DISPOSITIONAL FACTORS OF ATTITUDES TOWARDS STATISTICS IN SOCIAL SCIENCE STUDENTS: PERSEVERANCE AND ACADEMIC MOTIVATION

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Abstract

This paper describes the results of examining the relationship between attitudes towards statistics and academic motivation and perseverance in sociology students. Often, in everyday understanding, social sciences are identified with the humanities and therefore are considered as not requiring specific mathematical training. Such attitudes in social sciences students can lead to a decrease in their learning effectiveness and result in academic issues that could even lead to their expulsion. To measure attitudes towards statistics we used SATS-34, which covers a wide range of attitudes to both the academic subject and to statistics in general. The results showed that, based on the combination of various aspects of the attitude, the students can be divided into three types: those interested in mastering statistics, those who are nominally interested, and those who are uninterested in the subject. The groups differ in the level of perseverance and the prevailing academic motivation. In addition, significant differences between groups were found in the expected and actual grades in the course. The article concludes that attitudes towards

statistics are related to both psychological characteristics of students and to the level of course mastery. The differences between the groups were significant notwithstanding the hard and regular monitoring and the high importance of the course in the curriculum, i.e. the hardness of control does not negate the contribution of psychological factors in the learning effectiveness. We assume that the differences between the groups would have been even more pronounced in a more relaxed learning environment.

While still in school, students often ascribe themselves labels, evaluating their ability in different subjects. This is especially true of pupils who are not very good at mathematics: characteristics such as "I do not have a mathematical mind" or "I am definitely into humanities" firmly stick to the students, determining the choice of their specialization, first in school and then in college. However, the directions of higher education are not so clearly divided by mathematical or non-mathematical subjects: there is a whole group of sciences in which educational and professional development require a combination of mathematics and theoretical foundations of these areas. To a great extent this applies to social sciences, such as psychology, sociology, political science, and others. In society, there is no clear understanding of these sciences and traditionally they are considered to be part of the humanities. This representation is transferred onto the expectations from the relevant subjects in the course curriculum. In reality, many entrants to the faculties of social sciences are not aware of the need to gain mathematical knowledge during their forthcoming studies. Even if the results of mathematical examinations are considered among other entrance requirements, students starting those degree programs have negative rather than positive attitudes towards maths.

However, courses involving statistics and requiring mathematical apparatus play an important role in the curricula. The conflict between the expectations of the future profession and the curriculum often causes difficulties for a number of students. The problem was recognized in the early 1980s, and, to date, there is a large body of research on the factors that cause anxiety towards statistics. The main factors to be named here are students' gender (Baloğlu, 2003; Rodarte-Luna & Sherry, 2008), age (Baloğlu, 2003), nationality (Baloğlu, Deniz, & Kesici, 2011), and personal traits (Chew & Dillon, 2014a).

The Russian professional community has been discussing methods of teaching mathematics and statistics to students of non-mathematical specialties, the extent to which formal topics should be explored, the ratio of the mathematical foundations and practical applications of various data analysis and problem-solving methods, etc. (Firmin & Proemmel, 2011; Tolstova, 2002a, 2002b, 2007; Vakulenko et al., 2010). In this article, instead of looking at the course content or teaching approaches, we would like to explore the intrinsic characteristics of students that may help or hinder them in their studies.

The main aim of this study was to determine how various aspects of the

social sciences students' attitudes towards statistics are related to their perseverance and motivation. These characteristics are considered among so-called dispositional factors of attitude towards statistics (Onwuegbuzie & Wilson, 2003).

Despite the fact that there are a number of studies looking at the contribution of dispositional factors in the formation of attitudes to mathematical subjects, dispositional factors are still poorly understood compared to other factors, such as the socio-demographic characteristics of the students. However, in our view, these factors are the key to explaining students' problems in mastering mathematics courses. Secondly, having this information, the teachers will be able to adapt their teaching approaches to the audience to achieve maximum learning efficiency.

Furthermore, in this article we will provide an overview of the studies of attitudes towards statistics and factors of their formation, as well as of tools to measure attitudes towards statistics and personality traits. Finally, we will describe the results of the study.

Attitudes towards statistics

Initially, attitudes towards statistics were interpreted quite narrowly: as negative behavioral manifestations associated with anxiety about a complex subject. The concept of statistics anxiety grew from similar studies on school mathematics in general, beginning in the early 1970s (Finlayson, 2014). When mathematics began to occupy more space in the curricula of faculties of social sciences, the problem of attitudes and stereotypes that hinder its effective learning moved beyond school and attracted researchers in higher education. Along with this, the anxiety linked to mathematics or statistics-related subjects gained a broader understanding and later scales measured not so much anxiety as more general attitudes towards statistics (Schau, Stevens, Dauphinee, & Vecchio, 1995; Wise, 1985).

The following definition of statistics anxiety originally suggested by Zeidner has almost become traditional and is widely cited by other researchers: "a performance characterized by extensive worry, intrusive thoughts, mental disorganization, tension, and physiological arousal when exposed to statistics content, problems, instructional situations, or evaluative contexts, and is commonly claimed to debilitate performance in a wide variety of academic situations by interfering with the manipulation of statistics data and solution of statistics problems (Zeidner, 1991, p. 319). However, nowadays a broader approach to the subject is more widespread; researchers discuss attitudes towards statistics as a phenomenon that describes the whole range of attitudes and experiences of students related to this course (Chew & Dillon, 2014b). Nevertheless, when describing constructs of anxiety and attitudes towards statistics Chew argues that these concepts are fairly close to each other: both contain a strong affective component and are traditionally measured with the same instruments (for example, the most popular STARS questionnaire measures both statistical anxiety and attitudes to statistics (Papousek et al., 2012), and researchers do not distinguish between the results of the evaluation of these two constructs).

