COGNITIVE ASPECTS OF ATHLETE ACTIVITY

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Article is devoted to the issues of symbolic mediation and diagnostic of time perception in sport. Distinction between iconic and symbolic mediation is discussed. Evidences of effective implementation of symbolic mediation in sport are examined. Means of optimization of sportsmen and sportswomen training by the instrumentality of symbol are considered. The results of time perception diagnostic of Russian synchronized swimmers are described. It was shown that sportswomen are greatly varied in accuracy and stability of reproduction of long (2–5 sec) and estimation of short (less than 250 ms) time intervals, which were filled with different contents – ticks of metronome, persistent sound, pressuring the button and etc. The improvement of individual characteristics of time perception is an important psychological resource of sports achievements increase.

Keywords: sport psychology, symbol, icon, image, situation of uncertainty, synchronized swimming, time perception.

Challenging the achieved results in some sports today requires great, if not superhuman, efforts. Despite of, the use of physical resources is already close to genetically conditioned limitations. For these reasons, the usage of psychological resources in high achievement sports is considered to have prospects, with a special emphasis on the development of an athlete cognitive abilities. This article presents the study of the cognitive aspects of athlete: iconic and symbolic mediation and perception of time.

Iconic and symbolic mediation in sports

The problem of iconic-symbolic reflection has its long history of study and continues to attract attention of psychologists (Piaget, 1969; Freud, 1999; Jung, 1998; DeLoache, 2000). A subject's retention of two plans: the plan of reality and the plan of its representation, is traditionally believed to be the requisite condition for presence of iconic and

symbolic reflections. However, there is still no commonly accepted distinction between iconic mediation and symbolic mediation.

We assume that iconic mediation differs from symbolic mediation. Unlike with icon or sign, the use of a symbol is particularly connected with the emergence of the situation of uncertainty. Icon, in turn, has a certain meaning and therefore is used in certain situations (situations, when the structure is clear to a subject, i.e. is described with a system of meanings). Therefore, in this case external characteristics of an icon aren't very important to a subject. Effective system proposed by G. Martin and S. Palmer (Palmer, 1992) in figure skating can serve as an example. According to G. Martin, four components are required for effective figure skating skills: key words, denoting certain skating elements; mental performance of figures, actualization of emotions that correspond with certain elements of a performed pattern; equalizing time of mental and actual figure performances. S. Palmer, in her turn, assumed that athlete's drawing sequence of figure elements would be equally effective.

In D. Garza and D. Feltz (Garza, and Feltz, 1998) experiment 27 female figure skaters (10 to 18 years old) were divided into two groups. The first group used the drawing method. At first, sportswomen listed all elements of their respective programs, chose key words, and imagined their performance. Then the performance music was turned on and figure skaters drew their patterns while saying aloud key words, describing figure elements. The music assisted in synchronizing the speed of drawing with the speed of actual performing on the ice. At this sportswomen were asked to place key elements of their pattern in accordance with their spatial performance on the ice. Figure skaters from the first experimental group had been practicing according to this technique daily for four weeks. At the same time sportswomen from the second group did various stretching exercises. Coaches came to a conclusion that sportswomen from the first experimental group have significantly improved their jumps and spins compared to the athletes from the second one. Moreover, sportswomen from the first group have also showed improvements in their self-esteem. Thus, icon representation can be used as an effective tool in athletes training. It is important to note that at this point we talk about iconic representation, because in this experiment a drawing works as a distinct model of a situation.

On the other hand, a symbolic image, while emerging in a situation of uncertainty, becomes vivid for a subject with its external form and

rich image content, which, when addressed by mind, comes to the forefront. The content of a symbol is concentrated in its outward symbolic surface on which cognitive activity of a person is transferred from an actual situation. This is possible because figurative content of a symbol allows interpretation of meanings. We assume that by analyzing a symbol, one can reveal its meaning enclosed within a structure of relations between symbol elements. Defining such a structure, a subject can transform the latter into a structure of relations between the elements of a given situation, which, in turns, leads to its definition and therefore eliminates uncertainty (Veraksa, 2006; 2007; 2009).

