Differences in Sensorimotor Skills between Badminton Players and Non-Athlete Adults

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Abstract

This study is focusing on the badminton top players vs. regular adult population. In our previous study on adolescents, variances showed the impact of puberty on timing skills (Hromčík & Zvonař, 2018). The timing in training is topical these days (Forner-Cordero, Quadrado, Tsagbey, & Smits-Engelsman, 2018), and also brain specifics and learning anticipation skills (Wang, Dong, Wang, Zheng, & Potenza, 2018). We added some new insight in this theme and tried to determine the dynamics in the accuracy of sensorimotor skills, which plays an essential role in ball games. Only boys from one club were tested. Subjects have undergone a special PC test with a length of about 45 minutes to test their response and timing of movement with number of tasks in which they tried to hit a moving target, which appeared on the screen at 3 different angles (0°, 15° and 30°) and at different speeds (accelerating, decelerating, constant). Everything happened at unpredictable intervals in 45 minutes rotation. We compared these outcomes with our measurements from last year through specific timing hits and missed shots, and in the terms of sport season. Predictive motor timing suggests that the cerebellum training plays the relevant role in integrating incoming visual information with the motor output reaction.

Keywords: Sensorimotor; Badminton; Timing Skills; Ball Games Training; Brain Responses.

1. Introduction

The role of cerebellum as part of the brain responsible for the activity of basal ganglia and primarily for subconscious coordination of accurate rapid movements and balance is the actual topic. It interests researchers a lot more, especially in an increasing quantity of human activities and sports, where understanding the process can improve training and results. This time we center on the function of the cerebellum that affects the most accurate timing based on visual stimulation and the motor learning process (Zvonař & Duvač, 2011). In the current study, we use again a specific test for the cerebellum (perception and timing operations). The test was repeatedly performed at the Neurological Clinic (Prof. Martin Bareš) and Sports faculty in Brno. They examined the causes of timing in the adult generation and older population affected by cerebral diseases. (Bareš, 2008) described how strongly these diseases affect timing and what are the classic consequences. As the results of the middle age cerebellum dysfunction population were already obtained by prof. Bares, we have decided to follow the methodology of measurement with badminton skilled players and find out whether and how they differ from ordinary population.

In the faculty of sport studies we came up with a similar methodology that we applied on the badminton top players to discover the differences in the RT (reaction time) development versus ordinary students. Dynamics of the sensory-motor abilities developed by adolescents during ontogenesis (Gimunová, 2015, Vespalec, 2016) partly affect our results. The importance of brain motor functions for timing was showed for basal ganglia (Meck, 2005) and cerebellum in a wide range of movements (Braitenberg, 1967), or a specific role of motion timing and evaluation (Ivry, 2004) in the general population. Different types of sensorimotor trainings are formed to prove the effects on particular training components. More often, the studies on this level demonstrated superior visuomotor reaction time during sport-specific visuomotor tasks in athletes vs. nonathletes (Ando, Kida, & Oda, 2001; Nakamoto & Mori, 2008; Ghuntla, Mehta, Gokhale, & Shah, 2012). The sensorimotor training can uplift performance in reactive drop-jump by improved neuromuscular activity immediately after impact (Bruhn, Kullmann, & Gollhofer, 2004). Excellent visuomotor performance in players rise up from faster visuomotor transformation (premotor and supplementary motor cortical regions), rather than from earlier perception of visual signals (Hülsdünker, Strüder, & Mierau, 2016). Neurophysiological parameters differentiating badminton players from non-athletes cannot necessarily determine performance within a homogeneous group of athletes, especially the speed of visual perception (Hülsdünker, Strüder, & Mierau, 2018/02/07).

In addition, it was well documented that practicing with systematic increases in contextual interference during visuomotor tasks would benefit the learning of a continuous visuomotor skill (Porter JM & Magill RA, 2010; Bootsma, Hortobágyi, Rothwell, & Caljouw, 2018: Porter & Beckerman, 2016). The different skills lead to another training methodology, a ways to improve the exercise in ball games exercise (Litkowycz, 2014; Forner-Cordero, Quadrado, Tsagbey, & Smits-Engelsman, 2018; Bhabhor MK et al., 2013). Repetitive motor tasks were tested numerous times in recent years. Timing is inherent to coordinated movement, but it applies for movements with a specific temporal goal, such as tapping to a beat, not for sport timing decision (Galea, Traynor, & Pierrynowski, 2018; Hands B, McIntyre F, & Parker H, 2018).

Our goal was to determine the level of timing and the accuracy of the reaction, describe partly the level of motor memory of badminton players. We aimed to find changes that should be affected by the type of activity, eventually the relationships of different kinds of variables such as sports or playing background games.

