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ADAPTABILITY OF SELECTED MOTOR ABILITIES IN BOYS BETWEEN 12 AND 15 YEARS OF AGE: THE RESULTS OF THE "TRAINING – DETRAINING – RETRAINING" EXPERIMENT

by

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The main goal of the work was to determine changes in motor abilities as a result of a 3-year training experiment, which consisted in applying a two-fold training (in the 1st and in the 3rd year) spaced with a 1-year interval, in two random selected, 20-persons groups of 13-year old boys. The experimental groups differed in their training structure (with a similar load of ca. 50% of the usual load in competitive sports): group A was subjected to the endurance, – speed – strength training, with group B to the speed – strength – endurance training (the difference in the emphasis amounted to 12-18%). The tests were performed 15 times (every 3 months), and they were: 8 ability tests, with which speed tests (standing long jump, 60 m and 300 m runs), endurance abilities (1.000 m run and the Cooper test) and strength abilities (bent-arm-pulling up medicine ball throw and pushing up a load) were examined. The control group consisted of 50 boys of the same age, with the initial parameters close to the experimental groups. The analysis was performed in standardised values of intergropup differences between particular experiment phases with simultaneous elimination of the development trend (the natural development dynamics). It has been found that directed training affects the level of strength abilities most (up to 2 SD over the population level), with speed (0.5 – 0.7 SD) and endurance (0.5 – 0.6 SD) abilities less affected. Even slight differences in the training structure resulted in significant differences in the level of particular skills: thus their ecosensitivity is very high at this age. The achieved training effects were not stable: in the de-training period the speed and endurance abilities dropped down even below the level noted in the compared population. Re-training results in changes, which are decidedly higher than those in the training. It has been confirmed estimated in the population scale may be complementary measure to heritability of particular abilities.

Key words: motor abilities – trainability – longitudinal experiment

Introduction

Adaptability is a term used for determining sensitivity of the organism for changing environmental conditions. In reference to functional traits, which respond to these changes in the first order, lifestyle is the main factor, especially

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movement activity (a review see: Bouchard et al. 1997, Szopa et al. 1996). In the sciences of physical culture, especially in the theory of sport, research questions have been focused mainly on the effect of training (or its discontinuity) on the level and dynamics of changes in particular physiological characteristics, or, on a more comprehensive level, of motority abilities. Two notions have the key meaning here: the training experience and the so-called "sensitive periods". If the former is theoretically clear (adaptability), with its conditioning known (the individual genotype, the genetic control strength over a given characteristics and the power of stimuli), the problem of the sensitive periods remains open (Raczek 1989, Szopa et al. 1996), due to both terminological (overlapping notions) and methodological (the way they are defined) reasons.

Undoubtedly, two issues are the key ones here. The first of these is the problem of **volume (scale) of adaptive changes** under the impact of certain stimuli. Current research has been focused on the so-called sports form examinations, especially in reference to children and the youth, yet the training structure was always imposed by the specific nature of the given sport discipline (which is obvious), with equally rare simultaneous description in terms of structure, volume and intensity. This makes it practically impossible to assess the actual training experience in particular types of motor abilities. The difficulty is aggrieved by the fact that the said research efforts were largely of cross-section nature, their performance was extended over long time intervals, and usually no elimination was applied for the initial level differences (i.e. the impact of the initial selection). Maybe this was the reason why, despite an impressive number of studies, it is so difficult to assess the actual scale of the impact exerted by the doses of movement applied in the examined groups upon the level and dynamics of their motority development (the review of research cases: Malina and Bouchard 1991, Bouchard et al. 1987, Szopa and Srutowski 1990, Szczepanik and Szopa 1993).

