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ОРИГИНАЛЬНОЕ ИССЛЕДОВАНИЕ
ORIGINAL RESEARCH

Effectiveness of sensorimotor training in different social conditions of men's and women's activities in mono-gender dyads

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Abstract. Relevance. Investigation the features of human achievement of the results of purposeful activity in different conditions of social interactions is relevant and of high significance. The importance of this issue is underscored by the need to equip businesses with skilled professionals who possess the necessary competencies, including social abilities, in line with the evolving demands of the modern world, and also to increase the effectiveness of the educational process. Furthermore, it is crucial to safeguard the psychosomatic health of the general public, which is heavily influenced by societal factors throughout their lives and work relationships. The aim of the study was to examine changes in performance measures of sensorimotor training in different social contexts of activity in same-sex male and female pairs. **Materials and Methods:** Sixty-five pairs of men and 63 pairs of women (age 19 years 7 months $\pm$ 3 months) were examined, using the sensorimotor training “Columns” of the hardware-software complex “BOS-Kinesis” (Neurotech LLC, Taganrog, Russia). The research protocol included performing the tasks in different social contexts: individually, competitively, and collaboratively with a partner in conditions with and without feedback from participants’ actions. **Results and Discussion.** Three groups of subjects were identified according to the indicator of maximum performance in three individual trainings: high-, medium-, and low-performers. In competition, an increase in productivity was observed in the latter two groups. Sex differences were found in the proportion of subjects with initially low performance who improved performance in competition: their % was significantly lower among men than in the sample of women. In interpersonal sensorimotor coordination with feedback from partners’ actions, males had a significant decrease in personal performance and pair integral outcome measures, in contrast to female dyads. In cooperation without feedback

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from participants' actions, a decrease in personal and integral performance was found for all pairs of subjects, but it was more significant in male dyads. **Conclusion.** Changes in result indicators in the joint contexts in dyads of subjects were determined by their initial individual performance levels and differed significantly between male and female pairs.

Keywords: performance, sensorimotor activity, social context, competition, cooperation, dyads

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Introduction

The study of the effectiveness of joint activities of people in various social conditions is an important problem of modern psychophysiology, which requires an interdisciplinary study of social, psychological and neurobiological mechanisms for achieving the results of purposeful human behavior in society [1, 2]. Work in this area has high practical significance in terms of increasing the efficiency of the educational process for schoolchildren and students [3], and providing enterprises with qualified personnel who meet modern professional requirements. In many professional fields, employees must have, in addition to special skills, so-called “non-technical” skills, which include the ability to establish optimal production relationships with colleagues and effectively interact with them to

achieve a collective result. For example, such skills are necessary in the work of medical and rescue teams, for the coordinated activities of civil and military aviation crews [4, 5]. The development of measures to improve the social well-being of enterprise employees, young and elderly people helps to maintain psychosomatic health, increase the life expectancy of the population and improve labor productivity. In addition, understanding the characteristics of human interaction during sensorimotor activity, including interaction using technical devices in controlled movement processes, will contribute to the development of social and rehabilitation robotics and the development of software and hardware systems with artificial intelligence [6].

Competition and cooperation are the main forms of interaction in both interpersonal and professional rela-

tionships. In recent years, many studies have compared the performance of individual motor activity and that performed in various types of group interactions [7, 8]. The authors of studies that note an improvement in the effectiveness of joint activities compared to individual ones explain these positive effects by an increase in people's motivation [9], the ability to compare personal movements with the collective result of actions [10], the summation of physical efforts and the ability of partners to communicate and take specialized roles to solve assigned tasks [11].

It is known that cooperation facilitates the processes of motor learning and the development of motor skills by increasing the levels of internal motivation of participants and establishing positive interpersonal relationships [12]. Competitive conditions, on the other hand, reduce the perceived similarity between participants, which lead to attempts by one person to hinder the actions of another and reduce performance.

Studies have found inconsistent results when assessing the performance of participants in competitive and cooperative contexts in sport [13]. According to this study, the highest performance indicators of athletes were associated with dominance motivation, as opposed to the affiliative motive of belonging to a group. The observed decrease in a person's personal performance in team activities in a number of cases is also explained by "social laziness" that occurs when the actions of participants are anonymous, work is unevenly distributed among group members, and in other conditions that reduce the level of personal responsibility to the team [14].

Thus, studies of performance in the contexts of competition and cooperation are relevant; however, their results are contradictory and ambiguous, which is probably determined to some extent by the gender of the interacting subjects. During the evolution of human communities, as a result of intra-family and group interactions, different adaptive strategies and social roles of male and female individuals were formed, which influenced the levels of expression of different inter-gender socio-psychological characteristics of personality. It has been shown that men have a greater tendency to dominance and aggression in a social

context; they are characterized by a more pronounced motivation for competition and a positive perception of the competitive conditions of interactions [15]. Women typically play a leading role in caring for offspring, not only their own, but also those of other family members or groups. During the evolution of species, women have developed empathy and compassion, the ability to recognize the emotional states of others, and a tendency to cooperate to a greater extent than men. It has been shown that adaptive social strategies under stressful conditions also depend on gender: in men, such forms of behavior as "fight or flight" predominate, selfishness and competitiveness increase; for women, behavior of the "tend and befriend" type is more typical, with a focus on perceiving the feelings of others and a desire for mutual assistance [16].

