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Improving the reliability of professional psychological selection of aviation specialists

Olga V. Arinicheva, *Saint Petersburg State University of Civil Aviation, Saint Petersburg, Russia*
Alexey V. Malishevsky, *Saint Petersburg State University of Civil Aviation, Saint Petersburg, Russia*


Olga V. Arinicheva


Alexey V. Malishevsky

Abstract. Aim. *The paper examines one of the possible ways of improving the reliability of professional psychological selection of aviation specialists using the method of assessment of their behaviour strategy in conflict situations in order to prevent failures of interaction within aircraft crews and air traffic control shifts.* **Methods.** *The research used the Thomas-Kilman Conflict Mode Instrument (TKI) (more specifically, TKI-R, the Russian adaptation by N.V. Grishina) psychodiagnostic procedure to assess the behaviour strategy in conflict situations, as well as the Buss-Durkee Inventory to determine the tendency of subjects to various forms of aggressive behaviour. Statistical processing of the findings was done using the Bravais-Pearson correlation coefficient and Pearson's χ^2 criterion.* **Results.** *At the first stage of the multipurpose experiment 48 student dispatchers were surveyed, at the second stage the total of 603 subjects were surveyed (students of the Saint Petersburg State University of Civil Aviation and the Institute of Philology, Foreign Languages and Media Communications of the Irkutsk State University), i.e. while emphasizing operator professions in order to improve the validity of the experiment the sample was significantly extended to include, among others, students of the humanities. It was found that the results of the Buss-Durkee Inventory have an inverse correlation with the tendency to an adaptation strategy and direct correlation with the tendency to rivalry and collaboration strategies. According to Pearson's χ^2 fitting criterion, there are significant differences in the manifestation of such behaviour styles as rivalry and avoidance between pilot and humanities students, while for the samples of males and females the differences are in the manifestation of such behaviour stiles as rivalry, avoidance and compromise. Females are significantly less inclined to rivalry and somewhat more inclined to avoidance and compromise as compared to males. There are also no observable crucial differences between the intercorrelations of the TKI-R results of the first and second stages of the experiment. The authors' findings were compared with the published results of the survey of the students of the Tuvan State University and Yaroslavl State Medical University, as well as with the results of surveys of athletes and business owners.* **Conclusions.** *By generalizing own findings and those set forth in other authors' publications, we can conclude that uncooperative behaviour of all tested students is dominated by average manifestation of strategies of competing, collaborating, compromising, avoiding and accommodating, which indicates the ability of the subjects of this age for flexible behaviour in conflict situations subject to the specific conditions of interaction. That means that students, unlike the success-seeking business owners, while prioritizing collaboration and compromise in conflict situations, flexibly use other behaviour strategies. This must be taken into consideration when planning measures aimed at improving the reliability of professional psychological selection in commercial aviation. It appears that in view of the above reasons, the application of the TKI-R procedure in the professional psychological selection of aviation specialists is unviable.*

Keywords: *commercial aviation, professional psychological selection, psychological assessment, dependability, conflict, behaviour strategy.*

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Introduction. Professional psychological selection (PPS) is a set of measures aimed at ensuring quality staff selection in an organization based on compliance assessment of the level of relevant psychophysiological (individual) qualities and characteristics of individuals with the professional requirements [1].

In most cases, such professional psychological selection involves an assessment of the level of some individual psychological and personal characteristics of candidates for specific professions that determine the success of their professional activity, in order to identify their compliance with the requirements of a specific profession [1], which, of course, includes aviation. Currently, in the Russian civil aviation the PPS is conducted in accordance with the Guidance [2].

It is well known that most flight accidents are associated with the human factor. Therefore, the problem of its negative impact will remain most important and urgent for many years. In order to reduce it, it is required to improve the reliability of professional psychological selection of aviation specialists [3, 4].

The authors have already pointed out in their papers, as for example in [5], the significant weakness of the current PPS [2]. In some papers, such as [6-10] and others, the authors considered various possible ways to increase its reliability. In this paper, the authors also intend to point out another aspect of this issue.