The second issue concerns the **stability of training effects**, i.e. the degree of regressive changes after discontinuation of training, and the progress dynamics after returning to exercises. This problem is well examined in adult, competitive sportsmen. It is commonly known that dropping training even for a short period of time (9 days, 2-4 weeks) leads to reduction in the blood volume, the cardiac output, changes in the number of mitochondria (Coyle et al. 1986), reduction in VO_{2max}, parameters of the acid-base blood balance and lung ventilation (Platonow 1990). The (quite obvious) relationships are also known between the training intensity and the earlier level of the given characteristics and the regression volume (Walt and Buskirk 1983, Costill et al. 1985, Sharp et al. 1984). Much less is known in this respect in reference to children and the youth: this research would require longitudinal experimental research to assess the scale of post-training changes (the training experience) with simultaneous assessment of regressive changes, occurring after discontinuation of applying the stimuli: this is a really difficult task, especially from the point of view of organisation and methodology. This paper summarises this kind of effort, in which the following research questions were formulated:

1. To which extent a directed training with a specific structure would affect the level of speed, endurance and strength abilities in boys between 13 and 16 years of age?
2. What is the stability of training effects, measured with the regressive changes associated with a one-year break in trainings?
3. What is the scale of changes after repeated, identical one-year training in the same individuals?
4. Is the adaptability degree in particular ability in all the stages of the experiment related to their genetic control strength?

Material and methods

This paper was based upon the results of a 3-year experiment consisting of three stages. The first year saw specialised, directed trainings, in the second year, the trainings were discontinued (detraining), in the third year training sessions were repeated with identical nature as in the first stage (retraining). The experiment was begun with preliminary examination of 99 boys at the age of 12 years. Then, 43 boys were randomly selected, out of which 2 experimental groups were formed: A and B. The other boys formed the control group (K), which was subject to the regular physical education programme (2 hours per week). The experiment was personally conducted by the first of the authors of this paper in the Primary School in Katowice in the years 1989-1992. The complete research data were collected for the 40 boys of groups A and B (20 in each group) and 50 boys of Group K. The selected groups did not differ in respect of their basic somatic parameters (body height and weight). Group A

Table 1. Volume and intensity of training effort in I and III macrocycles

Group	endurance exercises			strength exercises (t)	speed exercises				sport games (h)	gym-nasatics (h)	starts (km)
	continuous run	intervals run	speed endurance		dashes (km)	skipping (no.)	multiple jumps (nrs)	run ups (km)			
A	458.0	35.0	21.0	37.0	22.0	14.0	3 600	12.0	50.0	33.0	2.0
B	385.0	37.0	25.0	54.0	24.0	15.0	4 200	22.0	46.0	30.0	2.0
intensity index	0.35	0.65	0.76	0.65	0.88	0.65	0.65	0.75	0.55	0.45	0.95

Table 2. Training loads in "contract units"

Group	endurance exercises				strength exercises	speed exercises					sport games general	gym-nasatics (h)	total
	continuous run	intervals run	speed endurance	general		dashes	skipping	multiple jumps	run ups	general			
A	160.3	22.7	15.9	198.9	24.0	19.4	9.1	234.0	9.0	271.5	27.5	14.8	538.5
B	134.7	24.0	19.0	177.7	35.1	21.1	9.8	273.0	16.5	320.4	25.3	13.5	574.0

performed endurance, speed and strength training, while Group B performed speed, strength and endurance training. Different emphasis, due to the necessity of observing ethical principles of the experiment, were relatively small and ranged from 12% to 18%. Tables 1, 2 present detailed data on the type, volume and intensity of exercises and training loads in both groups, the data being made on the basis of documents (training schedules and logs) according to the principles accepted in the theory of sport. Training intensity was assessed measuring heart rate with the PE 3000 Sport Tester (for endurance exercises) and by means of calculating the relationship between the actual effort and the maximum effort (for strength and speed exercises). Multiplying effort volume by the intensity index, **training load in the so-called contract units**, these units being comparable for all types of exercises, was calculated (Tab. 2). The global loads were 538 units for Group A, 580 units for Group B. These values reach 50% of the load applied in competitive sport. Generally speaking, the loads were largest in speed exercises, then in endurance and strength exercises. This is obviously important for the assessment of the training results.

The authors are aware of the controversial aspects of the method applied; however, no better ways have been designed so far.

