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GENETIC OR SOCIAL DETERMINATION OF THE DIRECTION OF TURNS DURING PHYSICAL EXERCISES

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It was found that the direction of turns varies according to the kind of sport, gender, complexity of exercise and handedness. It seems that development of motor abilities is initially characterised by symmetry of movements, or at least it is so at 10 years of age. Later on, asymmetry in turns is begining to develop, as the result of specific nature of sport practised or other kind of exercising.

Movements with turns occupy an ever more significant position in contemporary competitive sport; in some sports they are dominant, e.g. in figure ice and roller skating, sport and artistic gymnastics, acrobatics, diving. From the technical point of view the turns determine the difficulty of the particular sport. The more turns are included in the sport discipline, the higher its coordination difficulty level is. The increase of the standard in these sports takes place mainly through an increased number of turns in the individual exercises (up to 4 turns around the longitudinal axis and 3 around the transverse axis of the body). Training drills which include a large number of turns require a high level of coordination. Therefore, the abilities required for success in these sports are determined by inborn predispositions. But how can they be evaluated? The tests of motor abilities recommended so far do not solve the problem, especially in regard to their utilization in selecting athletes in competitive sport (16–25).

Exercises including turns are performed to the left or to the right, and sometimes in both directions. In certain sport disciplines the direction of turns is traditional. It has been suggested that this is a „natural direction" (Stein – 26). Can we really identify the origin of this dominant direction of movements, i.e. is it genetically or socially determined? More over, is the direction of turns same for everybody? The above questions are of great significance for the theory and practice of teaching movement and sports instruction.

The review of references did not provide an answer to any of the above questions. Few existing reports have merely outlined some aspects of the problem (3–27). Therefore, it can be concluded that *there is no comprehensive approach to this issue, yet so important for the sport practice.*

Material and methods

The material and methods were selected according to the purpose of the study. The basic material was collected from the athletes representing the sports in which exercises with turns are predominant (figure ice and roller skating, artistic gymnastics). For comparison purposes, the athletes of other sports were also analyzed. As a model sport ice figure skating was chosen, and served as a basis for most of the analyses. The subjects represented different age groups, sport experience and level of advancement (from a beginner to a world champion). Total of 6 701 subjects was studied.

The material was collected using various methods, such as an interview, observations, capacity tests, experiments, references review. The preferred methods were chosen so as to enable their usage under natural conditions of sports training and competition. In this way the predisposition of turning in the particular („natural") direction could demonstrate itself, without any bias introduced by organization and methods of studies. A minor part of research consisted laboratory investigations, in which the author's own test of coordination was used (maximum turn in jump). The turn test results were obtained using a special coordination meter with one-degree precision. The motor task, maximum turn to the right and left, was performed twice. Better results were analyzed. The investigations were carried out in the morning, prior to physical effort. The test was started with the direction selected by the subject. A more detailed description of the method was published earlier (16–25). The interview was carried out using a uniform set of questions. In observations, the author's own method of recording the elements performed by the subject in the programme was applied, using a special code of exercises (14).

Results and discussion

The results were analyzed taking into account the following problems: 1) the direction of turns predominant in various sports, 2) the direction of turns and gender; 3) the direction of turns and take-off leg in jumping; 4) the direction of turns and the type of exercise; 5) the direction of turns, and right-or left-handedness; 6) the direction of turns, and their speed in spins; 7) the direction of turns, and age and method of teaching.

1. The direction of turns predominant in various sports

This problem was analyzed in 1,690 subjects in four sports (*Fig. 1*). First, the results of 512 ice figure skaters were analyzed, with observations carried out mainly (70.9%) during European and World Championships and

Olympic Games. The direction of movement was established on the basis of 30 elements performed in the free programme. The elements were recorded separately for each subject in 30 second intervals. This detailed recording (chronometrage) of the individual technical skill of the subject was combined with identification of the direction of turns performed during exercises. Arithmetical means of three recordings reveal the left turn predominance in 74.1% ice skaters. A similar trend (77.5%) was observed in 80 top-class ice and roller skaters studied by F. Stein (26). The left turn predominated (92.0%) in beginning roller skaters.

Left turn is not so pronounced in 254 women artistic gymnasts (8). In the four exercises analyzed, left turns were performed by 44.0% subjects. This observation is confirmed by the results of investigation carried out on 15 Polish top artistic women gymnasts. The athletes performed two motor tasks: maximum turn in jump from one leg and another one from both legs, included in the coordination test (16–25). The tasks were performed in both directions. The direction to which the subjects achieved higher results was considered as better direction. The quality of performance of motor tasks with different difficulty level (jumps from both legs easier) was identical: 53.3% subjects performed higher number of left turns.

