

## Anticipatory Competence and Ability to Probabilistic Forecasting in Adolescents: Research Results

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### ABSTRACT

The relevance of this problem is related to the urgent need to explain peculiarities of anticipation and probabilistic forecasting in adolescence. It has revealed a contradiction: on the one hand, the problem of anticipation in ontogenesis is well developed, and, on the other hand, there remain understudied mechanisms of anticipation in adolescents. Therefore, this article is aimed at presenting the findings of anticipatory competence in teenagers. The theoretical base of the study is anticipatory concept of neurogenesis that considers the formation and development of neurotic disorders in connection with such personal characteristics of the patient, as the inability to predict the possible traumatic situations in the future and to plan ways to overcome them, - anticipatory competence. The basic methods in the study of this problem are the empirical methods of studying and comparing, allowing to reveal the specifics of anticipation in adolescents. The main results of the paper are as follows: both adolescents and young men reveal an average level of anticipatory competence; in adolescents overall anticipatory competence is made up of personal-situational anticipatory competence, spatial and temporal anticipatory incompetence. At the youthful age overall anticipatory competence is made up of personal-situational anticipatory competence and spatial and temporal anticipatory incompetence. The article submissions are of practical value for psychologists working with teenagers.

### KEYWORDS

Anticipatory incompetence, probabilistic forecasting, adolescence, information activities.

### ARTICLE HISTORY

Received 20 March 2016  
Revised 28 April 2016  
Accepted 9 May 2016

### Introduction

The concept of anticipation in the space of research is introduced by W. Wundt (1880). Over a century the term has undergone a significant transformation in the system of psychological knowledge. The scope and

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dynamics have changed significantly. The phenomenon of anticipation was viewed from different angles and received different names: "anticipation" (Wundt, 2002), "purpose" (Uznadze, 2001), the "model of required future" (Bernstein, 1991), "operational presetting" (Tikhomirov, 1984; Tikhomirov, 1995), "acceptor of action results, anticipatory reflection" (Anokhin, 1975), "probabilistic forecasting" (Feigenberg and Ivannikov, 1978; Ivannikov, 2006), "extrapolation" (Bartlett, 1959). The phenomenon of anticipatory reflection of a greater or lesser extent is evident in the study of any mental phenomena, and therefore in psychology there emerged a variety of theories, concepts and hypotheses concerning the problem of anticipating the future in the organization of behavior and human activities (Anokhin, 1975; Bernstein, 1991; Wundt, 2002; Zimnyaya, 1973; Zimnyaya, 1974; Zimnyaya, 2001; Tikhomirov, 1984; Feigenberg, 1986). On the one hand, adolescence is sensitive with regard to the formation of anticipation; on the other hand, the study of anticipation in adolescence takes only 5% and that of prediction - 2%. Methodological logic of the study involves the implementation of bibliometric analysis of the studied object. The phenomenon of anticipation appears as the object. The diachronic cut of bibliometric analysis spans a 10 year period (2005-2015.). The analysis was carried out through the scientific information space of the electronic library E-library and Scopus database by keywords (anticipation, forecasting) in the psychology section. The total volume of publications found on the phenomenon of "anticipation" was 141, on the phenomenon of "forecasting" - 924 (Table 1).

**Table 1.** Frequency analysis of publication activity for the period of 2005-2015 in the system of the Russian Science Citation Index (RISC) and Scopus database on the phenomenon of "anticipation" and "prediction"

|   |  | Anticipation |      |      |      |      |      |      |      |      |      |      |
|---|--|--------------|------|------|------|------|------|------|------|------|------|------|
| Year                                      |  | 2005         | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Number of publications in RISC            |  | 0            | 1    | 1    | 4    | 2    | 4    | 9    | 5    | 6    | 17   | 7    |
| Number of publications in Scopus database |  | 6            | 3    | 1    | 3    | 3    | 11   | 8    | 6    | 13   | 18   | 13   |
|   |  | Forecasting  |      |      |      |      |      |      |      |      |      |      |
| Number of publications in RISC            |  | 19           | 30   | 34   | 48   | 82   | 112  | 114  | 115  | 171  | 99   | 70   |
| Number of publications in Scopus database |  | 2            | 2    | 1    | 1    | 4    | 5    | 2    | 1    | 5    | 1    | 6    |

Evaluation of the dynamics of scientific research on the anticipation and forecasting by years (2005-2015) revealed that research dynamics is positive; on the other hand, the research activity of anticipation and forecasting phenomena is not high.

