USE OF THE DANCE PAD FOR THE DEVELOPMENT OF RHYTHMIC ABILITIES

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Case study

Abstract

In our research we assessed the effect of an intervention programme based on regular use of the dance pad on the level of rhythmic abilities as important factors influencing the performance in gymnastic sports, dancing, figure skating and so on. The sample consisted of 28 dancers aged between 8-13 years. The tested persons were divided into 2 groups according to age and length of dance practice. Each group was then divided into experimental and control group. Experimental groups were asked to dance on the dance pad 3 times a week for two and a half months. The level of rhythmic perception was measured by the test of rhythmic discrimination by Seashore. The level of rhythmic execution was measured by the test Software reaction meter and Hands and feet drumming. For data analysis of rhythmic abilities we chose descriptive statistics and T-test, calculation of Cohen's d coefficient and Spearman rank correlations. Although the research did not confirm positive influence of dance pad on the development of rhythmic abilities of the tested persons, more options to investigate were shown.

Keywords: *rhythmic perception, rhythmic execution, intervention programme, testing.*

INTRODUCTION

One of the issues associated with motor performance, which has not been dealt with extensively by previous research, is a perspective on movement in terms of rhythm. Rhythm is related not only to music or dance expression, but it also has broad applications. Rhythm is understood as a dynamic time-division motor act, which is an important part of correct execution of movement, and movement in connection with a technique improves performance, as confirmed by experts in the field of kinanthropology. For example Měkota and Novosad (2005) and Krištofič (2006) argue that rhythmic ability is not only important for technical and aesthetic sports, but it is also to some extent used for example in sports games.

The ability to perform rhythmic movement has a significant impact on the quality and economy of body movements. It can be easier to practice rhythm in cyclical movements, whereas the acyclic motion tasks (exercises on the trapeze, high jump, game activities, etc.) are very challenging as regards rhythm (Skotáková, 2014).

Rhythm during exercise movements must be aligned with the rhythm of

inhalation and exhalation, alternating tension and relaxation have to be arranged, and stress and relaxation. Joining movements in certain units - phrasing helps learning and remembering the sequence of movements (Novotná, Panská & Šimůnková, 2011).

Authors (Lehnert & Zítko, 2010; Měkota & Novosad, 2005) dealing with motor learning classify rhythmic ability as a coordination ability. There are two dominant components in the process of developing rhythmic abilities:

- Rhythmic **perception** – perception of acoustic (often musical), tactile and visual rhythmic stimuli from the external environment and their transformation into movement.
- Rhythmic **execution -** capturing the rhythm and translating this rhythm into one´s own physical activities. This way of rhythmic motor learning has got a great significance for acquisition of any movement.

Krištofič, Novotná, Panská, and Chrudimský (2009) in their book mention experiments in which it was shown that acoustic information given during movement streamlines the learning process. For example, the first group learned how to start and jump over the vaulting table with the sound recordings from a tape, the second group was taught by usual way, the result was clearly favourable for the first group.

The close connection between rhythmic abilities and sports performance was confirmed by Bago, Hedbavny and Kalichova (2013). In gymnastic sports, e.g. artistic gymnastics, team gym and sport aerobics, a high level of rhythmic abilities is needed in order to coordinate the movements with music accompaniment. A huge emphasis on rhythmic abilities is laid mainly in women artistic gymnastics where their routines include dance elements and in floor gymnastics they are accompanied by music.

In Code of Points (FIG, 2013) a correct rhythmic realization of movement is judged also within artistic performance, however, not only for the routines exercised with music accompaniment, but also for balance beam or uneven bars. In men gymnastics the rhythmic ability is of a significant importance as every movement, in order to perform correctly, has to be in the correct rhythm, as stated also in v Code of Points for Men's Artistic Gymnastics Competitions.

Also Loo Fung Chiat & Loo Fung Ying (2014) dealt with the topic of enhancement of the music accompaniment in a sports routine, particularly in terms of congruence between the two subjects in a rhythmic gymnastics. The experimental approach of using music in a sports routine was also one of the objectives in this research. It was found that the intended congruence between a music and routine was evidently perceived visually by respondents with a dancing background.

The importance of rhythm perception in children with deafness was verified by Fotiadou, Tsimaras, Giagazoglou, Sidiropoulou, Karamouzi and Angelopoulou (2006). Their findings show the effectiveness of the specific program in terms of improving rhythmic ability, thus indicating its use in educating children with deafness.

The above given results show the importance of developing rhythmic abilities not only in the aesthetic-coordination sports, but in physical activities in general.

