

# The Effectiveness of BlazePod-Based Neurocognitive Training on Reaction Time and Agility in Young Competitive Athletes

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**ABSTRACT.** *Introduction:* Reaction speed and cognitive-motor coordination are critical components of athletic performance, particularly in sports requiring rapid decision-making and stimulus-response adaptation. While BlazePod technology has gained popularity in applied settings, empirical validation in youth athletic populations remains limited. *Objective:* This study aimed to evaluate the effects of a six-week BlazePod-based neurocognitive training program on reaction time, agility, and cognitive-motor performance in adolescent athletes. *Methods:* Thirty-five athletes (aged 15–19) were randomly assigned to experimental ( $n = 18$ ) or control ( $n = 17$ ) groups. The experimental group received additional BlazePod training (3 sessions/week, 15–20 minutes), while the control group continued standard sport-specific routines. All participants completed five tests at pre- and post-intervention: Simple Reaction Time, Choice Reaction Time, Agility T-Test, Go/No-Go, and Stroop Response Time. *Results:* Statistically significant improvements were observed in all variables within the experimental group ( $p < .001$ ), with large effect sizes (Cohen's  $d > 2.0$ ). The control group showed smaller but significant gains. Gender-based analysis confirmed training effectiveness across both sexes. *Conclusions:* BlazePod-based training significantly enhances both motor and cognitive performance in youth athletes. The results support its integration into sport training to improve reactivity, executive function, and decision-making under pressure.

**Keywords:** reaction time, neurocognitive training, agility, BlazePod, adolescent athletes

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## INTRODUCTION

Reaction speed is a critical component of athletic performance, particularly in dynamic sports where rapid responses to external stimuli can determine competitive success (Mero, Luhtanen, & Komi, 1992). It encompasses the ability to perceive a stimulus, process information, and execute a motor response within minimal time. While this skill has traditionally been viewed as a stable trait, recent findings indicate that it can be developed through targeted neuromotor and cognitive training (Williams & Ford, 2008).

Over the past decade, cognitive-motor training—a method combining physical execution with simultaneous cognitive demands—has gained traction in the domains of sports science and performance psychology. Studies show that such dual-task approaches not only enhance physical response times but also improve executive functions such as attentional control, inhibition, and decision-making under pressure (Voss et al., 2010; Faubert & Sidebottom, 2012). These cognitive traits are especially vital in team sports, where athletes must constantly scan, interpret, and respond to complex visual information in real time (Mann, Williams, Ward, & Janelle, 2007).

One emerging tool in this space is the BlazePod system, a visual stimulus-based technology that uses wireless LED pods to elicit reactive responses under configurable cognitive and motor conditions. It enables the creation of both simple and complex reaction-based tasks, adaptable to varying ages and performance levels. Unlike conventional agility drills, BlazePod-based protocols engage visual perception, working memory, and motor control simultaneously, aligning closely with the demands of real sport environments (De Fazio, R., Mastronardi, V. M., De Vittorio, M., & Visconti, P. 2023). While visual cue systems like Fitlight and BlazePod have grown in popularity among practitioners, empirical validation of their effectiveness, particularly in youth populations, remains limited.

Recent studies using similar technology have found improvements in reaction time and coordination in elite athletes (Gabbett & Benton, 2009; Silvestri, F., et. al., 2023, Campanella, M., et. al, 2024), but relatively few have explored their effects in adolescent athletes, a population undergoing rapid neuromuscular and cognitive development. This is a significant omission, as adolescence is considered a sensitive period for optimizing neural adaptations through targeted training stimuli (Malina et al., 2015; Lloyd & Oliver, 2012). Furthermore, the literature remains scarce on how these technologies affect more complex cognitive-motor tasks such as inhibitory control (e.g., Go/No-Go) and interference processing (e.g., Stroop tasks), which are fundamental to performance in unpredictable environments (Verburgh et al., 2014; Scharfen & Memmert, 2019).