The research was conducted with 3-month intervals (13 in total) and covered 8 tests for motor fitness, which reflect with satisfactory reliability the level of the three basic motor abilities, especially with their structural and energy background.

It has been assumed that the level of speed skills will be determined with the standing long jump and 60-m run tests, (alactacid MAP) and with the 300-m run (lactacid MAP). The strength skills were tested with 2-kg medicine ball throw backwards and pushing a load with legs in the "Atlas" set (“absolute strength” measuring) and “bent arm pulling up” test (“relative strength” measuring). For endurance abilities tests, the Cooper test (aerobic background) and the 1,000-m run (mixed background) were taken. The following methods have been applied for material preparation:

The basic statistic characteristics were calculated (x and SD) for results in particular tests in successive examinations in all the groups.

In order to obtain comparable results, the standardised differences were calculated between average results in particular tests in the selected groups at the beginning and in the end of each stage (training: the V-I examination, detraining: the IX-V examination, retraining: the XIII-IX examination). The standardisation was performed with view on standard deviation in the control Group in the final moment of the particular stage.

To eliminate the development trend from the assessment of the actual scale of changes, the standardised increase (or regressions) values in Groups A and B were adjusted with the "development" values (analogous differences in Group K were deducted). The values obtained ($Z_A - Z_K$ and $Z_B - Z_K$) were interpreted as "pure" change measures for particular periods under the impact of training or detraining.

Results and discussion

Tables 3, 4 and 5 present values for the basic statistic characteristics for particular tests in compared groups, while Figure 1 presents changes in the arithmetic means values in successive examinations.

As one can see, only in the case of the 1,000-m run, experimental groups significantly exceeded the values obtained for the control group "from the start."

During the experiment, clearly visible are the effects of particular training periods and breaks in trainings upon the changes in all the examined individuals, their motor abilities, at different scales dependent upon the training type (Groups A and B) and the test type.

The control group shows a systematic improvement in results in almost all the tests, with dynamics significantly increased in the summer holidays period in case of the 300-m run, the Cooper test and the ball throw (examinations: 4-5 and 8-9). On the whole, the highest relative increase are evident in the results of long jump tests and in 1000-m run, with the mean values obtained for strength and speed abilities, with the worst dynamics represented in the Cooper test (which is consistent with the results in a number of physiological examinations), in which the decisive role is attributed to the maximum oxygen uptake (Tab. 6).