Those researchers who distinguish between statistics anxiety and attitudes towards statistics agree on the fact that negative attitudes to statistics-related subjects are closely associated with high levels of statistics anxiety (Chiesi & Primi, 2009; Mji & Onwuegbuzie, 2004; Onwuegbuzie, 2000; Watson, Kromrey, & Hess, 2003; Watson, Lang, & Kromrey, 2002; Zanakis & Valenzi, 1997). However, although attitudes towards statistics are not limited by negative manifestations and represent a broader construct, the range of predictors of certain attitudes and of anxiety level is almost identical.

In a comprehensive review of statistics anxiety the American researcher Anthony Onwuegbuzie distinguishes three groups of its possible antecedents (Onwuegbuzie & Wilson, 2003):

– situational — related to the unique situation of a particular person (prior statistics knowledge; relationship with the course teacher; opportunity to get assistance);

– dispositional — related to personal characteristics of the student (their attitudes, self-esteem, self-efficacy in mathematical subjects);

– environmental — related to the socio-demographic characteristics of the student (gender, age, social status, cultural identity, etc.).

**Dispositional antecedents
of attitudes towards statistics**

In modern psychology, one the most popular methods for assessing a wide class of personal characteristics is the Big Five method (John & Srivastava, 1999). Researchers of attitudes towards statistics have naturally applied this model too. Chew and Dillon

(2014) showed that all scales, except Conscientiousness, are correlated with various aspects of attitudes towards statistics measured by the SARS questionnaire. Thus, Neuroticism is positively correlated with the "Worth of Statistics", "Fear of Asking for Help" and "Fear of Statistics Teachers" scales. Openness showed a connection with the same scales, but the correlation was reversed. Extraversion is positively correlated with the "Interpretation Anxiety", "Test and Class Anxiety" and "Fear of Asking for Help" scales. These results seem quite logical and expected, given the content of the scales: a high level of neuroticism is associated with difficulties in establishing contacts and recognition of the difficulties in mastering the material. On the other hand, an inverse correlation with Openness suggests that students who aim at mastering the new material are ready to get in touch with teachers, fellow students or other professionals to understand the subject and resolve their difficulties. In a validation study of the Russian version of SATS-34 it was shown that lack of interest in statistics, a high perceived level of difficulty of the subject, negative expectations of the course and rare use of academic knowledge in everyday life are highly correlated with high Neuroticism scores (Orel & Khavenson, 2013).

Among other dispositional antecedents of attitudes towards statistics, researchers list level of self-confidence in mathematical subjects (Zeidner, 1991), perfectionism (Onwuegbuzie & Daley, 1999), procrastination (Onwuegbuzie, 2000), learning strategies (Baloğlu et al., 2011), and the ability to work with written texts (Schacht, 1990), etc.

Let us consider such dispositional factors as academic motivation and perseverance. Presumably, different types of academic motivation are associated with different manifestations of attitudes towards mathematical subjects, and perseverance is associated with the general willingness to master a complex course.

Research on the relationship between academic motivation and attitudes towards statistics is scarce, but does exist. In general, results show that intrinsic motivation has a positive effect on reducing statistics anxiety (Dunn, 2013; Lavasani, Weisani, & Shariati, 2014). In the first of these studies the relationship between students' motivation and their propensity to delay the execution of tasks in online statistics course was analyzed; the second study looked into the relationship between motivational factors and statistics anxiety.

**Perseverance and motivation
as dispositional antecedents
of the attitude towards statistics**

Academic motivation as the human desire to learn and master new knowledge and competence is considered in several theoretical approaches (Deci et al., 1991). One of the most comprehensive and detailed analyses of motivation in the academic environment is the description presented by Ryan and Deci (Deci, Ryan, 1985, 1991) and operationalized in the Russian language in the Academic Motivation Questionnaire – AMQ (Gordeeva, Sychev, Osin, 2013).

According to Ryan and Deci, there are three types of motivation, each of which is divided into separate subty-

pes, eventually resulting in seven separate variables describing human motivation. Motivational factors of the first level are extrinsic motivation, intrinsic motivation and amotivation. Let's discuss each of them in detail.

The term "intrinsic motivation" describes a condition in which satisfaction results from the mere fact of doing activity for itself and achieving its objectives. Deci and Ryan argue that the basis of intrinsic motivation is formed by the basic needs for competence and self-determination (Deci, Vallerand, Pelletier, & Ryan, 1991). Canadian researchers Vallerand, Pelletier, and Blais (1992) identified three subtypes within intrinsic motivation: intrinsic motivation to know, intrinsic motivation toward accomplishment, and intrinsic motivation to experience stimulation.

Intrinsic motivation to know is defined as the fact of performing an activity for the pleasure and satisfaction that one experiences while learning, exploring, or trying to understand something new.

Intrinsic motivation toward accomplishments is defined as the fact of engagement in an activity for the pleasure and satisfaction that one experiences when accomplishing or creating something.

Intrinsic motivation to experience stimulation is present when a person is involved in an activity for the sake of experiencing stimulating sensations (sensory pleasure, aesthetic experiences, and emotional reactions).

The term "extrinsic motivation" describes the diversity of behavior controlled by the stimuli that are external to the individual. Ryan and Deci argue that the types of extrinsic motivation

can be aligned along a self-determination continuum: external, introjected and identified.