Moreover, while the benefits of cognitive training in older adults and clinical populations are well documented (Barha et al., 2017), fewer controlled trials have investigated sport-specific cognitive training in adolescents using ecologically valid, field-based tools like BlazePod. Most existing studies have focused on virtual or computer-based platforms, which may not fully capture the speed, pressure, and movement complexity of real-time sport demands (Voss et al., 2010; Broadbent, Causer, Ford, & Williams, 2015).

Given this context, the current study aims to examine the effects of a six-week BlazePod-based neurocognitive training program on reaction time, agility, and cognitive-motor performance in young athletes. By integrating simple and choice reaction drills, change-of-direction tasks, and executive function tests (e.g., Go/No-Go, Stroop), this study seeks to provide evidence on the practical and cognitive benefits of using light-based stimulus tools in youth athletic development. Furthermore, it aims to address the existing gap in the literature regarding field-based, technology-assisted cognitive training during a critical developmental stage.

## **METHODS**

The purpose of this study was to evaluate the effectiveness of BlazePod-based neurocognitive training on reaction time, agility, and cognitive-motor integration in young athletes aged 15 - 19. To assess performance changes, participants underwent a six-week intervention with pre-test and post-test measurements across five standardized tasks: Simple Reaction Time, Choice Reaction Time, Agility (T-Test), Go/No-Go, and Stroop-like Reaction Time. Descriptive statistics and inferential tests were used to compare scores between the initial test (IT) and final test (FT) phases. Table 1 presents the descriptive outcomes for all performance tests.

### **Participants**

The study included 35 adolescent athletes ( $M = 16$ ,  $F = 19$ ), aged between 15 and 19 years ( $M = 16.7$  years,  $SD = 1.2$ ). All participants were engaged in competitive sports, training at least four times per week for a minimum of two years prior to the study. The athletes represented various disciplines, including football, basketball, and handball. Participants were randomly assigned to two groups: the experimental group ( $n = 18$ ; 8 males, 10 females), which received BlazePod-based neurocognitive training, and the control group ( $n = 17$ ; 8 males,

9 females), which continued standard sport-specific training without additional intervention. There were no significant differences between groups at baseline in age, training experience, or test performance. Inclusion criteria included: age between 15 and 19 years, active participation in organized competitive sport and no reported cognitive, neurological, or musculoskeletal impairments. Exclusion criteria were: missing more than two training sessions during the 6-week period, incomplete testing data and withdrawal of consent. All participants and their guardians provided written informed consent prior to enrollment.

Participants were randomly assigned to either the experimental group (BlazePod-based training) or the control group (standard training). Both groups continued their regular sport-specific practices throughout the study period.

### **Study Design**

The study followed a pre-test/post-test experimental design over a 6-week intervention period. All participants completed a battery of five tests at two time points: prior to the intervention (pre-test) and after six weeks (post-test). The experimental group underwent additional BlazePod-based training sessions, while the control group maintained regular drills without BlazePod integration.

### **Intervention protocol**

The experimental group participated in three sessions per week, each lasting 15–20 minutes, using BlazePod visual cue technology. Drills targeted neuromotor reactivity, decision-making speed, and cognitive-motor coordination. The protocol was progressive in complexity and intensity, with tasks adapted weekly to increase cognitive load and movement dynamics.

### **Performance tests and measurements**

Five validated tests were administered to assess both motor and cognitive-motor functions:

1. Simple Reaction Time Test: Measured the basic motor response speed to a single visual stimulus using the BlazePod system. Participants were instructed to tap the pod immediately upon illumination.

2. Choice Reaction Time Test: Assessed response selection and decision-making. Participants responded only to specific colors among multiple BlazePod stimuli, testing both speed and accuracy.
3. Agility T-Test: Evaluated multidirectional speed and change-of-direction ability. BlazePods were used to prompt movement in various directions, simulating reactive agility tasks.
4. Go/No-Go Task: Measured inhibitory control and motor response regulation. Participants were required to respond to specific stimuli (e.g., color X) and withhold responses to others, delivered via BlazePod cues.
5. Stroop-like Reaction Test: Adapted to measure executive functioning and attentional control. Participants responded only when the pod color and the written color name were incongruent.