### Materials and Methods

The study used the following psycho-diagnostic methods: test of anticipatory competence (predictive competence) (Mendelevich, 2003); Method-Test "The

ability to predict" (Regush, 2003). Statistical processing was carried out using descriptive and comparative statistics methods. Descriptive statistics methods include a description of the average values ( $\bar{X}$ ), modes ( $M_o$ ), the median ( $M_e$ ), the standard quadric deviation ( $\sigma$ ), minimum (min) and maximum (max) values.

As the methods of comparative statistics we used correlation analysis, nonparametric Mann-Whitney U- test to assess the significance of differences at the level of the studied feature for two unrelated samples; the structural analysis by generalized index indicators of organization, integration and differentiation of the structure (Karpov and Skityaeva, 2005).

The study was conducted on the basis of secondary schools, colleges, universities. The total sample size was 190 people aged 12 to 21. The experimental group consisted of young people (100 people, the number of boys - 48, girls - 52). The age of the test subjects in the experimental group varied for girls (from 12 to 15), for boys (from 13 to 16). The control group included 90 persons of the youth age (students of secondary special colleges) - 45 people and young men (higher school students) - 45 people. The age of control group test subjects ranged from 17 to 21 years for boys, from 16 to 20 - for girls (Table 2).

**Table 2.** Quantitative and qualitative sample characteristics.

| Group                                   | Total number | Social status                            |  |             | Gender features |       |
|---|--------------|--|--|-------------|-----------------|-------|
|   |              | Young men<br>(higher school<br>students) | Young men<br>(secondary<br>special colleges<br>students) | Adolescents | boys            | girls |
| Experi-<br>mental group<br>-adolescence | 100          | -  | -  | 100         | 48              | 52    |
| Control group<br>-<br>youth age         | 90           | 45                                       | 45   | -           | 45              | 45    |

Research groups were equal by the following parameters: social status - all the adolescents were comprehensive institutions students; all the young men were secondary special institutions students. Boys were equal 50% to 50% accordingly. The research organization was formed by the way of constant conditions (the study was conducted in the first half of the day, individually, with the presentation of a uniform stimulus material, instruction and motivation). The samples were equal on the gender basis (50% to 50%).

## Results

Statistical analysis of anticipatory competence indicators in adolescents found that the overall level of anticipatory competence in adolescents corresponds to anticipatory competence level ( $\bar{X} \pm \sigma = 256,10 \pm 20,35$ ) (Table 3). Anticipatory competence is understood as the ability of a person to anticipate the course of events with a high probability, to predict the development of the situations and their own reactions to them, to act with the temporal-spatial anticipation (Mendelevich, 2002).

**Table 3.** The values of descriptive statistics of indicators of anticipatory competence, ability to predict in adolescents (in point values).

| Descriptive statistics indicators | Anticipatory competence |         |          |         | Ability to predict |
|-----------------------------------|-------------------------|---------|----------|---------|--------------------|
|                                   | Personal-situational    | Spatial | Temporal | General |                    |
| X                                 | 168,75                  | 49,34   | 38,01    | 256,10  | 9,74               |
| o                                 | 12,49                   | 8,74    | 6,29     | 20,35   | 2,21               |
| min                               | 116                     | 25      | 23       | 197     | 4                  |
| max                               | 198                     | 66      | 55       | 302     | 16                 |
| Mo                                | 181                     | 46      | 39       | 262     | 9                  |
| Me                                | 168                     | 49      | 38       | 258,5   | 10                 |

In adolescence, the level of anticipation and prediction is characterized by the ability to probabilistic anticipation of events, situations, their own reactions. Nevertheless, the overall anticipatory competence in adolescence is the sum of indicators of personal and situational, spatial and temporal anticipatory competence. A special feature of anticipation and forecasting in adolescence is that the overall anticipatory competence is formed of personal-situational anticipatory competence at spatial and temporal anticipatory incompetence.