The disciplines analyzed so far belong to the acyclic group of sports. Is the observed trend of left turn predominance, typical just for this group of sports? This may be confirmed by observations of 815 students of the Academy of Physical Education in Warsaw who were undergoing training in basic kayak paddling (9–15). At the end of training the students had to perform the so-called kayak loop. The task required execution of half of the loop to the right, and the other half to the left. From the time needed to perform each part of the exercise, the better direction of turn was identified, i.e. to the right for 50.8% subjects.

The whole set of results reveals the left turn as dominant in majority of the subjects. Can we regard this direction of turn as „natural", genetically determined and typical for man? Such a conclusion would be premature. One of the reasons is that the predominance of the left turn varies, depending on the hind of sport. Perhaps a trend of performing exercises associated with the particular direction of turns has been established during historical development of certain sports.

2. The direction of turns and gender

In order to define the relationship between the direction of turns and gender (15), results of four series of studies, carried out on 375 women and 217 men ice and roller skaters (*Table 1*) were analyzed. Arithmetical means in four independent studies suggest the left turns as predominant in most subjects, the trend being more pronounced in men in all the studies. At the same time, in the male group the number of subjects who performed exercises with right turns and symmetrically, i.e. in both direction (the same exercise in the right and left, or part of the exercises to the right, and part to the left) was smaller. This may be an evidence of better technical (and perhaps also motoric) versatility of women and their ability of modification of the traditionally established form of movements.

3. The direction of turns and the take-off leg in jumping

The material was obtained interviewing 149 figure skaters of the U.S.S.R. and Poland (12, 15). The questions dealt with the take-off leg during long, high, and skating jumps (*Fig. 2*). The analysis of the technique permitted to consider the skating jump as the most difficult. In the skating jump the take-off is performed from „sliding". The perception and identification of the moment to take-off is difficult and requires longlasting training. The next stage, flying, provides better motivation. In long jump the non-support phase is not complicated and does not include turns. High jump is usually performed using a turn around the longitudinal axis of the body. Turns in jumping make their technique difficult, since turns must be properly coordinated with movements of the whole body. In skating jumps the number of turns is considerably higher (180^{O} to 1440^{O}).

The interviews (*Fig. 2*) revealed an interesting trend: *the more complicated the jump, the higher the number of subjects performing the take-off with the left leg.* This was observe both in men and women. With the increasing level of difficulty, the number of subjects using the right-leg take-off was reduced, and the number of those using the left leg increased (dispersion within 20.8%). Comparison of the performance of jumps with turns and spins (cf. Fig. 1) and take-off during jumps reveals that in the former the left turns, and in the latter the left leg are predominant. Similar observation was reported by F. Stein (25). This suggests the following trend: *the method of jump performance is determined by the direction of turns rather than the take-off leg. The higher the number of turns in the jump, the more often it is performed to the left.* This has been confirmed by N. Wolanski (27) who has demonstrated that left leg is used more often, resulting in its better development (bigger size). This also applies to the competitive sport, as confirmed by observation of 137 world top track-and-field athletes and analysis of literature data on 128 track-and-field athletes (*Fig. 3*). The aim was to identify the take-off leg during four different jumps (13, 15). In technically more difficult jumps, take-off with left leg is dominant. Similar data were obtained by the author in his own studies, as well as in other observations carried out on 2,999 atletes (*Table 2*).

The trend observed here is of significance for physical education practice, and especially for competitive sport. The choice of the take-off leg is determined more frequently by a more „convenient" direction of turn rather than by a „better" or stronger lower limb. However, it is difficult to establish whether the direction termed by some authors as „natural" is more convenient. Is this direction genetically or socially determined? The author's own numerous studies seem to suggest (4–25) that convenient direction is most often the one which the subjects used in their first successful trials and which they sub-

sequently followed. In most cases, this direction is demonstrated and demanded by the coach who does not care for the development of symmetrical skills.

4. The direction of turns and type of exercise

The material was obtained from interviews of 149 advanced ice skaters of U.S.S.R. and Poland (12, 15). The purpose of the analysis was to determine the variation of turns, depending on the type of exercise. The latter term also includes a particular nature of the exercise, environment (ice skating on the rink, choreographic exercises in a hall), clothes and equipment (skates for obligatory and free skating), instructor (coach, choreographer) and methodology, also associated with the direction of turns.