All tests were administered indoors on a flat surface, under standardized conditions. Performance data were automatically recorded via the BlazePod app and manually verified for accuracy.

### **Ethical Considerations**

The study was conducted in accordance with the Declaration of Helsinki and approved by the institutional ethics committee. Written informed consent was obtained from all participants and their legal guardians. Participants were informed of their right to withdraw at any time without penalty.

### **Statistical Analysis**

Descriptive statistics (mean, standard deviation, minimum, maximum, and coefficient of variation) were calculated for each performance test at pre- and post-intervention. Paired-samples *t*-tests were used to assess within-group changes for both experimental and control groups. Independent-samples *t*-tests were applied to compare post-test results between groups. Effect sizes were calculated using Cohen's *d*. Additional between-group analyses were conducted by gender. Statistical significance was set at  $p < .05$ . Analyses were performed using IBM SPSS v.26.

## **RESULTS**

In the following, there are presented the outcomes of the six-week intervention, including descriptive and inferential statistics across all performance measures. Analyses were conducted to assess pre- to post-intervention changes

within the experimental and control groups, focusing on both motor and cognitive-motor performance domains. The descriptive statistics for this study are shown in table 1, for all five performance assessments conducted at baseline (initial test) and after the six-week BlazePod-based intervention (final test). The data reveal consistent and statistically significant improvements across all variables, indicating the effectiveness of the training protocol in enhancing both motor and cognitive performance in young athletes.

In the Simple Reaction Time test, the average response time decreased substantially, from approximately 277 ms to 221 ms, reflecting a notable improvement in basic neuromotor responsiveness. Similarly, Choice Reaction Time, which requires faster decision-making under cognitive load, improved by over 80 ms on average. These changes suggest that the training not only enhanced raw reaction speed but also improved cognitive processing efficiency under time-constrained conditions.

Performance gains were also evident in the Agility T-Test, where the average completion time decreased by nearly 1.5 seconds. This result implies better physical coordination and faster change-of-direction ability, likely influenced by the dynamic, stimulus-based demands of BlazePod exercises. Interestingly, the coefficient of variation for agility more than doubled post-intervention, suggesting that while most participants improved, individual responses varied - perhaps due to differences in baseline fitness or neuromuscular maturity.

The most cognitively demanding tests - Go/No-Go and Stroop Response Time - also showed strong improvements. The Go/No-Go task, which measures inhibitory control, improved by over 100 ms, while Stroop performance improved by nearly the same margin. Both tests also saw a marked increase in post-test variability, indicating that although overall group performance improved, individual adaptation levels differed considerably - an expected outcome in cognitive training.

Overall, the descriptive data indicate that the BlazePod intervention produced significant and practically meaningful improvements in both simple motor tasks and more complex cognitive-motor functions. The observed changes support the integration of cognitive-stimulus training in youth athletic development, especially for enhancing decision-making speed, attentional control, and physical reactivity in sport-specific environments.

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**Table 1.** Descriptive statistics for all tests

