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Study of the Relationship Between the Predictive Abilities of Student Air Traffic Controllers and Their Behaviour in a Conflict

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ABSTRACT

The objective of the research is to study the relationship between the predictive abilities of student air traffic controllers and their behaviour in a conflict. These personal characteristics were chosen due to their high professional significance in the field of air traffic control. The article substantiates the relevance of studying the relationship between the intellectual and communication abilities of air traffic controllers, the need to develop these abilities when obtaining higher professional education.

The results identify the relationship between the manifestation of the basic properties of thinking of air traffic controllers, characterising their ability to predict the situation, and the strategies of their behaviour in a conflict. The main research methods included theoretical analysis of literature, generalisation, testing, analysis, and statistical methods.

The provided study involved 64 second-year students at Ulyanovsk Civil Aviation Institute, studying within the speciality profile «Air Traffic Control».

Testing using the Thomas-Kilmann instrument (adapted by N. V. Grishina), aimed at identifying the behaviour strategies of respondents in a conflict situation, as well as testing using the «Forecasting Ability» testing method developed by L. A. Regush were used as empirical research methods. The diagnostics allowed to measure the following properties of thinking characterising the prognostic abilities of students: analytical thinking, consciousness, flexibility, perspective and evidence-based thinking.

Analysis of the test results allowed building a diagram of the group average manifestation of five main strategies of behaviour of respondents in a conflict, as well as a diagram of manifestation of five main components (according to L. A. Regush) of the predictive abilities of student air traffic controllers and considering the relationship between them. The analysis of the results obtained was carried out from the point of view of the requirements regarding the future occupation of the respondents.

To determine the degree of consistency of the series of values of behaviour strategies in conflict and the properties of predictive thinking in the group of respondents, the Pearson correlation coefficient (Pearson R) was used as a method of statistical data analysis.

Keywords: air transport, anticipation, predictive abilities of air traffic controllers, behaviour in a conflict, professional skills of an air traffic controller.

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INTRODUCTION

An air traffic controller is a highly qualified civil aviation specialist who ensures regular, safe, economically feasible movement of aircraft. An air traffic controller in the field of civil aviation coordinates movement of aircraft from the phase of towing the aircraft across the airfield, take-off, cruising flight to landing and towing to the parking area. Air traffic controllers maintain close professional interaction with pilots, airport ground services, and airline services. Professionally important qualities of an air traffic controller are determined by the content of relevant activity, job responsibilities, situational requirements, which are prescribed in the Federal Aviation Regulations [1], the Single Qualification Reference Handbook of Positions of Managers, Specialists and Employees [2]. Since the occupation of an air traffic controller covers a wide range of professional tasks of high complexity, the requirements for the personal features of an air traffic control specialist include cognitive, communicative, emotional-volitional and moral components that are in complex relationship but make up a single whole of the professional's personality. The study of these relationships and the features of their influence on the professional activities of an air traffic controller seems to be an interesting research task, approaches to the solution of which are partly presented in this paper.

The profession of an air traffic controller can be attributed to two professional systems at once (according to the classification by E. A. Klimov): «human-to-machine» and «human-to-human» [3]. The work of an air traffic controller is an operator type of job with a predominance of intellectual functions in professional activity. The job is associated with constant analysis and forecasting of a rapidly changing situation, making operational decisions that ensure flight safety in the air sector controlled by the controller. Each decision, at the same time, is a consequence of complex intellectual actions. The air traffic controller prevents dangerous approaches and collisions of aircraft, gives them instructions to change the flight mode.

As part of his activities as of an operator of complex automated systems, an air traffic controller performs a whole range of psychological actions: sensory-perceptual actions (review and identification of luminous points on the locator screen, etc.); speech motor actions (radio exchange); actions of attention aimed at monitoring and evaluating one's activities; mnemonic actions that contribute to «retention» and ordering of objects in memory; actions of imagination (creation of a complex dynamically changing image of the air situation, etc.); mental actions (modelling of navigation and professional actions, decision making, etc.) [1; 2].