Problem definition. Failed interaction within the crew is one of the primary or associated causes of all plane crashes that made the headlines over the last few years. As a rule, such failures of interaction are followed by conflicts of varied intensity. An example of such conflict is the An-148 crash in the Moscow region, when "the captain was trying to obtain higher readings (authors' note: critically low speed displayed by the instruments) by nosediving, while the co-pilot was opposing such actions. At the same time, the interaction between crew members was affected by psychoemotional stress, pilots were swearing according to the voice recorder" [11]. A similar direct conflict was the reason of the Tu-134 crash near Ivanovo, when "virtually, the captain alone was piloting the plane, and didn't accept any information from the crew members" [12]. "Probably, co-pilot's and air navigator's mistakes made during landing approach in the Mineralnye Vody Airport were the reason for increasing tension between captain and crew members. The captain's comments could be the key factor in determining the style of the crew's future behaviour during the flight back to Ivanovo" [12]. When a Tu-134 crashed in Petrozavodsk, on the contrary, the air navigator was the leader in the situation. Investigators noted that one of the causes of the crash was "unsatisfactory interaction among crew members and crew resource management (CRM) on the part of the captain of flight 9605 during landing. The captain was following the air navigator's instructions, who was very active and under the influence of alcohol, and, in fact, while the co-pilot removed himself from the process at the final stage of the accident flight" [13]. Similarly, the investigation of the Yak-42 crash [14] near Yaroslavl identified "uncoordinated actions of the crew during the last stage of the run" and heated debates with the use of strong language. The crashes near Kazan [15] and Perm [16] were characterized by conflicts between the onboard crew and air traffic controllers, as well as general perplexity, when both crew members avoided accepting responsibility for the aircraft control and "during the turn maneuver the crew were complaining about the dispatcher" [15, p. 232]. Similarly, "the dispatcher's instructions to seek guidance made the crew members, the captain in particular, extremely annoyed, which as confirmed by the instrumental analysis of speech (paragraph 1.16.6, time 22:51:40)" [16, p. 128]. Pointing out the current altitude, the dispatcher asked whether the aircraft was descending, which caused "a strong reaction of the captain, who emotionally asked to "Tell the altitude! Tell the altitude!". That question, as well as the captain's constant errors (call sign, frequency, flight levels) showed that his psychoemotional state and situation awareness were far from optimal" [16]. The perplexity and avoidance of responsibility are evident "at 23:08:55, when the left bank angle was 30°, and the speed was less than V_{ref}, (authors' note: target speed of landing) the co-pilot asked the captain to take control ("…take it, take it, take it…!"), obviously being conscious of his own inability to control the aircraft". However, by that time the captain was also unable to assume control the situation ant the aircraft: "Take what (non-printable words), I can't do that either" [16, c. 147].

All the above examples of in-flight conflicts (and we only examined a few) show that improving the reliability of professional psychological selection of aviation specialists, especially pilots, it requires the research of the tendency of flight school applicants to conflicts, as well the behaviour strategies employed in conflict situations, if such arise. Let us take a closer look at this problem.

Behaviour in conflict. "A conflict is understood as the most acute way to resolve significant contradictions that arise in the course of interaction that consists in based on opposition between the parties to the conflict and is accompanied by negative emotions" [17]. The necessary and sufficient condition of a conflict is the opposite motives or judgements of the subjects of social interaction [17]. The so-called interpersonal conflicts most often occur during flight. "An interpersonal conflict is a confrontation between interacting parties on the basis of the arisen contradictions, which include opposite aims that are not compatible in some specific situation. An interpersonal conflict can arise in the course of interaction between two or more people. In interpersonal conflicts the parties confront each other and sort out their relations face to face. This is one of the most common types of conflict" [18]. In other words, "an interpersonal conflict is a confrontation between parties perceived and experienced by them (or, at least, one of them) as a significant psychological problem, which requires its resolution and causes the activity of the parties, aimed at overcoming the contradiction and resolving the situation in the interest of one or both parties" [19].