Jumps with turns and spins were performed by the majority of subjects (82.4–84.2%) to the left (*Fig. 4*). Most of the subjects (65.2%) also maintained this direction of turns in choreographic exercises. What may be the reason for the decrease (over 18%) of left turns in choreographic exercise? It might be ascribed to the collision of two different trends preferred in figure ice skating and choreography, i.e. left turns in the former, and right turns in the latter. Choreographic exercises organized for ice skaters must have undergone certain modifications, taking account of left turns as predominant in ice figure skating. However, a complete modification of choreographic methodology was impossible. Hence, the collision of two separate traditions in motor performance of subjects resulted in decreased predominance of left turns, and increased the number of subjects performing turns in both directions. It was also the reason why 10.0% of subjects were not able to determine the predominant direction of turns in choreographic exercises. The majority (35.0%) of 59.3% subjects were convinced that their first coach performed the elements with turns to the left.

The waltz step on the floor was performed by most of the subjects (38.2%) in the traditional direction to the right; however, a large number (33.8%) could dance waltz in both directions. The above data suggest that the majority of subjects became accustomed to the tradition of right turns in waltz. At the same time, some of the subjects transferred the direction of turns from ice skating to floor dancing. A certain number of women (14.4%) danced waltz in both directions. It cannot be ignored that this was a result of their higher versatility in exercises with turns, associated with the natural need for and enjoyment of this form of movement.

The rules of obligatory exercises only partly demand symmetrical abilities (12). The performance is usually started with the right leg, i.e. right leg is being preferred. Most of the subjects (45.9%) pointed out at the right leg as being more precise in execution of obligatory exercises. Nevertheless, a large number of subjects (29.6%) performs the exercises successfully on both legs, what on the basis of their subjective evaluation, demonstrates their symmetrical skills.

5. The direction of turns and left- or right-handedness

The material was obtained from interviews of 149 ice skaters of U.S.S.R. and Poland (12, 15). The analysis included correlations between righthandedness and the direction of turns. A pronounced relationship (85.6%) was observed between righthandedness and the left direction of turns (*Fig. 5*). It may be a result of higher strength of the right hand, enabling a stronger swing which determines the speed and number of turns in spins and jumps. This is, however, only an assumption, since the other (right) direction of turns predominates in choreography, and the swing is performed by the left hand.

The analysis of reference reports (4, 15) shows that C. Colledge, a world champion, being lefthanded, performed her jumps and spins originally in the left direction. Her attempts of more difficult jumps were met with certain difficulties. Though at that time she was already a world champion, her coach, G. Lussi, made her perform the exercises with turns in the opposite direction. As a result, she mastered difficult double jumps. Another world champion, D. Jackson, was also lefthanded. In his exercises with turns the left direction was predominant, and he performed split jump and Paulsen Axel in the left direction.

A different performance of exercise with turns has been observed in lefthanded persons. An equal number of subjects (33.33% each) prefered either left or right turns, while the rest performed jumps to the left and spins to the right. This seems to point to the effects of social factors (tradition, organization of sessions, model competitor, teaching methods, requirements of an instructor, etc.) on the athlete's motor performance. Consequently, some of the subjects maintained their „natural" direction of turns, while the others changed it slightly (jumps to the left, spins to the right) or completely. It shows man's high abilities of adaptation to various forms of movement, including to the direction of exercises with turns. At the same time, it makes the idea of the „natural" direction of turns doubtful; if the direction may be changed, could it be genetically determined? *The question of whether left turns in righthanded, and right turns in lefthanded are their natural property, specific for man's motor abilities,* remains to be answered.

6. The direction of turns and their speed in spins

Review of references (15) reveals another problem: does the asymmetrical distribution of internal organs (according to M. Iwanicki, the right side of the body is heavier by some 500 g) favours more rapid turns in one or the other direction? Additional motivation for such analysis was an attempt to contribute new material into the dispute on traditional but different directions of turns observed in classical dance (right turns predominant)*

* Predominance of right turns in the majority of ballet soloists was determined through many years' observations (chronometrage of movements during performance) of the leading ballet groups, including the Opera and Ballet in Moscow, Leningrad, Warsaw.

and ice figure skating (left turns). To this end, observations were carried out recording the number and speed of turns during different spins in figure ice skating. The investigations, aimed at identification of the relationship between the speed of turns in spins and the direction of their performance, were carried out on the participants of international competitions, European and World Championships, and revue soloists (14–15). The recording was always made by the same two persons. The final result was the mean value of two observations. Results of 458 observations of six spins (20 were studied) are presented in *Table 3*. The average speed of turns was found to change only slightly (non-significant variation) according to the direction of spins. On the other hand, left spins are slightly more rapid. In conclusion, the distribution of internal organs does not have any significant effects on the direction of movements. The results seem to suggest that either direction may be natural for the individual subjects during performance of spins.

