;
- presence of a powerful digital platform, wide use of online and offline forms of interaction with the target audience;
- modern website of the provider;
- development of regional SEL promotion sites;
- active work in social networks.

The above-mentioned characteristics are relevant for marketing promotion of SELs. During the study of existing SEL audiences, 5 consumer segments were identified (Table 1). For the purposes of our research, the youth segment, which is conditionally designated as “Applicants” is of interest, bearing in mind that

their motivation is often associated with future career guidance and admission to university.

**Table 1.** Segmentation of SEL consumers

<b>"Applicants" segment 14-18 years old</b>	<b>"Parents" Segment 30-45 years old</b>	<b>"Professionals" segment 18-70 years old</b>	<b>"Erudites" segment 25-70 years old</b>	<b>"Seniors" segment 70+</b>
Consumption motive: vocational guidance, self-realization	Consumption motive: motivated by the interests of children and their vocational training, and expansion of horizons	Consumption motive: professional interest, search for professional contacts, broadening of outlook, deepening of knowledge. As a rule, they go for names known in their field (professors, experts)	Consumption motive: attend for the sake of broadening their outlook, general development, pleasant communication	Consumption motive: attend lectures for the sake of socialization and pleasant communication. A lecture is a cure for loneliness.

**Source:** Gerasimenko, 2017

To implement such motives as career guidance and self-realization, a high degree of interest is needed, which is not always observed. It is the youth audience that is least involved in socially significant educational projects, including the subject of introducing new biomedical technologies. The reason often lies not in the content of the issue, but in the «packaging» of the educational product: lack of focus on target segments to create their motivation, weak positioning, unattractive content, lack of bright network communication to create communities in the youth audience, ready to actively interact with potential consumers and providers of telemedicine services, etc. In other words, social marketing does not work.

The approach of social marketing to the problem of mass literacy in scientific disciplines enables outlining the following risks:

- taking into account the social significance of educational activities in the field of achievements of modern science, this activity should be directed to all the most important socioeconomic groups of society. However, the information submitted in a single context to a wide audience inevitably loses a significant part of the audience, especially young people with special preferences and motives of behaviour. Therefore, segmentation of consumers is necessary for effective market positioning and promotion of SELs;
- the state's efforts to increase the level of general biomedical literacy must be undertaken in an open environment, which means that socially-

- oriented activities will inevitably have to compete with similar commercial activities promoted through aggressive marketing;
- taking into account the scale of social tasks facing the state in terms of increasing the biomedical literacy of the population, the development of programs of this orientation should be provided with significant budgetary infusions. As a result, information activities are to undergo long preparation, multi-stage coordination, multi-level control, and therefore, they will fail to meet their original goal - to provide flexible and prompt information to citizens on the latest achievements of science and state-of-the-art technologies in this field. We need new, more flexible and accessible formats of promotion, which would take into account modern technologies of social engineering.

In this study, one of the most important consumer segments was chosen, namely the youngest part of the target audience as an object for searching for opportunities for social engineering with the aim of constructing self-organizing structures capable of carrying out scientific and educational activities in the field of biomedicine without significant budgetary expenditures on the part of the state.

### **Neuro-evolutionary approach as a methodological basis for social engineering**

The papers of the Russian researchers [Petrunin, Andreyuk, 2008; Andreyuk, 2011; Alekseev et al., 2012; Andreyuk, 2016; Andreyuk, 2018] have shaped a relatively recent methodological approach to construct social systems, which are able to independently solve organizational problems in managing economic systems [Petrunin, Andreyuk, 2008; Andreyuk, 2011; Alekseev et al., 2012], including in the area of high technologies [Andreyuk, 2011; Alekseev et al., 2012; Andreyuk, 2018], education and socially significant civil initiatives [Andriyuk, 2016]. Within the framework of this approach, it is proposed to consider social groups as a type of «computing» systems capable of processing incoming information, making decisions and implementing them, as well as self-learning. The validity of such an examination is justified by the fact that structurally a group of cooperating people can be compared with a neural network in the mathematical sense of the term, i.e., as a set of information elements - simple processors («neurons») - connected and interacting with each other. Each element (person in a group) can receive and send signals. Certain principles of organization of connections (one of which is a **multi - layered hierarchical structure with a high density of inter-element links within the layer and relatively rare bonds between elements** belonging to different layers) provide the ability to solve such problems as pattern recognition, discriminant analysis, clustering. Formally, such tasks include a large part of so-called «managerial decisions» i.e. decisions that need to be taken by a group of people for productive teamwork.