"The strategy (authors' note: or style) of behaviour in conflict is an orientation of a person towards a conflict and towards certain forms of behaviour in a conflict situation" [20].

"In the early 1970's Ralph H. Kilmann and Kenneth W. Thomas, using the theoretical model by Robert Blake and Jane Mouton, proposed an instrument to measure the manifestation of five main behaviour types in interpersonal conflict: competing, collaborating, compromising, avoiding and accommodating. That is called "Management-of-Differences Exercise" or MODE [21]. Similarity of the abbreviation with the term "mode" led to the fact that the authors of this instrument started calling it the "Thomas – Kilmann Conflict Mode Instrument (TKI)" meaning the conflict management tool. Using this instrument, it became clear that this is a powerful tool for managing interpersonal conflicts" [22]. (In Russian psychological literature the Russian-language version of the TKI-R test is more commonly known as the "K.Thomas test adapted by N.V. Grishina" [23]. This version was used by the authors in this paper). Usually, the so-called Thomas-Kilmann model is used to interpret the TKI test [24, 25] (Figure 1).

Tendency towards aggression. A large number of scientific publications are dedicated to the problem of conflict and the factors that influence the emergence and development of such conflict. It is logical to assume that tendency towards conflict and aggression should be connected with a positive correlation. In [26], the authors note that "based on the collected data it can be concluded that individuals, who choose ineffective strategies of behaviour in conflict situations, have a higher level of aggression, which may be associated with conflicts and disputes that satisfy their own interests in conflicts". Unfortunately, the authors of [26], while using TKI-R to assess the behaviour style, made further analysis of the results difficult by using non-standard terms. In particular, the authors write that "while evaluating the degree of realization of the interests by opponents and conflict resolution quality using a specific strategy in conflict, we should talk about the efficiency of a behaviour strategy in a conflict. Efficiency is assessed based on two criteria: satisfaction and productivity. Based on these criteria collaborating and compromising were defined as effective behaviour strategies (EBS) because if they are used, the interests of counter-parties will be satisfied to a greater extent; competing and accommodating were defined as ineffective behaviour strategy (IEBS) because if they are used, the interests of only one party will be satisfied; avoiding is a neutral behaviour strategy (NBS), because in this case the interests of both parties are not satisfied" [26]. (From the authors' point of view this is a strange classification. We suppose, if the strategies are ranked from the best to the worst, they will be presented as follows: collaborating, compromising, accommodating, competing and avoiding. According to the authors, the in-nobody's-favour solution, when resolving the conflict is impossible, is the least effective strategy of all).