Athlete training can be compared with an educational process, as both of these cases assume mastering certain content for certain achievements. In our research we have tested the hypothesis that symbolic mediation can be successfully applied to learning new notions in cases when figurative content of a symbol corresponds with an actual situation. This hypothesis was tested while teaching schoolchildren mathematical notions in order to apply afterwards the research results to the field of sports.

The experiment

Studies aimed at mastering mathematical notion "function" and its graphic representation were held on the 4th grade pupils of secondary school (according to the curriculum, this subject is normally taught in the 6th grade). Experiment included 49 children (average age 10 years and 2 months). Studies were held in three groups equalized by the results of *Raven Progressive Matrix* Test (Color Form).

Six 40-minute studies were held in each of three groups during 3 weeks of the experiment. At the first stage of the experiment all children were asked to solve a task "From point A to point B bicyclist is going with the speed of 10 km/h. The distance between these two points is 50 km. After how many hours one should depart on a bus going with the speed of 40 km\h to get to point B faster than the bicyclist?" None of pupils could solve this task: this educational situation thus appeared as a situation of uncertainty.

For each group there was a specially designed program.

In the experimental group we aimed to form a productive symbolic image of the situation which to our opinion would allow to reflect objective relations within educational content (comprehending the "func-

tion" notion and corresponding algorithms for task solving). The main goal of the program was to get children to "suddenly discover" the idea of transformation. For this reason an image of a magical country was introduced where fairies did magic and could turn everything into everything and likewise transform themselves. Introduction of the new definition (particularly "function") created situation of uncertainty and therefore the image we have described above was introduced for symbolic mediation of the respective part of mathematics as an aid in solving this situation of uncertainty by children. Then a transition was made from the symbolic image to the educational content by the establishment of correspondence between them. For that we have invented ways of graphical depiction of transformations done by a magic wand so that later children could proceed to a similar table entry of transformation of an independent variable by its function.

In the controlling group the work was based upon unproductive symbolization. This group was used in the experiment to eliminate influence of emotional involvement and additional motivation factors. The studies were likewise devoted to a magical country, but the content of studied stories about its inhabitants (while literally including theme of mathematics, for example, stories about bears going to a math class), lacked any connection with the introduced notion of function. The second control group was taught by traditional curriculum. After all six studies were over (no later than in three days), pupils were given a test with five tasks on graphical solving (for successful solving of each task a pupil was awarded one mark).

Discussion of the results

There were found no statistically significant discrepancies among the results of children passed Raven Test that fitted the interval of 50-95 percentiles. For children within an interval of 25-50 percentiles, statistical discrepancies by *Manna-Whitney criterion were found at the level of significance of 0.01.* Discrepancies between average results of experimental group participants and the first control group amounted to 1.5 points; for the experimental group and the second control group – 1.63 points (in favor of experimental group). This data shows that productive symbolic mediation in cognitive activity can be effectively used for people having difficulties with applying iconic mediation. At the same time, low indexes of first control group indicate that emotional involvement alone is not sufficient for an effective transition from symbolic to iconic mediation.

However, using symbol doesn't always resolve the situation of uncertainty and allow to make transition to meanings – widespread are the cases when a symbol facilitates settlement of a problem situation and transmits emotional tension connected with it. To illustrate just stated we'll give the following example. The work of I. E. Josephs (Josephs, 1998) is concentrated on studying behavior of people who lost their close ones. Among numerous examples of people behavior in a situation like this the author shows how grave becomes a symbol of a departed person. Through their attitude towards this place people reconcile themselves to a situation of death of a close person: they look after the grave, establish special rituals which express special feelings to a deceased, share their worries and tell the latest news from their life (a vivid example of this is a case of 76 year-old man who came to his father's grave to tell him about a recent purchase of a new car). Such behavior, in our opinion, demonstrates orientation within figurative content of a symbol that allows coping with one's emotions and adapting to the changed world.