Gender differences in performance were also identified in conditions of individual activity; for example, in a task of recognizing visual images with a fixed time and feedback from the results of one's own actions, the quality of task performance was also higher in men compared to women [17]. This study also shows the influence of the personal characteristics of the subjects on the success of goal-directed activity and the correlation of performance with the characteristics of physiological support, in particular, indicators of heart rate variability.

The main interrelated factors contributing to sex differences are thought to be hormonal, contextual (e.g. parental roles in the family), and sexual selection (e.g. mating patterns of the species) influences. Despite the results of the above studies, the author of a recent meta-analysis of long-term studies of the gender aspects of cooperation in social dilemma choice tasks came to the conclusion that there is no absolute evidence of differences in cooperative behavior between men and women [18].

Thus, the data from the scientific literature indicate a significant influence of social contexts of activity on its effectiveness, the efficiency of learning and the quality of interpersonal relationships. However, a lot of contradictory data is found, depending on the type and models of activity, the initial individual psychophysiological characteristics of people, personal qualities,

abilities and skills of a person, as well as the gender of the interacting subjects. Despite the large number of studies of joint activities, the influence of social contexts on personal and integral sensorimotor performance of the same subject's remains insufficiently studied. In connection with the above, further study of this problem is necessary; the study of the characteristics of achieving results of activities by the same people in different contexts of social interactions is relevant and has high fundamental and applied significance. The aim is to study changes in performance measures of sensorimotor training in different social contexts of activity in same-sex dyads of men and women.

Materials and methods

Objects of the study

256 healthy subjects, university students (65 pairs of men and 63 pairs of women, average age 19 years, 7 months $\pm$ 3 months), without uncorrected visual impairment, neurological and cardiovascular diseases in the anamnesis. Subjects who knew each other participated in the study in pairs on an unpaid basis. All subjects gave voluntary informed consent to participate in the study and consent to the processing of personal data in accordance with the Declaration of Helsinki of the World Medical Association (WMA Declaration of Helsinki — Ethical Principles for Medical Research Involving Human Subjects, 2013).

Activity model

The "Columns" training was used as a model of sensorimotor activity, based on biological feedback from electromyographic signals (EMG) recorded from the flexor muscles of the hand of the subjects' leading hand using the "Kolibri" telemetry sensors of the "BOS-Kinesis" hardware-software complex ("Neurotech" LLC, Russian Federation, Taganrog). During sensorimotor training (SMT), a column with a dynamically changing height corresponding to the current amplitude characteristics of the EMG is displayed on the computer monitor. The subjects were required to maintain a level of muscle tension to keep the column height within the highlighted target range (50 $\pm$ 10% of the maximum

muscle tension recorded during EMG signal calibration), with the column colored green. When the height of the column is outside the target area (<30%) its color changes to yellow, and if it is more than 30% high, it becomes red. Performance of the SMT was evaluated as a percentage of the duration of holding the column height in the target range of the total training time.

Study design

Subjects performed the SMT sitting at computer monitors at a distance of 80 cm at separate, side-by-side desks. The social contexts of the activity were set through changes in the task environment and additional instructions from the experimenter. In the individual SMT sessions, participants were separated by partitions and performed the training 3 times for 2 min with 20–30 sec rest pauses. Then, during the joint activity stages, the partitions were removed and subjects performed SMT at a common computer monitor.

During the competition, two separate resultant columns from the EMG signals of both participants were displayed on the screen, with a training duration of 3 min. The position of the personal columns corresponded to the seating of the subjects, and the competitors could see the color and height of both columns, allowing them to evaluate their own and others' current performance. Before this training participants were instructed to try to keep their bar height in the target range longer than their opponent. Cooperation conditions were created by presenting one common column on the monitor, the height of which corresponded to the integral resultant calculated from two personal columns of the participants in the software "BOS-Kinesis". In the first cooperative training (Coop+), subjects saw a personal contribution to the pair's overall performance, i.e., the height and color of their columns. In the second cooperative task (Coop-), subjects were shown a dynamic representation of the overall resultant column only. The durations of SMT in the cooperative context were also 3 min.

Statistical analysis

The data were analyzed for normality of distribution using the Shapiro-Wilcoxon, D'Agostino-Pearson and Kolmogorov-Smirnov methods. Non-parametric statis-

tical methods were used because the data distributions differed from normal. Changes in performance measures between different contexts were analyzed using the Wilcoxon criterion (Wil) and the Friedman method (Fr) with correction for multiple comparisons. Differences in performance between independent groups of subjects were tested using the Mann-Whitney (MU) test and the Kraskell-Wallis (KW) method with corrections for multiple pairwise comparisons. Chi-square method (χ^2) was used to assess the significance of differences between the distributions of the number of subjects in different subgroups of samples of men and women, and between activity contexts. Relationships between variables were analyzed using Spearman's rank correlation coefficient (r).

Results and discussion

Each subject's maximum initial performance ($R_{\max-i}$) was defined as the result of the most successful attempt of the three individual SMTs. Three modes on the histogram of the distribution of the $R_{\max-i}$ index for the whole sample were identified (97.5%, 87.5% and 77.5%). Based on this polymodal distribution, boundaries were defined to separate groups of subjects with different levels of individual performance: low-performers ($R_{\max-i} < 83.75\%$), medium-performers ($83.75\% \leq R_{\max-i} < 91.25\%$), and high-performers ($R_{\max-i} \geq 91.25\%$).

