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A study of the socionic characteristics of males and females for improving the reliability of aptitude screening of aviation specialists

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Abstract. Aim. *This article continues the series of studies aimed at improving the aptitude screening of commercial aviation personnel. The socionic characteristics of a human operator define his/her work with information flows, and their significance is the higher, the greater is the time shortage they have to deal with as part of their professional activities, therefore, in this paper, those characteristics were examined as professionally important qualities of both a pilot, and an air traffic controller. The task consisted in evaluating the socionic characteristics of male and female control room specialists, who have successfully completed aptitude screening in commercial aviation, identifying the presence or absence of differences between the obtained results. Additionally, for the sake of comparison, the research covered the socionic characteristics of males and females, whose professional activities have nothing to do with technology. In total, the study includes data of over 3116 tested persons.* **Methods.** *The 5-th modification of the MM-1 socionic test developed by the Saint Petersburg State University of Civil Aviation was used as the psychodiagnostic method for estimating constituent socionic characteristics. The obtained samples were primarily compared using Pearson's chi-squared test. The results were also processed using correlation analysis.* **Results.** *The paper presents socionic portraits, i.e. the distribution of the dominating components of the human socionic model among various samples, socionic models of various professional groups (human socionic model for a typical member of a sample), as well as graphical data per individual psychological dichotomies: "extraversion – introversion", "logic – ethics", "sensorics – intuition", "rationality – irrationality".* **Conclusions.** *The identified differences between the studied samples are primarily professional in their nature, i.e. comparing samples of individuals from the same professional group and approximately the same age, but different gender, in no case reliable differences were identified. Thus, no fundamental gender-specific differences were identified by the socionic psychodiagnostic method used as part of this work. However, the analysis of a number of Russian and foreign sources dedicated to gender differences suggests that improving the reliability of aptitude screening of aviation specialists requires further research involving the evaluation of the differences in the expression of the necessary professionally significant qualities of control room specialists, not by criterion of biological sex, but rather in accordance with the identified gender-related personality type.*

Keywords: *aptitude screening, gender differences, socionics, socionic characteristics.*

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Introduction

The positive properties of intelligence, such as logic, quick-wittedness etc. were always classified as "general abilities adequate to the flying work" [1]. However, it would be more correct to classify them as any type of operational activity. And, without calling the above into question, it should also be noted that, for an operational activity, not only the level of intelligence matters, but also the ability to use it in a timely manner. If a software designer or an engineer can afford to stop and think over the optimal solution to a problem, an operator cannot do so. He/she has to not only continuously process large amounts of information, but do it at a high pace. Therefore, his/her thinking process is to comply with a number of quite specific requirements.

In the last century, Polish psychologist Antoni Kępiński [2] introduced the concept of "information metabolism" (IM) as the process of continuous exchange of information, in its broadest meaning, between an individual and the environment. The Lithuanian researcher Aušra Augustinavičiūtė, a follower of the Swiss psychiatrist Karl Gustav Jung, integrated his theory of psychological types [3] with Kępiński's theory of information metabolism, thus creating such discipline as socionics [4] that studies such processes of information exchange.

Therefore, it is quite obvious that the socionic characteristics of an operator that define his/her capabilities in terms of information exchange with the environment, including other crewmembers or air traffic controllers [5-8], are to be considered as his/her professionally important qualities (PIQ). Therefore, their correct consideration has a direct effect on the reliability of aptitude screening (AS) of aviation specialists.

Problem definition

In [9], the authors already defined the problem of the requirement to take gender differences into account as part of AS of aviation specialists. This matter is completely ignored in the current AS Guidelines [10] that, being a worsened version of the Soviet-era Guidelines [11] and due to then-working regulations, was designed exclusively for selecting males. That is to say nothing of other shortcomings of the Guidelines [10] that the authors analyzed in detail in [12-14] and a number of other works.

In [15], the authors dwelled upon the reasons why AS for females is to differ from the AS for males. It is another matter that it is quite difficult to pinpoint those PIQ, where it is required to take into consideration exactly the male and female features. It is quite obvious that, at least at the level of common sense, male psychology differs from female. The question is whether it affects the performance of aviation specialists and, if it does, then in what way? In [9], the authors aimed to examine some professionally important qualities in males and females and identify the presence or absence of differences in the obtained results. The analysis of the results of the conducted research [9] showed that, according to the employed psychodiagnostic methods – the Arnold H. Buss and Ann Durkee test[1], Prognoz-2 questionnaire[2] for estimating the stress tolerance and Hans Jürgen Eysenck's[3] test identifying the level of intellectual development – no fundamental gender-based differences were identified. An exception is the tendency towards physical aggression that was identified using the Arnold H. Buss and Ann Durkee test, where positive differences were found using Pearson's chi-squared test ($\chi^2_{0.01} = 11.345 > \chi^2_{emp} = 11.1289 > \chi^2_{0.05} = 7.815$ for $\nu = 3$). In females, this indicator is clearly lower, though there are girls who display high aggressiveness.