An analysis of the evolutionary retrospective of a human being, as a biological species, and those close to it in the social organization of animals, suggests the existence of an evolutionary vector in the direction of increasing the conventional «computing power» of social «neuro networks». In other words, according to one of the existing hypotheses, the competitive advantage of a person in interspecific competition is ensured by his ability to cooperate in large groups, which, in turn, are capable of solving increasingly complex information problems [Andreyuk, 2016].

Taking this analogy as a basis, it is possible to formulate some relatively simple practical rules that need to be followed to improve the effectiveness of cooperative interaction. First of all, the object for engineering is the **structure and density** of connections between people in the group. The second important factor is the size of the group, it is proportional to the scale of the goals. For large sizes, it is necessary to separately design the **architecture of the subgroups** and to establish rules for the exchange of information between them.

In order to achieve relatively simple goals, from an information standpoint<sup>1</sup>, this approach is practically transformed into the work of finding active, communicating, easily trained representatives of the target audience of interest and creating a range of communications that is effective in terms of tasks for them. After that, the created «neural network» group should be «trained» on specific applied problems, relatively simple, but functionally close to the target. In other words, if we create a group to popularize knowledge, the already constructed group must undergo practical training in organizing some public, preferably mass, events. The methods of this training and the methods of interaction in the group should be adequate to the interests and behaviors that are characteristic of the target audience.

### **The results of approbation of the approach: formation, analysis and testing of the effector group**

Within the framework of the above-stated neuro-evolutionary approach, recommendations were formulated for designing groups of influence<sup>2</sup> on

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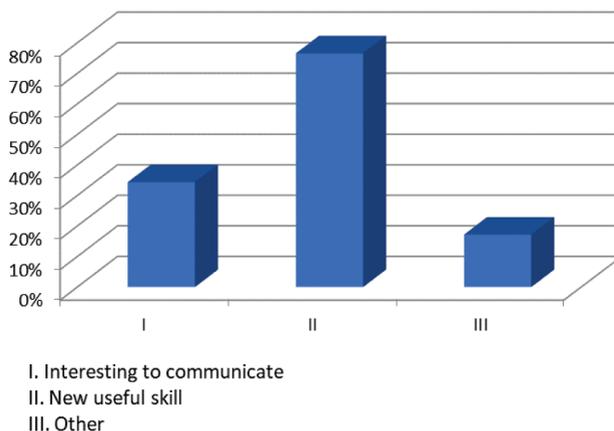
<sup>1</sup> The goal of increasing general literacy is a «simple goal», as the process of achieving it can be fragmented into a relatively small number of elementary decisions / choices. The complexity increases with imposing a mass requirement, but on the described segment of social engineering work and to achieve the following performance indicators, one can limit himself to an extremely simple network architecture.

<sup>2</sup> From an information standpoint, the neural network solves the classification problems, to which most of the management tasks for choosing the optimal mode of operation relate to or are included in. The action itself must be performed by some effector. In general, the neuro-evolutionary approach suggests constructing a separately controlling and separately acting - effector - neural networks. However, in our case, taking into account the specifics of the youth audiences, both

representatives of the target audience identified at the stage of marketing analysis of scientific and educational lectures, namely, the youth segment of «Applicants». On the basis of the regional network of the all-Russian public organization «Russian Association for the Promotion of Science» a framework of young candidates was formed to participate in educational activities. In August 2018, 64 candidates were interviewed in order to characterize the motives and limitations of potential organizers of the educational «conveyor belt». 14 regions of the Russian Federation were covered geographically (4 federal districts are represented). Further, the entire interviewed audience is for brevity referred to as the «impact group» or «effector group».

By age composition, the impact group is slightly older in age than the target groups of young people: the age variation in the effector group is from 16 to 38 years, the average age for the target group is 23 years. In the study sample, women were slightly larger than men (in a 3:2 ratio), which is explained, in particular, by a relatively high percentage of persons with medical and/or biological specialization. It is known that in these professions the proportion of women is higher than the average in society. By profession / social status, effector groups were made up of students, graduate students and young scientists from those regions in which it was planned to carry out educational activities. The motivation for their participation in educational activities is shown in Fig. 1.