Personal-situational anticipatory competence reflects a communicative level of anticipation, i.e. the ability to predict life events and situations. Spatial anticipatory incompetence demonstrates the inability to anticipate the movement of objects in space, to forestall them, to co-ordinate their own movements, showing motor dexterity. Temporary anticipatory incompetence is characterized not by the inability to predict the course of time and accurately distribute it. The main contribution to the adolescence (66%) to the overall anticipatory competence is made by personal-situational anticipatory competence that reflects a communicative level of anticipation, i.e. the ability to predict life events and situations. Statistical indicator's analysis shows that the ability to predict in adolescents (by the method of the ability to predict by Regush L.A. (2003) (Table 4) the average value ( $\bar{X} \pm \sigma = 9,74 \pm 2,21$ ) corresponds to the average level of ability to predict at high heterogeneity of results ( $\max - \min = 16 - 4 = 12$ ), which exceeds the average indicator for the sample. This range indicates a significant variation in predictive activity of teenagers. The average prediction level is characterized by the construction of two variants of the forecast based on significant conditions, but still taking into account the non-essential ones. Carrying out statistical analysis of anticipatory competence indicators, we found that the overall level of anticipatory competence of students corresponds to the level of anticipatory competence ( $\bar{X} \pm \sigma = 256,40 \pm 20,75$ ) (Table 4).

Thus, the students formed a sufficient level of ability for probabilistic anticipation of events, situations, their own reactions. In this case, the overall anticipatory competence consists of personal-situational anticipatory competence and spatial and temporal anticipatory incompetence. Through a statistical indicator's analysis of the ability to predict in the students by the method of the ability to predict (Regush, 2003), we came to the following conclusions:

**Table 4.** The values of descriptive statistics of indicators of anticipatory competence, the ability to predict in the young men (in point values).

| Descriptive statistics indicators | Anticipatory competence |         |          |         | Ability to predict |
|-----------------------------------|-------------------------|---------|----------|---------|--------------------|
|                                   | Personal-situational    | spatial | temporal | general |                    |
| X                                 | 167,28                  | 50,93   | 38,19    | 256,40  | 10,17              |
| o                                 | 12,70                   | 7,42    | 6,97     | 20,75   | 2,26               |
| min                               | 131                     | 36      | 22       | 211     | 4                  |
| max                               | 194                     | 68      | 54       | 301     | 15                 |
| Mo                                | 177                     | 46      | 43       | 268     | 11                 |
| Me                                | 168                     | 51      | 38       | 259,5   | 10                 |

The average value ( $\bar{X} \pm \sigma = 10,17 \pm 2,26$ ) corresponds to the average level of ability to predict, at a high heterogeneity of results ( $\text{max} - \text{min} = 15 - 4 = 11$ ), which exceeds the average indicator's value (see Table 5). The correlation analysis of the parameters of anticipatory-predictive system in teenagers was carried out using the method of correlation analysis (r-Spearman's rank correlation test,  $p \leq 0.05$ ).

Through evaluation of the indicators' interrelation of personal-situational, spatial, temporal and overall anticipatory competence, ability to predict in adolescents using the correlation analysis, the following results were obtained: the structure of the indicators' interrelation of personal-situational, spatial, temporal and overall anticipatory competence, the ability to predict in adolescents contains 10 interrelations. Eight of these interrelations are significant and proportionally direct (Table 5).

**Table 5.** The indicators' correlation coefficients of anticipatory competence, of the ability to predict and those of time perspective in adolescents (P, Spearman ( $p \leq 0.05$ )).

| Indicator            | Personal-situational | spatial | temporal | general |
|----------------------|----------------------|---------|----------|---------|
| Personal-situational | 1,00                 |         |          |         |
| spatial              | 0,18                 | 1,00    |          |         |
| temporal             | 0,32*                | 0,43*   | 1,00     |         |
| general              | 0,78*                | 0,67*   | 0,67*    | 1,00    |
| ability to predict   | 0,24*                | 0,27*   | 0,17     | 0,34*   |

\*- interrelation significance.