The following distributions of participants in these groups during individual SMT were identified: the majority of subjects fell into the high-performance group (56.9% of males, 59.5% of females); 17.7% of males and 19.8% of females were medium performers, and 25.4% of males and 20.6% of females were low performers. These differences in the proportions of subjects between the groups of males and females in the individual activity stage are not reliable.

A significant correlation was found between $R_{\max-i}$ and performance in competition (R_{comp}) in the samples of all male ($r = 0.50$, $p < 0.0001$) and all female ($r = 0.52$, $p < 0.0001$) subjects. A comparative analysis of the dynamics of SMT performance in competition (R_{comp}) in comparison with performance in individual stages

($R_{\max-i}$) for samples of all subjects and separately for men and women did not reveal any reliable changes. However, sex differences were found between the ratios of the shares of subjects in groups with different levels of performance in competitive activities compared to those in the individual stage. In the male sample, the percentage of high-performing participants decreased (53.8%), the percentage of medium performers did not change, and the percentage of low performers increased (28.4%). For women, there was a different pattern of change in the distribution of these groups: the proportions of high-performing (61.1%) and low-performing (23.0%) participants increased, while the proportions of medium-performing participants decreased (15.9%).

Differential analysis of the dynamics of performance in the competition compared to the performance of the individual stage in groups with different initial levels of success revealed the following reliable changes (Figure 1). In the group of initially high-performing subjects in the competitive context, R_{comp} decreased significantly in both male ($p(\text{Wil}) = 0.0005$) and female ($p(\text{Wil}) = 0.0042$) samples. In the groups of initially average-performing subjects, changes in performance during competition are not reliable. Initially low-performing subjects had an increase in R_{comp} during competition compared to $R_{\max-i}$, significant only for this group of women ($p(\text{Wil}) = 0.0024$).

Personal values of relative performance differences between competitive and individual performance contexts $\Delta R = (R_{\text{comp}} - R_{\max-i})$ were also analyzed. A significantly higher percentage of participants with an increase in performance in the competition condition was found in initially medium-performing (males, 43.5%, $p(\chi^2) = 0.0018$; females, 56.0%, $p(\chi^2) = 0.0001$) and low-performing (males, 54.6%, $p(\chi^2) = 0.0001$; females, 76.9%, $p(\chi^2) = 0.0001$) subjects, compared to initially high-performing participants (10.8% males and 12.0% females). Significant differences were found in the distributions of the proportions of participants with different directions of change in performance during the competition compared to the individual activity stage between initially low-performing men and women ($p(\chi^2) = 0.093$). This category of subjects showed a significantly higher percentage of female participants

with an increase in performance in competition (76.9%) compared to the same group of males (54.5%). In 36.4% of initially low-performing men, performance decreased

further in competitive conditions and only 11.5% of initially low-performing women showed a similar dynamic.