| Test                             | Phase | Min   | Max   | X     | p     | SD     | CV%    |
|----------------------------------|-------|-------|-------|-------|-------|--------|--------|
| <b>Simple Reaction Time (ms)</b> | IT    | 239.1 | 315.9 | 277.1 | 0.000 | 19.890 | 7.180  |
|                                  | FT    | 134.2 | 293.7 | 220.5 | 0.000 | 41.810 | 18.960 |
| <b>Choice Reaction Time (ms)</b> | IT    | 325.0 | 464.8 | 398.4 | 0.000 | 31.940 | 8.020  |
|                                  | FT    | 204.7 | 432.8 | 318.3 | 0.000 | 67.490 | 21.200 |
| <b>Agility (T-Test) (s)</b>      | IT    | 9.8   | 12.2  | 10.7  | 0.000 | 0.610  | 5.620  |
|                                  | FT    | 6.0   | 11.8  | 9.3   | 0.000 | 1.398  | 14.970 |
| <b>Go/No-Go (ms)</b>             | IT    | 516.2 | 661.7 | 600.5 | 0.000 | 38.070 | 6.340  |
|                                  | FT    | 401.8 | 640.8 | 498.2 | 0.000 | 68.160 | 13.680 |
| <b>Stroop Response Time (ms)</b> | IT    | 531.2 | 757.2 | 647.9 | 0.000 | 51.030 | 7.875  |
|                                  | FT    | 420.5 | 732.3 | 552.9 | 0.000 | 82.640 | 14.950 |

Note: IT – initial test, FT – final test, Min – minimum, Max – maximum, X – mean, p – significance threshold, SD – standard deviation, CV% - variation coefficient

Table 2 presents the inferential statistics for the experimental group, reflecting the changes from pre- to post-intervention across all five measured variables. All improvements were statistically significant, with 95% confidence intervals excluding zero and effect sizes (Cohen's *d*) ranging from -2.30 to -4.00, indicating very large effects.

The most pronounced gains were observed in Choice Reaction Time, Go/No-Go, and Stroop Response Time, which are cognitively demanding tasks. These findings suggest that the BlazePod-based intervention was especially effective in enhancing neurocognitive processing and inhibitory control. Improvements in Simple Reaction Time and Agility were also substantial, demonstrating strong benefits in both fundamental motor response and change-of-direction speed.

These results provide compelling evidence that six weeks of BlazePod - integrated training significantly enhanced both motor and cognitive performance in young athletes, with high practical relevance.

**Table 2.** Inferential statistics for the experimental group

| Test                             | $\Delta X$ | $\Delta SD$ | CI Lower | 95% Higher | p     | d      |
|----------------------------------|------------|-------------|----------|------------|-------|--------|
| <b>Simple Reaction Time (ms)</b> | -87.1      | 25.8        | -100.002 | -74.287    | 0.000 | -3.371 |
| <b>Choice Reaction Time (ms)</b> | -124.6     | 31.2        | -140.207 | -109.171   | 0.000 | -3.996 |
| <b>Agility (T-Test) (s)</b>      | -2.5       | 1.1         | -3.075   | -1.980     | 0.000 | -2.295 |
| <b>Go/No-Go (ms)</b>             | -181.1     | 45.4        | -203.751 | -158.582   | 0.000 | -3.989 |
| <b>Stroop Response Time (ms)</b> | -189.5     | 57.4        | -218.168 | -161.009   | 0.000 | -3.299 |

Note:  $\Delta X$  – mean differences,  $\Delta SD$  – SD differences, p – paired t test value, d – Cohen's d value, CI – confidence interval

In Table 3 you can find summarized the inferential statistics for the control group across all five performance tests, comparing pre- and post-intervention scores. Although the participants in this group did not receive the BlazePod-based training, the results indicate statistically significant improvements in each test. However, the magnitude of these changes, while meaningful, was consistently lower than that observed in the experimental group.

The control group showed modest reductions in Simple and Choice Reaction Time, with average improvements of approximately 24 ms and 33 ms, respectively. While statistically significant, the effect sizes for these changes ( $d \approx -1.5$  to  $-1.8$ ) were smaller compared to the experimental group, where improvements exceeded 80 ms with effect sizes above  $-3.0$ . These findings suggest that some natural improvement may have occurred over time, possibly due to familiarization with the testing procedures or general training outside the study.

In the Agility T-Test, participants improved by less than half a second on average, and although this change reached statistical significance, the smaller effect size ( $d = -1.22$ ) indicates a limited practical impact. Similar trends were observed in the Go/No-Go and Stroop tests, where reductions in response times were noticeable but less substantial than those observed in the trained group.