Extrinsic motivation refers to behavior governed exclusively by external stimuli, such as reward or punishment. In the case of introjected regulation a person internalizes the external stimuli urging them to act, but their nature still remains external to the activity performed. Identification is the form of regulation closest to the high level of self-determination; it appears when internalized external stimuli become subjectively meaningful to the person.

Amotivation arises in a situation where someone does not perceive contingencies between their own actions and outcomes; it leads to feelings of incompetence and uncontrollability of the situation. Amotivated people perceive their own actions as something that elude their control and often stop any activity completely.

A test to measure all types of motivation (3 types and 7 subtypes) was developed by a group of Canadian researchers led by Vallerand et al. (1992); it was focused on motivation in the learning and academic field. The original questionnaire was developed in the French language; as with the English-language version it contained 7 scales, each with 4 items. In Russian, the test was adapted by Gordeyeva, Osin and Sychev (2013), but its factor structure differed from the original. The Russian version, used in the present study, contains 28 items divided into six scales: cognitive motivation (corresponds to intrinsic motivation to know), self-development motivation (corresponds to intrinsic motivation toward accomplishments), identified motivation, introjected motivation, external moti-

vation and amotivation. Thus, the Russian-language version does not include the intrinsic motivation to experience stimulation.

Perseverance is defined as persistence that manifests itself at the level of psychological traits and is characterized by a tendency to achieve long-term goals (Duckworth & Quinn, 2009). Angela Duckworth and Patrick Quinn argue that perseverance as a trait is different from Conscientiousness, a Big Five scale, in that perseverance is an ability to firstly, put effort into performing an activity, and secondly, to maintain interest in that activity. In this case, people with a high level of perseverance are able to continue to carry out the activity, even in the absence of positive feedback.

An empirical study of the relationship between attitudes toward statistics, academic motivation and effort

Measures

1. To measure the attitude towards statistics we used the SATS-34 scale (Orel & Khavenson, 2013). This is a composite scale that consists of six subscales that measure different aspects of the possible attitude of students to courses related to statistics. Below we list and briefly describe these sub-scales:

– "Statistics in professional life" (Cronbach's Alpha – 0.898). This scale reflects the expectations of the students as to whether or not statistics will become a part of their future professional activity. The scale shows students' understanding of the content of their future profession, and their acceptance of this; students may realize that

statistics is essential in most possible professional paths, but try to avoid it at any cost in their particular path. We can assume that this factor is associated with extrinsic academic motivation.

– "Statistics in everyday life" (Cronbach's Alpha — 0.828). In contrast to the previous scale, this scale measures students' opinions on the importance of statistics in their everyday life. Presumably the importance of statistics in everyday life will be associated with intrinsic academic motivation.

– "Expectations" (Cronbach's Alpha — 0.874). This scale reflects the emotional attitude of students towards the course studied. The scale may detect apprehensive negative attitude to the course.

– "Interest" (Cronbach's Alpha — 0.720). This scale reflects interest and positive attitude to the course. Like the importance of statistics in everyday life, this scale is presumably related to the intrinsic academic motivation.

– "Effort" (Cronbach's Alpha — 0.843). This scale indicates intentions of the students related to their performance in the course, ie their willingness or unwillingness to invest time and effort in the study of the subject in order to overcome possible difficulties and generally take responsibility for their learning. Most likely, in addition to general attitudes to learning, such traits as perseverance and concentration may play a role in the formation of this factor.

– "Difficulty" (Cronbach's Alpha — 0.701). This scale reflects the expected difficulty of the course and the amount of effort that students find it necessary to make in order to successfully pass the course. Unlike effort, perception of the course as simple or complex is important in this scale.

As we have previously shown in the validation study (Orel & Khavenson, 2013), all six scales measure independent constructs. Together, they provide a broad overview of the attitude of a student or a group of students to statistics, reflecting both the importance of statistics and readiness to work and emotional attitude. Calculation of a total score seems useless; that is why we will consider links between each of the aspects and academic motivation, perseverance and other students' characteristics.

2. To measure perseverance we used the GRIT-S scale by Angela Duckworth (Duckworth & Quinn, 2009) that was adapted into the Russian language by Tyumeneva, Kuzmina, and Kardanova (2014). The questionnaire consists of two scales: "Stability of interests" (Cronbach's Alpha — 0.69) and "Perseverance in goal achievement" (Cronbach's Alpha — 0.78). The questionnaire was validated in a study of 6000 high school students and university freshers.

3. Academic motivation was measured by the above described AMQ (Gordeyeva et al., 2013).

Participants

The sample consisted of 83 sophomore students of the Sociology Department of the Higher School of Economics (16 males and 65 females), which makes three-quarters of randomly selected students. The survey was conducted round the middle of the first semester of the course "Probability theory and mathematical statistics" (PTAS) that lasts for 3 semesters (1.5 years).

Results

Descriptive Statistics

As we can see from Table 1, all averages in the dispositional scales are within the middle range of the scale. The only exceptions are extrinsic and intrinsic motivation. This can be explained by the fact that PTAS is one of the key courses in the curriculum and is presented to students as crucial for all future studies and work. The lectures are accompanied by regular monitoring and homework, which substantially affects the final grade and obviously stimulates the increase in extrinsic motivation. However, most of the students are aware of the relevance and importance of the course; therefore, intrinsic motivation is also high.