The analysis of structure organization of anticipatory competence and ability to predict in adolescents is characterized by coherence, divergence, organization structure index indicators. Coherence is a measure of integration, synthesis, and cohesion qualities in an integral structure. Coherence structure index (CSI) is defined by the formula: (a number of positive interrelations with  $p \leq 0,05$  multiplied by 2) + (a number of positive interrelations with  $p \leq 0.01$  multiplied by 3).

The divergence structure index shows the degree of differentiation, "fragmentation", but openness and plasticity of the structure. Divergence structure index (DSI): (a number of negative interrelations, with  $p \leq 0.05$  multiplied by 2) plus (a number of negative interrelations with  $p \leq 0,01$  multiplied by 3). The organization structure index (OSI) is defined by the formula: CSIDSI and points a measure of dominance of the integrative structure mechanisms over disintegrative ones. Through the analysis of organization structure of

anticipatory competence and ability to predict in adolescents the following results were obtained: a coherence structure index in adolescents is 64; the divergence structure index in adolescents is zero; the organization structure index in adolescents is 64. The description of the interrelation system found a significant correlation between temporal, personal-situational anticipatory competence (0.32 \*), general and personal-situational anticipatory competence (0.78 \*), personal-situational anticipatory competence and the ability to predict (0.24 \*), being proportionally direct. Characteristic is the fact that at increasing some indicators, others increase as well.

Significant interrelations were also revealed between spatial and temporal (0.43 \*), as well as between general (0.67 \*) anticipatory competence; between the ability to predict (0.27 \*) and general anticipatory competence, being proportionally direct and also between general (0.67 \*) anticipatory competence and temporal proportionally direct anticipatory competence.

Through correlation analysis of indicators of personal-situational, spatial, temporal and general anticipatory competence, of the ability to predict in the young men the following results were obtained: the indicators' interrelations structure of the personal-situational, spatial, temporal and general anticipatory competence, of the ability to predict in the young men contains 10 interrelations that are statistically significant, being proportionally direct (table 6).

**Table 6.** The indicators' correlation coefficients of anticipatory competence, of the ability to predict and those of time perspective in the young men (P, Spearman ( $p \leq 0.05$ )).

| Indicator            | personal-situational | Spatial | Temporal | General |
|----------------------|----------------------|---------|----------|---------|
| personal-situational | 1,00                 |         |          |         |
| spatial              | 0,31*                | 1,00    |          |         |
| Temporal             | 0,46*                | 0,26*   | 1,00     |         |
| General              | 0,88*                | 0,61*   | 0,69*    | 1,00    |
| Ability to predict   | 0,30*                | 0,25*   | 0,24*    | 0,32*   |

Through the analysis of organization structure of anticipatory competence and ability to predict in the young men the following results were obtained: a coherence structure index in the young men is 42; the divergence structure index in the young men is zero; the organization structure index in the young men is 42. The description of the significant interrelations found a significant correlation between spatial (0,31\*), temporal (0,46\*), general (0,88\*) anticipatory competence, between the ability to predict (0,30) and personal-situational anticipatory competence, being proportionally direct. Characteristic is the fact that at increasing some indicators, others increase as well.

Significant interrelations were also revealed between temporal (0.26\*), general (0.61\*) anticipatory competence; between the ability to predict (0.25\*) and spatial anticipatory competence, as well as between general (0.69\*) anticipatory competence, the ability to predict (0,24\*) and temporal proportionally direct anticipatory competence.

Significant interrelations between ability to predict (0,32\*) and proportionally direct general anticipatory competence are obtained.