In our study we chose dance pads, which work on the principle of interactive simulation dances and thus belong to the group of interactive computer games. We asked the question whether using of interactive computer technology can help develop rhythmic abilities. We included dance pads to a practice of a dance group practicing street dance, mainly because the level of rhythmic ability is one of the limiting factors in the performance of the dancer.

The dance pad has already been used in research, e.g. by Hoysniemi (2006), whose results confirmed that playing on the dance pad has a positive impact on social life and physical health of the players, developing endurance, muscle strength and sense of

rhythm and creativity. Different types of dance pads are also applied in the prevention of falls in the elderly (Lange, Flynn, Chang, Liang, Chien, Nanavati, & Rizzo, 2010) and also applied in working with people with visual disabilities (Gasperetti, Milford, Blanchard, Yang, Lieberman, & Foley, 2010).

The aim of the work was to determine whether the regular use of dance pad can lead to increased level of rhythmic ability.

METHODS

The sample consisted of 28 girls aged between 8-13 years. This period can be in the dance industry divided into two age categories, the children and the juniors. The test subjects were selected and divided according to age (8-10 years and 11-13 years) and length of dance practice.

In the children category we selected a dancer with a two-year practice and in the junior category a dancer with four-year dance practice. In this selection we wanted to avoid deviations that could result in the selection of different performance levels of the test subjects (e.g. speed familiarization and orientation on the dance pad etc.).

The number of tested persons in both categories was the same - 14 people in the children category and 14 people in the junior. Each category was divided (randomly) into experimental group (7 persons), using the dance pad and the control group (7 persons).

The intervention program was the basic idea of the research. The program was limited to girls belonging to the experimental group. It was about two and a half month period during which the dancers regularly trained on the dance pad. Training was led by trained educators. In this two and half month period they were asked to dance on the dance pad 3 times a week before the training session. We gradually increased the level (accelerating pace and increasing complexity of rhythmic patterns), individually according to performance of the tested persons. We oversaw the regularity and helped children with technology. The pad was connected to the screen, allowing better screening and better orientation. In this period, each of the girls had to complete at least 25 workouts on the pad.

Before and after the intervention program we carried out the following tests. Testing rhythmic abilities was divided, according to the focus, into three groups:

1) perception and recognition of rhythmic patterns

2) expression of rhythm by movement

3) the accuracy and speed of execution of the new movement

For our purposes we chose one test for each group.

1) Test of rhythmic discrimination

The test measures rhythmic perception and its author is Seashore (Seashore, 1919; Baldwin 2012) However, we use an innovative recording by Dohnalová. It is a recording of fifteen rhythmic patterns, five parts to individual beats -2/4, 3/4 and 4/4. Of all the thirty formulas sixteen patterns are identical and fourteen patterns different. The tested person (TP) listens to a recording and marks in the table whether the following beats are identical or not (Dohnalová, 2010; Seashore, 1919; Baldwin 2012). The smaller value, the better the result.

2) Software reaction meter

We measure rhythmic execution with a reaction meter. In evaluation, acoustic recording is compared with motion recording. TP sits at the table with the prepared the computer; finger is put on the mouse button and focuses on the acoustic signal emitted by the computer at regular intervals in the range of 2 seconds. The TP reacts to the acoustic signal. (Měkota & Novosad, 2005). The smaller value, the better the results.

3) Hands and feet drumming

The test is performed with the TP in a standing position facing the wall. First, the steps are explained. 1. the left foot hits twice the left side wall (at least 10 cm from the floor), 2. the right palm hits once the right side wall, 3. the left palm hits twice the left side wall, 4.the right foot hits once the right

part of the wall and takes the basic position. These four phases together form a cycle that TP repeat for 20 sec. The result is the number of cycles performed correctly during a specified time interval. We repeated the test three times and recorded all three results in the table. In the final evaluation test we used only the best result. (Měkota & Blahuš, 1983)

For statistical analysis we used the program Statistica 12 firmy Statsoft. For data analysis of rhythm abilities we chose descriptive statistics (average, standard deviation, minimum, maximum) and T-test. T-test is used to compare whether the results of the first measurement (pretest) are statistically different from the results of the second measurement (posttest). The calculations use the 5% level of significance. To be able to carry out t-test we had to verify the normality of the data.

As the calculations of statistical significance depend on the number of people tested, we use the processing results of the main concept of substantive significance. In our case we work with a small research sample, and therefore for processing and evaluation of results, statistical significance will not be the most important factor. The level of substantive significance was assessed by calculating the coefficient of Cohen's d. To verify the relationship between items in variables we used Spearman rank correlations.