Averages in perseverance and concentration also lie within the middle range of the scale. We were expecting somewhat higher scores in these scales, because, in order to enter University, people have to pass through a tough selection process. However, we do not have data on the general population, so we cannot accurately assess whether or not the obtained values are common to all or demonstrate an offset.

Among the SATS-34 scales, the highest scores were obtained in "The significance of statistics in professional life" and "Effort". This is consistent with the above causes of high extrinsic and intrinsic motivation: The course is very

Table 1

Descriptive statistics: motivation scales, perseverance and attitudes towards statistics

	Average	Confidence interval		SD	Scale
		Low	High		
Intrinsic motivation	3.56	3.38	3.78	0.84	From 1 to 5
Intrinsic + identified motivation	3.49	3.29	3.69	0.93	
Introjected motivation	3.12	2.9	3.34	1.00	
Extrinsic motivation	4.07	3.88	4.25	0.86	
Amotivation	2.07	1.88	2.25	0.84	
Perseverance in goal achievement	2.51	2.37	2.65	0.63	
Stability of interests	2.73	2.58	2..88	0.68	
Statistics in professional life	5.61	5.4	5.81	0.92	From 1 to 7
Expectations	4.98	4.74	5.21	1.06	
Effort	5.29	5.02	5.55	1.22	
Statistics in everyday life	4.37	4.12	4.62	1.14	
Interest	3.99	3.77	4.21	1.02	
Difficulty	2.99	2.77	3.21	1.02	

important and almost all students are willing to make an effort to study this subject.

Patterns of students' attitudes towards statistics

Presumably, students do not just have different attitudes to statistics and related courses but there are certain types of students with different ratios of scores on the SATS-34 scales. In order to describe these types, we conducted cluster analysis and identified some of the most common types of students.

Three clusters of approximately equal size were identified. Two participants consistently formed a separate cluster and had unique characteristics: low scores on all scales except for "Difficulty". Moreover, differences between the two closest clusters ranged from 1 to 2.5 points on 5 out of 6 scales. In order to maintain cluster homogeneity, we decided to exclude these cases from the analysis.

The remaining observations split into three groups almost evenly: three clusters included 25, 29 and 27 students respectively.

Mean scores on the scales are listed below in Table 2 and Figure 1. To test the significance of differences between the mean scores we used ANOVA; the differences were proved to be significant for all six factors. Pairwise comparisons indicate that the second cluster is different from the first and the third clusters in all six scales. The first and the third clusters differ from each other on the "Expectations", "Statistics in everyday life", "Interest" and "Difficulty" scales, but do not differ in "Statistics in professional life" and "Effort".

Based on these results, we can describe the clusters. The first cluster includes students with high scores on all scales, reflecting some aspect of the attitude towards statistics. Compared to two other clusters, they have higher scores across all scales, except for "Effort" (on this scale the scores are the same as in other two clusters). This group of students is characterized by their appreciation of the need for statistics in their future professional life. Despite the fact that this is characteristic of all the students of the Department of Sociology, as they are mostly focused on further research in the field of marketing or sociology, the scores in this cluster were

Table 2

Mean scores for the SATS-34 scales in three clusters

Scale	Interested	Uninterested	Nominally interested	Whole sample
1. Statistics in professional life	6.2	5.1	5.8	5.6
2. Expectations	5.8	4.1	5.3	5.0
3. Effort	5.9	4.3	6.0	5.3
4. Statistics in everyday life	5.5	3.7	4.3	4.4
5. Interest	4.9	3.1	4.2	4.0
6. Difficulty	3.6	2.5	2.8	3.0

significantly higher than for other students[1]. This group is not inclined to consider this course as challenging and does not hold negative attitudes towards statistics-related courses in general. A high score on the "Expectations" scale does not allow us to say whether or not the students hold neutral or positive attitudes, but taking into account the fact that their score on "Interest" is also almost one point higher than that of the whole class, we can say that they have a positive attitude with high interest in the subject. This conclusion is also supported by the high mean score on "Statistics in everyday life" (it is higher than the mean score for the whole group and the mean scores for two other clusters). Such high values on this scale indicate that these students use statistical information not only in their profession or studies, but also in everyday life. It is clear that these students are ready to make an effort to study statistical courses to get the best result. The score of 5.9 on "Effort" is significantly higher than the average for the sample of 5.3[2]. We labeled this cluster "Interested".

The second cluster is to some extent the opposite of the first one. On the contrary, students in this cluster have the lowest averages on all scales, although they are not so low relative to the center of the scale. If we look at all scales, we can see the following: firstly, this group of students has negative expectations about statistics-related courses, which implies a fear of failure in tests and exams and a generally high level of stress associated with these courses.

Secondly, their scores on "Interest" and "Statistics in everyday life" are significantly lower than those of the whole sample. Third, their score on "Subjective complexity" indicates that the students perceive the course as difficult and are not ready to make a big effort to overcome the difficulties in training — their average score on "Effort" is almost 2 points lower than that in the two other clusters. However, despite all of the above, this group of students appreciates the importance of statistics in professional life, i.e. they perceive this subject area as crucial to professional development. A mean score of 5.1 on "Statistics in professional life" is significantly lower compared to the sample mean or the means in the other two clusters, but it is still at the positive end of the scale. In general, this group of students has an anxious attitude towards statistics and reduced interest, and they are not willing to try very hard to study this subject, although they do believe that the knowledge gained in the course will be useful to them in their future work. We named this cluster "Uninterested".