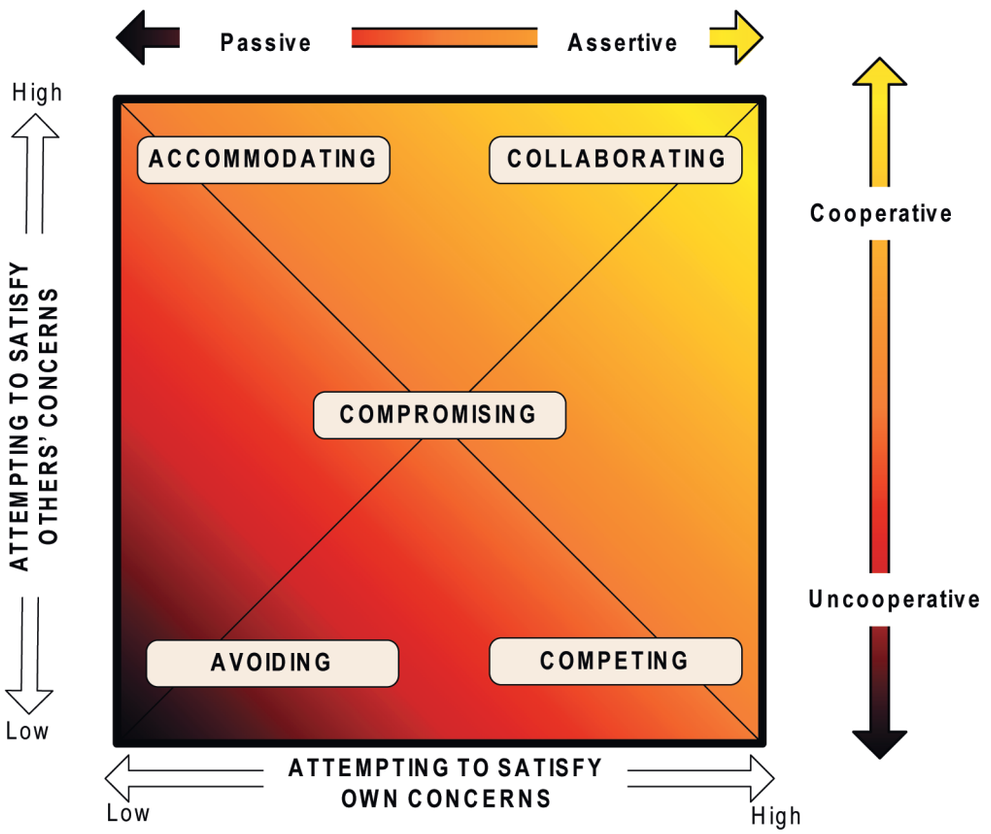

Figure 1. Thomas-Kilmann model

In [26], a comparison of the Buss-Durkee test results [23] (where A_P is physical aggression, A_{Ind} is indirect aggression, A_I an irritation, A_N is negativism, A_R is resentment, A_S is suspicion, A_{VA} is verbal aggression and A_A is autoaggression) for individuals with different behaviour strategies (Figure 1). "Adequate diagnostic indicators of aggressiveness include physical aggression, as well as emotional experiences associated with aggression, i.e. irritation, negativism, resentment, suspicion, hostility and guilt. Analysis of the research results of the students' level of aggression showed a relatively high level of suspicion in the NBS group with IEBS and EBS groups (Table 1). Probably, this is due to the fact that people, who prefer to avoid conflicts, are anxious, timid, avoidant. It is easier for such people to avoid conflict and remain neutral towards the source of the conflict. IEBS students have higher rates of irritation and negativism, they are characterized by impetuosity, emotionality, proactivity and therefore, only care about their own point of view and do not accept others' opinion, do not allow compromises and agreements" [26].

Table 1. Average values of aggressiveness and hostility indicators of students per the Buss-Durkee test, scores [26]

Indicators	IEBS	NBS	EBS
A_P	4.4±0.5	4.0±0.7	4.4±0.4
A_{Ind}	4.3±0.4	4.4±0.7	4.1±0.3
A_I	5.3±0.4	4.5±0.8	4.5±0.5
A_N	2.2±0.3	1.9±0.3	1.9±0.3
A_R	3.2±0.3	3.1±0.7	3.4±0.4
A_S	5.7±0.3*	6.6±0.5^{*+}	5.7±0.3^{+}
A_{VA}	6.4±0.4	6.6±0.5	6.0±0.8
A_A	6.3±0.4	6.5±0.5	5.9±0.3

Note: the data are given as arithmetic means (*M*) and their errors (*m*);
* is a significant difference between IEBS and NBS groups;
$^{+}$ is a significant difference between NBS and EBS.

Taking into consideration that, according to [26], the IEBS group includes people with "accommodating" behaviour style, the last sentence sounds strange indeed. In addition, individuals with an "avoiding" strategy, of course, try to avoid the conflict, and, first of all, its resolution.

Another example. As the author writes in [27]: "according to the research data of athlete student, being in a conflict situation, they apply such behaviour strategies as collaborating, compromising and competing. To a lesser extent they apply avoiding and accommodating behaviour styles. There are significant differences that were determined during detailed analysis of students' behaviour styles (Table 2)" [27].