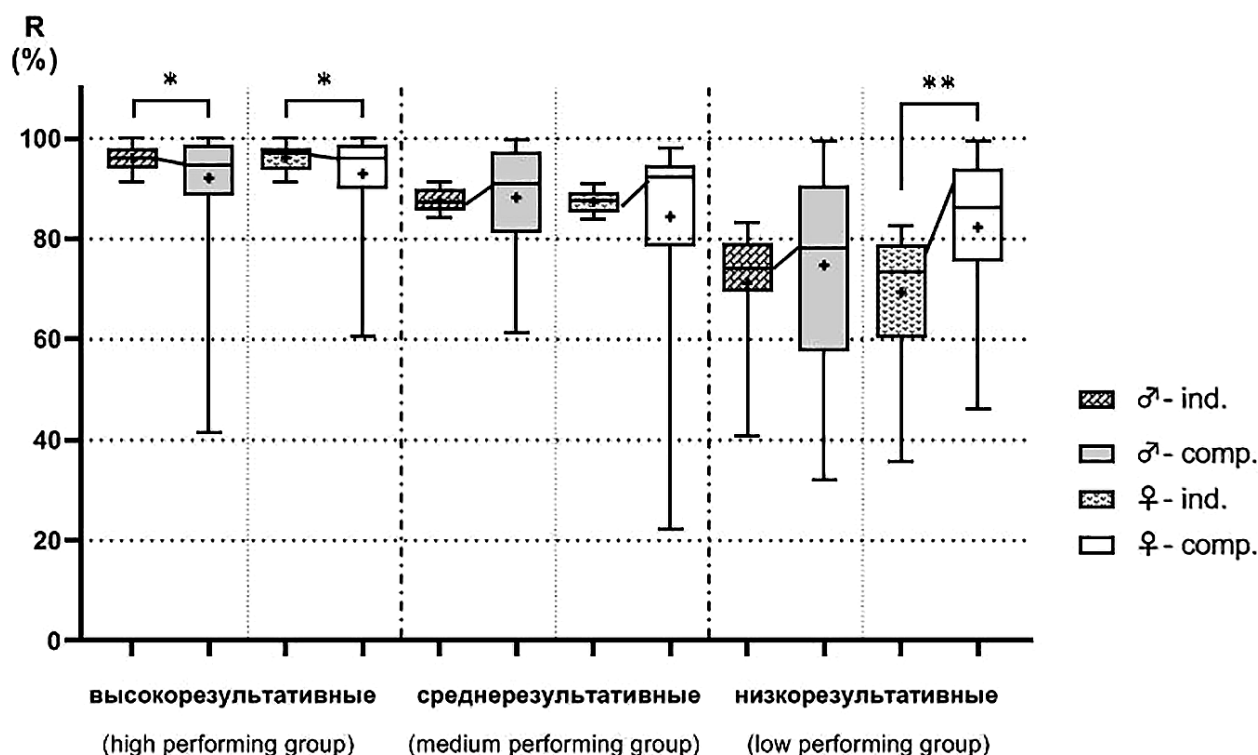


Fig. 1. Dynamics of the SMT performance in individual (ind., shaded boxes) and competitive (comp., unshaded boxes) contexts of activity in groups of young men (♂, gray boxes) and young women (♀, white boxes). The abscissa axis shows groups of high-, medium- and low-performance subjects. The ordinate axis shows the performance indicator (% of maintaining the column in the target range). Levels of reliable differences * – $p < 0.05$, ** – $p < 0.01$

The results of the comparative analysis of personal performance in individual, competitive and cooperative activity conditions are shown in Figure 2. Changes in SMT performance in the different activity contexts were significant in the samples of males (stat(Fr) = 172, $p(\text{Fr}) < 0.0001$) and females (stat(Fr) = 182, $p(\text{Fr}) < 0.0001$). A pairwise comparison of performance between samples of males and females in different social contexts of SMT revealed an overall reliability of differences (stat(KW) = 392, $p(\text{KW}) < 0.0001$).

Significant sex differences were found in both cooperative activity conditions. The performance of SMT

in conditions of cooperation in a sample of men significantly decreased compared to individual and competitive contexts: with feedback from the partners' contribution ($p(\text{Wil}) < 0.05$) and without feedback ($p(\text{Wil}) < 0.0001$). The performance of SMT in a sample of women did not change in conditions of cooperation with feedback from the participants' contribution and was significantly higher than that of men ($p(\text{MU}) = 0.0002$). In the conditions of cooperation without feedback, women also showed a decrease in performance compared to previous contexts ($p(\text{Wil}) < 0.0001$), but the level of performance was significantly higher than that of men ($p(\text{MU}) = 0.021$).

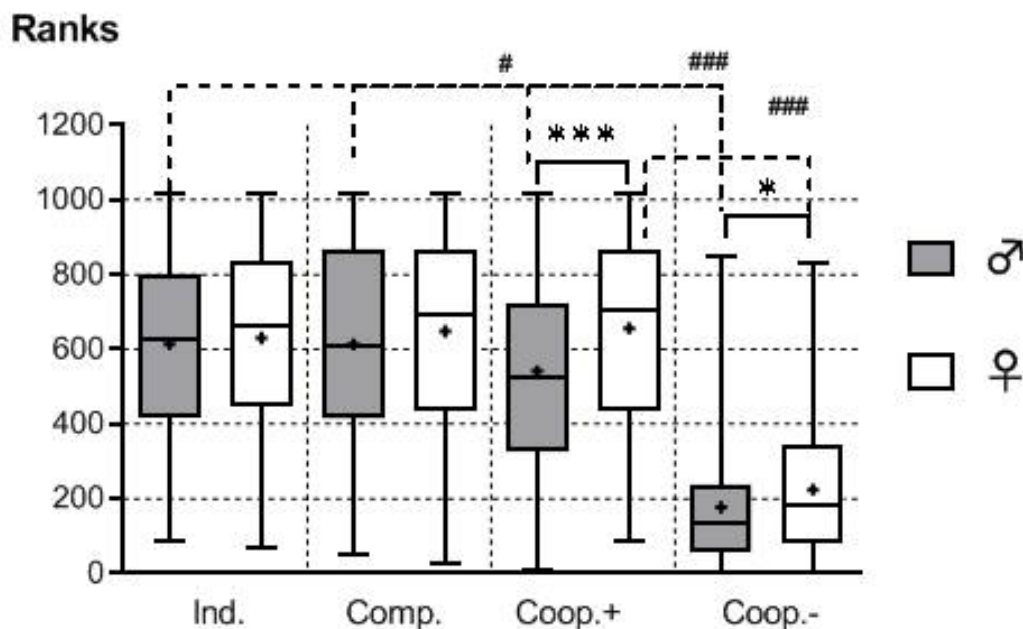


Fig. 2. Performance indicators in groups of men (♂, grey boxes) and women (♀, white boxes) in different contexts of sensorimotor activity: individual (Ind.), competitive (Comp.), cooperative with feedback (Coop.+) and without feedback (Coop.-) from the partners' actions. Abscissa axis – contexts, ordinate axis – performance ranks. Designations: box boundaries – upper and lower quartiles, lines in boxes – medians, crosses in boxes – means, whiskers of boxes – minima and maxima. Reliability of differences: asterisks – between samples of boys and girls * – $p(\text{MU}) < 0.05$, *** – $p(\text{MU}) < 0.0001$; hashes – between contexts # – $p(\text{Fr, Wil}) < 0.05$, ### – $p(\text{Fr, Wil}) < 0.001$

Based on the values of personal performance of the SMT in conditions of cooperation with feedback from the contribution of partners, all subjects were divided into high-, medium- and low-performance participants, similar to the division of participants at the individual and competitive stages. The ratios of the proportions of subjects with different levels of success in three activity contexts are presented in Figure 3.

