

Psychological Predictors of Self-Efficacy in Scientific Field of a Specialist-Defectologist

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Abstract

In recent years, the works devoted to the mechanisms and specific features of scientific activity has described either the requirements for the personality of a scientist or the characteristics of the scientific activity itself and its' considerable result, but the specific individual psychological characteristics that ensure the successful performance of scientific activity have never been determined. In order to "make" this sphere achievable and accessible, we proposed to study the first substantive steps in a research career, starting with the first university courses and up to the stage of the most successful students-researchers who entered post-graduate studies, defended their PhD theses and became professional scientists. This approach allows us to trace the stages of professional development of the scientist's personality on the way to the scientific result and to consider his/her individual psychological indicators as "internal reserves" which considered to be the basis for the self-efficacy of scientific activity. In our study we based on the theoretical and methodological Russian psychology approaches of such authors as: Klimov (1996), Peisahov (1991), Ponomarev (1960), Rubinstein (2002), and there were four stages of research activity development identified: the stage of selection, the stage of adaptation, the stage of internality, the stage of mastery.

Keywords: scientist, the research activity, psychological determinants, self-efficacy, high education.

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Introduction

If we knew everything, then many great discoveries would have been in the distant past, and a generation of brilliant creators would become the norm for modern society. But at the moment, scientific achievements are as well provoke an inexhaustible interest, and the understanding of enthusiasm and involvement in research activities are so far explained by psychological science through the presence of difficult stages in its formation and development and / or a special complex of personal qualities of a scientist.

Purpose and objectives of the study

The problem is that psychologists have not presented a specific set of personal characteristics that are the determinants of a successful academic career. We should note that herewith the search for psychological characteristics that distinguish scientists from representatives of other professions has been conducted in psychological science and practice since the end of the 19th century to the present day. Thus, the goal of this paper is to study the specifics of the researches and to identify possible personal predictors of effective scientific activity.

Literature review

The novelty and the importance of our research for other areas of psychology of personality. A review of the literature on the problem

The subjects and objects of psychological research in the field of analysis of scientific activity are quite diverse. One thing we know for sure is that scientific activity is of mental nature and its realization is not available to every person (Peisahov, 1991) and requires some personal efforts. This fact allowed us to divide the existing approaches to the problem to be close to the full correctness of the research – to reveal the nature of personality's mental efforts on the research activity example. Therefore, in the theoretical part of our study we singled out those works that relate to the mental abilities of the individual – this is the studies of psychophysiological inclinations and the demonstration of individual differences (De Bono, 2015; Nebylitsyn, 1976; Rusalov, 1991; Teplov, 1985; Kholodnaya, 2002) and papers about the intellect and creativity, where the product of intellectual activity is the criterion of creativity (Aizenk, 2003; Gilford, 1965; Druzhinin, 2001; Spearman, 1950; Torrance, 1980). We attributed this approach to attempts to understand the personality of a scientist, his/her inner content and predispositions. Other group of studies have dealt with the problem of cognition and scientific thinking. We attributed them to attempts to understand the process of scientific activity. In particular, these are the works on the study of the role of the intuitive and conscious in scientific creativity (Adamar, 1970; Altshuller, 2013; Asmus, 1947; De Broil, 1962; Bunge, 1967; Helmholtz, 1934; Dekart, 2011; Dunker, 1965; Poia, 1975; Popper, 1983; Pankare & Kutuyura, 2007) and work on determining the prerequisites and principles for the development of scientific thought (Kedrov, 1958; Yaroshevsky, 1969). At last we attributed one more block of author's theories to the research of psychological mechanisms of the inner aspiration of the individual to cognition and self-realization (Maslow, 1997; Olport, 2002; Rogers, 1997; Frankl, 2000; Fromm, 2004; Yung, 1998) which are as well the attempts to understand why some people are oriented toward spiritual achievements (for example, scientists working with speculative objects with the power of mind and thought only), but others are not.

Now it became clear that to achieve the *goal* of our research, it is necessary to develop our own firm position using the baggage of past scientific researches and works. And in this way we can enrich the existing scientific experience.