7. The direction of turns, and the age and methods of teaching

The purpose of the analysis was to elucidate the following questions:

a) is it possible to perform the turns equally correctly both directions?

b) at what age does the predisposition for performance of turns in one direction develops?

The answer to the first question was provided by data of 6 years' observations carried out on 330 top ice skaters performing free programmes during championships (4–5, 15). The group included numerous European and World champions (4–5, 15), among which 49 competitors were able to perform difficult jumps and spins with turns in the direction opposite to their „own". The number of exercises performed symmetrically varied from 1 to 7. The largest number of such exercises was performed by R. McKenzie, a professional skating world champion. He performed symmetricall even the jumps with two turns and jumps for spins with only slight variation of turn performance to the left and right.

The second question was answered by experiments carried out on 20 advanced figure ice skaters. It was found that performance of spins and jumps with turns in one direction only (asymmetrical performance) resulted in development of one-sided stability of the atrial analyzer (15). Adaptation to the particular direction of turns may develop as early as at the age of 7, but it is unstable and may be erased through appropriate exercises. In view of this, the method of teaching figure ice skating was modified and based on the idea of development of complete symmetry of movements in all exercises performed on the ice rink and in a hall. An experiment on 16 children of a music school (aged 8–11 years), and a subsequent six-years' experiment on 500 trainees of the skating school at the Academy of Physical Education in Warsaw have shown that it is possible to master difficult exercises with turns in both directions (*Table 4*), with slight variation in performance quality (4, 10, 15). Using an appropriate proportion of exercises, the dominant direction of turns was changed. Based on objective indices, one of the directions was identified as the leading one for the particular individual. Nevertheless, further improvement of the other direction was not discouraged, since long-term maintenance of a similar level of performance in both directions favours improvement of motor coordination and technique, as well as learning of new exercises. It has been found that learning more difficult skating exercises requires a higher coordination level. And those exercises contain a higher number of turns. Hence, the ability of performing maximum turn depends on the coordination level. A higher coordination level enables better turn. This gave rise to the idea of measuring the coordination level with maximum turn in jump (the author's test). Measurement of coordination with left and right turns permits to determine not only the coordination level but also the dominant direction of turns.

Taking account of this, investigations were carried out on 1651 children of Warsaw schools (aged 10 years) who performed two repetitions of maximum turn in jump to the right and to the left under the same conditions (time of the day, organization of testing conducted by the same person). Better results were subjected to statistical analysis. Comparison of performance in the right and left direction helped in identifying better result (*Fig. 6*). A slight predominance of right turns in girls, and of left turns in boys was observed. Analysis of total results (girls and boys) showed almost completely uniform performance in both directions (difference 1.6%).

The subjects were non-athletes, hence their coordination abilities may be treated as „free" from the influence of directed training. The data presented here point out at lack of pronounced predispositions for the particular direction, since half of the subjects demonstrated dominance of the left turns and the other half — of the right turns.

This is also confirmed by slight variation of performance of maximum turn in jump in both directions, hence there are no grounds to regard either of the directions of turns as „natural", i.e. genetically preferred. The data suggest that the preferential direction of turns is the one which is most often practised. This points out at social rather than genetical determination of the direction of turns. Practising a particular sport results in development of the dominant direction of turns, as confirmed by the results of studies on coordination (maximum turn in jump) carried out on 246 athletes of Polish national teams in seven sports (*Table 5*). In figure ice skating, wrestling, and judo, the left direction is predominant in technical exercises (19–20). The athletes in these sports obtain better results in maximum turns performed in this direction. This would suggest adaptation of athletes to the specific nature of their sport and man's high abilities in this respect.

Conclusions

1. Exercises with turns occur in numerous sports. They belong to the most difficult exercises from the point of view of coordination. Despite this, they have received very little attention, and the problem of the direction

of turns has not been subjected to a comprehensive analysis.