PROBLEM STATEMENT

The most important professional skills of an air traffic controller include his ability to predict the situation. The problem of forecasting is currently becoming more and more relevant for various occupations and jobs, because it is related to the success of decision-making.

It should be noted that the ability to predict in the scientific literature is considered as a component of a person's prognostic abilities, the essence of which is to anticipate events and actions. Forecasting does not come down to predicting the future, but through a probabilistic approach, considering possible alternatives for development of the situation, helps to identify the optimal solution to the problem. Psychophysiologist N. A. Bernstein, defining the essence of forecasting, argued that «in the human brain, in encoded form, there is an anticipation of the required final result of movement. The model of the required future allows a person to control his movements» [3, P. 281].

A significant contribution to the study of the problem of development of predictive abilities was made by domestic scientists B. F. Lomov [4], V. D. Mendelevich [5], N. P. Nichiporenko [6]; of probabilistic forecasting – by P. K. Anokhin [4], I. M. Feigenberg [7], et al.

[1] Federal Aviation Regulations «Requirements for air traffic controllers and parachutist instructors» (approved by the order of the Ministry of Transport of the Russian Federation dated November 26, 2009, N 216).

[2] Single qualification reference book of positions of managers, specialists and employees (approved by the order of the Ministry of Health and Social Development of the Russian Federation dated 29.01.2009, № 32).

[3] Occupational Psychology: Textbook. Ed. by E. A. Klimov, O. G. Noskova. 2nd ed., rev. and enl. Moscow, Yurait publ., 2023, 308 p. ISBN 978-5-534-16233-2.

[4] Anokhin, P. K. Essays on the physiology of functional systems: Study guide. Moscow, Meditsina publ., 2012, 447 p. ISBN (EAN): 978–5–458–38439–1.

There is a significant body of research on conflictology (for example [5, 6]). There are a significant number of substantive works in the fields of socionic characteristics of pilots [8; 9], assessment of pilots' proneness to conflict [10], interaction of the aircraft crew with the air traffic controller [11], prognostic criteria for the effectiveness of interaction in the aircraft crew [12]. However, the study of the predictive ability as the most important professional skill specifically in relation to air traffic controllers is practically absent in the scientific literature.

For an air traffic controller, a well-developed ability to forecast allows designing an information model or a spatial image of the real air traffic situation, which makes it possible to predetermine development of the air situation, factors causing risks and unusual cases, and to model ways to transform a conflict situation into a conflict-free one. An incorrect or incomplete understanding of the state of at least one element of a given air traffic control information model can pose a threat to flight safety.

As part of a helping relationship, the air traffic controller must strictly adhere to standard radio communication phraseology, provide timely feedback, possess active listening skills and emotional self-regulation in stressful situations. Research on the communication skills of air traffic controllers is most often limited to their linguistic competence, and less often to other aspects of professional communication, namely, communicative assertiveness, behaviour in conflict [13–17].

It should be noted that an air traffic controller's communication skills are related to his predictive abilities. An air traffic controller's incorrect forecast of behaviour of pilots and colleagues, and the inability to anticipate development of a particular air or ground situation increases the risk of their uncontrolled development

The integration of the professional skills of an air traffic controller as of an operator of complex technical systems and as of a business communicator allows us to talk about the importance of studying the relationship between the helping, intellectual and technical skills of this specialist.

In this regard, the *objective* of the research is to study the relationship between the predictive abilities of student air traffic controllers and their behaviour in a conflict. The study of this relationship is of particular importance namely regarding air traffic controllers. This is because the skills of forecasting and anticipating the development of an air situation and the skills of constructive behaviour in an emotionally tense environment of air traffic control can be considered the most important professional skills of air traffic controllers.