As for the third cluster, as we noted above, the students in this cluster are very similar to the students from the first. They also highly value the role of statistics in their professional life and demonstrate willingness to master the course. Average scores on the "Statistics in professional life" (5.8) and "Effort" (6.0) are significantly higher than the sample means. Their scores in the remaining scales are somewhat lower. Their mean score in

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[1] $t = 7.38$, $p = 0.0000001$.

[2] $t = 3.38$, $p = 0.003$.

Mean scores in SATS-34 scales in three clusters
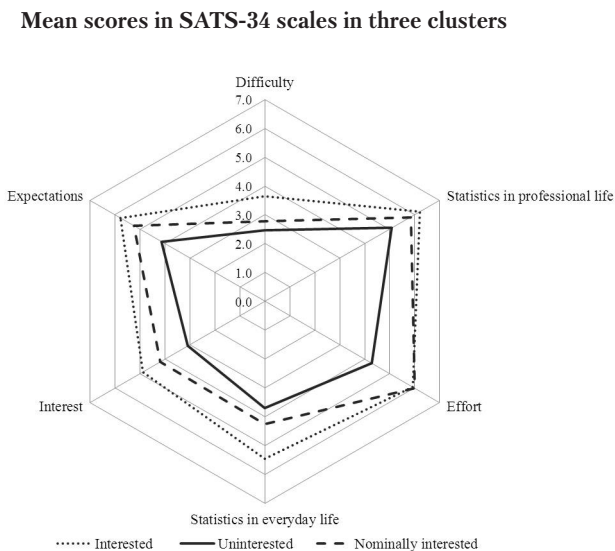
"Expectations" is 5.3, which is significantly higher than the sample mean[3] but significantly lower than the mean for the first cluster[4]. This group of students holds neutral attitudes towards statistics — they do not demonstrate any strong negative emotions but do not feel particularly positive either (their score in "Interest" is 4.2, which is very close to the sample mean). Their low score on "Statistics in everyday life" (1.2 points lower than in the first cluster) goes in line with this description — these students are not particularly interested in applying statistics outside of school and work. Unlike the students in the first cluster, these students perceive the course in statistics as complex, in that they are closer to the second cluster. In general, students in this cluster can be described as diligent and ready to learn statistics by virtue of professional necessity but not having personal interest in the subject. We called this cluster "Nominally interested".

Attitude towards statistics, academic motivation and perseverance in different types of students

As the clusters differ in terms of the variables that underlie the classification we assumed that the psychological determinants of attitudes towards statistics were different in each group. We hypothesized that students from different clusters would be characterized by different academic motivation and stability of interests. Some would be more likely to have internal interest in statistics, others would be dependent on external factors such as the need for statistics in any future jobs, the desire

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[3] $t = 2.1$, $p = 0.041$.
[4] $p = 0.019$.

to get high marks, etc. The degree of perseverance would determine how hard or easy it would be for the students to overcome difficulties associated with mastering the subject.

To test the hypothesis of the different strength of motivation in three clusters, we used ANOVA with the types of academic motivation and perseverance each being an independent variable and the three clusters being the factor. Of the five types of academic motivation, three showed statistically significant differences in at least one pair of clusters.

So what are the types of motivation that distinguish students who are interested in studying statistics and aware of its role in their future professional activity from less involved students? Firstly, it is intrinsic motivation. The mean score on intrinsic motivation in the "Uninterested" group is 3.3, which is significantly lower than the means in the "Interested" and "Nominally interested" groups (3.9 and 3.7, respectively)[5]. Although the difference does not look very big, this group of students is less inclined to study statistics for the pleasure of learning and new knowledge as such. The same can be said about identified motivation: the means are almost the same as on the intrinsic motivation ("Interested" — 3.7; "Uninterested" — 3.2; "Nominally interested" — 3.8)[6]. This leads us to the conclusion that despite the importance of this course for all sociology students, the group of uninterested students does not perceive the

need for the course and they learn it because they are being forced to.

Secondly, the highest level of extrinsic motivation is demonstrated not by the "Uninterested" but by the "Nominally interested" students. For them, extrinsic motivation (mean — 4.4) is the main "engine" to power their work on the course. Students in the "Interested" and "Uninterested" clusters are equally motivated by external stimuli (4.0 and 3.9 respectively; the difference is not statistically significant). The difference between the two clusters is that students in the "Interested" group are self-motivated; they have an understanding of the importance of statistics and the desire to learn, i.e. the external stimuli are, firstly, understood and accepted by the student, and secondly, in some way complement the existing intrinsic motivation. In the "Uninterested" group extrinsic motivation is "working" alone; it is not supported by the original interest and not subsequently internalized by the students.

The results are consistent with students' responses to a direct question: "If the choice was up to you, how likely would you be to choose courses related to mathematics and statistics?" Among the students who like statistics 92% would choose this course; among the "Nominally interested" the percentage was 88%; and among the "Uninterested" students it was as low as 21%.

The answers to the question "How important is knowledge of statistics in

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[5] $F = 4.9$; $p = 0.01$. Bonferroni Pairwise comparisons: 1st and 2nd clusters — $p = 0.01$, 3rd and 2nd clusters — $p = 0.08$.

[6] There are significant difference only between "Uninterested" and "Nominally interested" clusters. $F = 4.04$; $p = 0.02$. Bonferroni pairwise comparisons: 2nd and 3rd clusters – $p = 0.03$.

the area in which you want to work?" are also indicative. Among the students of the "Interested" cluster everybody answered that they needed statistics in their professional work; the vast majority (96%) of the "Nominally interested" students also agreed they needed statistics for their work. Interestingly enough, the majority (69%) of the "Uninterested" cluster did so too. Despite their lack of interest and low intrinsic motivation, they are aware of the need to study the course, which is also consistent with their high extrinsic motivation scores.