2. Investigations carried out on 1690 athletes in four sports have shown dominance of left turns in figure ice and roller skating (74.1–92.0%) and artistic gymnastics (44.0–53.3%). The task of the so-called kayak loop was performed by 50.8% kayakers more rapidly when the right direction was used. The predominance of the left direction varies depending on the kind of sport, the lowest predominance was observed in artistic gymnasts. The reason might be that in this sport there are two conflicting trends in the performance of exercises with turns (classical dance – to the right, and ice figure skating – to the left). This resulted in decreased (by over 18%) dominance of left turns in ice skaters while performing choreographic exercises.
3. The results of four independent investigations suggest a more pronounced dominance of left turns in men. A lower number of men performed the exercises with turns to the right and in both directions, i.e. symmetrically. This may be an evidence of greater motor versatility in women.
4. The interviews revealed an interesting trend: the more complicated the jump, the higher the number of competitors who performed it with the left-leg take-off. It is the direction of turns, and not the take-off leg, which determines the method of jump performance. The more turns in the jump, the more frequent the left direction of performance.
5. The interviews have shown the interrelationship between right-handedness and left turns in most subjects (85.6%). A different trend was observed in the left-handed subjects: the same number of them prefer either right or left turns (33.3%). The other subjects performed jumps to the left, and spins to the right. The results seem to point out at the effects of social factors (tradition, organization of training sessions, model of a competitor, etc.) on the subject's motor activity.
6. Measurement of speed of turns in spins, according to their direction, showed non-significant variation; the left spins were performed slightly faster. This would suggest that asymmetrical distribution of man's internal organs does not affect predominance of either direction of turns.
7. Experiments have shown that predispositions for particular direction of turns may be developed at a very young age. Practice results in the development of specialized movements which the subject terms as his or her „own" or „better". The choice of one's „own" direction may also take place after a longer period of training, on the basis of the subject's evaluation of his motor skill and his experience in performing exercises with turns in both directions. The latter type of choice is more proper, because symmetrical performance of exercises improves motor coordination. This permits a more rapid learning of new exercises with turns in both directions and their presentation during championships.
8. The development of child's motor abilities is characterized initially by symmetry of movements, as confirmed by investigations on coordination of 10-year-old children, in whom low variation of performance in maximum right and left turns was observed. With age, the functions of sides of the body become differentiated, i.e. asymmetryc, including turns. This is, above all, a result of man' adaptation to his environment conditions, which also includes adaptation to the specific nature of the sport practised. The results provide no evidence that either direction may be regarded as „natural". Either of them, left or right, be natural.

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Table 1 Direction of turns during execution of free skating elements by women and men ice and roller figure skaters (n = 592)

Author	Gender	N	Direction of turn: left	right	left–right	Method of investigation	Specialization (level of advancement)
Starosta	W	110	81,8	14,55	3,65	Interview	figure skating competitors from different coulntries (from beginner to sport master)
	M	89	84,7	14,05	1,25		
Starosta	W	194	56,1	9,8	34,1	Observation, chronometrage	figure skating (top world competitors)
	M	136	62,5	12,5	25,0		
Starosta	W	19	73,7	26,3	—	Observation	Figure skating (top Polish competitors)
	M	14	85,7	14,3	—		
Stein	W	52	73,1	23,1	3,8	Interview(?)	ice and roller figure skating (world top competitors)
	M	28	85,7	10,7	3,6		
Total (% of final investigations)	W	375	71,4	18,4	13,9		
	M	217	79,7	12,9	9,95		

W women
M men
* includes execution of exercise in both directions part of exercises - right and the others left

Table 2. Take-off leg during execution of track-and-field jumps results of different authors
n = 2299

Author	Take-off leg	variant of jump: long jump	high jump	total results	N
G.Splelle (1) (interview)	R	50,7			135 - 158
	L		67,7	72,4	
N.Czebotariew(2) (interview)	R			62,2	(?)
	L				
T.Wasiljewa (3) (interview ?)	R				
	L			65,0	83
W.Starosta (4) (interview)	R				
	L	49,9	68,5		134
W.Starosta (5) (interview)	R				
	L	81,3	87,5		48
W.Starosta (6) (observation)	R				
	L	74,5	81,9		306 - 314
W.Starosta (7) (interview)	R				
	L	55,3	57,6		149
W. Starosta (8) (observation)	R	50,0			
	L		80,3		194
W. Starosta (9) (literature data)	?	M - 52,6			
	L	W - 66,7	75,0		217
E.Ambarow(10) (observation)	R				
	L	59,0	99,0	59,0	1000