In this paper, the authors had the goal similar to that in [9], i.e. to examine whether there are gender-based differences in the socionic characteristics.

Inputs and methods

Naturally, as the main purpose of the research was to improve the reliability of AS of traffic control specialists, the majority of study participants were aviation professionals, primarily pilots and air traffic controllers.

However, in order to correct the shortcomings described in [14], humanities students were additionally tested in the Saint Petersburg State University of Civil Aviation (SPBGU GA) and Institute of Philology, Foreign Languages and Media Communication of the Irkutsk State University (IPFLMC ISU). For that purpose, with the assistance of V.S. Kamenskaya, a freelance psychologist, to whom the authors express their sincere gratitude, IPFLMC ISU undergraduate students majoring in Foreign Studies and Practice and Theory of Translation underwent comprehensive testing.

In this paper, the authors used data on 3116 tested individuals, including:

- 2582 males.
- 534 females.

Including:

- professional pilots from more than three dozen airlines of Russia, Azerbaijan, Belarus, Kazakhstan, Ukraine, Uzbekistan and Estonia (803 people);
- air traffic controllers from practically all regions of Russia (563 people);
- pilot students (males) of SPBGU GA (659 people);
- pilot students (females) of SPBGU GA (24 people);
- air traffic controller students (males) of SPBGU GA (103 people);
- air traffic controller students (females) of SPBGU GA (53 people);
- humanities students (males) of SPBGU GA (34 people);
- humanities students (females) of SPBGU GA (195 people);
- humanities students (males) of IPFLMC ISU (29 people);

[1] Karelin A.A. [Large encyclopedia of psychological tests]. Moscow: Eksmo; 2007. (in Russ.)

[2] Berg T.N. [Anxiety disorder and methods of its identification: a study guide]. Vladivostok: Maritime State University; 2005. (in Russ.)

[3] Eysenck H.J. Check your own I.Q. EKSMO-Press; 2003.

Table 1. Gender-specific socionic portraits of samples for various professional groups (as of 01.01.2020)

TIM	"Fitness" coefficient	Flying personnel students			Air traffic controller students			Ground crew students		Humanities students		Transportation organization and cabin crew students		TOTAL
		Professionals	SPBGU GA students		Professionals	SPBGU GA students		males	females	males	females	males	females	
			males	females		males	females							
SLE	0	319	184	8	182	31	15	85	23	11	55	26	21	960
LSE	0	201	143	8	133	36	12	76	16	8	30	29	10	702
SLI	0.75	121	38	3	74	7	3	30	14	5	11	11	11	328
LSI	0.75	81	47	3	57	13	1	29	9	6	15	11	4	276
SEE	0.75	30	15	1	25	7	1	17	10	5	30	8	9	158
LIE	0.75	5	3	0	8	3	1	15	6	6	15	3	0	65
SEI	1.5	12	5	0	17	1	1	2	5	2	9	8	4	66
LII	1.5	9	3	0	6	1	0	5	1	2	9	1	0	37
ESE	1.5	3	4	0	5	0	0	5	2	2	17	1	3	42
ILE	1.5	5	1	0	5	0	0	3	2	1	9	0	1	27
ESI	2,25	2	1	0	3	0	1	1	0	1	10	2	2	23
ILI	2,25	5	3	0	3	0	0	6	0	3	4	2	0	26
IEE	2,25	2	3	0	3	1	0	2	3	3	18	0	2	37
EIE	2,25	3	3	0	7	1	0	6	5	5	23	1	4	58
IEI	3	2	1	0	10	0	1	3	0	3	9	0	1	30
EII	3	3	1	0	3	2	0	1	0	0	9	2	1	22
TOTAL		803	455	23	541	103	36	286	96	63	273	105	73	2857

Here, TIM are:

LSE – logic, sensoric, extroverted; ESE – ethical, sensoric, extroverted; SLE – sensoric, logical, extroverted; SEE – sensoric, ethical, extroverted; LSI – logical, sensoric, introverted; ESI – ethical, sensoric, introverted; SLI – sensoric, logical, introverted; SEI – sensoric, ethical, introverted; LIE – logical, intuitive, extroverted; EIE – ethical, intuitive, extroverted; ILE – intuitive, logical, extroverted; IEE – intuitive, ethical, extroverted; LII – logical, intuitive, introverted; EII – ethical, intuitive, introverted; ILI – intuitive, logical, introverted; IEI – intuitive, ethical, introverted;

• humanities students (females) of IPFLMC ISU (93 people);
• nonflying personnel (males) (286 people);
• nonflying personnel (females) (96 people);
• transportation organizers and cabin crew members (males) from various Russian aviation enterprises (105 people);
• transportation organizers and cabin crew members (females) from various Russian aviation enterprises (73 people);

Additionally, the analysis covered previously obtained data that were published by the authors in [14, 16] and a number of others. The data were collected by the authors between 1999 and 2019. Due to such long period of data collection, in some cases, while the final results were preserved, the initial data were lost and new samples could not be made in full. That also explains the fact that in certain tables taken from other papers the numbers of individuals of certain professional categories slightly differ from those stated above (sometimes a characteristic is present in the general data, while another one is not present due to being lost, and vice versa). However, in the authors' opinion, such factors cannot have a crucial effect on the final result, as the difference in the used data that differ from table to table does not exceed 1.5%.