In addition to the academic motivation, different groups of students differ in terms of their inherent perseverance in achieving goals. The highest levels of perseverance are demonstrated by the "Interested" (3.1) and "Nominally interested" students (2.9); the mean score of the "Uninterested" students (2.3) was significantly lower than in any other group. Since our initial assumption was that perseverance was a relatively stable personal trait, we can conclude that the low level of perseverance of the "Uninterested" students prevents them from mastering statistics.

To test assumptions about the different structure of the attitude towards statistics and a number of dispositional factors, we compared the correlation between these factors and the scales of attitude towards statistics for each of the three groups of students.

The first thing to note is the difference in the number of significant correlation coefficients for the sample as a whole and for individual clusters. A much larger number of significant coefficients in the whole sample indicates that the total correlation stems from the correlations within groups. As soon

as we consider the groups separately, each of them demonstrates a unique profile of correlations between dispositional factors and scales of attitude towards statistics. Indirectly, this confirms the validity of the classification: some connections with academic motivation and personality traits, such as perseverance and concentration, are different from group to group.

As for the students from the "Interested" cluster, the greatest number of correlations was found between academic motivation and perseverance on the one hand and "Effort" and "Difficulty" on the other hand. Knowing that students in these cluster have the highest scores on both scales, we conclude that effort and perceived difficulty of the course are due to their existing levels of motivation (both intrinsic and extrinsic) and perseverance. Positive correlation with introjected motivation shows that external motives, such as the need for statistics in future work, are recognized and accepted by the students. Interestingly, in this cluster there were fewer significant correlations for the remaining SATS-34 scales. This may be due to the fact that the entire group has similar values on those scales.

In the "Uninterested" cluster there were fewer significant correlations between different types of motivation and the SATS-34 scales. "Effort" was positively associated with both intrinsic motivation and amotivation. The "Effort" element of the SATS-34 scales does not reflect an inherent trait but rather the willingness of the student to work on a particular course. In this case, positive correlation with intrinsic motivation is understandable, but the correlation with amotivation seems

counterintuitive. Apparently, this is due to the fact that the great importance of the course, claimed by both students and teachers, does not let amotivation express itself. Even if it is too difficult for the student to study on this course, they are not interested or don't need statistics in their professional life, the overall situation around them either involves them in study, or at least they have to postulate their willingness to try. In addition, the course is accompanied by regular monitoring and a final exam, which also does not give students the opportunity to relax or avoid something they don't want to learn. As well as for those interested in statistics, uninterested students score higher on "Effort" if they have a higher level of perseverance as a personal trait.

Expected and actual marks

In the survey the students were asked: "What grade do you expect to get on this course?" The results showed that students from the "Interested" and "Nominally interested" clusters expect to get a grade of no less than 7 on a 10-point scale, and most expect to get 8 or 9. However, students from the second cluster mainly evaluate themselves as 6 or 7, with approximately two-thirds choosing 6. Almost none of them expect to get the highest grade.

Upon completion of part of the course (two out of three semesters) students passed the first exam on the course and their scores were added to the database. The results showed that

belonging to a certain cluster predicts the outcome well. As expected (Schau, 2003; Vanhoof et al., 2006), the students with the least positive attitude towards statistics and not interested in their study received the lowest grades; students with a positive attitude towards statistics in general and to the course in particular received higher grades. Mean scores in the clusters were: "Interested" – 6.8, "Uninterested" – 5.1, "Nominally interested" – 6.9. The "Uninterested" cluster is significantly different from the other two. It is also worth looking at the distribution of scores within clusters. In the "Uninterested" cluster, 52% of students were rated as "satisfactory"[7] and below and the rest were rated "good". There were no excellent ratings in this group. At the same time, quite a few students in other clusters were graded as "excellent": 48% of students from the "Interested" cluster and 42% of the "Nominally interested"[8] cluster. 22% of the "Interested" cluster and 18% of the "Nominally interested" cluster received "satisfactory" grades; the rest were rated as "good". In general, there are no differences in the distribution of grades or in average scores between the clusters of "Interested" and "Nominally interested". Their attitudes towards statistics, motivational strategies, and level of perseverance lead to about the same high level of mastery of the material. Despite the fact that nominally interested students have lower intrinsic motivation, do not consider statistics as important in their daily lives,

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[7] In order to make the description easier, we converted the grades on a 10-point scale to a more traditional 4-point scale ("excellent" — "good" — "satisfactory" — "unsatisfactory").

[8] The difference is not statistically significant.

and do not show self-interest in it, they master it at a high level, and, apparently, are ready to apply it in their professional lives. Perhaps the structure of the course or, again, the general opinion that the course is very important for their future studies, help them to achieve results that are equally high as those of the initially more motivated students.

If we look at the connection between the expected and actual grades within clusters, it appears that the interested students predicted their grades most accurately (correlation coefficient of 0.8, p-value = 0.00003). Students in the "Nominally interested" cluster predicted their grades somewhat less accurately (correlation coefficient of 0.6, p-value = 0.005). It could be that at the beginning of the course students were not sure of their future plans and their willingness to work on the course. The grade predictions of students who are not interested in studying statistics were even worse (correlation coefficient of 0.4, p-value = 0.02). What's more, this group of students overstated the expected grade the most significantly. It could be that this result was due to a lack of understanding of the possible grades for the course, but other students lacked this knowledge too. An alternative explanation could be that this was the risk group, which initially hesitated and could have been ready to work on the course (as evidenced by the relatively high scores on the "Effort" and "Statistics in professional life" SATS-34 scales and high scores on extrinsic motivation) but failed to overcome their fear and negative attitudes towards statistics during the course, which eventually led to low grades and overall poor mastery of the course.