Table 2. Indicators of athlete students' behaviour styles in conflicts (in scores) [27] per the TKI-R test

Behaviour style	Level of tendency towards conflict		
	High	Medium	Low
Competing	7.9±0.3	5.1±0.2*	1.8±0.2*
Collaborating	4.3±0.3	7.8±0.2*	7.3±0.5*
Compromising	5.1±0.3	6.5±0.3*	5.2±0.4
Avoiding	2.5±0.2	2.9±0.1	3.2±0.2
Accommodating	3.9±0.3	4.1±0.2	4.4±0.4

Note: *, $p < 0.05$, differences are reliable relative to indicators of students with high levels of tendency towards conflict

Results analysis. Let us compare the data with the results of our own experiments. In [6], we considered a group of 48 students (future air traffic controllers), but in somewhat different aspects. If we compare the sample from [6] with the sample from [26] (Figure 2), then it is obvious that in the sample of students of the Saint Petersburg State University of Civil Aviation (SPbSUCA) there are significantly more EBS students (according to the classification in [26]).

Table 3 shows the correlations between the K. Thomas and the Buss-Durkee tests on a sample of 48 student air traffic controllers. As it can be seen, there are few significant

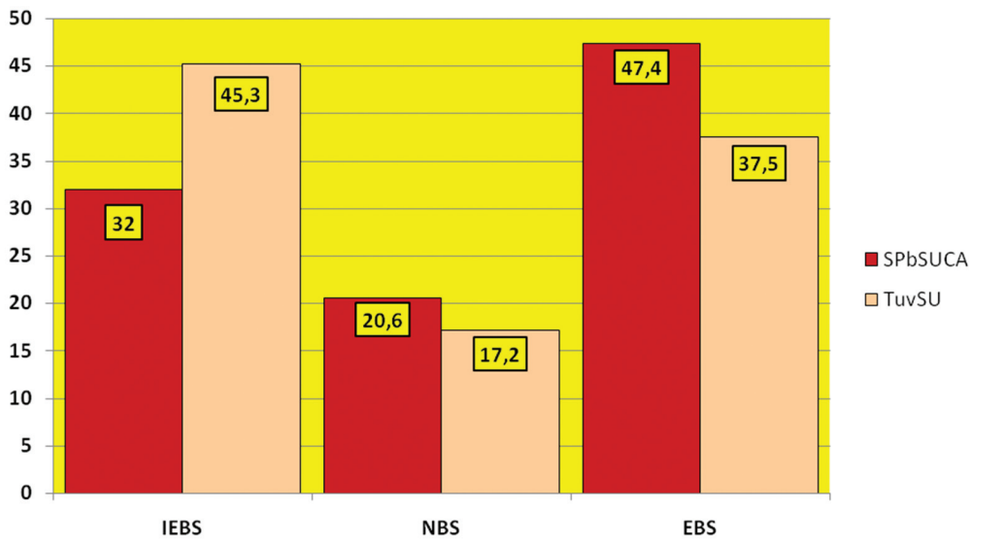

Figure 2. Comparison of the efficiency of behaviour strategies in a conflict situation identified among students of the Saint Petersburg State University of Civil Aviation (SPbSUCA) and the Tuvan State University (TuvSU)

Table 3. Correlation between K. Thomas and the Buss-Durkee test results on a sample of 48 student air traffic controllers

	Competing	Collaborating	Compromising	Avoiding	Accommodating
A_P	+0.1720	+0.1059	-0.1865	+0.1726	-0.2830
A_{Ind}	+0.2157	+0.1294	-0.1510	-0.0779	-0.1684
A_I	+0.0394	+0.2151	+0.2092	+0.0590	-0.3859*
A_N	+0.1374	+0.2227	-0.2594	-0.0039	-0.1094
A_R	-0.1533	+0.1010	+0.1390	+0.1353	-0.0889
A_S	+0.2387	-0.0729	+0.1059	+0.0605	-0.3809*
A_{VA}	+0.6146***	+0.1142	-0.2074	-0.0990	-0.5933***
A_A	-0.1612	+0.1134	-0.0431	+0.3318*	-0.1152