The findings were analyzed with the R programming language that is widely used as statistical software for data analysis and became a de-facto standard statistical program[1] (licensed under GNU GPL[2]). This work used correlation analysis methods and Pearson's chi-squared test ($\chi 2$)[3].

The research was conducted in accordance with primary bioethical rules[4] on a voluntary basis.

[1] Data Science and Analytics / University Information Technology. Available at: http://it.unt.edu/research

[2] Free Software Foundation. Available at: https://fsf.org/

[3] Bock D.E., Velleman P.F., De Veaux R.D. Stats: modeling the world. 4th Edition. Boston (USA): Pearson Addison Wesley; 2015

[4] Bioethics / Internet Encyclopedia of Philosophy. Available at: https://www.iep.utm.edu/bioethic/

Table 2. Comparison of TIM distribution per Pearson's chi-square test

1-st sample	N_1	2-nd sample	N_2	Number of degrees of freedom (ν)	χ^2_{emp}	χ^2_{crit}	Conclusion
1	455	2	23	2	0.294	5.991 for $p < 0.05$ 9.210 for $p < 0.01$	No reliable differences identified ($p > 0.05$)
1	455	3	103	3	8.874	11.070 for $p < 0.05$ 15.086 for $p < 0.01$	No reliable differences identified ($p > 0.05$)
1	455	7	63	4	83.982	9.488 for $p < 0.05$ 13.277 for $p < 0.01$	Differences are highly reliable ($p \leq 0.01$)
2	23	4	36	2	0.332	5.991 for $p < 0.05$ 9.210 for $p < 0.01$	No reliable differences identified ($p > 0.05$)
2	23	8	273	3	20.956	7.815 for $p < 0.05$ 11.345 for $p < 0.01$	Differences are highly reliable ($p \leq 0.01$)
3	103	4	36	3	2.213	7.815 for $p < 0.05$ 11.345 for $p < 0.01$	No reliable differences identified ($p > 0.05$)
3	103	7	63	5	32.664	11.070 for $p < 0.05$ 15.086 for $p < 0.01$	Differences are highly reliable ($p \leq 0.01$)
4	36	6	96	3	12.500	7.815 for $p < 0.05$ 11.345 for $p < 0.01$	Differences are highly reliable ($p \leq 0.01$)
4	36	8	273	4	31.551	9.488 for $p < 0.05$ 13.277 for $p < 0.01$	Differences are highly reliable ($p \leq 0.01$)
4	36	10	73	4	11.574	9.488 for $p < 0.05$ 13.277 for $p < 0.01$	Differences are reliable ($p \leq 0.05$)
5	286	6	96	7	10.014	14.067 for $p < 0.05$ 18.475 for $p < 0.01$	No reliable differences identified ($p > 0.05$)
6	96	8	273	10	31.987	18.307 for $p < 0.05$ 23.209 for $p < 0.01$	Differences are highly reliable ($p \leq 0.01$)
7	63	8	273	8	5.683	15.507 for $p < 0.05$ 20.090 for $p < 0.01$	No reliable differences identified ($p > 0.05$)
7	63	9	105	6	15.636	12.592 for $p < 0.05$ 16.812 for $p < 0.01$	Differences are reliable ($p \leq 0.05$)
9	105	10	73	6	8.530	12.592 for $p < 0.05$ 16.812 for $p < 0.01$	No reliable differences identified ($p > 0.05$)

SAMPLES			
1	Student pilots Males	2	Student pilots Females
3	Student air traffic controllers Males	4	Student air traffic controllers Females
5	Ground crew students Males	6	Ground crew students Females
7	Male humanities students	8	Female humanities students
9	Operations division Males	10	Operations division Females

Results and discussion

Let us examine the socionic portraits [16, 17], i.e., the distribution of the types of information metabolism (TIM) or, more precisely, the dominating components of an individual's socionic model (ISM) [17] out of various samples (Table 1). All data were obtained using the 5-th version of the MM-1 test [14, 16, 18]. Let us compare the obtained samples based on Pearson's chi-squared test and put the obtained results into Table 2.