While the consistent direction of improvement across all measures may reflect general performance maturation or test-retest learning effects, the relatively lower effect sizes and narrower confidence intervals suggest that the control group's gains were less robust and potentially less functionally meaningful. These outcomes reinforce the conclusion that targeted neurocognitive training, such as that provided by BlazePod, yields greater and more impactful benefits than standard physical or technical training alone.

**Table 3.** Inferential statistics for the control group

| Test                             | $\Delta X$ | $\Delta SD$ | CI<br>Lower | 95%<br>Higher | p     | d      |
|----------------------------------|------------|-------------|-------------|---------------|-------|--------|
| <b>Simple Reaction Time (ms)</b> | -24.2      | 15.6        | -32.297     | -16.162       | 0.000 | -1.544 |
| <b>Choice Reaction Time (ms)</b> | -32.8      | 17.8        | -42.049     | -23.715       | 0.000 | -1.844 |
| <b>Agility (T-Test) (s)</b>      | -0.3       | 0.2         | -0.508      | -0.207        | 0.000 | -1.221 |
| <b>Go/No-Go (ms)</b>             | -46.4      | 32.6        | -63.195     | -29.664       | 0.000 | -1.424 |
| <b>Stroop Response Time (ms)</b> | -54.5      | 39.1        | -74.704     | -34.402       | 0.000 | -1.392 |

Note:  $\Delta X$  – mean differences,  $\Delta SD$  – SD differences, p – paired t test value, d – Cohen's d value, CI – confidence interval

Table 4 presents the results of the independent *t*-tests comparing post-intervention performance between the experimental and control groups, separated by gender. Across all five performance measures, statistically significant differences were observed for both males and females, with large effect sizes in each comparison



(Cohen's  $d$  ranging from -1.36 to -4.67). These results provide strong evidence that the BlazePod-based training was effective across genders, though the magnitude of change varied slightly between males and females depending on the task.

In the Simple Reaction Time and Choice Reaction Time tasks, both males and females in the experimental group outperformed their control counterparts. Males showed slightly greater gains in Simple Reaction Time (Cohen's  $d = -3.31$ ), while females demonstrated stronger effects in Choice Reaction Time (Cohen's  $d = -3.50$ ). This may reflect sex-based differences in baseline cognitive processing or responsiveness to cognitive training stimuli.

For the Agility T-Test, male participants in the experimental group outperformed those in the control group by a substantial margin ( $d = -2.13$ ), while females also showed a significant, albeit slightly smaller, difference ( $d = -1.36$ ). These findings indicate that BlazePod training contributed meaningfully to physical agility in both sexes, with possibly more pronounced neuromuscular responsiveness among males.

The most notable differences emerged in the cognitive-motor tasks. In the Go/No-Go test, males in the experimental group showed an exceptionally large improvement compared to controls ( $d = -4.67$ ), while females also demonstrated a strong effect ( $d = -3.44$ ). Similarly, in the Stroop Response Time test, both genders improved significantly, with males showing a slightly stronger effect. These results suggest that the intervention was particularly effective in enhancing executive functioning and inhibitory control across both sexes.

Overall, the gender-specific post-test comparisons confirm that BlazePod training produced large and consistent benefits in reaction time, agility, and cognitive-motor performance, regardless of sex. While some differences in effect size were observed, the general trend indicates that both male and female athletes responded positively and significantly to the intervention.