Ensuring the quality of research

The validity and reliability of the tests used in the study was confirmed by the authors of the tests and studies. Respondents were informed about the whole research study and the precise procedure of measurement in subtests.

RESULTS

All the results are in the following tables.

Table 1
Test of rhythmic discrimination – descriptive statistics

	Group C-E n = 7 Mean±SD	Group C-C n = 7 Mean±SD	Group J-E n = 7 Mean±SD	Group J-C n = 7 Mean±SD	All Groups n = 28 Mean±SD
RhytmDisc (mistakes) pretest	3.14±4.1	3.57±3.51	3±3.7	3.86±3.53	3.39±3.51
RhytmDisc (mistakes) posttest	2.571±2.64	2.29±2.36	1±1.4	1.57±1.27	1.86±2

Legend: C-E – children experimental group, C-C – children control group, J-E – junior experimental group, J-C – junior control group

Table 2
Test of rhythmic discrimination – results of T-test and Cohen´s d

	Rhytmic discrimination			
	Group C-E	Group C-C	Group J-E	Group J-C
T	0.88	2.465	1.528	2.198
df	6	6	6	6
p	0.413	0.049	0.178	0.07
Cohen's d	0.15	0.4	0.66	0.8

Legend: T – value of student´s statistics, df – degree of freedom, p - statistical significance, Cohen's d - coefficient of effect size. C-E – children experimental group, C-C – children control group, J-E – junior experimental group, J-C – junior control group

Table 3
Test of software reaction - descriptive statistics

	Group C-E n = 7 Mean±SD	Group C-C n = 7 Mean±SD	Group J-E n = 7 Mean±SD	Group J-C n = 7 Mean±SD	All Groups n = 28 Mean±SD
SoftReact Time (ms) pretest	394.14±32.87	497.86±179.86	454.57±171.23	345.57±67.09	423.04±135.74
SoftReact Time (ms) posttest	366.14±29.17	437.29±148.8	316.57±81.15	277±60.36	349.25±105.34

Legend: C-E – children experimental group, C-C – children control group, J-E – junior experimental group, J-C – junior control group

Table 4
Test of software reaction - results of T-test and Cohen´s d

	Software reaction			
	Group C-E	Group C-C	Group J-E	Group J-C
T	2.353	0.883	2.228	2.704
df	6	6	6	6
P	0.057	0.411	0.067	0.035
Cohen's d	0.84	0.34	0.96	1

Legend: T – value of student´s statistics, df – degree of freedom, p - statistical significance, Cohen's d - coefficient of effect size, C-E – children experimental group, C-C – children control group, J-E – junior experimental group, J-C – junior control group Statistical significance and significant effect size is highlighted in red.

Table 5
Drumming test - descriptive statistics

	Group C-E n = 7 Mean±SD	Group C-C n = 7 Mean±SD	Group J-E n = 7 Mean±SD	Group J-C n = 7 Mean±SD	All Groups n = 28 Mean±SD
Drumming (cycles) pretest	6.71±0.76	6±2	9.86±0.9	8.14±1.22	7.68±1.95
Drumming (cycles) posttest	8.86±0.9	8.29±1.6	10±1.53	9.71±0.95	9.21±1.4

Legend: C-E – children experimental group, C-C – children control group, J-E – junior experimental group, J-C – junior control group

Table 6
Drumming test - results of T-test and Cohen´s d

	Drumming test			
	Group C-E	Group C-C	Group J-E	Group J-C
T	-6.301	-5.435	-0.311	-7.778
df	6	6	6	6
P	0.001	0.002	0.766	0.000
Cohen's d	-2.4	-1.17	0.11	-1.34

Legend: T – value of student´s statistics, df – degree of freedom, p - statistical significance, Cohen's d - coefficient of effect size, C-E – children experimental group, C-C – children control group, J-E – junior experimental group, J-C – junior control group

Table 7
Spearman rank correlations between items in variables

Variable	All Groups					
	rhythm 1	rhythm 2	drumm 1	drumm 2	reaction 1	reaction 2
rhythm 1	1.000	0.635*	-0.078	0.104	-0.333	0.142
rhythm 2	0.635*	1.000	-0.273	-0.017	-0.05	0.279
drumm 1	-0.078	-0.273	1.000	0.737*	0.059	-0.298
drumm 2	0.104	-0.017	0.737*	1.000	-0.027	-0.289
reaction 1	-0.333	-0.05	0.059	-0.027	1.000	0.621*
reaction 2	0.142	0.279	-0.298	-0.289	0.621*	1.000

Legend: rhythm 1 – pretest, rhythm 2 – posttest, beat 1 – pretest, beat 2 – posttest, reaction – pretest, reaction 2 – posttest, * - $p<0.05$.