Analyzing the findings shown in Tables 1 and 2 clearly shows that the differences between the studied samples are primarily professional in their nature. Comparing samples of individuals from the same professional group and approximately the same age, but different gender, in none of the five cases reliable differences were identified ($p > 0.05$). That wholly confirmed the prediction of Aušra Augustinavičiūtė [4] regarding the absence of differences in the gender-based distribution of TIM, but somewhat contradicts Jung's theory [3], according to which such psychological function as "ethics" in females (Jung's "Fühlen") is dominant. At the same time, highly reliable ($p \leq 0.01$) for both males, and females are the differences between the humanities specialists and nonflying personnel. The "service" professional group, as expected, in terms of its socionic characteristics, turned out to be something between the "humanities" and the "technology", but here the differences between the professional groups are reliable as well ($p \leq 0.05$). There are no reliable differences ($p > 0.05$) between same-gender student pilots and air traffic controller students, which was to be expected as well.

Table 3. Gender-specific socionic models of samples for various professional groups (%) according to the SPBGU GA data (as of 01.01.2020)

TIM	"Fitness" coefficient	Flying personnel students			Air traffic controller students			Ground crew students		Humanities students		Transportation organization and cabin crew students	
		Professionals	Students SPBGU GA		Professionals	Students SPBGU GA		males	females	males	females	males	females
			males	females		males	females						
SLE	0	14.9	14.1	12.8	12.8	11.3	13.9	11.6	12.3	9.6	9.5	10.4	11.7
LSE	0	11.1	11.8	14.0	10.4	11.6	9.9	10.7	8.9	7.9	7.6	10.3	8.5
SLI	0.75	10.0	8.2	9.2	9.2	7.0	86	7.8	7.9	6.8	5.8	8.3	86
LSI	0.75	7.5	7.5	8.9	7.4	7.6	6.1	7.4	5.6	6.5	5.6	7.2	5.3
SEE	0.75	86	86	7.5	8.4	7.6	9.6	7.8	9.8	7.8	8.7	7.5	9.7
LIE	0.75	5.7	6.8	6.9	6.2	7.7	6.6	7.2	6.6	6.5	6.6	6.8	5.8
SEI	1.5	6.0	5.2	5.2	6.2	5.1	6.3	5.3	6.4	5.7	5.3	6.4	7.0
LII	1.5	4.3	4.4	4.3	4.6	5.3	4.2	5.1	4.1	5.6	4.8	5.3	3.7
ESE	1.5	5.1	5.8	5.9	5.4	6.5	5.5	6.1	5.8	5.8	7.2	5.7	6.0
ILE	1.5	6.3	6.7	6.1	6.2	6.1	6.2	6.4	6.9	6.6	7.0	5.7	6.5
ESI	2.25	3.7	3.7	3.7	4.1	4.5	3.8	4.3	3.8	4.6	4.8	4.9	3.9
ILI	2.25	4.5	4.0	4.2	4.7	4.1	4.5	4.5	4.6	5.7	4.5	4.9	4.8
IEE	2.25	3.9	4.5	3.7	4.4	4.4	4.5	4.7	5.8	6.0	7.0	4.5	6.1
EIE	2.25	3.1	3.6	3.1	3.7	4.7	3.8	4.6	4.7	5.4	6.7	4.3	5.2
IEI	3	3.0	2.7	2.5	3.5	3.1	3.7	3.3	3.9	5.2	4.4	4.0	4.2
EII	3	2.3	2.4	2.0	2.8	3.4	2.8	3.2	2.9	4.3	4.5	3.8	3.0
TOTAL (people)		803	455	23	541	103	36	286	96	63	273	105	73

Here, TIM are:

LSE – logic, sensoric, extroverted; ESE – ethical, sensoric, extroverted; SLE – sensoric, logical, extroverted; SEE – sensoric, ethical, extroverted; LSI – logical, sensoric, introverted; ESI – ethical, sensoric, introverted; SLI – sensoric, logical, introverted; SEI – sensoric, ethical, introverted; LIE – logical, intuitive, extroverted; EIE – ethical, intuitive, extroverted; ILE – intuitive, logical, extroverted; IEE – intuitive, ethical, extroverted; LII – logical, intuitive, introverted; EII – ethical, intuitive, introverted; ILI – intuitive, logical, introverted; IEI – intuitive, ethical, introverted;

Table 4. Identified correlation between gender-specific socionic models of samples for various professional groups according to the SPBGU GA data (as of 01.01.2020)

Sample 1-st / 2-nd	1	2	3	4	5	6	7	8	9	10
1		+0.9674	+0.9682	+0.9702	+0.9932	+0.9387	+0.9606	+0.7869	+0.9701	+0.8931
2	$p < 0.001$		+0.9718	+0.9014	+0.9790	+0.8453	+0.8840	+0.6579	+0.9831	+0.8019
3	$p < 0.001$	$p < 0.001$		+0.8977	+0.9865	+0.8557	+0.8945	+0.7526	+0.9574	+0.7906
4	$p < 0.001$	$p < 0.001$	$p < 0.001$		+0.9477	+0.9801	+0.9658	+0.7932	+0.9414	+0.9566
5	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$		+0.9128	+0.9420	+0.7721	+0.9758	+0.8618
6	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$		+0.9690	+0.8714	+0.8846	+0.9845
7	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$		+0.8419	+0.8955	+0.9276
8	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$		+0.6587	+0.8432
9	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$		+0.8511
10	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	

Notes: On the right and at the top are the values of the Pearson correlation coefficient between such performance indicators, while on the left and at the bottom there are the characteristics of correlation significance.
The number of samples corresponds to the numbers of samples in Table 2.