R - Right leg, L - left leg, M - Men, W - Women
The individual investigations examined:
1-3 students, 4 [illegible] and Poland, 5-9 track-and-field
10 world [illegible]

Table 3. Speed of turns in various spins, according to the direction of their execution (to the left or right) in advanced figure skaters

gender	exercise	direction of turns: TO THE LEFT N	TO THE LEFT speed in s	TO THE RIGHT N	TO THE RIGHT speed in s	difference $\bar{x}_L - \bar{x}_R$	critical value	evaluation of the difference (validity)
women	stand spin	66	0,436	75	0,582	0,146	0,156	non-significant
	sit spin	20	0,511	11	0,650	0,139	0,224	non-significant
	camel spin	22	0,821	6	1,390	0,569	1,025	non-significant
	jump in the camel spin	60	0,814	11	0,768	0,026	0,262	non-significant
	buttonsitz	20	0,533	4	0,555	0,022	0,367	non-significant
	acrobatic spin	51	0,513	10	0,528	0,015	0,247	non-significant
men	stand spin	46	0,415	11	0,411	0,001 r	0,291	non-significant
	sit spin	19	0,483	5	0,628	0,199	0,585	non-significant
	camel spin	6	0,617	3	1,117	0,500	0,357	significant
	jump in the camel spin	34	0,748	4	0,705	0,043	0,374	non-significant
	buttonsitz	21	0,528	3	0,487	0,041 r	0,498	non-significant

r - better speed of turns with execution of exercise to the right
results for a number of subjects bellow 30 were evaluated (P > 0,05) n = 458

exercise	no	age (in years and months)	direction of rotation or the leg on which the exercise was performed (in points)		variation in favour of rotation or leg	
			to the right	to the left	to the right	to the left
1 Spin	15	9,4	3,62	3,69		0,07
2 spin	15	9,4	3,79	3,69	0,10	
3 spin	15	9,7	4,17	4,16	0,01	
4 spin	4	11,8	3,75	4,05		0,30
5 spin	14	9,5	2,77	3,00		0,23
6 sit spin	12	12,7	3,52	3,19	0,33	
7 camel spin	13	12,4	3,36	3,23	0,13	
8 camel spin	13	12,4	3,17	3,32		0,15
9 camel spin	9	13,5	3,93	3,61	0,22	
10 split jump	15	9,4	2,86	3,90		1,04
11 flip jump	9	13,5	4,11	4,68		0,57
12 salchow jump	3	9,5	3,47	3,70		0,23
13 salchow jump	14	9,5	2,79	2,86		0,07
14 salchow jump	15	9,6	3,90	4,11		0,21
15 rittberger jump	14	10,0	3,23	4,39		1,16
16 rittberger jump	13	12,4	4,04	3,63	0,41	
17 rittberger jump	13	12,4	3,73	3,59	0,14	
18 rittberger jump	4	11,8	3,88	4,00		0,12
19 rittberger jump	12	12,7	3,93	3,53	0,40	
20 arabesk spiral	28	9,9	2,72	2,69	0,04	
average results	12,45	11,0	3,48	3,55	0,19	0,17

Level of skill in the pupils of the Warsaw Skating School-Academy Physical Education with symmetric performance of figure skating elements (n = 249)

FIG. 1
Direction of turns during exercise performed by athletes of different sports (x of different exercises)
n = 1960

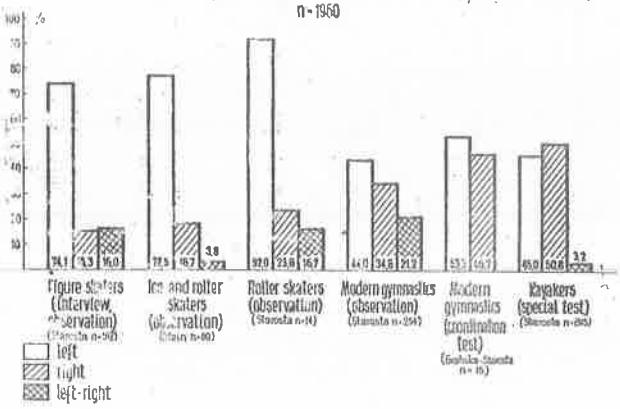


FIG. 2
Frequency of take-off with the left leg in various types of jumps in advanced figure skaters