2. Methodology

A specific visuomotor test using PC software created in LabVIEW 6.1TM environment, National Instruments, Austin, TX, USA was used. Settings and parameters of the program task are taken from previous research (Bares, 2007). The research sample comprehends 30 subjects (15 badminton skilled players, 15 ordinary students). Only boys were tested. Informed consents were signed by participants and parents as well, in some cases. The file structure: badminton profi team and students designated by random selection. Test subjects perform a perception test on a PC with a length of about 45 minutes to test their response and timing of movement. They went through a number of tests, in which the individual tries to hit a moving target, which appears on the screen at different angles and at different speeds (accelerating, decelerating and constant), at unpredictable intervals by rotation for about 45 minutes in 4 sections. The first was the training section, where tested subjects get used to shooting down a moving ball. This section also contains a series, where the ball changes color from green to red (to be pressed as soon as possible after the change in color) for controlling the level of the color discrimination. In the second and third part, which was crucial for us, is always 6 sets of 54 attempts with 20 seconds long pause.

Throughout the test, the subjects were supposed to sit 60 cm away from the screen and react with pressing the space bar. We used a 10-minute-long questionnaire (medical background, level of sports activity, the level of PC gaming), two valid questionnaires (degree of sleepiness and anxiety). PC gaming and sport background has 4 values: 1- not at all, 2 – occasionally, 3 – regularly, 4 – very often.

Table 1. Characteristics of the measured group of boys (own data processing)

Sport	Avg. Age	Avg. Tallness	Avg. Weight	Avr. Sport	Avg. PC Gaming
Badminton	21,8	181,8	76,2	3,3	1,8
Ordinary	26,2	182,1	79,0	2,8	2,4

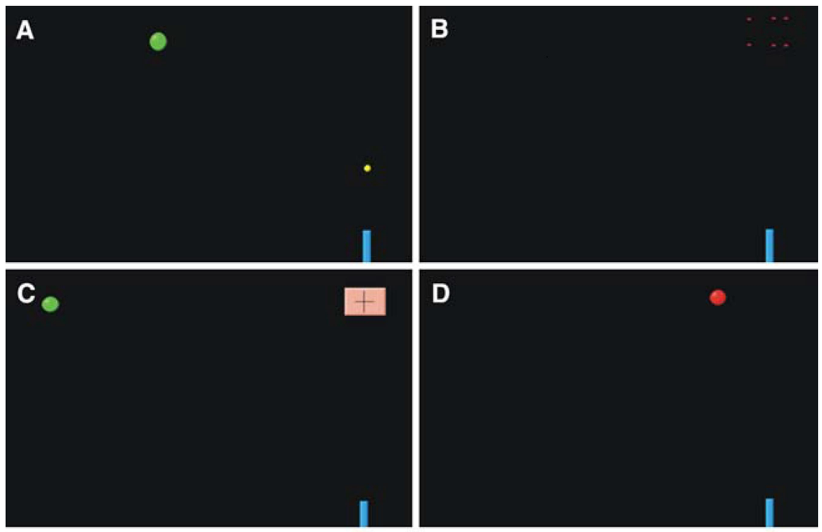


Figure 1. The main interception task - *The moving green target travelling to the interception zone located in the right upper side of the screen, where the yellow cannon ball will intersect the target. The blue cannon in the lower right corner launched the yellow fireball traveling with constant speed to intercept the moving target. If the subject successfully intercepted the target, both balls exploded (animated with small red points). No animation occurred, if the subject failed to intercept the target. Subjects had to push the fire button at the instant the target ball reached the interception area. If subjects were successful, the target exploded.*

3. Results and Discussions

As we planned, measurements were compared from many points of view. We supposed that there are some statistically significant correlations in terms of frequency of PC gaming and sport background among these heterogenic groups. Due to our goal, we were only interested in basic statistics and correlations. Data came from ordinary distribution. Pearson's correlation coefficient was used for the calculations overall and for each age category as well. We find relevant correlation between some variables.

The main premise was that the badminton group was significantly better in almost all indicators. We especially hoped for the influence of their visuomotor skills and their accuracy in repeatedly performed activity, that they developed in almost every training, because the badminton ball moves during the matches at 200 – 300 km/h. This is the quickest ballgame on the planet. We start with the primary data table, where we find the overview of main statistics, which was used afterwards. From comprehensive statistics and variables, we select only the important and significant ones to show the conditions of the sample (Table 2).