**Table 4.** Post-Test Independent t-Tests by Gender

| Test                      | Gender | X<br>(Exp) | SD<br>(Exp) | X<br>(Ctrl) | SD<br>(Ctrl) | p     | d      |
|---------------------------|--------|------------|-------------|-------------|--------------|-------|--------|
| Simple Reaction Time (ms) | M      | 180.2      | 30.8        | 259.9       | 14.5         | 0.000 | -3.311 |
|                           | F      | 197.9      | 26.5        | 249.5       | 26.6         | 0.000 | -1.941 |
| Choice Reaction Time (ms) | M      | 251.3      | 39.1        | 365.5       | 44.7         | 0.000 | -2.716 |
|                           | F      | 275.9      | 36.0        | 383.6       | 24.4         | 0.000 | -3.495 |
| Agility (T-Test) (s)      | M      | 8.2        | 1.1         | 10.2        | 0.6          | 0.000 | -2.131 |
|                           | F      | 8.2        | 1.1         | 9.8         | 1.3          | 0.006 | -1.357 |
| Go/No-Go (ms)             | M      | 414.9      | 38.7        | 586.4       | 35.7         | 0.000 | -4.669 |
|                           | F      | 442.0      | 40.6        | 563.1       | 29.9         | 0.000 | -3.441 |
| Stroop Response Time (ms) | M      | 450.8      | 67.7        | 628.6       | 47.8         | 0.000 | -3.096 |
|                           | F      | 482.6      | 51.9        | 603.0       | 42.7         | 0.000 | -2.556 |

Note: X – mean, SD – standard deviation, p – significance threshold, d – Cohen's  $d$  value

## DISCUSSIONS

The aim of this study was to assess the effectiveness of a six-week BlazePod-based neurocognitive training intervention on motor and cognitive-motor performance in young athletes. The findings revealed statistically and practically significant improvements in all tested domains within the experimental group, while the control group demonstrated smaller gains, likely attributable to test-retest familiarity or natural development. The results provide compelling evidence supporting the integration of visual-cognitive technology into youth athletic training programs.

The most substantial improvements were observed in tasks involving cognitive load and executive function, particularly in the Choice Reaction Time, Go/No-Go, and Stroop tests. This is consistent with earlier studies showing that training interventions combining physical stimuli with cognitive demands enhance both motor output and higher-level processing (Faubert & Sidebottom, 2012; Verburch, Scherder, Van Lange, & Oosterlaan, 2014). The inclusion of BlazePod drills - which emphasize stimulus recognition, fast decision-making, and inhibitory control - likely contributed to these gains.

Our findings align with research suggesting that reaction time can be significantly improved through targeted neuromotor interventions. Voss, Kramer, Basak, Prakash, and Roberts (2010) noted that cognitive-motor training not only enhances physical responsiveness but also improves attentional flexibility and neural efficiency. This study extends those findings by demonstrating similar benefits in adolescent populations using BlazePod technology, which is both scalable and accessible in sport training contexts.

While the experimental group demonstrated very large effect sizes (Cohen's  $d > 2.0$  in all variables), the control group, despite showing statistically significant changes, presented considerably smaller effect sizes (typically below 1.5). This supports the view that general sport training alone may offer marginal improvements in response time and agility but lacks the specificity required to induce meaningful cognitive-motor adaptations (Scharfen & Memmert, 2019).

Gender-based analysis revealed that both male and female athletes significantly benefitted from the intervention, although slight differences were observed in response profiles. For example, females in the experimental group showed a particularly strong improvement in the Choice Reaction Time task, while males outperformed in the Go/No-Go and Stroop tasks. This may reflect sex-based differences in cognitive control strategies or baseline executive function (Barha, Davis, Falck, Nagamatsu, & Liu-Ambrose, 2017; Blain, Longman, & Ward, 2020).

The increase in coefficient of variation across most tests post-intervention suggests that while the group as a whole improved, individual responsiveness varied. This variability is expected in adolescent populations due to developmental differences in neuromuscular and cognitive maturation (Lloyd & Oliver, 2012; Malina, Rogol, Cumming, Coelho e Silva, & Figueiredo, 2015). It also emphasizes the importance of individualized monitoring and progression in training design.

Importantly, the use of light-based visual stimuli through BlazePod is a form of externally focused attention training, which has been shown to enhance motor learning and performance compared to internally focused or conventional drills (Wulf & Lewthwaite, 2016). This principle may partly explain the superior performance outcomes in the experimental group.