### Motives of participants in the impact group



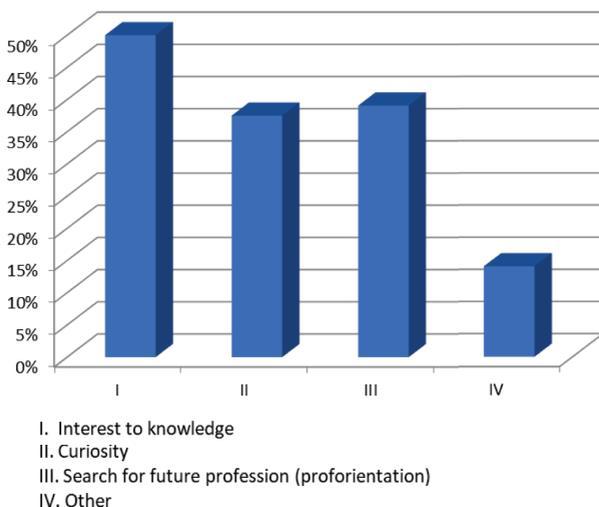
**Figure 1.** Distribution of answers to the question «What does it mean for you to read or organize lectures for the youth audience, mainly?» The questionnaire allowed for multiple answers.

these functions are performed by the same groups of people («they decided themselves - they did it themselves»).

Representatives of the impact group as a whole highly appreciate the level of their communicability: over  $\frac{3}{4}$  of the sample (77%) answered «yes» to the question «Do you consider yourself a sociable person?». At the same time, only 34% pointed to the opportunity to communicate (Figure 1). But the opportunity to acquire a new useful skill was noted as a significant motive by 77%. In the column «Other» there were motives such as self-realization, enlightenment of the population and even «debt repayment» - the last two formulations are obviously connected with the increased social responsibility of the respondents.

### Motives for the target audience

The data presented in Fig. 2. point out the multiplicity of possible motives for the target audience: answers between the options «Interest in knowledge», «Curiosity» and «Search for a future profession» were almost equally divided. In column «Other» there were such motives as networking, acquaintance with interesting speakers, the opportunity to spend time in comfortable surroundings, new acquaintances and obtaining useful professional skills.

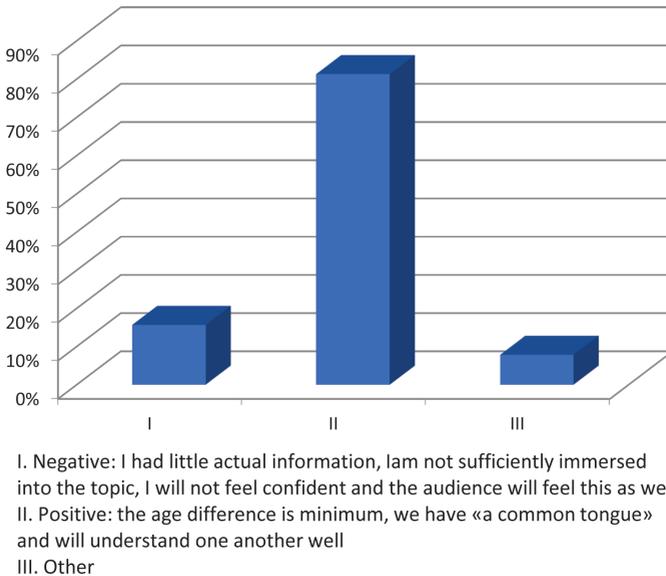


**Figure 2.** Distribution of answers to the question «What, in your opinion, is the main motive for young listeners to attend public lectures?» The questionnaire allowed for multiple answers.

### What is more important - professionalism or contact with the audience?

The audience of the impact group almost unanimously believes that lowering the barrier for mutual understanding is a more significant factor in reading lectures for