Another vivid description of spontaneous usage of a symbol can be found in works dedicated to studies of athlete's anxiety. The research of S. Hanton, G. Jones (Hanton, and Jones, 1999) cites the words of Canadian Olympic basketball team coach: "It's not a case of getting rid of the butterflies, it's a question of getting them fly in formation". Indeed, interviews with ten elite swimmers showed that all of them did experience feeling of anxiety in the beginning of their sport career and had difficulties in forming their attitude towards it. Here are the words of one of the sportsman: "I remember my first reasonably big meet… I was driving there with my dad, and I said I was nervous: I said I had butterflies in my stomach. He said that's a really good thing because that will get the adrenaline flowing. Obviously when you're young you haven't got any idea what adrenaline is, and he sad it was a good thing, so I took it as read that it was a good thing…" (Hanton, and Jones, 1999, p.10). This example illustrates the importance of positive interpretation of such uncertain situations; "a good thing" in this case builds grounds for a symbolic image formation because, as the athlete himself had said, he doesn't know the objective situation behind this feeling of anxiety. Later such feelings were interpreted as positive and even necessary: "… ou have to get nervous to swim well… If you're not bothered

about it. If you're not nervous you're not going to swim well… I think the nerves bring out the best in you, and I soon realized that I wanted to feel this way" (Hanton, and Jones, 1999, p. 9). According to the authors of this research, athletes eventually came to a notion of a "positive anxiety" which was an indicator of athlete's readiness to a competition. Interpretation of anxiety in studies of G. Jones was described as one of the characteristics of top athletes. For example, elite swimmers differed significantly in relation to this index – in their group 85% of participants considered anxiety as an indicator of readiness to a performance, while only 53% of regular athletes viewed anxiety this way (Jones, Hanton, and Swain, 1994).

L. Hardy questioned a conclusion made by a number of authors about athlete cognitive anxiety. He notes that there is a widespread notion that anxiety hampers any activity, including sportive ones. However, for example, according to one of the classical research of American Olympians, the successful ones used anxiety as a stimulus to a successful performance (Mahoney, 1977).

The research of L. Hardy and C. Parfitt (Hardy, and Parfitt, 1991) studied effectiveness of basketball players throws one day before and two days after the start of an important tournament. As it turned out, athletes while in a state of high cognitive anxiety showed either extremely low or extremely high results, whereas athletes in a state of low cognitive anxiety showed average results. L. Hardy claims that deliberate emergence of an athlete into an uncomfortable situation of uncertainty can raise his or her successfulness. We assume that this is true because in a situation of uncertainty a special role belongs to symbolic mediation which, as it was studied earlier, can either facilitate or inhibit successfulness of an activity.

We also should point out numerous cases of athlete's intuitive reference to symbols when confronting uncertain situations, which manifests itself, for example, in their religiousness. Therefore there is a reason for such organizations as *Brotherhood of Christian Athletes,* Center for Sport and Jewish Life in America, Christians in Sport of Great Britain.

Conclusions

1. Emergence of a symbolic image in a situation of uncertainty allows settlement of emotional tension connected with it through its transference into a symbolic area. Any new situation alike an athlete encounters with (including mastering new movement) it is natural to assume that an absent of an image can negatively affect orientation in this situation.

2. Symbolic image, in contrast to an icon, doesn't have a single meaning, one of its features is emotional tension caused by a discrepancy between the real situation and a figurative content of a symbol. It could be stated that its usage can facilitate motivation of athletes.

3. A symbolic image in a situation of uncertainty can serve as a basis for formation of adequate image of a situation.

4. One of the tasks of sport psychology, connected with athlete's forms of representation study, is working out a technology of facilitation of productive symbolization in situations of uncertainty.