Table 8
Spearman rank correlations between items in variables – group C-E

	C-E group					
	rhythm 1	rhythm 2	drumm 1	drumm 2	reaction 1	reaction 2
rhythm 1	1.000	0.861*	-0.02	-0.116	-0.546	0.073
rhythm 2	0.861*	1.000	-0.295	-0.144	-0.6	0.000
drumm 1	-0.02	-0.295	1.000	0.388	0.617	0.617
drumm 2	-0.116	-0.144	0.388	1.000	0.189	0.113
reaction 1	-0.546	-0.6	0.617	0.189	1.000	0.5
reaction 2	0.073	0.000	0.617	0.113	0.5	1.000

Legend: C-E – children experimental group. Rhythm 1 – pretest, rhythm 2 – posttest, beat 1 – pretest, beat 2 – posttest, reaction – pretest, reaction 2 – posttest, * - $p<0.05$.

Table 9
Spearman rank correlations between items in variables – group C-C

Variable	C-C group					
	rhythm 1	rhythm 2	drumm1	drumm 2	reaction 1	reaction 2
rhythm 1	1.000	0.972+	-0.426	-0.122	0.0	0.673
rhythm 2	0.972*	1.000	-0.333	-0.084	0.146	0.673
drumm 1	-0.426	-0.333	1.000	0.86*	0.273	-0.218
drumm 2	-0.122	-0.084	0.86*	1.000	0.110	-0.202
reaction 1	0.0	0.146	0.273	0.11	1.000	0.536
reaction 2	0.673	0.673	-0.218	-0.202	0.536	1.000

Legend: C-C – children control group. Rhythm 1 – pretest, rhythm 2 – posttest, beat 1 – pretest, beat 2 – posttest, reaction – pretest, reaction 2 – posttest, * - $p<0.05$

Table 10
Spearman rank correlations between items in variables – group J-E

Variable	J-E group					
	rhythm 1	rhythm 2	drumm 1	drumm 2	reaction 1	reaction 2
rhythm 1	1.000	0.132	0.221	0.505	-0.211	-0.146
rhythm 2	0.132	1.000	-0.042	0.686	0.342	0.199
drumm 1	0.221	-0.042	1.000	0.612	0.315	-0.51
drumm 2	0.505	0.686	0.612	1.000	0.195	-0.349
reaction 1	-0.211	0.342	0.315	0.195	1.000	0.541
reaction 2	-0.146	0.199	-0.51	-0.349	0.541	1.000

Legend: J-E – junior experimental group. Rhythm 1 – pretest, rhythm 2 – posttest, beat 1 – pretest, beat 2 – posttest, reaction – pretest, reaction 2 – posttest.

Table 11
Spearman rank correlations between items in variables – group J-C

Variable	J-C group					
	rhythm 1	rhythm 2	drumm 1	drumm 2	reaction 1	reaction 2
rhythm 1	1.000	0.704	0.03	0.358	-0.703	0.18
rhythm 2	0.704	1.000	0.051	0.132	-0.643	0.092
drumm 1	0.03	0.051	1.000	0.837	0.493	0.177
drumm 2	0.358	0.132	0.837	1.000	0.315	0.571
reaction 1	-0.703	-0.643	0.493	0.315	1.000	0.25
reaction 2	0.18	0.092	0.177	0.571	0.25	1.000

Legend: J-C – junior control group. Rhythm 1 – pretest, rhythm 2 – posttest, beat 1 – pretest, beat 2 – posttest, reaction – pretest, reaction 2 – posttest. Statistical significance is highlighted by red.

In the table 1 and table 2 are results of the test of rhythmic discrimination, they didn´t show any considerable progress in experimental groups. The rhythmic discrimination test determines the level of rhythmic perception. From the results we can conclude that regular use of dance pads used by our chosen dancers did not lead to increased levels of rhythmic perception.

To compare the results of pretest and posttest we chose median of response speed to acoustic signal as the starting value (table 3).

To compare the results of pretest and postest we chose the highest number of correctly completed cycles from the three measurements as the starting value (table 5).

