# THE USAGE OF THE BLAZEPOD PLATFORM IN SPORTS

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Abstract:

The implementation of information technologies in sports has proven to be a fertile ground for innovation and improvement of sports performance. BlazePod platform is a tool for measuring and quantifying motor and cognitive parameters such as reaction time, agility, attention and concentration. In this research, different age groups, a total of 214 male and female trainees who practice real Aikido at the Martial Arts Center Gymnasium in Loznica, were tested. The trainees were tested using the BlazePod platform with three different reaction speed tests (simple, complex and distracting test). Statistically significant ($p<0.05$) correlations of all variables were revealed, among which the negative relationship between age and impaired reaction time ($\rho=-0.88$) in women stands out. Numerous gender differences, as well as gender specificities of the researched relationships, were also discovered and described. The results confirm that the use of information technologies in sports, in this case, the BlazePod platform, gives the tested athletes valuable feedback in showing their motor and cognitive potential and helps in the creation of more effective training programs.

Keywords:

BlazePod Platform, Real Aikido, Reaction Speed, Cognitive Abilities, Test.

## INTRODUCTION

In an era defined by rapid technological advancement, the implementation of information technology in sports has proven to be a fertile ground for innovation and performance improvement. The integration of digital tools and new methods into athlete training has changed the way athletes train, compete, and analyze their performance [1]. This synergy is particularly evident in the field of martial arts, where the fusion of traditional techniques with cutting-edge technology offers new avenues for skill development and cognitive enhancement [2]. Real Aikido, a dynamic and practical martial art, emphasizes adaptability, precision, and efficient use of the opponent's energy [3]. Real Aikido also emphasizes the principles of timing and focuses on redirecting the opponent's energy, which requires exceptional timing, coordination, and reaction time. Reaction time is the time between a stimulus and the first appropriate response [4].

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Real Aikido was founded by Ljubomir Vračarević, who wanted to remove religious elements and mystification from Aikido and emphasize its efficiency [5]. It is a Serbian martial art that emphasizes hitting the vital areas before applying leverage. It is used in the training of special forces such as the army, police and bodyguards [5].

The inclusion of technological means, such as the BlazePod platform, represents an opportunity to objectively measure and quantify key cognitive parameters such as reaction time, attention and concentration in different age groups practicing real aikido [6]. The use of information technologies in sports provides athletes with valuable feedback, thus shortening the time needed to acquire the necessary skills, which influences overall sports performance. The current training process is unthinkable without the use of multimedia sports support [7], while BlazePod, a reaction training system using light-based signals, has gained popularity in sports training for its ability to improve cognitive and physical performance [8].

Contemporary athlete training emphasizes a holistic approach, integrating physical fitness with cognitive training to optimize psycho-physical characteristics in various sports disciplines. Studying reaction time, attention and concentration in all age groups is crucial, as these mental abilities are fundamental to the successful execution of techniques in martial arts such as real Aikido. Martial arts training is associated with improvements in cognitive function in children and cognitive control in adults [9], and participation in programs in martial arts schools can lead to better efficiency, modulation of attention and excitability of the motor cortex, cognitive flexibility and the ability to anticipate changes in the environment [10].

Previous research has shown that sports interaction technology often targets different combinations of performance, engagement and learning [11]. Martial arts and sports, in particular, have the potential to positively impact these cognitive abilities, including reaction time, attention, and concentration.

This study aims to investigate the effectiveness of BlazePod technology through three tests (simple, complex, and choice reactions) to measure reaction time, attention, and concentration among real Aikido practitioners of different age groups. Simple reaction time requires only one response to one stimulus, while in reaction time, there is an alternative stimulus, and the subject makes a specific response to the presented stimulus [12]. The ultimate goal is to assess the capacity of these technologies to provide coaches and athletes with valuable resources, improve athlete performance, and optimize training strategies, which will help them make optimal physical, technical, and tactical decisions [13]. By quantifying these cognitive parameters, we aim to provide insight into how real-world aikido training affects cognitive function across the lifespan and how technology can be used to optimize training strategies for practitioners of all ages. Although reaction time is the key component in martial arts, especially karate [14] because it requires a high level of execution of explosive techniques, research related to reaction time in this area is rare. Moreover, the existing literature regarding simple and choice reaction time in martial arts is contradictory [15]. Some studies suggest that martial arts practitioners possess superior sensory functions, while others indicate no significant differences. Studies suggest that karate training can improve sustained attention and reduce impulsivity, even in children with ADHD, and can also improve choice reaction time, which is important for explosive techniques. Athletes perform specific cognitive tasks faster and more accurately [16]. Increasing evidence suggests that physical activity can improve cognitive abilities in individuals of all ages.