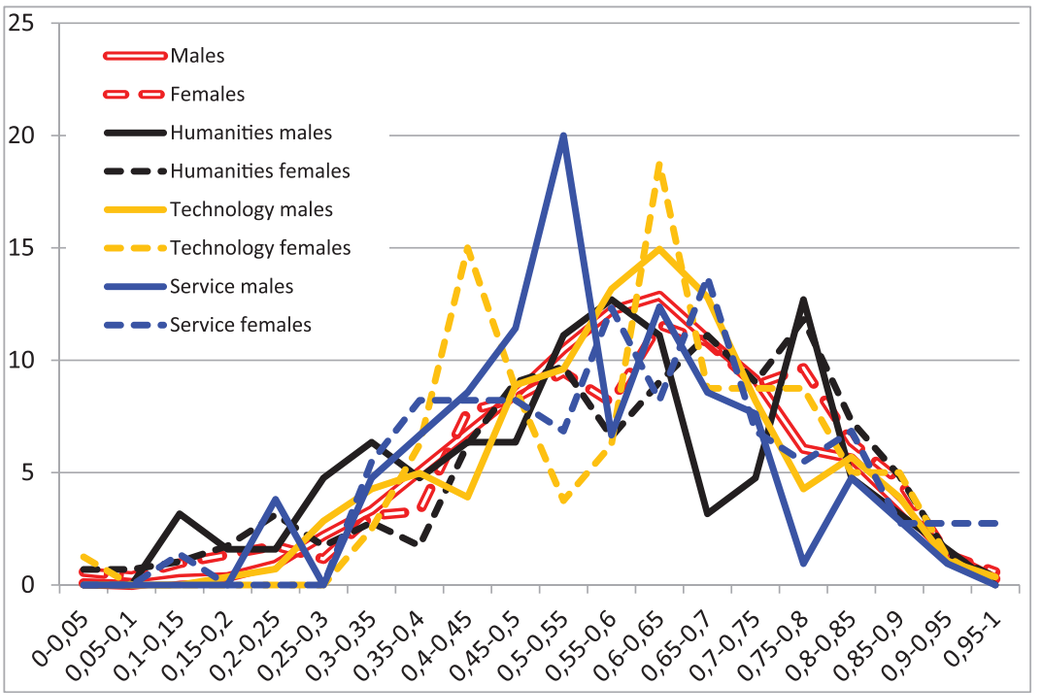

Fig. 1. Distribution of the obtained values per the "extraversion – introversion" psychological dichotomy among various samples studied by the authors

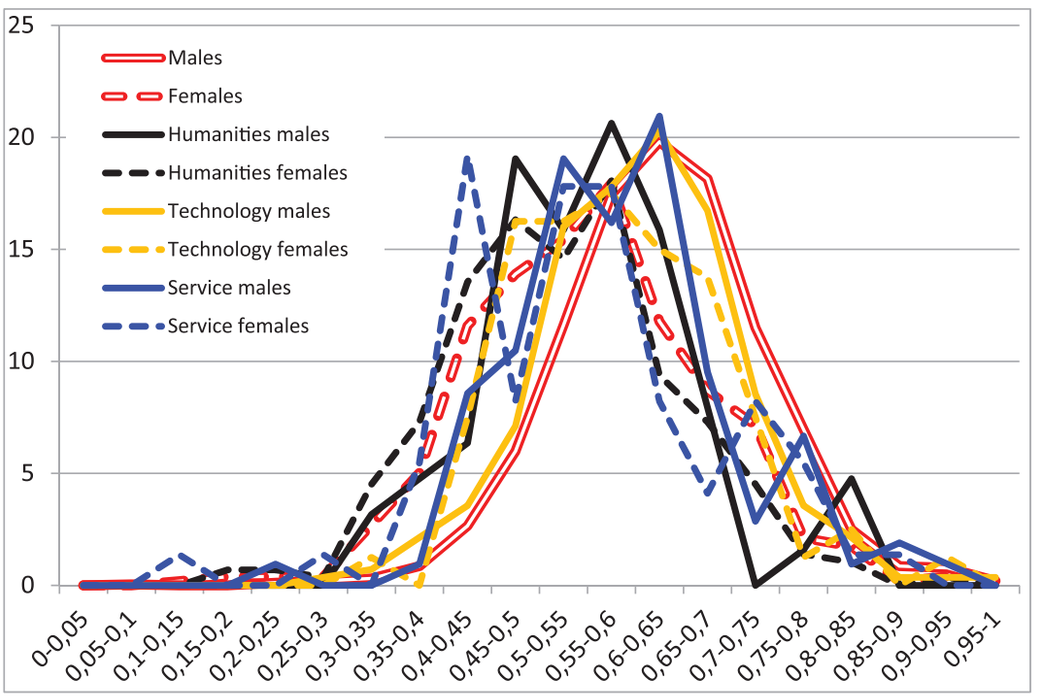

Fig. 2. Distribution of the obtained values per the "logic – ethics" psychological dichotomy among various samples studied by the authors