## Discussions

In science, the following aspects of the problem of anticipation are studied in detail: neurophysiological, psychophysiological bases (Pavlov, 1973; Anokhin, 1975; Bernstein, 1991; Rusalov, 1979), the role of anticipation in providing cognitive mental processes (Brushlinsky, 1978, Tikhomirov, 1995; Shiyani, 1999; Feigenberg, 1986; Osnitsky, 2010), the features of probabilistic forecasting in health and disease (Feigenberg, 1986; Peresleni, 1976, 1982; Guldan, 1985; Mendelevich, 2002; Gromova, 2003; Akhmetzyanova 2014; Akhmetzyanova, 2015), the development of anticipation in ontogenesis (Sergienko, 1988; Sergienko, 1989; Sergienko, 1997; Regush, 1997), the role of anticipation in the mental process (Lisichkina, 1972), anticipation of operators (Plokhikh, 2002; Rusalov, 1979), communicative anticipation of teachers (Batrachenko, 1991). The most studied to date are anticipatory abilities in schizophrenia (Mendelevich, 2002; Feigenberg, 1986), in organic disorders (Skidanenko, 2003), in osteochondrosis (Demakina, 2004; Mendelevich, Solovieva, 2002), in neuroses and neurosis-like states (Solobutina, 2014, 2015 ; Gromova, 2003; Mendelevich and Solov'eva, 2002; Abitov 2015; Artemyeva, 2015), in epilepsy (Skidanenko, 2003), in personality disorders (Uzelevskaya, 2002), in speech development disorders (Akhmetzyanova 2014), at motor disorders in children (Bernstein, 1991), in drug addiction (Minullina, 2014).

Basic researches of probabilistic forecasting operation were conducted by I.M. Feigenberg, his colleagues, students and followers (Feigenberg, 1986; Feigenberg and Ivannikov, 1978; Gurevich, Feigenberg, 1977; Feigenberg and Zhuravlev, 1977; Shiryaev, 1986; Akopov and Sluchevsky, 1981; Akopov, 1983 ; Menitsky, 1981; Peresleni, 1976, 1982). Anticipation of speech activity was often viewed in the works of I.A. Zimnyaya (1974), R.M. Frumkina (1984). As part of the well-known psychological theories it is proved that an adequate anticipation of the future is possible only on the basis of accumulated and stored by the individual experience of adaptation to changing environmental conditions, which, in turn, is probabilistic in nature. It is stated that the condition for successful adaptation of the individual is the ability for anticipation as the ability to reflect the environmental laws in the structure of the past experience, to form behavioral strategies, anticipating the course of events (Brushlinsky, 1978; Lomov and Surkov, 1980; Mendelevich, 2002; Sergienko, 1997; Feigenberg and Zhuravleva, 1977).

The whole analysis of the anticipation phenomenon studies shows that the latter, as it were, permeates all forms and levels of psychic reflection of reality. It occurs as systematically integral process, forming in the real human activity and being one of the most important components of the regulation mechanism of this activity (including behavior in general). In our understanding, anticipation as the immanent property of mental reflection process includes not only the effect of the temporal and spatial anticipation of events, but also the selectivity of environmental impact, the direction of activity, behavior in the age-specific activity conditions.

However, the problem of anticipation in adolescence remains poorly studied, although the magnitude of the problem is clearly understood.

## Conclusion

Based on the results of the anticipatory-forecasting system study of adolescents the following tendencies were revealed:

- both adolescents and young men identified average level of anticipatory competence; adolescents' overall anticipatory competence is made up of personal-situational anticipatory competence (reflecting a communicative level of anticipation, i.e. the ability to predict life events and situations), of spatial one (characterized by the ability to anticipate the movements of objects in space, to forestall them, to co-ordinate their own motions, showing motor dexterity) and temporal anticipatory incompetence (which manifests itself in the ability to predict the course of time and distribute it accurately);

- in the youth age adolescence overall anticipatory competence is made up of personal-situational anticipatory competence and spatial and temporal anticipatory incompetence. The ability to predict in both adolescence and youth is characterized by an average level of forecasting, but the youth observes the positive dynamics of forecasting formation. The evaluation result of the overall organization of the anticipatory competence and forecasting interrelations structure in adolescence and the youth revealed contradictions. On the one hand, the organization structure index of young men is lower than that of adolescents; on the other hand in the youthful age the coherence structure level is significantly higher than in adolescence. Coherence has a property of integration, ensuring stability of the interrelation of anticipatory-forecasting system. The structure divergence index as an indicator of differentiation and plasticity in both adolescence and in the youthful age is absent.

Thus the developmental advantage of structure organization in the youthful age is the structure of anticipation and forecasting interrelation, which combines the properties of plasticity and integration.

## Acknowledgement

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Notes on contributors

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