This study is concerned with how to effectively measure simple reaction speed, choice reaction when there is more than one stimulus (for which the dominant factors are attention and concentration), and reaction time, i.e., concentration and attention when distracting factors are present.

## 2. METHOD

### 2.1. PARTICIPATION

A total of 214 participants took part in this research, all of whom are active members of the Real Aikido club "Gymnasium" in Loznica. The sample was stratified into five different age categories to account for developmental variations in cognitive and motor skills.

Preschool group (4-6 years old): 19 girls and 29 boys. The participants in this category held the following ranks: 10th kyu (30 participants), 9th kyu (6 participants), and 8th kyu (12 participants).

Younger pioneers (7-9 years old): 28 girls and 35 boys. Their ranks were distributed as follows: 10th kyu (12), 9th kyu (4), 8th kyu (15), 7th kyu (14), 6th kyu (11), 5th kyu (6), and 4th kyu (2).

Senior pioneers (10-12 years old): 30 girls and 17 boys. The distribution of ranks in this group was: 10th kyu (9), 8th kyu (6), 7th kyu (6), 6th kyu (6), 5th kyu (3), 4th kyu (3), 3rd kyu (1), and 2nd kyu (3).

Juniors (13-17 years old): 20 girls and 9 boys. Their ranks were: 10th kyu (10), 8th kyu (6), 7th kyu (4), 6th kyu (6), 5th kyu (5), 4th kyu (3), 3rd kyu (4), 2nd kyu (1), and 1st kyu (3).

Seniors and veterans (18+ years old): 9 females and 18 males. The participants in this group held the following ranks: 6th kyu (3), 5th kyu (1), 4th kyu (2), 3rd kyu (4), 1st kyu (1), 1st day (12), 2nd day (3), and 3rd day (2).

All participants had been training intensively for at least six months, with rankings ranging from children's yellow belt (10th kyu, beginner level) to advanced master title (black belt, 3rd day). The diverse experience levels among the participants allowed for a comprehensive analysis of the effects of BlazePod training across different skill levels.

## 2.2. EXPERIMENTAL PROCEDURES

This research seeks to comprehensively evaluate the reaction time of real Aikido trainees using the BlazePod platform, focusing in particular on simple reaction time, complex reaction time (a reflection of attention and concentration) and reaction time under the influence of distracting light and sound stimuli.

A single BlazePod device was used for simple reaction time assessment and data quantification. The device was programmed to emit blue light at unpredictable intervals, ranging from 0.5 to 4 seconds, thus preventing prediction and ensuring an honest response to the stimulus. Each test protocol lasted 30 seconds, providing enough data for a reliable analysis. The participants were tested individually, in the presence of an examiner, in a controlled environment to minimize any distractions during the test phase. The participants were instructed to stand at the table where the BlazePod was placed, maintaining a consistent hand position over the device. After the blue light was turned on, the participants were instructed to react as quickly as possible by touching the BlazePod to record their reaction time. Before the start of the actual test, each participant was allowed a practice trial in order to familiarize themselves with the test procedure and minimize any potential learning effects during the formal data collection phase.

For the complex assessment of reaction time, a task known as the "Clap Challenge", which is a protocol standardized by BlazePod for assessing attention and concentration, was implemented. In this protocol, four BlazePod devices are arranged linearly on a table, each separated by a distance of 20 centimeters. During the 30-second test, the device glowed in different colors, with three different lights flashing in an unpredictable order, which added cognitive load and required the participants' selective attention. The participants were instructed to respond to each color stimulus in a specific manner: the blue light was to be deactivated with the left hand, the red light with the right hand, and the green light required hand clapping before deactivation, introducing a motor coordination component to the task. Average reaction time, measured in milliseconds, was recorded upon completion of the test, which provided a quantitative measure of the participant's ability to process and respond to multiple stimuli under time constraints. The data was processed in Blazepod, which calculated the mean value in milliseconds after the completion of the protocol.

In order to simulate distraction during exercise in real-world situations, a third test was conducted that included distracting light and sound stimuli to mirror scenarios in which athletes must maintain focus amid ambient noise. In this test, the setup reflected a complex reaction time assessment, with four BlazePod devices arranged in a linear order on the table. During this test, the participants stood in front of a table with four BlazePods, which were arranged as in the previous test in order to reduce the effects of spatial familiarity. The participants were instructed to respond exclusively to a predefined color, while other colors served as distractors, which required increased attention control and cognitive inhibition. Additional complexity was provided by the audience present during this test, which introduced an element of social pressure and auditory distraction that could affect the participants' concentration and reaction time. This multifaceted approach enabled a comprehensive assessment of reaction time, attention and concentration at different levels of cognitive demands.