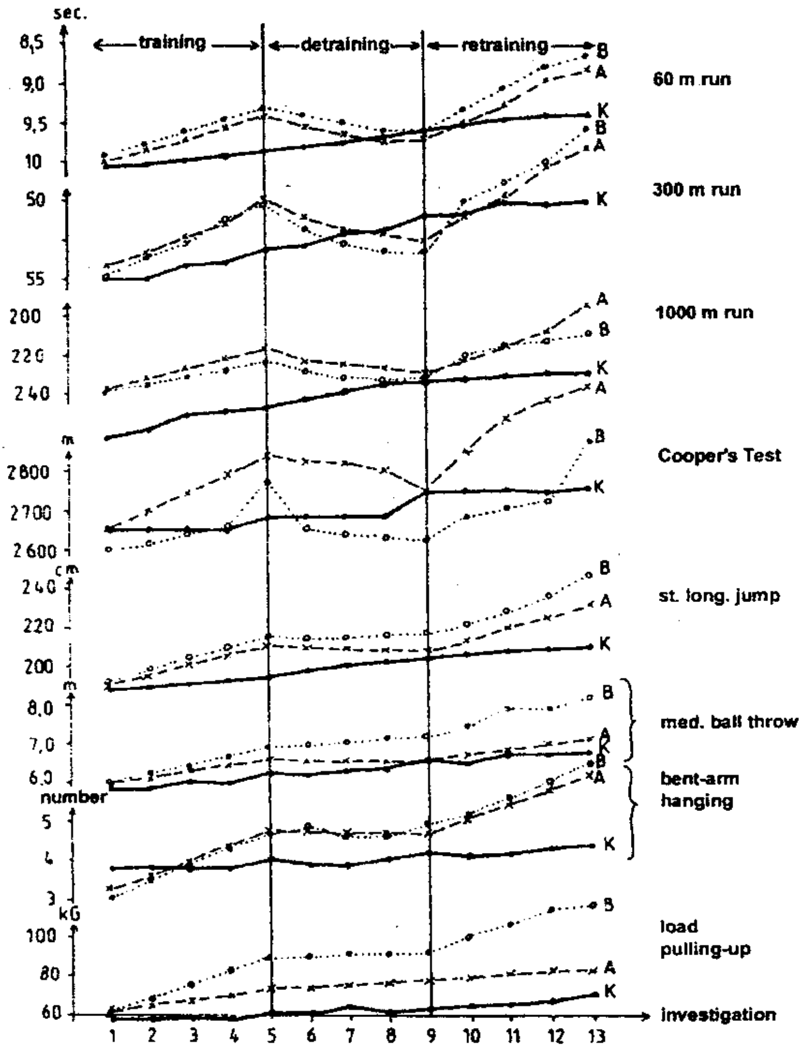

Figure 1. The level of results in particular motority ability tests in the examined groups.

With this taken into account, the effect of particular experiment stages (training-detraining-retraining) may be observed clearly along with the structure of training loads. In the first stage of the training, we do notice significantly higher result progress in experimental groups. In Group A (the endurance, speed and strength training), it is faster in the endurance abilities tests, while in Group

Table 3. Results of the motority ability tests in successive examinations in the K Group

Test	in ve st.	Year 1					Year 2				Year 3			
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
60-m run (s)	x	10.12	10.06	10.0	9.94	9.88	9.82	9.76	9.69	9.62	9.54	9.45	9.39	9.40
	s	0.50	0.67	0.66	0.67	0.67	0.67	0.69	0.71	0.80	0.82	0.85	0.93	1.01
300-m run (s)	x	55.1	55.1	54.1	54.0	53.0	53.0	52.0	52.0	51.0	51.0	50.0	50.2	50.0
	s	4.5	4.6	4.5	4.4	4.2	4.6	4.7	4.9	5.1	5.4	5.3	5.5	5.7
1,000-m run (s)	x	251	248.9	246.8	244.7	242.6	240.6	238.7	236.6	237	232	229.3	228.8	228
	s	14.2	16.7	17	16.5	16.6	16.7	16.8	17.1	17.4	15.5	14.3	13.9	13.9
Cooper test (m)	x	2651	2651	2652	2652	2686	2686	2686	2687	2688	2751	2752	2748	2756
	s	249.0	249.8	249.6	249.6	223.8	230.8	230.0	234.0	234.0	229.2	230.0	230.0	311.0
long jump (cm)	x	187.3	189.4	191.4	193.5	195.5	197.6	200.0	201.6	203.1	205.1	208.1	209.0	210.0
	s	10.1	12.5	12.9	13.8	13.9	14.6	16.0	17.0	17.0	17.9	18.9	19.0	19.8
ball throw (m)	x	5.88	5.90	6.05	6.00	6.22	6.20	6.39	6.35	6.56	6.50	6.73	6.70	6.75
	s	1.00	0.89	0.92	0.85	0.82	0.75	0.79	0.77	0.82	0.81	0.78	0.74	0.75
bent-arm pull-up (no.)	x	3.80	3.78	3.82	3.8	4.00	3.90	3.85	4.0	4.20	4.10	4.15	4.25	4.34
	s	1.36	1.08	0.95	0.84	0.8	0.76	0.69	0.72	0.70	0.63	0.59	0.55	0.53
weight lifting (kg)	x	58	57	58.5	58	60.2	59	62.9	60	62	64	64	66	70.3
	s	9.7	9.2	8.9	9.3	10.0	8.8	9.7	9.2	9.5	9.8	9.9	10.15	11.0

Table 4. Results of the motority ability tests in successive examinations in the A Group