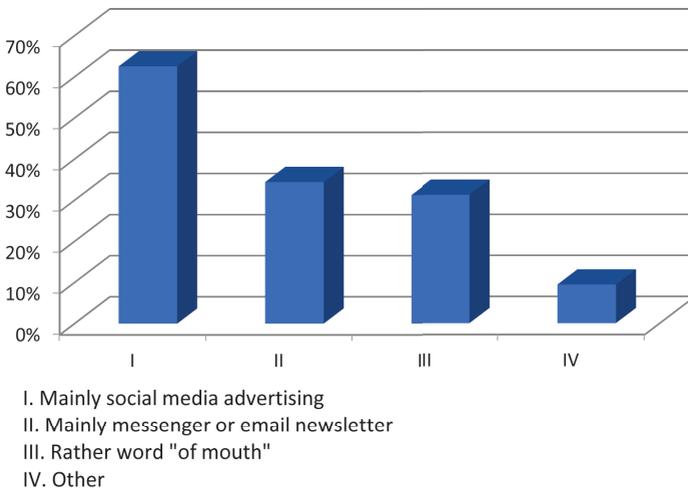
schoolchildren and students. Figure 3 shows that only 16% consider the negative factor associated with the lack of professional knowledge, as more significant. It is interesting that among «skeptics» i.e. those who chose the «negative» option, the proportion of men is significantly higher than the average in the sample (60%, versus 40% in the sample as a whole), as well as a higher proportion of those who consider themselves uncommunicative (36% versus 23% in the sample as a whole).



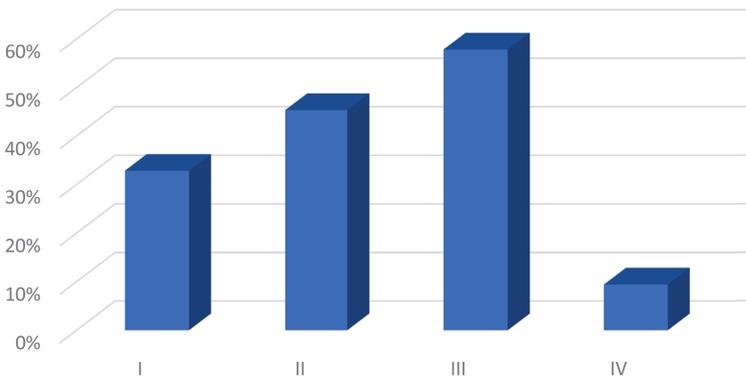
**Figure 3.** Distribution of answers to the question «If you were the lecturer for the youth audience, in your opinion, which factor would be more significant?» The questionnaire allowed for multiple answers.

## Marketing tools for promotion of educational products

When choosing the possible tools for promoting educational products, representatives of the impact group prefer advertising in social networks (Figure 4). At the same time, it is indicative that respondents consider the increase in the usefulness of activities for the target audience to be a priority in relation to marketing (Figure 5), and of the two options for increasing the attractiveness of content - by attracting famous scientists or using youth formats - they definitely prefer the latter.



**Figure 4.** Distribution of answers to the question «What should be the promotion of popular science educational products (lectures) for the youth audience?» The questionnaire allowed for multiple answers.



- I. To perform marketing in social networks and youth forums
- II. To hold events (lectures, interviews) with famous scientists and transmit them via the Internet
- III. To connect people of close spirit, for example, young lecturers, bloggers who will hold events in an understandable language and an understandable vivid form, for instance, smartphones, slams or battles, to communicate with the target audience
- IV. Other

**Figure 5.** Distribution of answers to the question “How to increase the interest of young people in participating in popular science lectures (educational products for schoolchildren and secondary school graduates)?” The questionnaire allowed for multiple answers.

## Evidence of the effectiveness of effector groups

To prove the effectiveness of effector groups and the feasibility of the social engineering approach in the popularization of science during 2017-18 academic year, five self-organized and self-directed youth projects of an educational orientation in the field of biology and medicine were launched:

- city of Kaluga: the project on the organization of scientific and educational activities of ecological orientation for schoolchildren (“ecological paths” where students and schoolchildren act as guides), the number of guided tours - over 70, over 1500 people of total coverage of the audience
- Moscow region, Stupino: 2 projects for the organization of intellectual leisure for schoolchildren (intellectual games, flash mobs for the purpose of promoting healthy lifestyles), over 1000 people are involved during the year
- Chelyabinsk: a project for the organization of scientific and educational activities of a humanitarian orientation for schoolchildren - “philosophical battles” - including 11 on topical problems of modern biology and medicine, a total of 750 participants
- city of Tula: a project to attract lecturers to expand the horizons of students and graduate students of the Tula State University, 5 lectures with a total “live” audience of over 300 people (including biomedical topics - 3 lectures, 250 people total audience)
- Nizhny Novgorod: project on the organization of scientific and educational lectures for students of the Nizhny Novgorod Medical Academy, 1 lecture was held, over 150 participants took part.