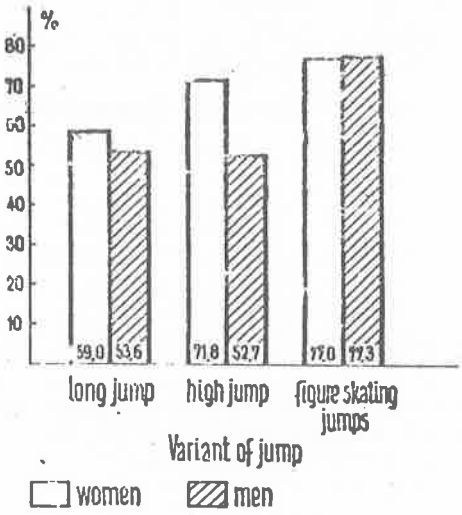


Table 5. Results of rotary movement coordination in leading competitors of various sport disciplines in the preparatory period of training (the number denote the mean values of maximum results in degrees)
n = 246

sport discipline (training group)	N	results of rotary coordination			according to scale	place
		rotation to the right	rotation to the left	differentiation		
figure skating (seniors)	4	695,5	767,3	71,6	96	1
judo (seniors)	12	407	449	42	57	2
weight lifting classical style (juniors)	24	396,8	413,4	16,6	54	3
wrestling free style (seniors)	31	371,7	406,6	34,9	52	4
wrestling free style (juniors)	22	368	390	22	50	5
judo (juniors)	27	362,3	387,7	25,4	50	6
wrestling classical style (seniors)	24	366,9	380,	13,1	50	7
ski jump (seniors)	11	372	369	3	50	8
canoeists (juniors)	9	343,6	358,4	15	47	9
kayakers (seniors)	21	343,6	339,7	3,9	45	10
ski jump (juniors)	7	339,4	340,6	1,2	45	11
kayakers (juniors)	9	324	348	24	45	12
weight lifting (juniors)	27	334,4	329,6	4,8	44	13
weight lifting (juniors)	13	305	319	14	42	14
canoeists (seniors)	5	304,8	316,8	12	41	15

FIG 3
Frequency of take-off with the left leg in various jumps in top track-and-field athletes n = 265

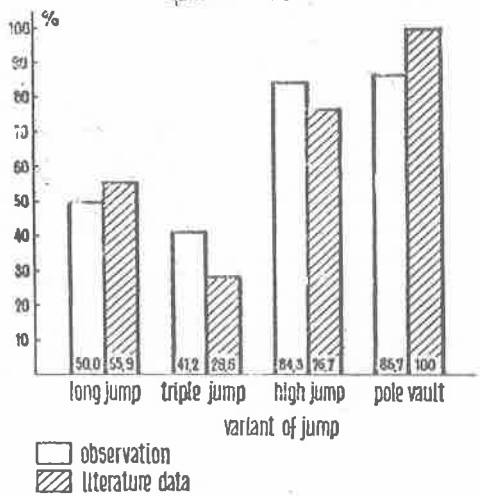


FIG. 4
Direction of turns during execution of various exercises by advanced figure skaters (n = 149)

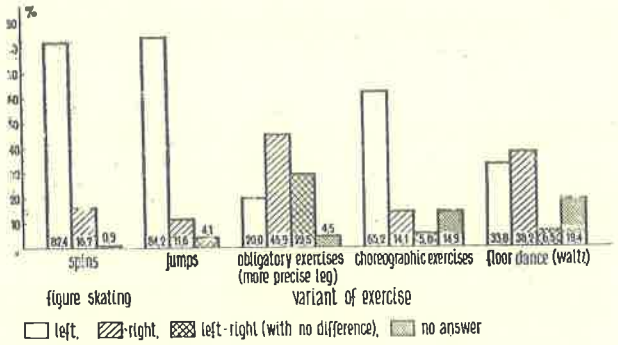


FIG. 5
Interrelationship between right- or left-handness and direction of turns during execution of jumps and spins in advanced figure skaters
n = 108