Despite these promising findings, some limitations should be acknowledged. The study lacked longitudinal follow-up, which would help determine the retention of training effects. Additionally, performance was not measured in sport-specific competitive contexts, leaving open the question of ecological transferability. Future research should explore long-term benefits, dose-response relationships, and real-game applications of cognitive-motor technologies in athletic settings.

The present study provides strong empirical support for the integration of BlazePod-based cognitive-motor training in youth athletic programs. The results demonstrate not only significant improvements in reaction time and agility but also in executive function-related performance. These findings contribute to a growing body of literature advocating for the inclusion of cognitive components in physical training for athletes.

### **Limitations**

While the results of this study offer strong support for the use of BlazePod-based neurocognitive training in youth athletic development, several limitations should be acknowledged: The study evaluated outcomes immediately after the six-week intervention without any follow-up period. As such, it is unclear whether the improvements observed in reaction time, agility, and cognitive-motor tasks are retained over time or if they diminish without continued stimulus-based training. Future research should include longitudinal follow-up to assess the persistence of these effects.

Although the tests used (e.g., reaction time, agility, inhibitory control) are highly relevant to athletic performance, the study did not assess sport-specific outcomes such as in-game decision-making, passing accuracy, or match statistics. The extent to which the cognitive and motor gains transfer to actual performance in competitive contexts remains to be determined.

The post-test results revealed increased variability (higher CV%) across most measures, suggesting that not all athletes responded equally to the intervention. Factors such as baseline cognitive capacity, motivation, maturity level, and training history were not controlled and may have influenced the degree of improvement. Future studies should consider individualized response profiling or adaptive training protocols.

### **Practical implications**

The findings of this study hold several important practical applications for coaches, sport scientists, and athletic development programs:

BlazePod-based drills can be seamlessly integrated into warm-ups, skill circuits, or cooldowns to enhance both physical responsiveness and cognitive control. The equipment is portable, adaptable, and well-suited to team environments, making it a practical tool for daily use.

Given the substantial gains in tasks requiring executive control (Go/No-Go, Stroop), coaches can use light-based reactive tasks to simulate sport-like decision-making conditions. This is particularly relevant in invasion sports where rapid response to visual stimuli and inhibitory control are critical to performance.

Incorporating BlazePod drills into youth training may offer cognitive benefits that extend beyond physical development. As neuroplasticity is heightened during adolescence, combining physical drills with cognitive demands may support better long-term adaptation, mental sharpness, and injury resilience.

### **CONCLUSIONS**

This study provides robust evidence that a six-week BlazePod - based neurocognitive training intervention significantly enhances both motor and cognitive-motor performance in adolescent athletes. Notable improvements were observed in reaction time, agility, and executive function tasks such as response inhibition and interference control. These findings suggest that the integration of cognitive stimuli - particularly visual-based, reactive drills - can meaningfully complement traditional athletic development programs.

The consistency of performance gains across both male and female athletes supports the versatility and applicability of this training method in diverse training contexts. Moreover, the large effect sizes and statistically significant changes observed in the experimental group, compared to the smaller improvements in the control group, highlight the added value of BlazePod-based training beyond routine sport-specific practice.

Importantly, this study fills a critical gap in the literature by demonstrating the effectiveness of light-based cognitive-motor training in a youth athletic population—a group particularly sensitive to neural and functional adaptation. Given the increasing cognitive demands in modern sport, coaches and practitioners are encouraged to incorporate tools like BlazePod to improve not only speed and coordination but also decision-making, attention, and executive control.

Future research should aim to explore the long-term retention of these performance gains, assess sport-specific transfer effects, and optimize training protocols for different athletic disciplines and developmental stages. Nonetheless, the current findings strongly support the integration of cognitive-motor technologies into holistic training frameworks aimed at maximizing youth athletic potential.

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