So, we set several tasks for achieving the goal: a) to address to the personality of the scientist, but not describing the requirements for it, as it was made earlier, but to give precise definitions to its individual psychological indicators; b) to consider the process of scientific activity in the context of professional individual self-determination and the stages of personal professionalization; c) to determine not the physiological prerequisites associated with the individual mental processes, but to define the internal aspirations associated with self-motivation, self-management and self-efficacy of the individual – all that can be assessed, changed and developed in oneself if one wishes to become a scientist.

Thus, taking into account all the foregoing, the scientific research activity (in our opinion) is a special kind of activity that has its own algorithms for obtaining a new result, and people with certain internal attitudes of self-motivation for achieving the success can be engaged in this kind of activity.

The novelty of the research is a new (nontrivial) transcription of theoretical and methodological principles in the psychology of personality

It would be enough the paragraphs written above for a usual theoretical study and the problem statement, but our goal and tasks are practically oriented and therefore we are to understand how and by whom our experimental group should be represented – this is a group of scientists with "internal resources" which are characteristic only for them. We decided to define its "psychological skeleton" relying exclusively on the theoretical and methodological basis of the psychology of the individual.

The first thing we started with was the formation of a fundamental vision and attitude towards the activity of the individual in the social environment since engaging in science is still a certain type of activity. Such a foundation was laid in the Russian psychological school of the subject-activity approach (Rubinstein, 2002; Brushlinskii, 1994), according to which the human psyche is formed in activity and there it demonstrates itself. And the principle of determinism, formulated in the frames of the same approach, explained that all psychic phenomena are regarded as dependent on the factors that have generated them: these are external and internal factors and the idea that a man is an active member of society in transforming the world and himself ("external causes act through internal conditions"). Rubinstein put forward the thesis of personality as "an integral set of internal conditions through which all external influences are refracted". It was he who supplemented the "subject" with the definitions of "self-determination, self-development, self-perfection": "the subject does not only act by transforming the object in accordance with its goal, but also acts in different ways in the process and a result of its implementation, when both the object and the subject are changing". We also take into account the theory of Deci & Ryan (1985) who regard self-determination as an innate tendency of the organism to be involved in the behavior of interest, and the concept of self-determination is closely related to the concepts of will, emotions and inner motivation. Deci & Ryan (1985) define *self-determination* as the sensation and realization of the choice freedom of the behavior mode and existence mode in the world, regardless of the external environment influencing him and the processes of upbringing that determine the reaction in interacting with the surrounding reality.

And then, according to this logic, we should define the process of scientific knowledge (that is what the scientist does) first of all as Activity – scientific activity that aspires to a new result, and the subject does it (that is active and transforming the surrounding reality person). *The first conclusion* can be made: scientific activity is an activity with external characteristics of transformation, when a new product

is achieved, and with internal characteristics of self-determination, when the productivity of thought is that internal potential of self-development and personal self-improvement.

After defining the activity and the personality as a subject of activity capable for self-development, we need to introduce a concept of Development in the activity of a scientist when he demonstrates new achievements and the pursuit of perfection. Here we join the position of the theory of Ponomarev (1960), who supposes that any development in any activity is possible only through the process of Interaction, when internal accumulation becomes external, form a new phenomenon (object) and then again enter into interaction until an objectively new product of this interaction is reached. The new structure of the object will change the nature of its further interactions with other objects and thus the development will continue. This way of development goes through the Stages, the stages form the Levels as indicators of the evaluation of the achievement of a new product which allow a scientist to move and occupy a new Stage of Development. All this is called "creativity" as a general principle of development. The creativity in a broad sense as the basic mechanism of development and transformation, the transition from the old to the new (Ponomarev, 1960) is an active self-process. "The creativity is a necessary condition for the substance development, the formation of its new forms, and along with this process the forms of creativity themselves are changing. The human creativity is only one of these forms". So, the **Stages** of the development of a phenomenon (for example, in our case it is the psychological content of scientific activity) are being transformed into the structural **Levels** of its organization (it means that each stage enriches the subsequent one with its psychological content), the Levels become the **Steps** for further development interactions (the "SLS" principle) (the stage of achieving an external scientific result occurs through an internal changing psychological content). So, the development is considered to be an obligatory interaction of the internal and external processes with the condition of achieving a new result. And it turns out that the development is always an intention for efficiency in activities, and if this efficiency is determined by the inner characteristics of the individual, then this is a phenomenon of self-efficacy, which is revealed in the social and cognitive theory of Bandura (1982). Both Ponomarev's (1960) and Bandura's (1982) theories emphasize the interaction of environment, behavior and personal factors, in which a special place is given to processes that ensure mental self-control and self-efficacy of the individual. The environment or the society has an impact on the personality in the same way that the person influences the environment and shapes the society. The theory of Bandura (1982) also refers to the continuous interaction of forces that create a certain balance between freedom and determinism. The concepts of "self-regulation", "self-control" and "self-efficacy" play an important role in his socio-cognitive theory. Self-efficacy of the individual implies a person's conscious ability to cope with specific and complex situations and influence the effectiveness of the activity and functioning of the individual as a system. The one, who has realized his self-efficacy, makes more efforts to solve complex problems, than those who have doubts about their capabilities. High self-efficacy, associated with the expectation of success, usually leads to positive results and promotes self-esteem. And, on the contrary, low self-efficacy, associated with the expectation of failure, leads to failure and reduces self-esteem. Mental self-control is important for self-regulation of behavior: it does not exist solely within the framework of internal (for example, willpower) or external forces (for example, stimulus-reinforcement in behaviorism), but manifests itself in a carefully planned Interaction between the individual and the environment.