Note: Correlation significance (* is $p < 0.05$; ** is $p < 0.01$; *** is $p < 0.001$)

Table 4. Intercorrelation between TKI-R test results on a sample of 48 student air traffic controllers

	Competing	Collaborating	Compromising	Avoiding	Accommodating
Competing		-0.1626	-0.3803	-0.4262	-0.4985
Collaborating	$p \geq 0.05$		-0.2866	-0.2066	-0.0230
Compromising	$p < 0.05$	$p \geq 0.05$		+0.1121	-0.1944
Avoiding	$p < 0.01$	$p \geq 0.05$	$p \geq 0.05$		-0.2668
Accommodating	$p < 0.001$	$p \geq 0.05$	$p \geq 0.05$	$p \geq 0.05$	

Note: At the top right there are values of the Pearson correlation coefficient between performance indicators, and at the bottom left there are the characteristics of correlation significance

correlations between the results of these test methods. The fact that the Buss-Durkee test results negatively correlate with a propensity for the accommodating strategy is clear enough, as well as the fact that they almost all (excl. A_A and A_R) positively correlate with the propensity for competing strategy. But the fact that they also positively correlate with the propensity for the collaborating strategy is not quite clear. The strongest (+0.6146) and most significant ($p < 0.001$) correlation can be observed between the propensities for verbal aggression and competing strategy. Thus, some IEBS students (in the terminology of [26]), i.e. who are inclined to the competing strategy are also inclined to aggression, and another part of IEBS students are inclined to the accommodating strategy and are not inclined to aggression. That also shows the inexpediency of such classification of the efficiency of behaviour strategies in a conflict.

Table 4 shows the intercorrelations between TKI-R indicators obtained on the same sample. Significant intercorrelations are only between the tendency towards the competing and compromising, avoiding and accommodating strategies. Intercorrelations, as expected, are negative, but they don't reach an average strength of correlation. This suggests that there is no clear predominance of any style.

Figure 3 shows a similar conclusion on the absence of significant preferences in the selection of one or another strategy. There is no seeming inclination for any behaviour

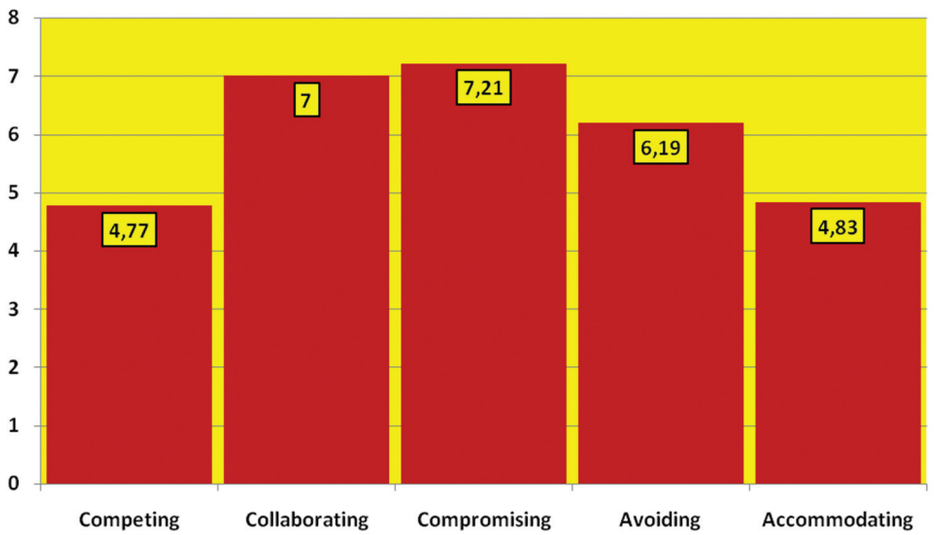

Figure 3. Indicators of average values of behaviour styles of student air traffic controllers in conflict situations per TKI-R in points (on a sample of 48 people from [6])