Conclusions

In our study we showed that attitudes towards statistics allow for dividing students into groups of distinct specificity, in terms of both the variables on which the classification was based and on the external characteristics. Each cluster has a specific structure of attitudes to the course, individual characteristics of students, and expectations of the course and, as a result, the groups differ in terms of final grades. Despite the fact that the course on statistics explored in our study was designed so that students have very little opportunity to shirk assignments, the clusters identified differ in individual psychological characteristics of students and their learning outcomes, i.e. the stringency of requirements did not equal the contribution of psychological factors in the effectiveness of training, although, most probably, individual differences would have manifested themselves even more strongly if the course monitoring were less harsh. It is particularly worth mentioning that, in general, all students are aware of the importance of this course and its significance for further education and professional life. However, not all students accept it and many are motivated only by external and often negative stimuli, such as as non-admission to the final exam or threat of expulsion.

The identified clusters can be considered in terms of the risks to students. More attention should be given to uninterested students. They are the ones who get low final grades and transfer their negative attitude towards statistics into their professional life. Taking into account their answers to the questions about the selection of statistics courses, one can assume that they will no longer attempt

to study statistics in other courses and to deepen their knowledge in this area, and in professional life they will most probably avoid tasks associated with the data analysis. Given the trends in modern social sciences and research methodology, narrowing the range of professional tasks may adversely affect the career prospects of such students.

Work on improving students' motivation and commitment must be carried out for each cluster individually. Teachers or tutors should be able to identify students at risk and work with them individually. For these purposes tailored tasks and more detailed study in the classroom might be used, as well as discussions of real-life problems involving statistics or career related talks in order to increase the awareness of the importance and significance of statistics for future profession.

References

Baloğlu, M. (2003). Individual differences in statistics anxiety among college students. *Personality and Individual Differences, 34*, 855–865.

Baloğlu, M., Deniz, M. E., & Kesici, Ş. (2011). A descriptive study of individual and cross-cultural differences in statistics anxiety. *Learning and Individual Differences, 21*(4), 387–391.

Chew, P. K. H., & Dillon, D. B. (2014a). Statistics anxiety and the Big Five personality factors. *Procedia – Social and Behavioral Sciences, 112*, 1177–1186.

Chew, P. K. H., & Dillon, D. B. (2014b). Statistics anxiety update: Refining the construct and recommendations for a new research agenda. *Perspectives on Psychological Science, 9*(2), 196–208.

Chiesi, F., & Primi, C. (2009). Assessing statistics attitudes among college students: Psychometric properties of the Italian version of the Survey of Attitudes toward Statistics (SATS). *Learning and Individual Differences, 19*(2), 309–313.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26*(3–4), 325–346.

Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the short grit scale (grit-s). *Journal of Personality Assessment, 91*(2), 166–174.

Dunn, K. (2013). Why wait? The influence of academic self-regulation, intrinsic motivation, and statistics anxiety on procrastination in online statistics. *Innovative Higher Education, 39*(1), 33–44.

Finlayson, M. (2014). Addressing math anxiety in the classroom. *Improving Schools, 17*(1), 99–115.

Firmin, M., & Proemmel, E. (2011). Towards remediating undergraduate students' statisticophobia. *College Teaching Methods and Styles Journal, 4*(4), 17–20.

Gordeyeva, T. O., Sychyov, O. A., & Osin, E. I. (2013). Inner and outer motivation in students: Its sources and influence on psychological well-being. *Voprosy Psikhologii, 1*, 1–11.

John, O. P., & Srivastava, S. (1999). Big five trait taxonomy. In L. Pervin, & O. P. John (Eds.), *Handbook of personality: Theory and research* (pp. 38 –102). New York: Guilford.

Lavasani, M. G., Weisani, M., & Shariati, F. (2014). The role of achievement goals, academic motivation in statistics anxiety: Testing a causal model. *Procedia – Social and Behavioral Sciences, 114*, 933–938.

Mji, A., & Onwuegbuzie, A. J. (2004). Evidence of score reliability and validity of the statistical anxiety rating scale among techniken students in South Africa. *Measurement and Evaluation in Counseling and Development, 36*(4), 238–251.

Onwuegbuzie, A. J. (2000). *I'll begin my statistics assignment tomorrow: The relationship between statistics anxiety and academic procrastination.* Retrieved from http://eric.ed.gov/?id=ED442872

Onwuegbuzie, A. J., & Daley, C. E. (1999). Perfectionism and statistics anxiety. *Personality and Individual Differences, 26*(6), 1089–1102.

Onwuegbuzie, A. J., & Wilson, V. A. (2003). Statistics anxiety: Nature, etiology, antecedents, effects, and treatments — a comprehensive review of the literature. *Teaching in Higher Education, 8*(2), 195–209.

Orel, E. A., & Khavenson, T. E. (2013). Attitudes towards statistics in social science students: Operationalization and measurement. *Psychology. Journal of the Higher School of Economics, 10*(1), 37–54.