Thus, thanks to the second methodological component, our definition of scientific activity can be expanded. We can make *the second conclusion* now: scientific activity is self-deterministic, its effectiveness is determined by the constant interaction between the psychological content of the personality

(inside the person) and external stimuli, all of which pass several "cumulative" stages leading to the achievement of the peak of development and the effectiveness of the activity. And we are to emphasize here again that this development takes place only in the Interaction and it depends on the self-efficacy potential of the individual and not on the external stimulation.

Thirdly, if we have noted the existence of desire for development in scientific activity, therefore, this is a conscious desire for activity efficiency, and the efficiency is noticeable in comparison especially when moving from the pole "ineffectively-inefficiently" to the pole "effectively-efficiently". And the presence or absence of achievements can be fixed in comparison of the results of activities at various stages of its implementation, that is at different stages of its professional mastering. To evaluate the assessment of the stages and to fix the existing differences between the initial stage and the final one we are to use the conception of the person's professional self-determination by Klimov (1996), who referred to four stages of professionalization: these are stages of options, adaptation, internality and skill. And to the idea of "a subject of self-government" by Peisahov (1991), according to which a person as a subject of self-management is able to control all levels of mental activity: experience, activity, behavior, communication. Our task is to notice the significant difference between the "mastery" stage of scientific activity and its real scientific results and to compare the personality of those who reached this level with those who are at the lower stages of professional scientific activity. *The third conclusion:* only when fixing the differences in the psychological characteristics of the individual at different stages, we will be able to ascertain the fact that there are such psychological characteristics that are the true predictors of research activities.

Fourthly, in order to achieve success in the activity, we must have guidelines in the structure of the internal qualities of the individual. According to our analysis of the literature on the professional self-awareness and self-determination of personality (Zeer, 2003, Zimnyaya, 2000, Balymova, 2008), the focus on achieving success (in our case, the scientific activity in university education) is characterized by several key points that we should take into account: the specific of a person's self-conscience, its goal orientation, the ability to self-reliance and self-management, and its value-semantic reference points. All of the above is the psychological content of the personality, which determines its' success in the chosen activity. *The forth conclusion:* there are some individual psychological determinants, which we must evaluate in scientists' psychological structure who have achieved success in science and in "not scientist's" structure at various stages of the process of their inclusion in scientific research activities:

- self-conscience or self-conception, because at the initial stages of mastering a new activity, when a person is mastering a new form of reality, it becomes important to define the attitude of other people to himself,

- the goal orientation of the person or his ideas of sense of life, since the importance of purposeful development is emphasized during the formation of life goals and attitudes, and the target life orientation is a decisive condition for the productive activity of the individual,

- the value-semantic sphere, which explains the successful solution of professional problems; the activation of the person's potential is carried out through the structuring of the system of spiritual values and satisfaction from the process of self-improvement and self- knowledge,