## 2.3. DATA ANALYSIS

Descriptive statistical analysis was conducted to describe and calculate the mean levels and dispersion of the examined variables in gender groups.

Instead of the variables that do not meet the criteria for the use of parametric statistics, this research employed testing differences between male and female groups using non-parametric the Mann-Whitney. To test the relationships between variables, we used Spearman's correlation. The level of statistical significance was set to $p<0.05$ and $p<0.01$

Jamovi software (version 2.6.44) was used for statistical processing.

## 3. RESULTS

Table 1 presents the results of the descriptive analysis of the female subsample by age category.

Table 2 presents the results of the descriptive analysis of men in the subsample according to age category.

The significance of the difference in scores between men and women that can be seen in Tables 1 and 2 was tested by analyzing variance using the non-parametric the Mann-Whitney, while differences between age groups were tested with non-parametric Krasakal-Wallis test, the results of which are shown in Table 3.

The results of the analysis of variance non-parametric the Mann-Whitney show no statistically significant ($p>0.05$) difference between women in any of the measured variables (Table 3). On the other hand, all differences between age groups are significant ($p<0.01$).

**Table 1.** Descriptive statistical analysis of female age categories. Values are presented as Mean ± Standard deviation

| Cat | ps | yp | op | j | s |
|---|---|---|---|---|---|
| Age | 5.3±0.8 | 8.1±0.8 | 10.7±0.9 | 14.8±1.1 | 29.8±17.9 |
| m lev | 1.7±0.9 | 3.8±1.8 | 4.5±2.8 | 7.8±2 | 10.6±1.9 |
| tra ex | 0.9±0.5 | 2±1 | 2.6±2 | 4.8±12.7 | 11.7±7.2 |
| com r | 1213±122 | 1036±113 | 885±157 | 734±116 | 697±235 |
| dis r | 943±184 | 719±184 | 561±82.8 | 470±146.2 | 503±139 |
| sim r | 507±94 | 416±62 | 367±119 | 351±1134 | 312±175 |

cat – category, m lev – mastery level, tra ex – training experience, com r – complex reaction [ms], dis r – disrupted reaction [ms], sim r – simple reaction [ms], ps - preschool, yp - young pioneers, op - older pioneers, j – juniors, s – seniors

**Table 2.** Descriptive statistical analysis of male age categories. Values are presented as Mean ± Standard deviation

| Cat | ps | yp | op | j | s |
|---|---|---|---|---|---|
| Age | 5.4±0.8 | 8±0.9 | 10.8±0.9 | 14.8±1.4 | 39.7±19.2 |
| m lev | 1.6±0.9 | 3.3±1.6 | 5.1±2.5 | 8.8±1.3 | 10±2.1 |
| tra ex | 0.8±0.5 | 1.8±1 | 2.7±1.4 | 6.2±3.2 | 9.5±6.8 |
| com r | 1198±131 | 1052±146 | 863±118 | 787±166 | 780±158 |
| dis r | 909±188 | 718±109 | 549±55 | 485±57 | 472±88.6 |
| sim r | 482±77 | 395±89.3 | 334±44.7 | 350±87.7 | 269±34.6 |

cat – category, m lev – mastery level, tra ex – training experience, com r – complex reaction [ms], dis r – disrupted reaction [ms], sim r – simple reaction [ms], ps - preschool, yp - young pioneers, op - older pioneers, j – juniors, s – seniors

**Table 3.** Non-parametric the Mann-Whitney test for the independent variable gender and non-parametric Krasakal-Wallis test for age group

| | Mann-Whitney U | Wilcoxon W | Z | Significance | | $\chi^2$ | Df | p | $\varepsilon^2$ |
|---|---|---|---|---|---|---|---|---|---|
| Age | 5147.5 | 11033.5 | -1.28 | 0.2 | Age | 203 | 4 | <0.01 | 0.955 |
| Level | 5312.5 | 11198.5 | -0.92 | 0.36 | Level | 138 | 4 | <0.01 | 0.648 |
| training experience | 5290 | 11176 | -0.98 | 0.33 | training experience | 106 | 4 | <0.01 | 0.498 |
| complex reaction | 4985.5 | 10656.5 | -1.63 | 0.1 | complex reaction | 134 | 4 | <0.01 | 0.628 |
| disrupt reaction | 5088.5 | 10759.5 | -1.4 | 0.16 | disrupt reaction | 106 | 4 | <0.01 | 0.496 |
| simple reaction | 5486.5 | 11372.5 | -0.52 | 0.6 | simple reaction | 155 | 4 | <0.01 | 0.729 |