Table 2. Basic characteristics of research sample with data (own data processing)

badminton/ordinary	% hitrate	# early errors	# late errors
badminton	58,6%	184	88
badminton	48,8%	118	215
badminton	56,3%	176	108
badminton	53,1%	155	149
badminton	53,6%	144	158
badminton	42,6%	208	166
badminton	45,7%	177	177
badminton	40,7%	137	260
badminton	55,2%	143	148
badminton	49,9%	187	138
badminton	66,2%	124	96
badminton	59,0%	136	131
badminton	68,1%	122	87
ordinary	51,0%	173	146
ordinary	50,6%	170	156
ordinary	49,8%	221	105
ordinary	46,1%	124	244
ordinary	49,1%	171	159
ordinary	51,1%	173	144
ordinary	44,3%	182	179
ordinary	49,5%	168	165
ordinary	49,7%	166	160
ordinary	55,3%	146	146
ordinary	56,9%	174	105
ordinary	54,7%	130	166
ordinary	51,9%	164	149

First of all, we compared the average hitratio in both groups from the whole task (2,3 block) to see what is the basic score. In our previous study with adolescents we have a higher overall amount of hits but there was a significant difference between them and recent data. It is interesting that also non-athletes have quite high scores despite the fact that they are not frequent game players and practice the sport recreationally. We hope that there are some aspects apart from heredity; something that we can mark as a trend or tendency.

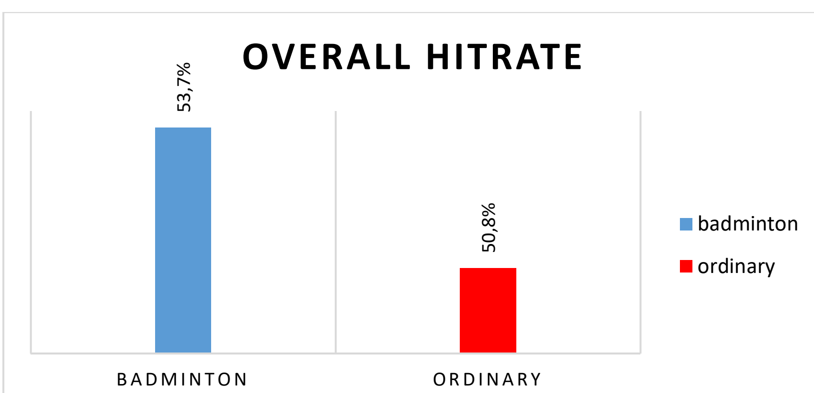


Figure 2. Overall hitrate score for both groups (own data processing)

In the other part of calculations we compare the success in the test in terms of sport (Table 3) and PC gaming (Table 4) background. Those who marked a higher level of sport background showed a much bigger difference between occasionally and regularly, than regularly versus professionals, whereas the gaming background had much bigger impact on results in professionals group.

Table 3. Hitrate comparison in in sport background (own data processing)

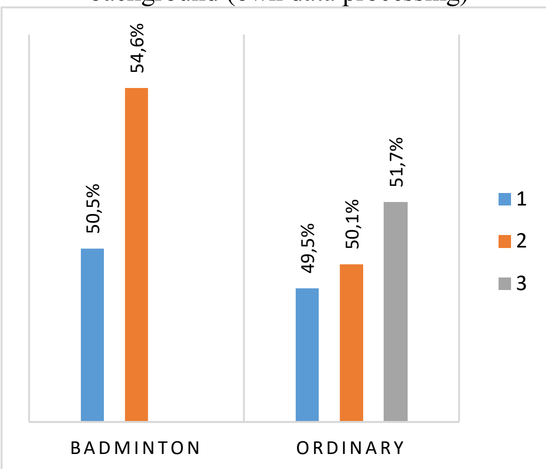
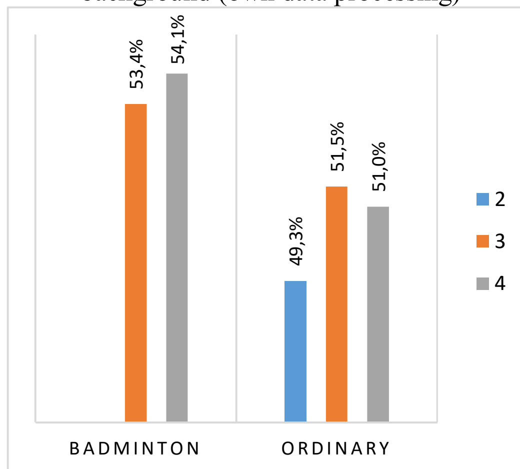


Table 4. Hitrate comparison in PC gaming background (own data processing)



We compared the number of average hitrates with the number of early and late missed shots and the results showed that in ordinary groups there is a slightly lower dependence in missed shots in ordinary group than in the badminton groups. That means that when the hitrate is better, errors are bigger in ordinary group, so the dispersion from hits correlates with the soft motoric skills.