- the ability to independently stimulate one's own activity is very important for the subject of scientific research activity – he / she is the subject of inner mental activity. A professional can change his professional biography, engage himself / herself in self-development and self-improvement

The final conception

The fifth conclusion (general) (our fundamental vision and attitude to the scientific activity research and the scientific activity subjects): thus, we will study a successful scientist as one who is always active and self-determined in the scientific activity (Table 1) and who strives for permanent development. His development is possible due to the constant interaction of the internal and external, thanks to the internal potential of self-efficacy of the individual, which will be expressed in specific psychological indicators. The psychological content of the research activity is possible to denote in comparing different stages of development of scientific activity in the context of the individual professionalization, where there is the possibility of fixing both external and internal conditions in their interaction. The psychological content of the final stage will be the result of interaction, and it will assess the changes in significant psychological aspects in the process of new activities mastering. These changes are such as: the features of self-consciousness of the individual, the features of its goal orientation, the ability to independence and self-management, and value orientations – all these elements make an internal tool of mastering the situation – that is the individual’s self-efficacy in the context of solving some scientific and creative problems.

Table 1

The scientific activity as an object of research

Scientific Activity	Activity, Self-determination
	Development, Interaction, Efficiency, Self-efficacy
	Stages of scientific professionalization
	Psychological conditionality and prerequisites

Methodology

To understand the psychological determination of research activities it is necessary to identify the stages of it as a kind of professional activity, where there is not only the mastering of a new form of activity, but also the achievement of a specific objective result which is a criterion for its successful development. We will implement this within the professionally oriented periodization by Klimov (1996), who proposed the following phases of a professional's life:

- the option is the period of acquaintance with the profession;
- the adaptation is entering the profession and getting used to it;
- the internal phase is the acquisition of professional experience;
- skills is qualified implementation of professional activity;
- the phase of authority is the achievement of a highly qualified professionalism;
- mentoring is the transfer of his / her experience by a professional.

The methods used in our study were determined according to the deterministic factors numbered in the theoretical part: the features of the person's self-consciousness, the features of the goal orientation of the personality, its ability to independence and self-management, and his / her value orientations. Then a psychodiagnostic block of tests was chosen, it included the following tests and questionnaires (4 pieces): "The questionnaire of self-relationship" (hereinafter abbreviated as MIS) developed by Pantileev (1993); multifactorial personality questionnaire "Self-actualization test" (hereinafter abbreviated as SAT), developed on the basis of the questionnaire of personal orientations (POI) developed by Gozman (1987); "The test of meaningful orientations" (hereinafter abbreviated as SZHO), developed by Leontev (1992) (adapted version of the test "Goal in life"); test "The ability to self-government" (hereinafter abbreviated as

SSU) developed by Peisahov (1991).

To process the results of the study, methods of mathematical statistics, interpretation methods, theoretical modeling were used. The analysis of the results included: comparison of the degree of expression of the indicators (comparison by average), comparative analysis of the expression of the results (statistical analysis with the usage of Student's t- criterion), correlation analysis, and divergent data analysis.

Reliability of the conducted research is ensured by the initial theoretical and methodological principles, deep analysis of cause and effect relationships on the problem, the selection of adequate research methods in accordance with the goal and research tasks, the representativeness of the test subjects, and the usage of adequate methods of mathematical statistics, abidance by rules and norms of psychological research.

Results and discussion

At the very beginning of this part we would like to note that the logic of analyzing the data we received proceeded from the fact that it is necessary to identify precisely those individual psychological indicators that distinguish the group of "scientists" from all groups of "non-scientists", that is, to pay special attention to the often and stably observed differences in the indicators revealed, and not on all the possible ones. We did this with the purpose to get the maximum clear idea about the significant psychological content of successful scientific activity.

Common points of the results of our study:

- a group of young scientists, defined through the stage of mastery, hereinafter will be called as "scientists" group, and groups of students and graduate students, identified through the stages of opting, adaptation and internality, will be called "non-scientists";

- the list of significant differences between the psychological indicators of the experimental group and the other three groups did not include indicators from the SAT methodology. We suppose that the value-semantic sphere does not determine the vector of the development of the personality as a scientist, as we thought at the beginning of the research;

- among all the reliable differences between the indicators in the compared groups (t-criteria), only 4 psychological indicators were revealed, but we should note here that the total number of expressed differences of the indicators is following ($p \leq 0.001^{***}$ and $p \leq 0.01^{**}$): between the group of "scientists" and "non-scientists" (the stage of option) – 13, between the group of "scientists" and "non-scientists" (the adaptation stage) – 5, between the group of "scientists" and "non-scientists" (the stage of internality) – 10.