In cooperation, the percentage of high-performing men decreased (to 40.8%), and the percentage of medium- and low-performing men increased (to 23.1% and 36.2%, respectively), which was significantly different from the distribution of subjects at the individual stage of training ($p(\text{Chi}^2) = 0.033$). In cooperation, the proportion of women participants with personal high performance increased (66.1%), while the percentage of medium- and low-performance women decreased. Reliable differences ($p(\text{Chi}^2) < 0.001$) were found in

these ratios of the proportions of subjects with different levels of performance in cooperation between samples of men and women.

Correlation analysis revealed significant correlations between personal performance in cooperation with feedback from partner contributions and performance in individual activity conditions in both male ($r=0.36$, $p<0.0001$) and female ($r=0.40$, $p<0.000001$) samples. An even stronger correlation was found between performance in this cooperative context and competitive performance in both males ($r=0.46$, $p<0.0001$) and females ($r=0.60$, $p<0.00001$). Women's personal performance in cooperation without feedback from participant contribution was also significantly correlated with individual ($r=0.23$, $p=0.009$) and competitive ($r=0.42$, $p<0.0001$) performance, whereas these correlations were absent in the male sample. Performance between the two cooperative contexts was significantly correlated in

females ($r=0.37$, $p=0.0002$) and more weakly correlated in males ($r=0.20$, $p=0.02$).

Next, we analyzed the values of the integral performance of pairs during cooperation (R_i , %), which corresponds to the percentages of the duration of holding the common column in the target range from the SMT time (Figure 4). The distributions of the R_i index differed significantly between samples of dyads of males and females ($p(\text{Chi}^2)=0.0039$) during cooperative activity in the condition of presenting feedback from partners' actions. This difference indicates a shift in the mode of the distribution of the integral performance of male pairs towards lower values compared to female pairs, with the mode of the R_i index

ranging from 90–100% in 60% of female dyads. This fact is also supported by the result of non-parametric comparison of R_i values of two independent samples of male and female dyads ($p(\text{MU})=0.0002$).

Integral performance R_i in cooperative conditions without feedback from the personal contribution of partners was significantly reduced in both male and female dyads. However, it remained significantly higher in female pairs than in male dyads ($p(\text{MU})=0.0216$), and 40% of female pairs had R_i over 75%. Thus, the integral result of pairs in cooperation was higher in female dyads compared to male dyads because it was determined by the more successful personal contributions of female participants.

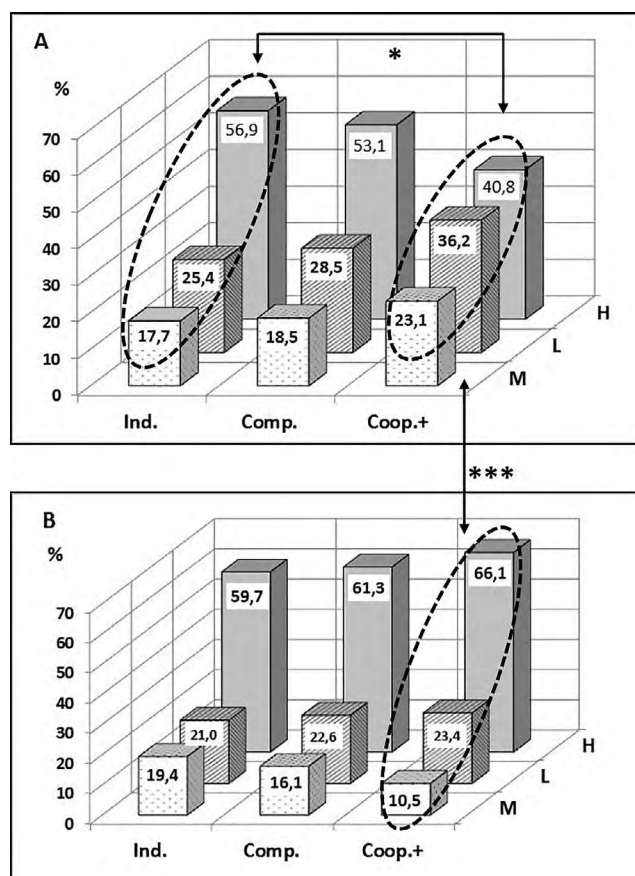


Fig. 3. Distributions of subjects in groups with different performance levels (H – high, M – medium and L – low) among men (A) and women (B) in different contexts of sensorimotor activity. The abscissa axis shows the contexts: individual (Ind.), competitive (Comp.) and cooperative with feedback from the contribution of partners (Coop.+). The ordinate axis shows the % of subjects in groups. Asterisks indicate reliable differences between the distributions highlighted by dotted ovals:

* – $p(\text{Chi}^2) < 0.05$, *** – $p(\text{Chi}^2) < 0.001$

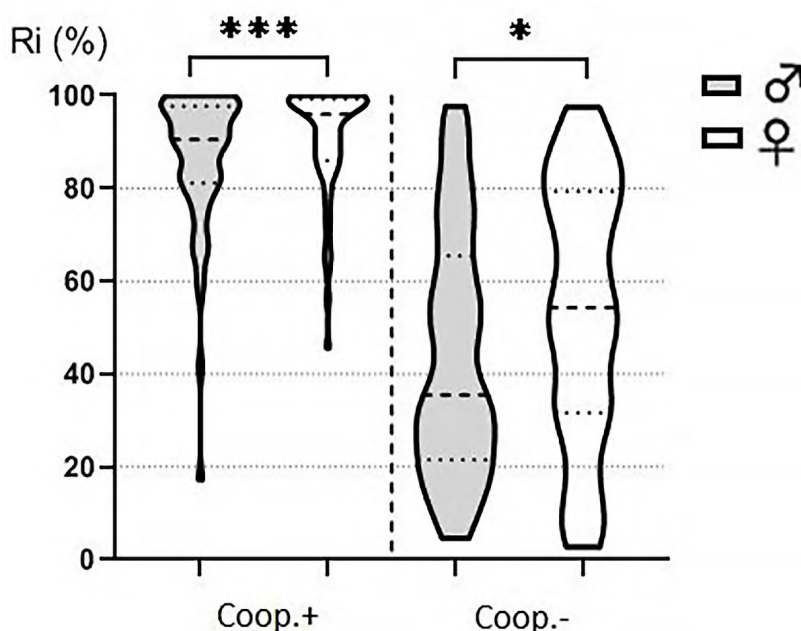


Fig. 4. Violin diagrams of distribution of integral performance of cooperative activity in pairs of men (♂) and women (♀) with feedback (Coop.+) and without feedback (Coop.-) from partners' actions. Significance of differences: * $-p(\text{MU}) < 0.05$, *** $-p(\text{MU}) < 0.001$

All subjects (both male and female) were divided into three groups according to their individual SMT performance: high-, medium-, and low-performers. In sensorimotor tasks of the static type, subjects are required to have a high level of motor self-control of behavior, which depends on the degree of emotional arousal, impulsiveness and characteristics of motor activity of individuals. The absolute values of the subjects' performance in the competitive context of the trainings and its relative changes were related to the initial level of performance achieved in the individual activity conditions. Gender differences were found between males and females with initially low SMT performance: a higher proportion of these female participants had increased performance compared to the corresponding group of males.

It has been shown that in competitive activity conditions, dominance motivation and the desire to compete are the leading factors of performance, especially in men [13, 15]. In these conditions, the level of attention and control over one's own and others' actions increases. It has been shown that men, compared to women, have more pronounced

changes in EEG parameters and characteristics of evoked potentials of cortical structures of subjects during competition, reflecting neurophysiological mechanisms of greater sensitivity to errors made by both the subject and his opponent [19]. In addition, the subject's observation of the behavior and activity tactics of the more successful opponent in the dyad during the competition may also contribute to improving his or her performance of the SMT. However, in the sample of initially low-performing men, a rather high percentage of subjects were found who further reduced their performance in the competitive context. It is likely that these young men were exposed to social stressors in a competitive context related to comparing their own and others' current performance and errors, which led to increased psycho-emotional arousal and negatively affected subjects' performance through negative feedback [20]. A more reliable prediction of a person's competitive success requires an assessment of baseline personality characteristics, impulsivity and self-control of behavior, as well as the degree of dominance of individuals' behavioral inhibition or activation systems in situations of stress.

Analysis of the personal performance of subjects in dyadic cooperative conditions revealed significant differences between samples of men and women. In cooperative conditions with feedback from participants' contributions, performance did not change in the female group and was accompanied by an increase in the proportion of high-performing participants, higher than in the male group. Reduced performance was found in the female sample only in co-operative conditions without feedback from personal contributions, while remaining significantly higher than in the male sample. The findings of women's higher performance in cooperative settings compared to men are consistent with studies [15, 16] that have demonstrated women's greater propensity for empathy and cooperation.

The data of correlation analysis of performance indicators in different contexts of SMT show their greater conjugation in the sample of women than in men. It is shown that conditions of cooperative activity without feedback from partners' actions cause disorganization of sensorimotor activity in men with a significant decrease in performance, independent of the results of previous training in other contexts.

Monitoring one's own and others' performance during cooperative interactions is crucial for effective mutual behavioral adaptation and interpersonal coordination. In the process of performing a common task, when participants assign roles and do complementary parts of the work, each of them has a holistic perception and integrated representation of their own and other participants' actions, as if the whole activity were being performed by him/herself [21]. This phenomenon is called the social Simon's effect, after the test in which it was discovered. It has been shown that common representations arise predominantly in the process of interpersonal coordination, while competitive conditions of activity reduce such integration [22]. It was found that the indicators of motor coordination of a person with another subject demonstrating movements on the screen depended on the gender and emotions of the presented avatar [23]. The Simon's effect has been shown to be more pronounced in women than in men, and the female participants were also more strongly influenced by environmental factors not directly related

to the activity [24]. The same study found that women's response speed was slower than men's, although there was no difference in accuracy. It has also been found that reaction times after one's own mistakes and the accuracy of task performance after observing the erroneous actions of others are modulated by the social context and depend on the gender of the subjects [20]. In men, changes in indicators of decision-making processes, including characteristics of evoked potentials of the brain, were more pronounced in a competitive context, while in women — in conditions of cooperation.