RESULTS AND DISCUSSION

To analyse the above-mentioned relationship, a study of characteristics of behaviour in a conflict and the predictive ability among second-year students in the specialty of Air Traffic Control was conducted at Ulyanovsk Civil Aviation Institute. 64 students participated in the survey. Testing according to the Thomas-Kilmann instrument (adapted by N. V. Grishina) [18; 19] to identify the behaviour strategies of respondents in a conflict situation and according to the «Forecasting Ability» method developed by L. A. Regush [7] was used as an empirical research method.

The content, internal and concurrent validity of the questionnaire, according to experts, is sufficient and scientifically rationale [20]. At the same time, the experience of application of the Thomas-Kilmann conflict mode instrument (TKI) in relation to the professional sample of «air traffic controllers» is very limited. Moreover, according to several scientists, when applied to aviation personnel, the TKI does not always allow for correct identification of preferences in choosing a dominant strategy of behaviour in a conflict; and during professional psychological selection, it is «not capable of measuring an individual style of behaviour in a conflict» in fact [9; 21; 22]. The study, in addition to solving its own problems, also made it possible to verify the validity of the statement about the limited applicability of the technique.

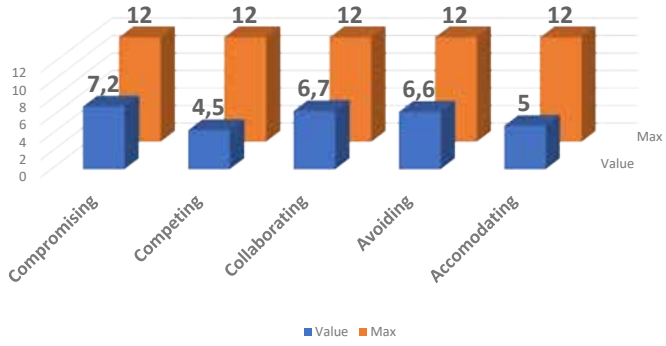
The essence of these methods and the diagnostic results based on them are as follows.

The TKI shows the relationship between

[5] Svetlov, V. A., Semenov, V. A. Conflictology: textbook for bachelors and masters [*Konfliktologiya: uchebnik dlya bakalavriata i magistratury*]. Moscow, Yurait publ, 2019, 351 p. ISBN 978-5-534-06982-2.

[6] Zaglodina, T. A., Kopalova, O. S. Conflictology: practicum: study guide [*Konfliktologiya: praktikum: uchebnoe posobie*]. Yekaterinburg, Publishing house of the Russian state prof.-ped. university, 80 p. [Electronic text]: URL: http://elar.rsvpu.ru/978–5–8050–0770–6. ISBN 978-5-8050-0770-6.

[7] Test «Forecasting ability». [Electronic resource]: https://vash-psiholog.info/knowledge/metodika-test-sposobnost-prognozirovaniyu3.html?ysclid=lljj8cjhc4769501593. Last accessed 25.11.2023.



Pic. 1. Average group manifestation of behaviour strategies in conflict among student air traffic controllers [performed by the authors].

a person's behaviour strategies in a conflict. This typology is based on a two-dimensional model of a conflict, the dimensions of which are the orientation of the interests of the conflicting parties: towards themselves and towards the partner. Based on this, we can identify the following methods of conflict resolution in the TKI [18]:

– Competing, or pursuing an individual's own concerns at the other person's expense.

– Accommodating, or neglecting by an individual of his or her own concerns to satisfy the concerns of the other person.

– Compromising, or finding of an expedient, mutually acceptable solution that partially satisfies both parties.

– Avoiding, or lack of pursuing an individual's own concerns or those of the other person or collaborating.

– Collaborating, or full and lasting satisfying the concerns of both persons [18].

Each of these strategies has opportunities and constraints that are determined by the goals of the conflicting parties.

The following diagnostic results of this test were obtained.

The group average manifestation of each of the above strategies among air traffic controller cadets is shown in Pic. 1.