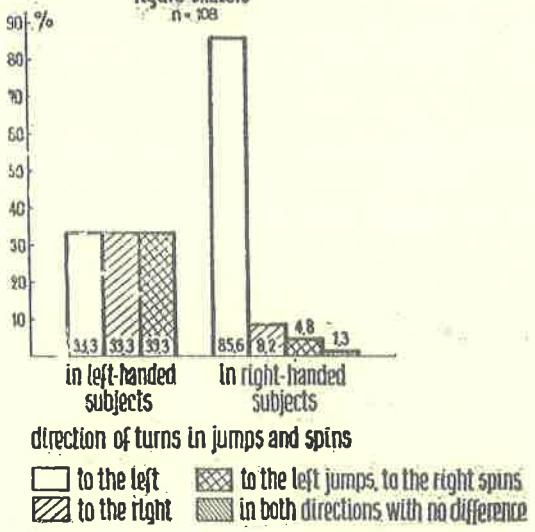
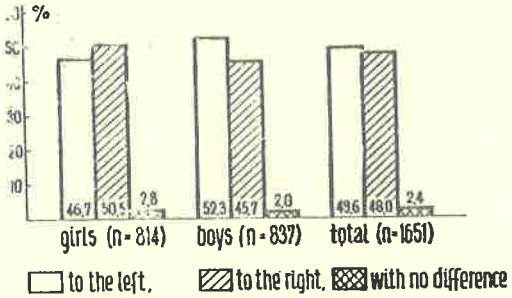


FIG. 6
Dominant direction of turns during execution of coordination test (maximum turn in jump) in 10-year-old children of Warsaw schools
n = 1651



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O GENETIČKOM ILI SOCIJALNOM ODREĐENJU SMJERA OKRETA U VJEŽBANJU

Rad proizlazi iz dugogodišnjeg bavljenja autora ovim problemom, pa su unutar izlaganja korišteni veoma različiti uzorci ispitanika, te metode određivanja preferencije smjera i točnosti izvođenja okreta u desno i u lijevo.

Nađeno je da smjer okreta ovisi u znatnoj mjeri o vrsti sporta (dominacija lijevog okreta kod klizanja i umjetničke gimnastike), o spolu (značajno prevladavanje lijevog okreta kod muškaraca), o broju okreta u jednom skoku (što veći broj okreta, to češći izbor okretanja u lijevo). Također na smjer okreta utječe desnorukost, odnosno lijevorukost. Kod desnorukih ispitanika izrazito prevladava lijevi okret, dok je kod lijevorukih nađen podjednak broj onih koji preferiraju desni i onih koji preferiraju lijevi okret.

Iako je nađeno da je brzina lijevog okreta u prosjeku nešto veća od brzine desnog okreta, razlika nije bila značajna.

Čini se da se predispozicija za određeni smjer okreta razvija veoma rano. Međutim, ne valja ispitanicima prepustiti izbor smjera u vježbanju okreta, jer je, sa stanovišta razvoja koordinacije, znatno korisnije vježbati okrete u oba smjera. Pogotovo jer je na desetgodišnjoj djeci utvrđeno da je razvoj motoričkih sposobnosti karakteriziran u toj dobi simetrijom pokreta, tj. podjednako točnim izvođenjem okreta u jednom i drugom smjeru.

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РОЛЬ ГЕНЕТИЧЕСКИХ И СРЕДОВЫХ ФАКТОРОВ В ОПРЕДЕЛЕНИИ НАПРАВЛЕНИЯ ВРАЩАТЕЛЬНЫХ ДВИЖЕНИЙ В СПОРТИВНЫХ ЗАНЯТИЯХ

Вращательные движения приобретают возрастающую роль в современном спорте. В некоторых видах спорта они доминируют, как например, в фигурном катании на коньках и роликовых коньках, спортивной гимнастике, художественной гимнастике, акробатике и др. Эти движения являются тем решающим фактором, на основе которого эти виды спорта можно считать самыми сложными с технической точки зрения. Утверждается, что чем больше вращательных движений в данном спорте, тем более сложным он является в координационном отношении. Повышение спортивного мастерства в приведеных видах спорта происходит за счет увеличения числа оборотов в отдельных упражнениях. Овладение такого рода упражнениями требует от спортсмена высокого уровня координации движений. Склонности к этим видам спорта и возможности развития спортивного мастерства зависят от генетических факторов. Но как ох определить?

Вращательные упражнения выполняются, чаще всего, в одну сторону: вправо или влево, редко в обе стороны. Существуют виды спорта, в которых направление вращательных движений имеет свою традицию. Даже утверждается, что оно является »естественным направлением«. Можно ли действительно у человека выделить такое естественное направление? Обусловлено ли оно генетически? Естественно ли для всех одно и то же направление вращательных движений? Вот существенные вопросы для теории и практики обучения. На основе собственных исследований, а также работ других авторов, автор статьи пытается ответить на эти вопросы. Материал исследований охватывает несколько тысяч лиц, в том числе большую группу высоко квалифицированных спортсменов. Данные собирались при помощи различных методов: вопросов наблюдений, проведения двигательных тестов, организации педагогических экспериментов и др.