After the socionic portraits of various professional groups, let us examine their socionic models that are the ISM of a typical member of this sample. Table 3 shows the gender-specific socionic models of samples for various professional groups (%) according to the SPBGU GA data (as of 01.01.2020)

As can be seen from the comparison of the socionic models of various samples shown in Table 3, there is a certain dominance of the logical and sensoric components in the model even for "humanities people". Probably, that is explained by local specificities (in [17], data is quoted on the specificity of TIM distribution in US citizens and the differences from the similar distribution in the UK). However, most probably that is due to the fact that most of the data was collected from air transport professionals.

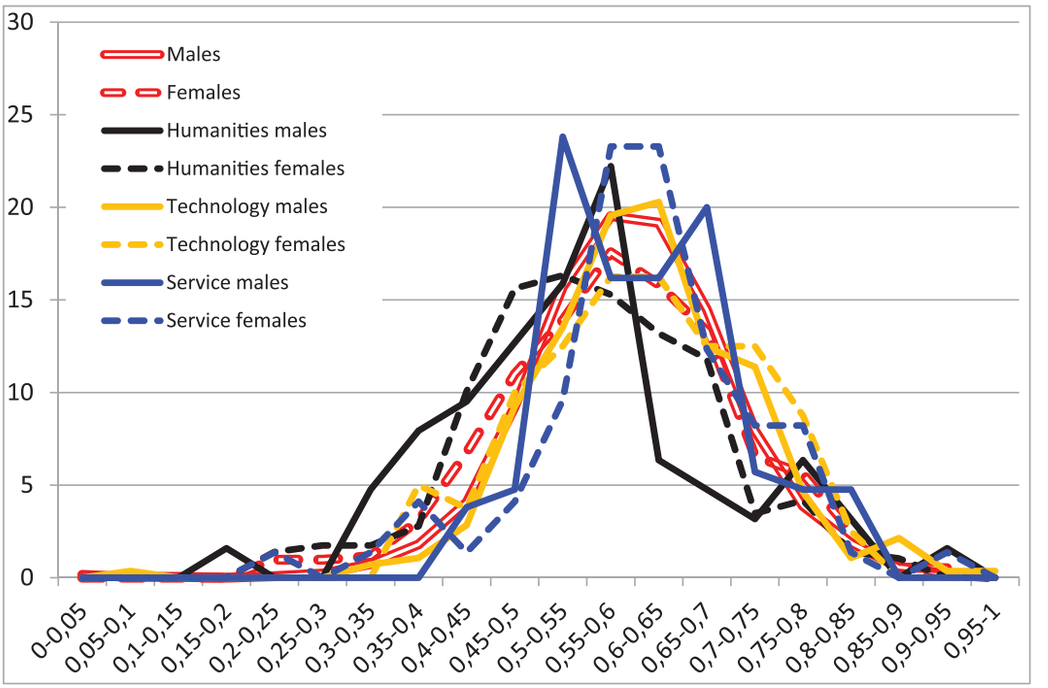

Fig. 3. Distribution of the obtained values per the "sensorics – intuition" psychological dichotomy among various samples studied by the authors