Some authors explain gender differences in the level of empathy, behavioral and neurophysiological indicators in the process of social interactions by neuroanatomical features of the functioning of the mirror neuron system, which plays a key role in ensuring the processes of interpersonal coordination [25, 26]. There is also evidence that gender differences in performance and decision-making characteristics in competitive and cooperative conditions of activity can be determined by the different sensitivity of men and women to positive and negative reinforcement factors [27].

Conclusion

Thus, the results of the study of the levels and dynamics of the effectiveness of subjects' performance of sensorimotor training in individual and joint conditions indicate gender differences associated with the different influence of social factors on the success of competitive and cooperative activities in dyads. In cooperation, women have significantly higher indicators of both personal and integral dyadic performance compared to men. In a sample of men, joint conditions of activity, especially cooperative ones, cause a decrease in personal and integral performance, as well as a decrease in the number of high-performing and an increase in the number of low-performing subjects.

References / Список литературы

1. Martsinkovskaya TD, Khoroshilov DA. The psychology of social cognition: Prospects for development in a changing society. *Vestnik of Saint Petersburg University. Psychology*. 2023;13(1):12–23. (In Russian) [Марцинковская, Т.Д., Хорошилов, Д.А. Психология

- социального познания: перспективы развития в изменяющемся обществе. Вестник Санкт-Петербургского университета. Психология, 2023. Т. 13 № 1. С. 12–23. <https://doi.org/10.21638/spbu16.2023.101>. doi:10.21638/spbu16.2023.101
2. Krendl AC, Betzel RF. Social cognitive network neuroscience. *Social cognitive and affective neuroscience*. 2022;17(5):510–529. doi:10.1093/scan/nsac020
 3. Coulombe S, Hardy K, Goldfarb R. Promoting wellbeing through positive education: A critical review and proposed social ecological approach. *Theory and Research in Education*. 2020;18(3):295–321. doi:10.1177/1477878520988432
 4. Evans JC, Evans MB, Slack M, Peddle M, Lingard L. Examining non-technical skills for ad hoc resuscitation teams: a scoping review and taxonomy of team-related concepts. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2021;29(1):167. doi:10.1186/s13049-021-00980-5
 5. Markose G, Berezowski BM, Chiu GA, Cousin GCS. Situational awareness in driving, and lessons for surgeons. *British Journal of Oral and Maxillofacial Surgery*. 2021;59(4):485–489. doi:10.1016/j.bjoms.2020.11.003
 6. Küçüktağ EB, Kim SJ, Wen Y, Lynch K, Pons JL. Human-machine-human interaction in motor control and rehabilitation: a review. *Journal of neuroengineering and rehabilitation*. 2021;18(1):183. doi:10.1186/s12984-021-00974-5.
 7. Jhangiani R, Tarry H, Stangor C. Principles of social psychology (1st international H5P edition). 2022. <https://opentextbc.ca/socialpsychology/>
 8. Batson JP, Kato Y, Shuster K, Patton JL, Reed KB, Tsuji T. Haptic coupling in dyads improves motor learning in a simple force field. 2020 42nd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC). IEEE. 2020;4795–4798. doi:10.1109/EMBC44109.2020.9176261
 9. Gorsic M, Tran MH, Novak D. Cooperative cooking: a novel virtual environment for upper limb rehabilitation. *Proceedings of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBS*. 2018; 3602–3605. doi:10.1109/EMBC.2018.8513005
 10. Takagi A, Hirashima M, Nozaki D, Burdet E. Individuals physically interacting in a group rapidly coordinate their movement by estimating the collective goal. *Elife*. 2019; 8: e41328. doi:10.7554/eLife.41328
 11. Mojtahedi K, Fu Q, Santello M. On the role of physical interaction on performance of object manipulation by dyads. *Frontiers in human neuroscience*. 2017;11:533. doi:10.3389/fnhum.2017.00533
 12. Kaefer A, Chiviacowsky S. Cooperation enhances motor learning. *Hum Mov Sci*. 2022;85:102978. doi:10.1016/j.humov.2022.102978
 13. Müller F, Cañal-Bruland R. Interindividual differences in incentive sensitivity moderate motivational effects of competition and cooperation on motor performance. *PloS one*. 2020;15: e0237607. doi:10.1371/journal.pone.0237607
 14. Yang D, Tu CC, He TB. Effect of conscientiousness on social loafing among male and female chinese university students. *The Asia-Pacific Education Researcher*. 2024;33(2):459–469. doi:10.1007/s40299-023-00742-0
 15. Buser T, Van Den Assem MJ, Van Dolder D. Gender and willingness to compete for high stakes. *Journal of Economic Behavior and Organization*. 2023;206:350–70. doi:10.1016/j.jebo.2022.12.016/
 16. Cohen L, Lansing AH. The tend and befriend theory of stress: Understanding the biological, evolutionary, and psychosocial aspects of the female stress response. In: Hazlett-Stevens H, ed. *Biopsychosocial Factors of Stress, and Mindfulness for Stress Reduction*. Springer International Publishing; 2021; 67–81. doi:10.1007/978-3-030-81245-4_3
 17. Merkulova MA, Akulina MV, Lapkin MM. Gender Features of Formation of Purposeful Human Behavior when Playing Images with Different Performance. *RUDN Journal of Medicine*, 23 (3), 308–317. (In Russian) [Меркулова М.А., Акулина М.В., Лапкин М.М. Гендерные особенности формирования целенаправленного поведения человека при воспроизведении зрительных образов с различной результативностью. Вестник Российского университета дружбы народов. Серия: Медицина. 2019. Т. 23. № 3. С. 308–317]. doi:10.22363/2313-0245-2019-23-3-308-317
 18. Spadaro G, Jin S, Balliet D. Gender differences in cooperation across 20 societies: A meta-analysis. *Philosophical Transactions of the Royal Society B*. 2023; 378(1868), 20210438. doi:10.1098/rstb.2021.0438
 19. Yang H, Duan Q, Peng M, Gu R, Sun X. Sex differences on the response to others' gains and losses under cooperation and competition. *International Journal of Psychophysiology*. 2022;182:211–219. doi:10.1016/j.ijpsycho.2022.10.012
 20. Koay JM, Meter AV. The effect of emotion regulation on executive function. *Journal of Cognitive Psychology*. 2023;35(3):315–329. doi:10.1080/20445911.2023.2172417
 21. Campos-Moinier K, Murday V, Brunel L. Individual differences in social interaction contexts: Examining the role of personality traits in the degree of self-other integration. *Personality and Individual Differences*. 2023;203:112002. doi:10.1016/j.paid.2022.112002
 22. Ciardo F, Wykowska A. Response coordination emerges in cooperative but not competitive joint task. *Frontiers in psychology*. 2018;9:1919. doi:10.3389/fpsyg.2018.01919
 23. Zhao Z, Salesse RN, Qu X, Marin L, Gueugnon M, Bardy BG. Influence of perceived emotion and gender on social motor coordination. *British Journal of Psychology*. 2020;111(3):536–555. doi:10.1111/bjop.12419
 24. Stoet G. Sex differences in the Simon task help to interpret sex differences in selective attention. *Psychological research*. 2017;81(3):571–581. doi:10.1007/s00426–016–0763–4
 25. Cheng Y, Chou KH, Decety J, Chen IY, Hung D, Tzeng OL, et al. Sex differences in the neuroanatomy of human mirror-neuron system: A voxel-based morphometric investigation. *Neuroscience*. 2009;158(2):713–720. doi:10.1016/j.neuroscience.2008.10.026
 26. Wu X, Lu X, Zhang H, Bi Y, Gu R, Kon. Sex difference in trait empathy is encoded in the human anterior insula. *Cerebral Cortex*. 2022;33(9):5055–5065. doi:10.1093/cercor/bhac398
 27. Li G, Zhang S, Le TM, Tang X, Li CSR. Neural responses to reward in a gambling task: sex differences and individual variation in reward-driven impulsivity. *Cerebral Cortex Communications*. 2020;1(1): tgaa025. doi:10.1093/texcom/tgaa025