The diagram shows that the most pronounced and most often used strategy of behaviour of respondents in an emotionally tense situation is compromising, or a focus on partial satisfaction of needs by both parties through mutual concessions.

The less pronounced strategies «Avoiding» and «Collaborating» also fundamentally involve the use of concessions. The combination of group average strategies shows that future air traffic controllers are least likely to compete and look for compromise in a conflict situation, which is an indicator of their well-manifested emotional self-regulation skills and ability to maintain their professional position. The remaining strategies are implemented by students to approximately the same extent and involve the use of concessions to achieve temporary or long-term agreement.

When analysing the personal values of the respondents, the predominant manifestation of the confrontation strategy (more than 10 points out of 12 maximum) is characteristic of 4,5 % of students. Basically, the vast majority of respondents expressed equable adherence to all strategies, which may indicate the flexibility of their behaviour in a conflict.

The maturity of the students' ability to predict the development of a situation was determined using the test «Forecasting Ability» by L. A. Regush. The substantive characteristics of the qualities of thinking that determine the ability to forecast, according to the author of the methodology, are analytical thinking, consciousness, flexibility, prospective and evidence-based thinking. Test tasks are aimed at assessing these properties of thinking and the integral indicator of respondents' predictive ability.

Let us explain the content of the questionnaire scales.

Analytical thinking is determined by the ability to systematise, structure, and interpret information. An important characteristic of analytical thinking is the ability to identify essential connections in the analysed object, find deep cause-and-effect relationships and, taking them into account, foresee development of the situation.

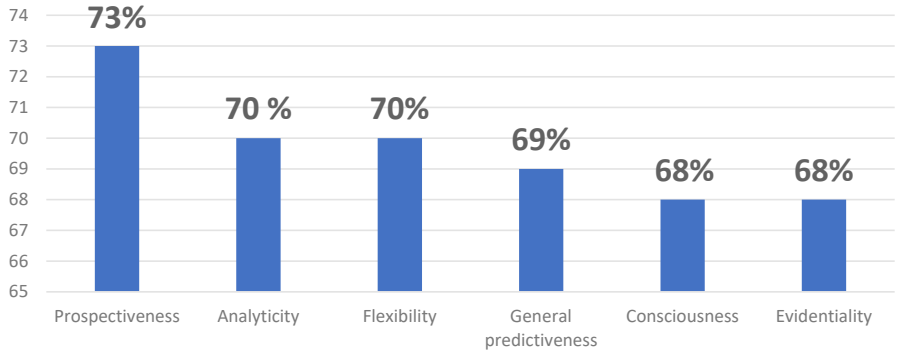
Consciousness of thinking is the ability to understand the essence of an object or phenomenon, understand the causes and foresee the consequences.

Flexibility of thinking reflects a person's

Table 1

Average manifestation of components of the predictive abilities of student air traffic controllers [performed by the authors]

Parameters	Analytic thinking	Consciousness	Flexibility	Evidentiality	Prospective thinking	Integral indicator of predictive ability
Group average (point)	2,8	2.7	5,6	4,1	4,4	26,3
Maximum value (point)	4	4	8	6	6	38
% of manifestation	70 %	68 %	70 %	68 %	73 %	69 %



Pic. 2. Percentage of manifestation of predictive thinking components of student air traffic controllers [performed by the authors].

Table 2

Pearson correlation coefficient values (R) [performed by the authors]

Properties of thinking	Strategies of behaviour in a conflict Pearson correlation coefficient (R)				
	Competing	Collaborating	Compromising	Avoiding	Accommodating
Analyticity	R=0.018	R=0,117	R=0,0005	R=0,104	R=0,035
Consciousness	R=0,119	R=0,005	R=0,03	R=0,003	R=0,145
Evidentiality	R=0,06	R=0,014	R=0,0004	R=0,0004	R=0,087
Flexibility	R=0,034	R=0,0225	R=0,02	R=0,02	R=0,008
Prospectiveness	R=0,0007	R=0,0034	R=0,222	R=0,075	R=0,006
General predictiveness	R=0.012	R=0,027	R=0,055	R=0,003	R=0,058

ability to cope with change, use different ways of solving problems, and generate ideas.