Test	inves.	Year 1					Year 2				Year 3			
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
60-m run (s)	x	10.01	9.85	9.72	9.56	9.40	9.55	9.65	9.72	9.70	9.50	9.26	8.93	8.81
	s	0.66	0.82	0.88	0.95	1.04	1.00	1.20	1.07	0.88	0.79	0.92	0.74	0.94
300-m run (s)	x	54.2	53.3	52.3	51.3	50.0	51.0	51.5	52.1	52.3	51.0	49.8	47.8	46.6
	s	4.9	4.4	4.7	5.1	5.3	4.25	4.68	4.70	4.81	4.63	5.15	5.31	5.09
1,000-m run (s)	x	238.0	233.0	22.7	221.0	216.0	223.0	224.0	226.0	229.0	222.0	215.0	207.0	194.0
	s	22.35	14.56	18.91	17.00	19.63	18.56	17.92	17.38	19.96	19.30	19.54	19.71	20.75
Cooper test (m)	x	2650	2698	2747	2795	2845	2839	2827	2802	2752	2851	2941	2990	3038
	s	294.0	224.0	220.0	243.0	271.0	258.0	235.0	215.0	201.0	237.0	255.0	260.0	268.0
long jump (cm)	x	191.0	196.0	202.0	207.0	211.0	210.0	209.0	209.0	208.0	213.0	220.0	225.0	232.0
	s	17.14	17.81	16.83	16.56	16.23	18.75	18.75	18.33	18.01	17.75	17.60	17.30	17.24
ball throw (m)	x	6.00	6.15	6.30	6.43	6.60	6.55	6.56	6.50	6.58	6.70	6.85	6.99	7.14
	s	1.10	0.87	0.78	0.71	0.68	0.62	0.59	0.72	0.69	0.78	0.72	0.78	0.84
bent-arm pull-up (no.)	x	3.23	3.59	3.98	4.33	4.73	4.71	4.69	4.70	4.68	5.05	5.41	5.81	6.16
	s	1.20	1.07	0.80	0.72	0.78	0.85	0.93	0.77	1.02	1.11	0.98	1.06	1.16
weight lifting (kg)	x	62.00	65.00	68.00	70.00	73.50	74.00	75.00	76.00	77.50	79.00	81.00	83.00	83.50
	s	10.33	10.80	11.33	11.66	12.10	12.66	14.80	14.36	14.54	15.27	14.50	15.54	15.10

Table 5. Results of the motority ability tests in successive examinations in the B Group

Tests	inv.	Year 1					Year 2				Year 3			
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
60-m run (s)	x	9.93	9.81	9.70	9.51	9.35	9.56	9.60	9.62	9.33	9.15	8.88	8.80	8.71
	s	0.78	0.72	0.85	0.90	0.99	0.95	0.98	1.01	0.90	0.85	0.90	0.80	0.74
300-m run (s)	x	52.50	53.5	53.9	52.4	51.5	49.7	50.8	51.0	53.0	51.4	50.0	46.2	45.5
	s	4.50	4.40	4.50	4.90	4.80	4.30	4.60	4.77	4.70	4.71	4.90	5.05	5.00
1,000-m run (s)	x	245.5	230.0	233.0	225.0	220.0	226.0	230.0	231.0	230	225.0	218	209	201.0
	s	18.80	18.90	20.00	19.98	19.90	18.91	18.80	18.70	18.65	18.80	18.80	18.88	19.75
Cooper test (m)	x	2645	2675	2701	2725	2765	2750	2750	2745	2720	2800	2846	2870	2900
	s	270.0	277.5	236.0	246.5	247.0	245.0	238.0	224.5	217.0	230	242.5	245.0	285.5
long jump (cm)	x	188.0	195	203	208	212	209	209	210	210	215	225	236	240
	s	14.5	17.0	16.40	16.30	17.75	18.70	18.80	18.88	18.60	18.40	18.15	18.30	18.0
ball throw (m)	x	5.90	6.00	6.25	6.50	6.80	6.50	6.60	6.70	6.88	7.00	7.50	7.95	8.10
	s	1.10	1.00	0.90	0.87	0.80	0.88	0.90	0.89	1.00	0.90	0.81	0.84	0.80
bent-arm pull-up (no.)	x	3.61	3.48	3.60	4.00	4.40	4.80	4.80	4.60	4.70	4.88	5.80	6.50	6.80
	s													
weight lifting (kg)	x	60.0	65.7	71.4	80.5	88.9	80.3	78.8	76.4	87.1	90.0	95.0	107.2	110.5
	s	10.2	10.0	10.15	10.45	11.10	10.50	12.60	15.20	15.50	16.00	16.50	15.60	16.10