Time perception in sport

From 50th years in Russia the methods of diagnostics and evaluation of time perception are intensively studied as methods of development and of perfection the sense of time (Gellerstein, 1958; Fraisse, 1961; Elkin, 1962; Tsukanov, 2000; Strelkov, 2001; Bespalov, and Leonov, 2008). In research of Gellerstein (1958) it was revealed that training of temporal perception influenced sportsmen accuracy and speed of executable movements, eliminated premature or deferred starts. In work of B. Bespalov and S. Leonov (Bespalov, and Leonov, 2008) with sportswomen of synchronized swimming the special professional tasks exploring the sense of time were constructed taking into consideration features of that sport.

Participants and Procedure

Participants (N=14) and one of the team's coach. The average respondent age was 17, the coach was 50 years old. All respondents were female.

Experiment 1

In the first variant of the procedure the participant reproduced the duration (1,5 sec.) of the interval which was set by the clicks of metronome. The frequency was 120 clicks in a minute. Each participant received an instruction to press the button of console till the end of the presented interval after four clicks of metronome. In each probe the length of the reproduced interval (to the accuracy of 1 ms) was registered.

At the second variant of the procedure the presented interval was 1,67 sec., and it was set by 6 clicks of metronome. The frequency of stimulus was 180 clicks in a minute. In other respects the procedure was the same.

Measures

The sense of time was diagnosed by three indexes: 1) integral accuracy of reproduction the intervals – V_m; 2) average relative error $= (t_{av} - t_{set}) / t_{set}$; 3) average Tau-index $\tau_{av} = t_{av} / tset = \varepsilon_{set} + 1$. t_{set} – duration of the setting interval, t_{set} – the average duration (between ten reproduction intervals).

As a measure of integral inaccuracy of reproduction time intervals we used modified coefficient of variation V_m:

$$V_m = \frac{\sqrt{\Sigma(t_{repr} - t_{set})^2 / n}}{tset} = \frac{\sigma_{set}}{tset}$$

Reproduction of the interval consists of two stages: receiving the stimulus and following reproducing of it.

Results and discussion

Individual's means of Vm and Tau-index are showed in Table 1. Participants are ordered in an increasing way by the amount of $\Delta_{\tau\text{-}cp}$ – the difference between Tau-index in the first and second variants of the experiment 1. The differences between group's means are not significant (p = 0,29 and 0,73 respectively). But coefficients of correlation between Vm in the first and seconds variants of tasks are 0,82 (p<0,001), for Tau-index – $r\ (\tau_{av\text{-}1} * \tau_{av\text{-}2}) = 0{,}9$ (p < 0,001). It means that test is reliable and psychological mechanisms of fulfillment such test are similar.

Sportswomen who over reproduced presented intervals (Tau-index more than 1) had small and negative $\Delta_{\tau cp}$ and vice versa (see Table 1). The index $\Delta_{\tau cp}$ had negative correlation with means of Tau-index in the first and second variants of the test: $r\ (\Delta_{\tau\text{-}cp} * \tau_{cp\text{-}1}) = -0{,}78$; ($p < 0{,}01$ and $r\ (\Delta_{\tau\text{-}cp} * \tau_{cp\text{-}2}) = -0{,}44$; $p < 0{,}1$.

This result can be explained by the influence of two factors: "quantity of the clicks" in the limited time interval (4 and 6) and "frequency of the clicks" (120 and 180 click/min).

As it has been shown in works of H. Shiffman (2003), P. Fraisse (1978) the interval filled with most clicks of metronome is perceived as longer stimulus than interval filled with less clicks. Hence it is possible to expect that the difference of Tau-index in the first and second variants of the experiment 1 should be positive and significant. But this tendency appeared to be not common for all participants. This fact compelled us to make an assumption about the influence of factor "quantity of clicks" on Tau-index. Intervals filled with clicks of most frequency were reproduced shorter than intervals filled with less frequency. Probably high frequency of metronome's clicks impels some sportswomen to increase inner score during reproduction of the interval and as a result to underreproduct the intervals.