Papousek, I., Ruggeri, K., Macher, D., Paechter, M., Heene, M., Weiss, E. M., ... Freudenthaler, H. H. (2012). Psychometric evaluation and experimental validation of the statistics anxiety rating scale. *Journal of Personality Assessment, 94*(1), 82–91.

Rodarte-Luna, B., & Sherry, A. (2008). Sex differences in the relation between statistics anxiety and cognitive/learning strategies. *Contemporary Educational Psychology, 33*(2), 327–344.

Schacht, S. P. (1990). Statistics textbooks: Pedagogical tools or impediments to learning? *Teaching Sociology, 18*(3), 390–396.

Schau, C. (2003). *Students' Attitudes: The "Other" Important Outcome in Statistics Education.* Parts of this paper were presented at the Joint Statistics Meetings, San Francisco. Retrieved from http://evaluationandstatistics.com/JSM2003.pdf

Schau, C., Stevens, J., Dauphinee, T. L., & Vecchio, A. D. (1995). The development and validation of the survey of attitudes toward statistics. *Educational and Psychological Measurement, 55*(5), 868–875.

Tolstova, Yu. N. (2002a). K voprosu o printsipakh postroeniya uchebnogo kursa "Analiz sotsiologicheskikh dannykh" [Developing the curriculum of "Data analysis in social sciences" course]. *Sotsiologiya: Metodologiya, Metody, Matematicheskoe Modelirovanie*, 3–4, 154–163.

Tolstova, Yu. N. (2002b). Prepodavanie matematiki studentam-sotsiologam: problema i podkhody k ee resheniyu [Teaching mathematics to the sociology students: issues and solutions]. *Sotsiologicheskie Issledovaniya,* 2, 111–120.

Tolstova, Yu. N. (2007). *Matematiko-statisticheskie modeli v sotsiologii (matematicheskaya statistika dlya sotsiologov)* [Mathematical and statistical models in sociology (mathematical statistics for sociologists)]. Moscow: Publishing House of the Higher School of Economics.

Tyumeneva, Y. A., Kuzmina, J. V., & Kardanova, E. (2014). Russian version of the Grit Scale: Reliability and criterion-related validity. *NRU HSE Basic Research Program Working papers. Series: Psychology WP BRP 24/PSY/2014* (pp. 1–22).

Vakulenko, E. S., Kamalova, R. U., Kisel'gof, S. G., Smirnova, Zh. I., Stukal, D. K., & Khavenson, T. E. (2010). Developing teaching materials for the courses devoted to quantitative methods applied to social and economic tasks. *Economic Sociology (Electronic Journal), 11*(4), 190–194.

Vallerand, R. J., Pelletier, L. G., Blais, M. R., Briere, N. M., Senecal, C., & Vallieres, E. F. (1992). The Academic Motivation Scale: A measure of intrinsic, extrinsic, and amotivation in education. *Educational and Psychological Measurement, 52*(4), 1003–1017.

Vanhoof, S., Sotos, A. E. C., Onghena, P., Verschaffel, L., Dooren, W. Van, & Noortgate, W. Van den. (2006). Attitudes toward statistics and their relationship with short- and long-term exam results. *Journal of Statistics Education, 14*(3), 34–46.

Watson, F. S., Kromrey, J. D., & Hess, M. R. (2003). *Toward a conceptual model for statistics anxiety intervention.* Retrieved from http://eric.ed.gov/?id=ED477937

Watson, F. S., Lang, T. R., & Kromrey, J. D. (2002). *Breaking ground for EncStat: A Statistics Anxiety Intervention Program.* Retrieved from http://eric.ed.gov/?id=ED477936

Wise, S. L. (1985). The development and validation of a scale measuring attitudes toward statistics. *Educational and Psychological Measurement, 45*(2), 401–405.

Zanakis, S. H., & Valenzi, E. R. (1997). Student anxiety and attitudes in business statistics. *Journal of Education for Business, 73*(1), 322–332.

Zeidner, M. (1991). Statistics and mathematics anxiety in social science students: some interesting parallels. *British Journal of Educational Psychology, 61*(3), 319–328.

Диспозиционные факторы отношения к статистике у студентов, изучающих социальные науки: Настойчивость и академическая мотивация

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Резюме

В статье описаны результаты изучения связи между отношением к статистике и академической мотивацией и настойчивостью у студентов-социологов. Часто в обыденном представлении социальные науки отождествляются с гуманитарными, а значит, не требующими математической подготовки. Подобные установки у студентов, изучающих социальные науки, могут вести к снижению эффективности обучения и академическим проблемам, вплоть до отчисления. Для измерения отношения к статистике применялась методика SATS-34, охватывающая широкий спектр установок как к предмету, так и к статистике в целом. Результаты показали, что по сочетанию различных аспектов отношения можно разделить студентов на три типа: заинтересованные в изучении статистики, формально заинтересованные и не заинтересованные в этом предмете. Выделенные группы студентов различаются по уровню настойчивости и преобладающей академической мотивации. Кроме того, существенные различия между группами были обнаружены в ожидаемых и реальных оценках по курсу. В статье делается вывод, что установки к статистике значимым образом связаны как с психологическими особенностями студентов, так и с результативностью освоения курса статистики. При этом различия между группами оказались значимыми, даже несмотря на жесткий и регулярный контроль и высокую значимость курса в учебном плане, т.е. жесткость контроля не нивелирует вклада психологических факторов в эффективность обучения, и можно предположить, что различия между группами были бы еще более яркими в более свободных для студентов условиях.

Ключевые слова: отношение к статистике, академическая мотивация, настойчивость, SATS-34, тревожность по отношению к статистике.