We used the test of software reaction meter to investigate rhythmic level of implementation. In children groups (experimental and control) statistically significant changes weren´t shown (table 4). Improvements are seen only in terms of substantive significance - in children experimental group there is a great effect, in children control group a mid- effect. In both junior groups, we have not seen significant differences in favour of the experimental group.

Based on these claims, we conclude that the children category could use the dance pad to work on increasing of the level of rhythmic execution. In another research study it would be useful to investigate the role of age and initial level of ability. Furthermore, we acknowledge the fact that the test does not assess the rhythmic abilities separately, but is strongly influenced by the reaction rate of the tested persons.

Drumming test was included to determine the level of rhythmic execution. Unlike the previous test, drumming is unrelated to the reaction rate, but to differentiation capabilities and ability of grouping (division of coordination abilities according to Schnabel, 2003).

In both children groups the level of this ability was increased in both statistical and material significance. In the junior categories there were even better results in the control group (table 6).

The best relationship is between pretest and posttest of each test (table 7). Besides those relationships there are only small correlations. It means the absence of possibility to change all tests. All tests apparently describe different level of rhythmic perceptions.

This group (C – E) has the best predisposition for this test. Other tests are significantly more difficult to conduct in such sensitive period (table 8). Intervention on the dance pad has had a negative impact on the results of the “beat” and “reaction” tests in the group C – E, where the coefficient correlation value decreased sharply.

The dance pad has had a slightly different impact on the group C – C, the correlation between the tests "rhythm" and "beat" is very high (table 9). The correlation expressed by the correlation coefficient in the test "reaction" is lower and statistically insignificant.

We can conclude that in the group J – E there isn´t any closed relationship between the three tests expressed by this correlation (table 10). In addition, in the test "rhythm" the correlation value is extremely low (0, 13).

The use of the dance pad hasn´t brought significantly positive impact on juniors (table 11). The "rhythm" and "reaction" test correlation value coefficient is 0, 7, but in test "reaction" is very low (0,25).

DISCUSSION

It cannot be claimed that regular use of dance pads leads to an increased level of rhythmic ability of the tested persons. The question is whether there would be significant statistical changes of similar testing of the specific groups (seniors, people with sedentary job, etc.).

De Bruin , Schoene, Pichierri and Smith (2010) describe the potential of dance pad training protocols in the elderly and report on the theoretical rationale of combining physical game-like exercises with sensory and cognitive challenges in a virtual environment.

Also Brox, Luque, Evertsen and Hernandez (2011) confirmed that games with motion sensors that require the players to move, so-called exergames, have become very popular.

As implies from the above, there is already research focusing on the use of the dance pad in seniors to increase their physical activity and enhance cognitive functions. We could contribute by investigating the level of rhythm and balance abilities in this age group.

Another direction of research is to measure athletes for whom the level of rhythmic abilities represents one of the limiting factors for their sports performance (in artistic gymnastics, rhythm gymnastics, team gym, sport aerobics, figure skating, etc.).

Limitation

The number of tested persons was low, that is why the results cannot be generalised. Furthermore, the level of rhythmic abilities in dancers was high already before intervention that is why no significant difference was found. It would be advisable to select a group in which no other type of intervention was conducted (dance training in our case) focused on the same ability.

CONCLUSION

Our results show a certain improvement in rhythmic abilities in all the groups, which suggests that the cause of the improvement was not the use of dance pad, but regular dance training of all the groups. Our research was focused on the possibility of raising the level of regular rhythmic abilities using dance pad. Although the research did not confirm a positive influence of dance pad on the development of rhythmic abilities, more options to investigate were shown. We tested the girls in a sensitive period for the development of rhythmic abilities with two and four years dance experience. Extending the research sample, this study could be the basic building block for further research work. The results show that the very regular and properly led training dance training leads to the development of rhythmic ability.

In other measurements we would like to determine the effect of exercise on the dance pad on the selected motor abilities in the general population - people with no previous dance experience at different ages. Also we would like to test athletes who have rhythmic abilities as one of the limiting factors of their workout (rhythmic gymnastics, artistic gymnastic, team gym, sport aerobics, etc.)

Furthermore, we would focus our attention in research investigations on the fact that use of dance pad will help the

independent development and implementation of rhythmic perception, therefore each sub-rhythmic ability. Due to the fact that we have not found a test that measures the level of a rhythmic ability (the results obtained may be affected for example by levels of response speed, thus hybrid capability and with test of software reaction meter), in our future research we would include more tests that could be correlated to obtain more accurate results.

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