We have confirmed our suggestions in a study on diagnostics of inner score of sportswomen of synchronized swimming (Bespalov, and

Table 1

Parameters of Vm and Tau-index in the first and second variants of the test 1

Subjects	Variant 1 4 clicks of metronome, frequency 120 clicks/min			Variant 2 6 clicks of metronome, frequency 180 clicks/min			Differences between Tau-index and Vm in the 1 and 2 variants
	V_{m-1}	T_{av-1}	SD τ_{av-1}	V_{m-2}	T_{av-2}	SD τ_{av-2}	$\Delta_{\tau-av} = \tau_{av-2} - \tau_{av-1}$
Sh. B.	0,22	1,2	0,015	0,08	1,05	0,011	**–0,15***
C. A.	0,34	1,3	0,033	0,19	1,16	0,015	**–0,14***
B. D.	0,28	1,25	0,022	0,19	1,13	0,044	**–0,12***
Z. E.	0,09	1,03	0,016	0,09	0,93	0,009	**–0,09***
A. B.	0,15	1,04	0,047	0,1	0,97	0,023	–0,07
C. M.	0,12	0,91	0,01	0,14	0,88	0,005	–0,03
B. K.	0,17	1,15	0,01	0,15	1,13	0,012	–0,02
P. E.	0,06	1	0,007	0,09	1,01	0,022	0
coach	0,1	1,07	0,010	0,1	1,08	0,009	0,01
M. D.	0,05	0,98	0,004	0,06	1	0,01	0,02
O. A.	0,04	0,99	0,004	0,04	1,01	0,005	0,02
P. C.	0,12	1,09	0,002	0,19	1,17	0,011	**0,08***
T. L.	0,22	0,8	0,008	0,14	0,9	0,02	**0,1***
Y. A.	0,4	0,63	0,013	0,28	0,74	0,007	**0,12***
mean	0,15	1,06	0,01	0,12	1,03	0,02	–0,01

Marked differences (*) are significant at the level $p < 0{,}05$ (ANOVA).

Leonov, 2008). It turned out that during listening of the same musical fragment inner scores of sportswomen of synchronized swimming differed from each other. But coefficient of correlation between inner score and the frequency of inner score (Tau-index) in the first variant of the experiment 1 is 0.5 (p = 0.15), the coefficient of correlation between frequency and difference of Tau-index is 0.7 (p=0,02).

Thus the effect of frequency which is located on the stage of producing interval using inner score could be estimated by the differences of Tau-index in the first and second variants of the experiment 1.

$$Effect\_frequency_{clicks} \sim \tau_{av\text{-}1}\,(120\text{-}clicks/min) - \tau_{av\text{-}2}\,(180\text{-}\ clicks/min)$$

The factor's effect of quantity of clicks is proportional to the difference of Tau-index in the first and second variants of the experiment 1.

$$Effect\_\ quantity_{clicks} \sim \tau_{av\text{-}2}\,(6\text{-}\ clicks) - \tau_{av\text{-}1}\,(4\text{-}\ clicks)$$

It is possible that factors "quantity" and "frequency" could be mixed i.e. they could appear simultaneously, but with different value. They could compensate each other partly. That's why we evaluated only difference of these effects.

$$\Delta_{\tau\text{-}av} = \tau_{av\text{-}2} - \tau_{av\text{-}1} \sim effect\ of\_\ quantity_{clicks} - effect\ of\_frequency_{clicks}$$

If Tau-index < 0, it means that factor of frequency dominates, If Tau-index > 0 – factor of quality prevailed. Individual's results are presented in the Table 2.

The group was divided into 3 subgroups on the basis of value of Tau-index. In the first subgroup there were sportswomen with good sense of time (Tau-index is between 0.95 and 1.05), second subgroup – "hurry" sportswomen: Tau-index < 0,95, third subgroup – "delayed" sportswomen, Tau-index > 1,05.

Factors of "frequency" and "quantity of clicks" do not influence sportswomen with good sense of time. It may be caused by the fact of absolute compensation of these contrary factors (if the effects are equal) or the lack of influence of these factors on sportswomen (see Table 2).