## Discussion of the results

Beginning with Mark Granovetter’s fundamental article on the “strength of weak links” [Granovetter, 1973], group organization work has been largely focused on information dissemination processes in large segmented communities [Granovetter, 1973; Onnela et al., 2007; Grabowicz et al., 2015; Iribarren, Moro, 2011; Aral, Van Alstyne, 2011]. Especially with the development of digital means of communication and online social networks, a significant array of experimental data that describe the patterns of information transmission within groups and between groups was obtained [Onnela et al., 2007; Grabowicz et al., 2015], as well as the dependence of the “capacity” of the communication channel on the emotional “strength” of this connection [Iribarren, Moro, 2011; Aral, Van Alstyne, 2011]. Obviously, understanding the patterns of how information is spreading through the social network does not give us an unambiguous idea of how the community in question will respond to this information signal.

For practical (constructive) purposes of social engineering, one must understand the mechanisms of self-motivation and self-organization of individuals and communities. A fundamental study of these phenomena is actively conducted in the world science, at least in three areas:

- Neurophysiology of sociality, connection with empathy, analysis of specific brain structures involved in social activities [Lockwood et al., 2016; Lee, Seo, 2016; Rilling, Sanfey, 2011; Moll, Schulkin, 2009; Ruff, Fehr, 2014]
- Studies of altruistic behaviour, experimental games on the distribution of public goods, donations, etc. (see, for example, [Fehr, Fischbacher, 2003])
- Modelling and experimental study of dynamic, short-lived social networks and mobilization mechanisms for cooperative interaction [Rand et al., 2011; Fowler, Christakis, 2010].

The third direction is the most promising from the standpoint of this research. In particular, in a number of works of one group of researchers, the role of social connections in the process of military mobilization in small local communities of warring tribes in Africa was studied in detail [Glowacki et al., 2016] and a possible evolutionary mechanism for directed positive selection of such patterns in the human population was shown [Glowacki, Wrangham, 2015]. These data most closely lead us to the design of active “under the task” communities, but the conclusions about the maximum effectiveness (preferability) of aggressive and destructive forms of behavior in active communities force great caution in relation to practical technologies based on this direction.

It is not ruled out that in the long term it will be possible to build effective design teams through directed activation of certain brain zones in each of the participants, for example, through social-game mobilization mechanisms. However, today models of the “black box that makes collective decisions” are still an effective trade-off enabling the usage of engineering approaches to social systems, the objective principles of organization and functioning of which remain unclear.

In particular, in our work it was proposed to build the technology of social engineering based on the neuro-evolutionary approach. Its essence lies in the fact that the social group is analyzed from the standpoint of the conditional “computing power of a social network” - the level of complexity of tasks in which the group is able to evaluate current information and make effective collective decisions. This methodological approach has already been successfully applied in the creation of an interregional network of volunteer mentors that promote the involvement of schoolchildren in design and research activities [Andreyuk, 2016]. Technically, the methods provide for artificial adjustment of the system of intra-group communication, as well as the organization of self-reproduction mechanisms, where effective groups are used to recruit and train all new groups of activists.

## Conclusions

Thus, the conducted studies enable considering the neuro-evolutionary approach of social engineering as useful in the popularization of science, taking into account the specific features of the motivation of the target groups of the population. The approach was developed to implement the goals identified and substantiated in the marketing of scientific and educational lectures as a social product. Neuro-evolutionary methodology focuses the attention of developers on the information structure of the created network communities, namely the community should have a high ability to self-organization and have a communication links structure similar to neural networks, as effective for making collective decisions.

The study revealed the presence of a serious motive to acquire additional professional skills by lecturing for younger followers among students, graduate students and young scientists. At the same time, the reduction of the communication barrier between the lecturer and the audience is named by them as a more significant factor than the availability of the lecturer's great wealth of professional knowledge on the topic of the lecture, or than the marketing promotion of lecture products. If you nevertheless turn to marketing tools, then the interviewed audience prefers advertising and communication in social networks.

Within the frames of the topic under consideration, without a significant financial expense<sup>1</sup>, a wide range of educational activities was organized: only at the testing stage over 3 thousand people took part as users of scientific and educational products of biomedical orientation.

This approach, combining the techniques of classical marketing with elements of social engineering based on neuro-evolutionary methodology, can be recommended for scaling to organize mass educational activities in order to increase the biomedical literacy of the population.

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