Результативность сенсомоторных тренировок в различных социальных условиях деятельности мужчин и женщин в моногендерных парах

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Аннотация. *Актуальность.* Исследование особенностей достижения человеком результатов целенаправленной деятельности в разных условиях социальных взаимодействий актуально и имеет высокую научно-практическую значимость. Высокая практическая значимость обусловлена необходимостью обеспечения предприятий квалифицированными кадрами, соответствующими нарастающим современным требованиям к компетенциям и навыкам, включая социальные, а также для повышения эффективности образовательного процесса школьников и студентов. Кроме того, актуально поддержание психосоматического здоровья населения, которое существенно зависит от влияния социальных факторов в процессе жизнедеятельности и характера производственных отношений. Цель исследования — изучить изменения показателей результативности выполнения сенсомоторных тренировок в разных социальных контекстах деятельности в однополых парах мужчин и женщин. Материалы и методы. Обследовано 65 пар мужчин и 63 пары женщин (19 лет $7 \text{ мес} \pm 3 \text{ мес}$), с использованием сенсомоторного тренинга «Столбики» программно-аппаратного комплекса «БОС-Кинезис» (ООО «Нейротех», Таганрог, РФ). Протокол исследования включал выполнение задания в разных социальных контекстах: индивидуально, конкурентно и в сотрудничестве с партнером в условиях с обратной связи от действий участников и без нее. *Результаты и обсуждение.* По показателю максимальной результативности за три индивидуальных тренинга определились три группы испытуемых: высоко-, средне- и низкорезультативные. При соревновании увеличение результативности наблюдалось в двух последних группах. Обнаружены половые различия в доле испытуемых с исходно низкой результативностью, которые улучшали показатели результативности деятельности в конкурентных условиях: их % был достоверно ниже среди мужчин, чем в выборке женщин. При межличностной сенсомоторной координации с обратной связью от действий партнеров у мужчин происходило достоверное уменьшение персональной результативности и показателей интегрального результата пар, в отличие от женских диад. При сотрудничестве без обратной связи от действий участников выявлено снижение персональной и интегральной результативности всех пар испытуемых, но более значимо в мужских диадах. *Выводы.* Изменения показателей результативности в совместных контекстах деятельности в диадах испытуемых определялись их исходными уровнями и достоверно различались между мужскими и женскими парами.

Ключевые слова: результативность, сенсомоторная деятельность, социальный контекст, соревнование, кооперация, диады

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