Table 6. Normalised differences in the results in particular tests between the initial and final moments in particular stages of the experiment in Groups K, A and B with the development trend eliminated

TEST	Group K			Group A			Group B			Groups A – K			Groups B – K		
	year 1	year 2	year 3	year 1	year 2	year 3	year 1	year 2	year 3	year 1	year 2	year 3	year 1	year 2	year 3
60-m run (s)	0.36	0.33	0.22	0.58	- 0.34	0.91	0.71	- 0.32	1.19	0.22	- 0.67	0.69	0.35	- 0.65	0.98
300-m run (s)	0.46	0.40	0.17	0.80	- 0.48	0.81	1.18	- 0.49	1.63	0.34	- 0.88	0.64	0.72	- 0.89	1.46
1,000-m run (s)	0.51	0.32	0.64	1.12	- 0.65	1.20	0.90	- 0.45	1.94	0.61	- 0.97	1.06	0.39	- 0.77	1.30
Cooper test (m)	0.15	0.28	0.02	0.70	- 0.42	1.07	0.72	- 0.53	0.82	0.55	- 0.70	1.05	0.57	- 0.81	0.80
long jump (cm)	0.59	0.51	0.42	1.24	- 0.17	0.39	1.40	0.13	1.91	0.65	- 0.68	0.97	0.81	- 0.38	1.49
ball throw (m)	0.41	0.41	0.25	0.88	- 0.03	0.67	0.98	0.34	1.11	0.47	- 0.44	0.42	0.57	- 0.07	0.86
bentarm pull-up (no.)	0.25	0.26	0.27	1.92	- 0.02	1.28	1.62	0.29	2.27	1.67	- 0.28	1.03	1.37	0.03	2.00
weight lifting (kg)	0.22	0.19	0.76	0.95	0.27	0.39	2.28	0.23	1.79	0.73	0.08	- 0.37	2.06	0.04	1.03

B (the speed, strength and endurance training) it is faster in speed abilities tests. In both groups, the highest relative increase was present for strength abilities. As the training emphasis differences were relatively small (only the strength exercises loads were relatively lowest), major differences show the dominant role of the training factor against genetic conditionings of the training experience (Szopa et al. 1996), at least for speed and endurance abilities. In the strength abilities progress, their weak genetic control seems to also play an important meaning.

In the second stage, visible results of dropping the additional movement activity (detraining) in the form of significant lowering of the speed abilities level (the 60-m and 300-m runs) and endurance skills (the 1,000-m run and the Cooper test) as well as reduction in the increases in strength abilities test results – for both experimental groups, no matter what the training was and what the level of results was. In some cases (the 60-m and 300-m runs in Group A and the Cooper test in Group B), these reductions were even below the control group levels, though they never reached the initial level results. It is noteworthy that the regression rate is slightly higher in the first detraining stage (3 or 6 months), with no regressions changes noted in the strength abilities tests.

Returning to training (retraining) shows in highly dynamic result increases: much faster in the control group and much higher than in the first stage. It is interesting that differences in the training structure are marked for groups A and B. These facts may result from two reasons. One is the phenomenon, commonly known in biochemistry, of the so-called "biochemical memory," which facilitates rebuilding of the existing metabolic paths (the supercompensation phenomenon is based on this rule). The other reason is the higher sensitivity in 14 to 15-year-old boys than in boys of 12-13 years of age, which is related to the end of the "adolescence spurt" and fast increase in the muscle weight.