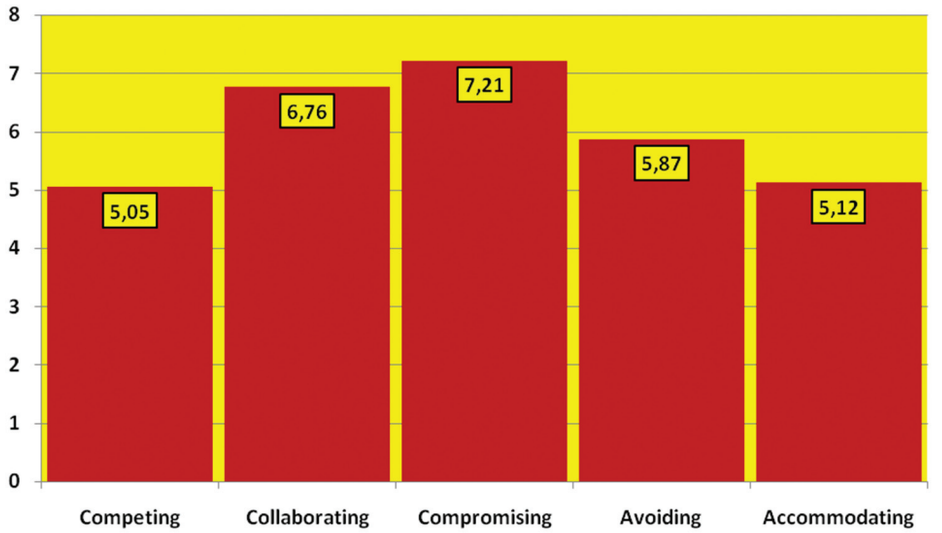

Figure 4. Indicators of average values of behaviour styles of SPbSUCA and PFLMC ISU students in conflict situation in accordance with TKI-R in scores (on a sample of 603 people)

style or its absence. Thus, according to the presented sample it can be noted that SPbSUCA students are most inclined to the collaborating and compromising strategies.

According to [27], "athlete students, being in a conflict situation, apply such strategies as collaborating, compromising and competing. To a lesser extent they apply the following 2 behaviour styles: avoiding and accommodating".

According to [28], female entrepreneurs mostly apply avoiding and competing strategies, while male entrepreneurs apply competing strategy.

The results in [20] are very interesting. The authors made a research on a sample of 129 students of the Yaroslavl State Medical University and noted that the first year students of the medical faculty use the compromising strategy (23.7%, the average score is 7.10) and avoiding strategy (23.6%, the average score is 7.07) approximately at the same degree, and in a lesser extent they use the competing strategy (15.4%, the average score is 4.62). "Therefore, for this group, it is important to focus on finding a mutually acceptable solution (temporary and intermediate) through concession. These respondents prefer to get at least something than to loose. At the same time, these students are inclined with the same extent to give up on their interests, but they are not ready to accommodate their partners. These respondents are less focused on the simultaneous realization of both their own interests and the partners' interests, they do not have the ability to explain the core of their interests and listen to their partner" [20]. First year students of the pediatric and dentistry faculties mostly use the compromising strategy (24.4%, the average score is 7.33, and 25.3%, the average score is 4.31), in a lesser extent they use the competing strategy (16.7%, the average score is 5.00, and 14.37%, the average score is 4.31), "therefore, first year students of all faculties are completely unwilling to come into confrontation or prioritize their own interests. Despite the fact that the compromising strategy is considered one of the most effective, the "doctor-patient" interaction process will not be fruitful, since it betrays the principles of both partners that is unacceptable during diagnostic and treatment processes. The avoiding strategy is ineffective at all for the medical profession. However, the first year students, obviously, do not have a clear vision of their future professional activity. Therefore, the identified dominant behaviour strategies in a conflict situation are characterized by individual and stylistic features to a larger extent than by the level of the professional qualities development" [20].