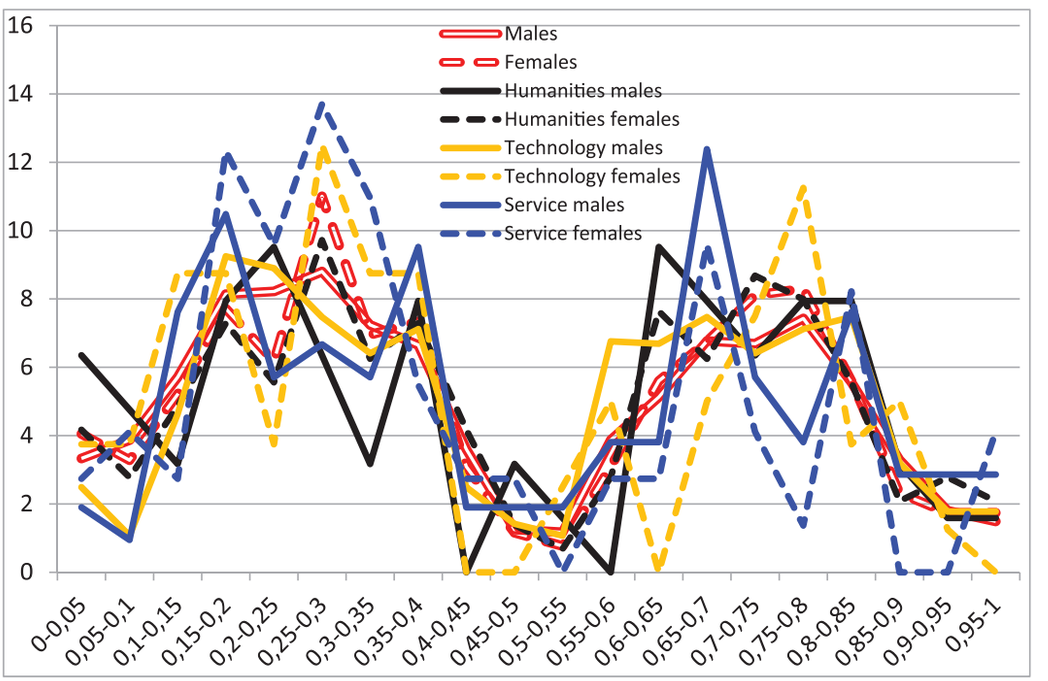

Fig. 4. Distribution of the obtained values per the "rationality – irrationality" psychological dichotomy among various samples studied by the authors

(The "humanities people" in Tables 1 to 3 are the 214 persons out of 336, students of the Humanities Faculty of SPBGU GA and only 122 are student of IPFLMC ISU).

Unlike in Table 1, in Table 3, what catches the eye is the similarity between the socionic models, rather than their differences, as that was in the case of socionic portraits. This difference is even more evident in Table 4 that shows the identified correlations between the socionic models of individual professional groups. Practically all of them, except two, are strong. All the average strength correlations are those between the ISM of "humanities" females and a number of other ISM. Additionally, all of them, except those two, are highly significant ($p < 0.001$). That could appear quite strange, but the authors are inclined to attribute those factors to the Russian mindset described in detail in [19].

Table 5. Correlation between the PDs obtained for various samples researched by the authors (the numbers of the samples correspond to the numbers of the samples in Tables 2 and 4)

First sample	Second sample	r_{corr}	Conclusion on the strength of correlation	Conclusion on the significance of correlation	
"Extraversion – introversion" psychological dichotomy					
Males	Females	+0.9428	strong	$p < 0.001$	very highly significant
7	8	+0.7043	strong	$p < 0.001$	very highly significant
5	6	+0.7215	strong	$p < 0.001$	very highly significant
9	10	+0.6632	medium	$p < 0.01$	highly significant
7	5	+0.7059	strong	$p < 0.001$	very highly significant
7	9	+0.5941	medium	$p < 0.01$	highly significant
5	9	+0.7634	strong	$p < 0.001$	very highly significant
8	6	+0.7100	strong	$p < 0.001$	very highly significant
8	10	+0.7207	strong	$p < 0.001$	very highly significant
6	10	+0.7001	strong	$p < 0.001$	very highly significant
"Logic – ethics" psychological dichotomy					
Males	Females	+0.7681	strong	$p < 0.001$	very highly significant
7	8	+0.9170	strong	$p < 0.001$	very highly significant
5	6	+0.9177	strong	$p < 0.001$	very highly significant
9	10	+0.7824	strong	$p < 0.001$	very highly significant
7	5	+0.8125	strong	$p < 0.001$	very highly significant
7	9	+0.8843	strong	$p < 0.001$	very highly significant
5	9	+0.9178	strong	$p < 0.001$	very highly significant
8	6	+0.8850	strong	$p < 0.001$	very highly significant
8	10	+0.8824	strong	$p < 0.001$	very highly significant
6	10	+0.7597	strong	$p < 0.001$	very highly significant
"Sensorics – Intuition" psychological dichotomy					
Males	Females	+0.8642	strong	$p < 0.001$	very highly significant
7	8	+0.8530	strong	$p < 0.001$	very highly significant
5	6	+0.9610	strong	$p < 0.001$	very highly significant
9	10	+0.8019	strong	$p < 0.001$	very highly significant
7	5	+0.7100	strong	$p < 0.001$	very highly significant
7	9	+0.6715	medium	$p < 0.01$	highly significant
5	9	+0.8726	strong	$p < 0.001$	very highly significant
8	6	+0.8494	strong	$p < 0.001$	very highly significant
8	10	+0.7390	strong	$p < 0.001$	very highly significant
6	10	+0.9118	strong	$p < 0.001$	very highly significant
"Rationality – Irrationality" psychological dichotomy					
Males	Females	+0.9489	strong	$p < 0.001$	very highly significant
7	8	+0.7028	strong	$p < 0.001$	very highly significant
5	6	+0.6237	medium	$p < 0.01$	highly significant
9	10	+0.6726	medium	$p < 0.01$	highly significant
7	5	+0.6589	medium	$p < 0.01$	highly significant
7	9	+0.5383	medium	$p < 0.05$	significant
5	9	+0.7767	strong	$p < 0.001$	very highly significant
8	6	+0.6727	medium	$p < 0.01$	highly significant
8	10	+0.5960	medium	$p < 0.01$	highly significant
6	10	+0.4744	moderate	$p < 0.05$	significant