The assessment of the relative scale in post-training and regressive changes, as well as comparison of training experience in the examined motor abilities, shall be based on normalised values for differences in results in particular tests between the beginning and the end of particular phases in experimental groups, with analogous differences taken into account in the control group: thus, the natural development trend being eliminated from the results. These data are given in Table 6, with the most important of them presented graphically in Figure 2. Combined with the above described general

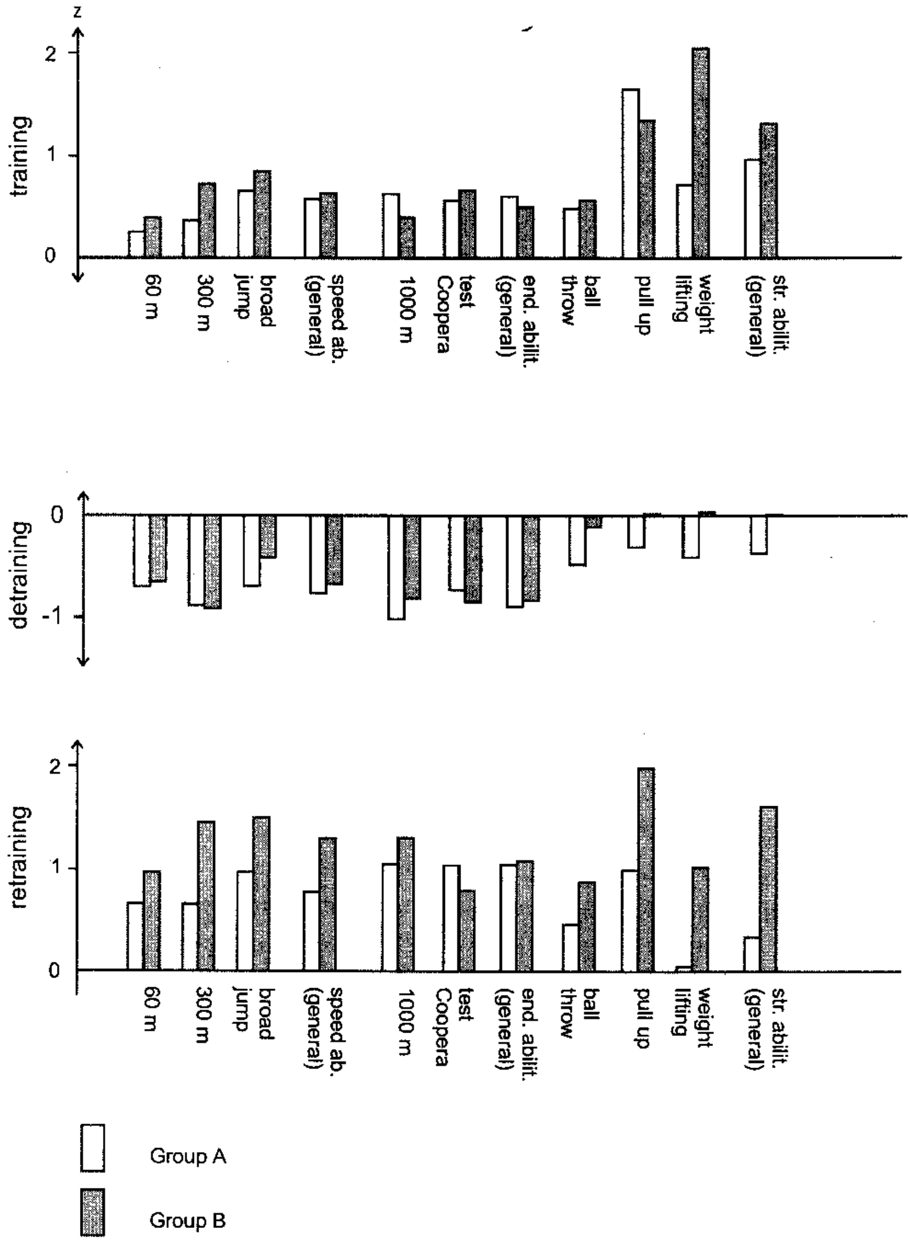

Figure 2. Normalised (against the control group) differences at the end of particular periods of the experiment.