Sportswomen who work in pairs have similar results with ones partner (SD, Vm, Tau-index).

Factor of "frequency" dominates at Sh.B. *и* Z.B., T.L. and Y.A. – factor of "quantity of clicks" partly compensates their insignificant "haste" (15% and 31%) at reproduction intervals.

Table 2

Accuracy of reproduction intervals and dominating factors in test 1

Participants	Means of variation and integral characteristic of accuracy of reproduction intervals $V_m = (V_{m\text{-}1} + V_{m\text{-}2})/2$		Means of Tau-index $\tau_{cp} = (\tau_{cp\text{-}1} + \tau_{cp\text{-}2})/2$	Characteristic of sense of time	Dominating factor
O. A.	***0,04***	***High accuracy***	**1,00**	good	no
M. D.	***0,06***	***High accuracy***	**0,99**	good	no
P. E.	***0,08***	***High accuracy***	**1,01**	good	no
Z. E.	***0,09***	***High accuracy***	**0,98**	good	**Frequency**
Coach	***0,10***	***High accuracy***	**1,08**	good	no
A. B.	***0,13***	***High accuracy***	**1,01**	good	no
C. M.	*0,13*	*High accuracy*	**0,90**	***hurry***	no
Sh. B.	0,15	Medium accuracy	1,13	late	**Frequency**
P. C.	0,16	Medium accuracy	1,13	late	***Quantity of clicks***
B. K.	0,16	Medium accuracy	1,14	late	no
T. L.	0,18	Medium accuracy	0,85	***hurry***	***Quantity of clicks***
B. D.	0,24	Low accuracy	1,19	late	**Frequency**
C. A.	0,27	Low accuracy	1,23	late	**Frequency**
Y. A.	0,34	Low accuracy	0,69	***hurry***	***Quantity of clicks***

Experiment 2

The purpose of that procedure was to measure the influence of factors on the sense of time.

At the first variant participant should reproduce the "empty" interval by pressing the button and keeping it till the end of the interval. The length of the interval was 2 sec., the reproducing interval was "filled".

The task of the second variant of the procedure was the opposite to the previous one. The participant received the "filled" interval and then should reproduce the "empty" interval. The length of interval was 2 sec.

Table 3

Parameters of Vm and Tau-index in the first and second variants of the experiment 2

Participants	Var. 1 Intervals empty/filled		Var.2 Intervals filled/empty		Effect of factor "pressing the button" $\Delta_{press} = -(\varepsilon_{av-1var} + \varepsilon_{av-2var})$
	V_{m-1}	ε_{cp-1}	V_{m-2}	ε_{cp-2}	
Y. A.	0,54	–0,49	0,14	–0,09	***0,58***
T. L.	0,45	–0,41	0,15	–0,12	***0,53***
A. B.	0,22	–0,16	0,28	–0,27	***0,43***
O. A.	0,31	–0,28	0,15	–0,12	***0,40***
M. D.	0,29	–0,27	0,09	–0,02	0,29
P. C.	0,27	–0,25	0,10	–0,04	0,29
B. D.	0,21	–0,19	0,10	–0,05	0,24
Z. E.	0,27	–0,21	0,17	–0,01	0,22
C. M.	0,33	–0,31	0,14	0,09	0,22
B. K.	0,18	–0,16	0,11	–0,05	0,21
C. A.	0,24	–0,20	0,08	0,01	**0,19**
Sh. B.	0,16	–0,14	0,08	–0,03	**0,17**
P. E.	0,23	–0,19	0,12	0,03	**0,16**
M.A. (coach)	0,10	–0,09	0,27	0,24	–0,15
Means	0,27	–0,24	0,14	–0,03	0,27

Coefficients of correlations between Vm1 and Vm2 are not significant (r = 0,15, p =*0,62)*.

At the same time differences of means (Vm1 and Vm2) are significant (p <*0,001*). It means that mechanisms of solving temporal tasks are different.