In conclusion, let us examine the data for individual psychological dichotomies (PD) in the form of a diagram. As can be seen from the graphs shown in Figures 1 to 4 (here, just as in Table 5, in the used samples, 2556 are males, 518 are females, 281 are "technology" males and 80 are "technology" females. In terms of size, the remaining samples match the data cited in "Inputs and methods") per all PDs, except "rationality – irrationality" (see Fig. 4), for all presented samples, a unimodal distribution is observed. (Not presented are samples of professional pilots and air traffic controllers,

as well as student pilots and student air traffic controllers, but they are also unimodal, and those categories of specialists are part of the total numbers of males or females. For brevity, humanities students from SPBGU GA and IPFLMC ISU are shown as "humanities", the nonflying personnel are shown as "technology", while the transportation organizers and cabin crew members are shown as "service"). In the graphs, the left-hand parts (values from 0 to 0.5) fall into "introversion", "ethics", "intuition" and "irrationality", while the right-hand parts (values from 0.5 to 1) fall into "extraversion", "logic", "sensorics" and "rationality" (Jung's Introversion, Fühlen, Intuition, Irrationalität and Extraversion, Denken, Empfinden, Rationalität, respectively).

The bimodal distribution in Fig. 4 is explained by the approach to its definition that is different from traditional socionics [4], as in Jung's interpretation this PD is not independent, because it is a dichotomy of not a psychic functions and mental sets, but pairs of psychic functions [3].

Out of Fig. 1 to 4 already clearly follows that the distributions of the degree of certain PD in an ISM for various samples are quite similar. That is further confirmed by the correlations shown in Table 5. In the "logic – ethics" PD, the correlations between all samples are strong ($r_{corr} > 0.7$) and very highly significant ($p < 0.001$). It must be noted that the "service" group goes the furthest outside the general trend. In the "extraversion – introversion" PD, the only just highly significant ($p < 0.01$) correlations of average strength ($0.5 < r_{corr} < 0.7$) are between the "service" samples of males and females, as well as males from the samples "humanities" and "service", while the rest are strong and very highly significant.

The situation is exactly the same in the last pair of samples both in the "sensorics – intuition" and "rationality – irrationality" PDs, where the correlation barely reached average and significant ($p < 0.05$). Finally, in the "rationality – irrationality" PD, the correlations between almost all samples are relatively the weakest, less significant, while between samples of "technology" and "service" females there is only a significant ($p < 0.05$) and moderate ($0.3 < r_{corr} < 0.5$) correlation. Table 3 shows that the manifestation of such psychological qualities as "logic" and "sensorics" is the highest in "pilots". That largely corresponds to the theoretical assumptions, as the relative dominance of such qualities as "logic" and "sensorics" according to [17] is exactly preferable for traffic control specialists. But even in the "humanities people" such psychological qualities are a little stronger than "ethics" and "intuition" respectively, the peak in the ISM being at the level of 0.45-0.6 of such qualities' manifestation (see Fig. 2 and Fig. 3.).

Conclusions

The analysis of research findings showed that the socionic psychodiagnostic methods used by the authors have not identified fundamental gender differences. Even in terms of the socionic portraits, positive differences are of professional, rather than gender-specific nature. That wholly confirmed the prediction of Aušra Augustinavičiūtė [4] regarding the absence of differences in the gender-based distribution of TIM, but somewhat contradicts Jung's theory [3], according to which such psychological function as "ethics" in females, as the "logic – ethics" PD (Jung's "Denken – Fühlen") is where the correlation between all the above considered samples is the strongest and highly significant.

The analysis of the results obtained by us in the works referred to herewith and our paper [9] (as well as an analysis of global scientific research in the subject of gender differences [20-24]) suggest that improving the reliability of AS requires researching the differences in the expression of the necessary PIQ of aviation specialists, especially control room employees, not by criterion of gender, but rather in accordance with the identified gender-related personality type.

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The authors' contribution

Arinicheva O.V. Review and analysis of the state of the art of the problem under consideration, collection of psychodiagnostic data for statistical processing. The theoretical component of the work. Processing of the obtained results.

Malishevsky A.V. Overview and analysis of the state of the art of the problem under consideration, collection of psychodiagnostic data for statistical processing. The theoretical component of the work. Processing of the obtained results.

Conflict of interests

The authors declare the absence of a conflict of interests.