trends, they allow obtaining an answer to all the research questions posed in the beginning. We shall begin with the analysis of the actual results in training, retraining and detraining. First of all, is even more evident that in case of speed and endurance skills, the scale of retraining changes is twice as high (the average of ca. 0.5 SD in stage I, 1 SD in stage 3). The scale of regressive changes in the detraining period is more extensive than the training results, especially for endurance abilities tests, which are based on aerobic changes and the glicolitic mechanism. The results do not confirm the data obtained in research in high-class competitive sportsmen (Coyle et al. 1986), from which it followed that the fastest and the strongest regression applies to aerobic mechanisms: in our research, the highest regression was noted for the 300-m run, which was dependent mainly on the efficiency of glicolitic mechanisms. Thus, the argument of Platonow (1990) has not been confirmed that abilities with little training experience show trend for quick "deadaptation" and slow "readaptation." In the examined groups, speed abilities (which are under the strongest genetic conditioning) show very broad scale of changes: the average increase was 0.63 SD(Z) in the 1st year and 1.31 in the 3rd year, with the average regression of 0.64 SD(Z); these values are higher than in the weaker genetically controlled endurance abilities: especially in the Group B. which executes the speed strength–endurance training. Also, the argument formulated before was confirmed that training stimuli are more important for controlling motor abilities level than their genetic conditioning: it is clear from the analysis of the level of changes in the results of particular tests in groups, which differed in their training emphasis: A and B. It may be so that this regularity applies only to the growing age, maturity age and individuals with not so high level of abilities under examination, as the data given by Coyle et al. (1986) and Platonow (1990), as well as Costill et al. (1985, 1990), Sharp et al. (1984) referred to sports people with very high training experience and were directed at determination of structural and biochemical changes occurring in short period of forced or planned breaks in training arranged from the point of view of sports practice (organisation of the training preparation period, stimuli in the retraining period, etc.)

Thus one can state that these results confirm the fact emphasised by Szopa et al. (1996) that the individual trainability is not a notion closely complementary to heritability indices but can be created as a complementary in the population scale. It does not mean that we question the generally acknowledged regularities, like the fact that the genetic control of the releasing energy from phosphocreatine (alactacid MMA) process is stronger than the glicolysis process (lactacid MMA) and the breathing chain (aerobic efficiency), which was emphasised by Simoneau et al. (1986), Maes et al. (1993), Boulay et al. (1986), Dionne et al. (1991) and others. We only pay attention to the fact, that the training experience scale depends on a much larger number of factors, both endogenous and exogenous (e.g. training loads).

The strength abilities occupy an exceptional place. Despite relatively lowest training loads, they show the highest post-training increase values (exceeding even 2 standard deviations) and the smallest regression changes in the detraining period, especially visible in Group B, where strength exercises were more intense. This suggests decidedly highest training experience in these skills, which is a fact known from both sport practice and genetic research.

The presented results allow formulating the following statements:

1. Directed training with loads of 530 – 570 contract units affects the strength abilities level most (up to 2 SD), and, which is also of some significance, speed (0.5 – 0.7 SD) and endurance (0.5 – 0.6 SD) abilities to a lesser degree.
2. Even slight (12-18%) differences in the training structure result in major changes in the motor abilities level: their ecosensitivity is quite high at the age of 12-15 years.
3. The results achieved in the one-year training are not stable: after discontinuing practising exercises (detraining), they fall down rapidly (even below the population level), with the highest regression visible in speed and endurance abilities.
4. Repetition of training with identical load (retraining) leads to definitely more extensive results than those in Stage 1: this proves that the organism holds a "biochemical trace," which facilitates replaying tracks and structures embedded before. Thus it seems that the common view of the negative role of training breaks is exaggerated.
5. The training effects depend not only on genetic conditioning: in the growing period, the volume and structure of the mobility activities is also of importance.

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