- according to the linear correlation, the specificity of the interrelationships of the revealed indicators in each group was determined, we also presented in the text of the article the outcome of the interrelations, in which there were only those that are characteristic only of one or another group in comparison with the group of "scientists". Interconnections within the groups with the same indicators remained on the periphery, we were interested in the difference, which showed the difference in the psychological content of the stages of professionalization in research activities in university education.

Thus, we can make a preliminary conclusion about the "scientists" group: it is characterized by the fact that, unlike other groups (the stages of research activities), it is guided more by the notion of itself as the main source of its own activity, results and achievements, as well as the source of development of one's own personality; for "scientists" it is more characteristic to analyze past experience and a new event for one's own assessment of what is happening with a purpose to regulate the situation. Moreover, this group is

more capable of optimal regulating their activities even in non-standard conditions and circumstances.

And here, judging by the results, the statement from the Bandura's theory (1982) is confirmed: the self-control of behavior is manifested in the carefully planned interaction of the individual with the environment, just like in the group of our "scientists", who have "self-guidance" and "planning" interconnected.

Conclusion

Firstly, in the group of "scientists" there is a specific severity of "self-guidance", "situation analysis", "the self-management ability", that means that the most important predictors of effective mastering of scientific activity are self-management of the person, his or her abilities for analytical activity and faith in his or her abilities.

Secondly, in the group of "scientists" there is a specific interrelations noticed between the selected indicators with indicators "planning", "life process" and "life as locus of control", that means that the important predictors of effective mastering of scientific activity are the ability to plan activities, satisfaction and value of the saturation of one's life, and conviction in one's own freedom of decision-making and their implementation.

Thirdly, it is possible to become a scientist, but one must be able not only to analyze and manage oneself well, but to understand that the success of one's achievements depends on clear plans and regime, to evaluate the new situation from the perspective of how it will affect one's satisfaction with life and always believe in the free control of one's own lives.

Fourthly, to develop oneself as a scientist, it is necessary to avoid those "mistakes" that are unproductive psychological indicators at the "non-scientists" stages. How to avoid them?

1 – One should understand that self-esteem should not determine the ability to self-manage, manage one's own life and achievements, because it is too subjective. It is more productive to base on the availability of a system of means to achieve the goals – the plan.

2 – One should understand that the analysis of the situation does not depend on how much it can be controlled or quickly resolved. One should analyze, based on the events impact on the life process.

3 – One should understand that the success of self-managing is not determined only by one's own decision or by the satisfaction with the process of life. Self-government is when you do not evaluate the process of life, but when you realize that what you have decided will be realized soon.

Proceeding from the foregoing, we have every right to present to your attention the conclusions that give a holistic and correct idea of the predictors of the individual's self-efficacy in research activities (in the higher education system) that answer the question "how to become a scientist?" and "what psychological characteristics must be cultivated for developing oneself as a subject of scientific research activity?». These are 6 psychological indicators in their specific interrelation: "self-guidance" and "planning" (0.55 $p \leq 0.01^{**}$), "the analysis of contradictions" and "life process" (0.75 $p \leq 0.001^{***}$), "self-management ability" and "life as locus of control" (0.63 $p \leq 0.001^{***}$).

The practical value of the study allows us to determine the recommendations basis for the formation of the researcher's personality, viz., the need for an adaptive psychological support for the process of achieving an academic career in the higher education system, with incoming testing and diagnosing the psychological characteristics of students and graduate students, with a view to providing the further corrective work (individual and group work) for the development and formation of isolated psychological determinants (most important and important) for the research activities. At the same time,

we cannot but note that the revealing of personality characteristics is the goal of many psychotherapeutic programs aimed at the psychological and mental health of the individual, which shows and proves the value of the revealed psychological determinants not only for the inner world of the scientist, but also in the context of the formation of a psychologically prosperous citizen of modern society, which can form the basis of our further research.

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