The authors of this paper conducted a multipurpose experiment on a large sample of SPbSUCA students (232 student pilots, 141 student air traffic controllers, 36 student air navigation specialists, 19 student advertisement and PR specialists, 53 student HR specialists). Additionally, in order to rectify the prevalence of students of technical faculties (although they were the focus of the research, since the PPS procedure generally concerns pilots and air traffic controllers) and conduct an objective analysis, with an active support of psychologist V.S. Kamenskaya form Irkutsk, the analysis results for 122 students majoring in Practice and Theory of Translation, Foreign Studies of the Institute of Philology, Foreign Languages and Media Communication of the Irkutsk State University (PFLMC ISU) were obtained. Thus, the total sample of experiment participants was 603 people. Figure 4 shows the distribution of average values of behaviour styles in conflict situations for the entire specified sample (SPbSUCA and PFLMC ISU students). Comparing Figure 3 and Figure 4, it is quite obvious that they are almost identical.

If we compare these 603 participants per individual samples, there are of course differences. There are highly-reliable ($p \leq 0.01$) differences in the manifestation of such behaviour styles as competing, compromising and avoiding between males (344 people) and females (259 people) according to the Pearson's χ^2 criterion. Females are significantly less inclined to the competing strategy and somewhat more inclined to avoiding and compromising as compared

Table 5. Intercorrelation between TKI-R results on a sample of 603 SPbSUCA and PFLMC ISU students of various specialties

	Competing	Collaborating	Compromising	Avoiding	Accommodating
Competing		-0.3188	-0.3783	-0.3924	-0.4847
Collaborating	$p < 0.001$		-0.1297	-0.1771	-0.0645
Compromising	$p < 0.001$	$p < 0.01$		-0.0211	-0.1972
Avoiding	$p < 0.001$	$p < 0.001$	$p \geq 0.05$		-0.1482
Accommodating	$p < 0.001$	$p \geq 0.05$	$p < 0.001$	$p < 0.001$	

Note: the values of Pearson correlation coefficient between efficiency indicators are located in the upper right; the characteristics of correlation significance are located in the bottom left

to males. This is to a certain extent consistent with the data of [20] that shows a significant difference in the maturity of competing strategy between female and male respondents (Mann-Whitney U-test, $U = 1003.5$ with $p = 0.036$): male students display a higher level than female students.

Student pilots (232 people) and students of humanities (194 people) also show highly reliable differences in the manifestation of such behaviour styles as competing and avoiding according to the Pearson's χ^2 criterion. Humanities students and student air traffic controllers (141 people) have highly reliable differences in the manifestation of the competing behaviour style.

Table 5 shows the intercorrelations between TKI-R results on a sample of 603 students of various specialties (SPbSUCA and PFLMC ISU). There are no fundamental differences between data in Table 4 and Table 5.

Conclusion. Thus, by generalizing the authors' findings and those set forth in other authors' publications [20, 26-29], we can agree with the conclusions of [29] in that "uncooperative behaviour of all tested students is dominated by average manifestation of strategies of competing, collaborating, compromising, avoiding and accommodating, which indicates the ability of the subjects of this age for flexible behaviour in conflict situations subject to the specific conditions of interaction". That means that students, unlike the success-seeking business owners [28], while prioritizing collaboration and compromise in conflict situations, flexibly use other behaviour strategies. This must be taken into consideration when planning measures aimed at improving the reliability of professional psychological selection in commercial aviation. It appears that in view of the above reasons, the application of the TKI-R procedure in the professional psychological selection of aviation specialists is unviable.

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About the authors

Olga V. Arinicheva, Candidate of Engineering, Senior Lecturer in Flight Operation and Safety in Civilian Aviation, Saint Petersburg State University of Civil Aviation, Russia, Saint Petersburg, e-mail: 2067535@mail.ru

Alexey V. Malishevsky, Candidate of Engineering, Associate Professor, Senior Lecturer in Flight Operation and Safety in Civilian Aviation, Saint Petersburg State University of Civil Aviation, Russia, Saint Petersburg, e-mail: 2067535@mail.ru

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