This difference was caused by the influence on Tau-index two factors at the first variant of the experiment 2: 1) interval that was to be reproduced "filled" with continuous sound; 2) interval that was to be reproduced "filled" with motor act (pressing the button). Both factors are located on the stage of reproduction.

At the second variant of the experiment 2 the "filled" interval (by continuous sound) influenced Tau-index on the stage of perception. As it has been showed in work of J.H. Wearden (Wearden, et al., 2007) the

interval filled with sound seemed longer than empty one. Hence the duration of the reproducing interval increases, i.e. factor of "filled" (by continuous sound) brings in a positive contribution to Δ_{sound} – relative error. It may be presented in a model of average relative error in the second variant of the experiment 2: $\varepsilon_{av-2} = \varepsilon_{av-0} + \Delta_{sound}$, where ε_{av-0} – relative error without factor "filled" with sound (if the presented and produced interval were empty), Δ_{sound} – effect of factor "filled" with sound.

In the first variant of the experiment 2 the model for relative error is $\varepsilon_{av-1} = \varepsilon_{av-0} - \Delta_{sound} - \Delta_{pressing.}$ It means that factors of "filled" and "pressing the button" affect in coordination and diminish relative error on Δ_{sound} and $\Delta_{pressing.}$ Objective duration of the producing interval diminishes because interval filled with perception of sound or pressing the button is subjective overestimated. The negative impact of the factors "filled" with sound and "pressing the button" on the ε_{av-1} is caused by localization them on the stage of production.

Comparing these models by the relative error of reproduction intervals in the first and second variant of the experiment 2: ($\varepsilon_{av-1} = \varepsilon_{av-0} - \Delta_{sound} - \Delta_{press}$) и ($\varepsilon_{av-2} = \varepsilon_{av-0} + \Delta_{sound}$) we can define Δ_{press}. The influence of this factor on the relative error: $\Delta_{press} = -(\varepsilon_{av-1var} + \varepsilon_{av-2var})$.

Means of factor "pressing" are presented in the Table 3. Participants are ordered in decreasing way by the amount of Δ_{press} and divided in three subgroups. This factor influences all sportswomen but the coach. It may be explained by the fact that the coach used special cognitive strategy to fulfill experimental task: the coach helped herself counting by swinging with her leg. In that situation her attention was not focused on the conditions of the task. According to her: "I didn't realize pressing the button of anything else but counting. This explanation was based on the assumption of reflexive foundation the sense of time.

Any movements will influence the estimation of producing temporal intervals if it is realized by a subject.

Conclusions

1. The accuracy and reliability reproduction of time intervals depend on the context and the duration of these intervals. It was shown that "fullness" of the intervals with rhythmic sounds, movements of hand influences on sportswomen. This should be taken into consideration when the training process is directed in order to develop the synchronous movements.

2. Sportswomen who work in pairs have similar indexes on the sense of time. Hence one of the psychological resources of increasing synchronism is to select sportswomen with similar characteristics concerning the sense of time. The diagnostics of the sense of time should be undertaken by the multiple-factor instrumental principles with following analyze of scaleable factors. In the task of the reproduction of the intervals they could be located on the stage of presentation or reproduction of intervals.

3. Factors "frequency" and "quantity" of the clicks of metronome are located on the different stages. The first factor is located on the stage of producing interval, the latter – on the stage of presentation. These factors particularly influence the sense of time of sportswomen. The first one shortens the subjective length of the producing interval (interval with more frequency is produced faster): the latter increases subjective duration of presentation interval (interval with most quantity seems longer to the participant).

4. Factor "fullness" with the continuous sound can be located at any stages. If it is on the stage of presentation of the interval, it increases the subjective length. If this factor is located on the stage of producing interval it shortens duration.

5. "Fullness" of the producing interval achieved by the continuous button pressing leads to shortening the objective length in comparison with "empty" interval. Factor "fullness" in terms of the the motor act influences the estimation of the interval if the participant pays attention to it. It reveals reflexive foundations of the sense of time.

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