**Table 4.** Spearman correlation for men and women

| | | age | mastery level | training experience |
|---|---|---|---|---|
| female | complex reaction | -0.779** | -0.697** | -0.626** |
| | disrupt reaction | -0.881** | -0.794** | -0.743** |
| | simple reaction | -0.782** | -0.663** | -0.584** |
| male | complex reaction | -0.367** | -0.709** | -0.548** |
| | disrupt reaction | -0.346** | -0.565** | -0.408** |
| | simple reaction | -0.347** | -0.337** | -0.293** |

**p<0.01

The correlation results for men and women are shown in Table 4.

The correlation results revealed the existence of a statistically significant negative correlation (p<0.01) between all variables.

## 4. DISCUSSION

The results of this research show that BlazePod is an effective tool for measuring and improving reaction time, attention, and concentration in different age groups of real Aikido, and it is a highly motivating factor for practitioners. In addition to reaction speed, concentration and attention, with its help, it is possible to influence almost all motor and cognitive abilities. Attention and concentration are of utmost importance for sports that require quick reactions, and this fact should be taken into account when planning training. The inclusion of cognitive tasks in motor tasks can be more effective for improving cognitive abilities than separating mental and physical functions in training [16]. Although the statistical analysis in our research did not indicate significant differences between men and women in the average values of reaction time (p > 0.05), female athletes showed better results on average in tasks that require selective attention, focusing and mental control. In tests with more stimuli, female athletes showed better results than their male counterparts. However, they noted that this could be influenced by seniority in sports and the fact that women emphasize accuracy rather than speed [28]. Herein lies the advantage and the ability of the BlazePod system to use light stimuli in different colors for different exercises to introduce an element of cognitive engagement in physical training, which potentially leads to improvements in both cognitive and physical performance [17]. Both children and adolescents, through martial arts training, can improve perceptual and visual processes. The correlation analysis in our work showed a significant correlation between age, skill level and age reaction time. Older and more experienced athletes displayed faster reaction times. Although there are studies which state that reaction speeds is relatively stable from 20-60, another study showed that reaction time in children is age-dependent. In contrast, the children's concentration was weaker than in adults [18]. In our research, younger respondents showed a slower reaction time as compared to older groups, which is particularly visible in complex reaction tests (p < 0.01). The most notable differences were observed between preschool children (4-6 years old) and senior pioneers (10-12 years old), as well as between younger pioneers (7-9 years old) and juniors (13-17 years old). These disparities can be attributed to neurophysiological maturation, cognitive development, and experience gained through prolonged sports engagement.

In the context of sports, reaction time is a critical component that determines the ability to perform maximally, especially in dynamic and fast-paced activities [19]. Athletes with faster reaction times are better able to predict and respond to rapidly changing stimuli, which gives them an advantage in competition [20]. This research showed that as the level of experience increased, the reaction time became shorter, which indicates the effect of training in improving cognitive-motor abilities. This fact also suggests that the continuous improvement of test results from the younger to the older ages is the product of a specific training procedure. Furthermore, taekwondo masters have confirmed that they have a better reaction speed to specific visual stimuli than the untrained [21], which suggests that long-term practice of martial arts can improve neuromotor excitability and reaction time of both large and small muscles. The tests of complex reactions and reactions to distracting stimuli showed that athletes with more experience better process and react to multiple stimuli at the same time but also show better resistance to distracting external

factors. Older age groups, as well as subjects with more extended training experience, had better results in tasks with increased cognitive complexity. Combat sports are precisely characterized by changing situations and the speed of decision-making.

## 5. CONCLUSION

The Conclusion section of the paper contains the closing words and compact statements that emanate as conclusions from the complete body of the text presented in the paper. It should be no longer than 300 words; this study confirms the value of the BlazePod platform as a tool for improving sports performance, especially in the domains of reaction time, attention and concentration. The research confirmed the importance of cognitive training in the context of sports and emphasized the importance of applying modern technologies in the training process. Although the results were not significantly affected by gender differences, age and experience variations, which are essential for creating effective training programs, were observed. The results show that this technology can be successfully applied in training programs to provide athletes with objective feedback on their cognitive abilities. Future studies could include a longer period of monitoring athletes, as well as the analysis of other cognitive and psychological parameters to understand better the more profound implications of using the BlazePod platform in sports. Analysis of psychological and cognitive factors in the training of athletes can provide deeper insights into the way specific motor skills develop during a sports career.

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