Evidential reasoning thinking is characterised by the ability to provide the necessary information to substantiate one's own position.

Prospective thinking is a person's ability to holistically perceive a situation and understand the dynamics of its development. Prospective thinking is related to strategic thinking and planning horizons.

The integral indicator of predictive ability has the following levels of expression:

- 0–12 points – low level;
- 13–25 points – average level;
- 26–38 points – high level.

Let us further consider the group average manifestation of components of the predictive abilities of student air traffic controllers (Table 1).

Let us imagine more clearly the percentage of manifestation of the above-mentioned thinking abilities (Pic. 2).

The diagram shows a fairly high expression of all types of thinking that characterise the predictiveness of respondents. The highest group average indicators of students were identified in terms of prospective thinking, that is, the ability to have a strategic and dynamic vision of the situation. The integral indicator of the predictive abilities of the respondents has a high level, which indicates the intelligence and pronounced

Table 3

Critical values of the Pearson correlation coefficient [8, P. 363]

Critical values of the Pearson correlation coefficient				
Sample size N / error	0,1	0,05	0,01	0,001
64	R=0,207	R=0,246	R=0,32	R=0,402

professional resources of the students.

Further, the study examined the relationships between the components of the predictive thinking of future air traffic controllers and the strategies of their behaviour in a conflict situation. It should be noted that the study of the relationship between the properties of thinking and individual's communication abilities has not been sufficiently studied in the scientific literature. Basically, these studies concern children and representatives of teaching professions (e.g., [23]), but in relation to civil aviation specialists, the study of this issue is limited to relatively small number of research works [24]. In this regard, one of the objectives of the study was to analyse the relationship between the group average manifestation of behaviour strategies in a conflict and the group average components of predictive thinking in the same group of respondents.

To determine the degree of consistency of the series of values of behaviour strategies in conflict and the predictive thinking abilities within one and the same sample, we used methods of statistical data analysis. To study the relationship between two metric scales on the same sample, the Pearson correlation coefficient (Pearson R) is used. It measures the strength of the relationship between two variables. The average group manifestation of each of four strategies of behaviour of respondents in a conflict was considered as variable X, and each component of predictive thinking (according to L. A. Regush) was considered as variable Y. The number of respondents is 64. The correlation coefficient was calculated using the classic Pearson correlation coefficient formula[8].

Table 2 presents the calculated values of the Pearson correlation coefficients for the stated sample of students.

Comparing the values of our R-Pearson correlation coefficients for two metric variables (strategies of behaviour in a conflict and characteristics of predictive thinking) (Table 2), with the corresponding critical values from the table of critical values of the R-Pearson correlation coefficient for a given sample of students (Table 3), it was discovered that there is only a trend towards a reliable relationship between prospective thinking of future air traffic controllers and their willingness to compromise in a conflict situation (with an error of 0,1). No other statistically significant relationships were identified in this group of respondents.

CONCLUSION

The discovered trend towards dependence of prospectiveness of thinking on willingness to compromising shows that the ability of future air traffic controllers to predict the situation, to see it holistically, to assess the opportunities and constraints in the dynamics of its development contributes to the respondents' search for a compromise in an emotionally tense environment of professional communication. This trend, on the one hand, contributes to the resolution of conflict situations for a certain time period. This can be helpful in dealing with colleagues on the ground. But, on the other hand, in the situation of communication between the pilot and the air traffic controller, uncompromising compliance with aviation rules is of absolute importance since it ensures flight safety.

The conducted research has shown not only the importance of studying the interdependencies between various professionally important qualities and skills of air traffic control specialists, but also the need to assess the impact of these relationships on the effectiveness of the professional activities of air traffic controllers.

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