Correlations of variables:

-0,439386479	hitrate vs. early errors in badminton pl.
-0,841556202	hitrate vs. late errors in badminton pl.
-0,149734405	hitrate vs. early errors in normal s.
-0,606337772	hitrate vs. late errors in normal s.

The age factor indicates that in the athletic group, the missed shots variable was more dispersed than in ordinary groups through the age spectrum. Due to more sensitive reactions, players were able to aim better, and had the ability to time their response to task shots closer to the hit. In the ordinary group with age level, the number of average early errors decreased, while the late errors rise up, and much more than in players. This variance is different in next graph where interestingly, the lines are more horizontal with little more inclination of early errors. Probably the late reactions were more stable due to specific training.

Table 5. Ordinary student's comparison in terms of average early errors

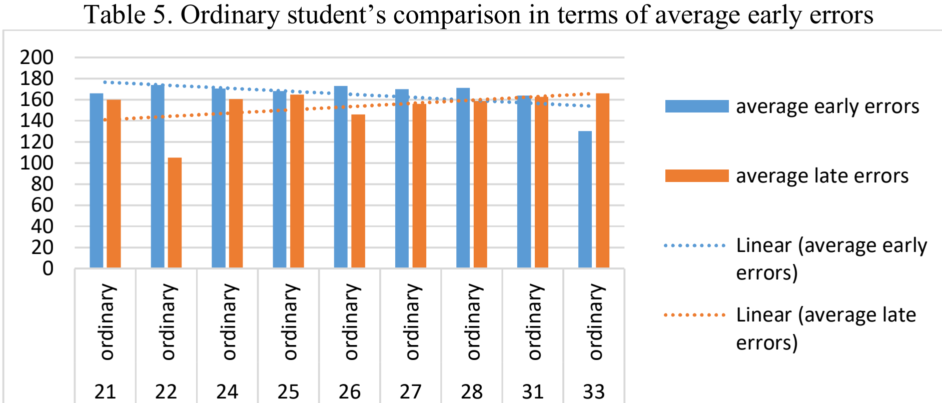
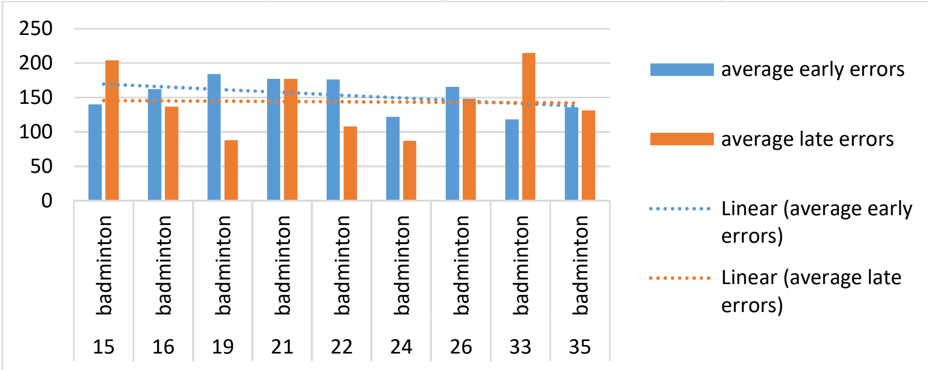


Table 6. Ordinary student's comparison in terms of average late errors



4. Conclusion

In the sight of the previews studies on the similar topic, we compared the specifics of the badminton skilled players and their timing abilities in this particular sensorimotor test. More visuomotor skilled players really have a better premise to soft motor timing, especially in longer interval when the cerebellum have time to moderately learn the precision. We also found some interesting differences in early and late error shots. As we assumed, some of these variables were new in the sport related sector, but mainly supported the similar researches with new contribution in complex knowledge. (Ghuntla, Mehta, Gokhale, & Shah, 2012); Hülsdünker, Strüder, & Mierau, 2018/02/07). Basic correlations indicated that the influence of sport proficiency had soft but statistically significant values and will be enlarged with other options in complex comparison with other specific population groups. Tallness and bodyweight did not show any crucial impact, as well as the score from questioners, but it could be the limitation of this research (number of participants).

After this first statistical approach we will continue with the evaluation of other specific groups. This year we already aim to find more reasonable results and to extend the study and find out if there is some pattern in the timing process and maybe detect some possible training recommendations.

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