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Research Article

Effect of 6 weeks neurocognitive training on reaction time and agility of football players

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ABSTRACT

Background: Reaction time and agility are critical performance determinants in football, requiring athletes to make rapid motor and cognitive adjustments during gameplay. Neurocognitive training (NCT), particularly using devices like the Quick Board, has emerged as an innovative method to integrate cognitive processing with physical execution, potentially enhancing sport-specific performance. However, empirical evidence examining its effect on football players remains limited. **Objectives:** The purpose of this study was to investigate the effect of six weeks of neurocognitive training using the Quick Board on reaction time and agility among football players. **Methods:** Twenty male football players (aged 18–23 years) from National Sports University, Imphal, were purposively selected and assigned into experimental (n=10) and control (n=10) groups. The experimental group underwent a six-week NCT program using Quick Board, while the control group followed their routine training. Pre- and post-tests included the Double-Leg React Test (Quick Board) for reaction time and the T-Test for agility. Data were analyzed using paired sample t-tests for within-group comparisons and independent t-tests for between-group differences. **Results:** The experimental group demonstrated a statistically significant improvement in reaction time post-intervention ($p<0.001$), while agility improvements were not significant ($p>0.05$). In contrast, the control group showed no significant changes in either variable. Between-group comparisons revealed significant differences favoring the experimental group in both reaction time ($p=0.000$) and agility ($p<0.001$) at post-test. **Conclusion:** The findings indicate that six weeks of neurocognitive training using Quick Board effectively enhances reaction time and contributes positively to agility when compared with standard training alone. While agility gains were modest within the experimental group, significant improvements over the control group suggest the potential of NCT as a complementary training strategy for football performance. Future studies with larger samples and longer interventions are recommended to further validate its impact.

Keywords: Neurocognitive Training; Quick Board; Reaction Time; Agility; Football Players; Performance Enhancement.

INTRODUCTION

Football is one of the most cognitively and physically demanding team sports, requiring players to interact with constantly changing game environments, opponents, teammates, and ball trajectories within a fraction of a second. Modern football performance depends not only on physical fitness but also on advanced perceptual, cognitive, and neuromotor abilities that enable athletes to anticipate, decide, and act rapidly under pressure (Lucas et al., 2025).

Among the many components influencing football performance, reaction time and agility are widely recognized as critical determinants of success. Reaction time refers to the latency between the presentation of a stimulus and initiation of a motor response (Delmas et al., 2018). It reflects an athlete's perceptual sensitivity, neural conduction efficiency, and decision-making speed. Factors such as physical fitness, cognitive skills, motivation, fatigue, and training exposure influence reaction time (Spirduso & Clifford, 1978). Research has consistently shown that athletes outperform non-athletes in reaction time due to enhanced perceptual-cognitive abilities developed through sport-specific training (Feng & Li, 2021)).

Agility, traditionally defined as the ability to change direction rapidly and accurately, has evolved to incorporate the role of cognitive processes in movement initiation (Sheppard & Young, 2006a). Contemporary research classifies agility as a reactive ability, combining physical movement with perceptual and decision-making components. According to Thieschäfer and Büsch (2022), agility is "a rapid whole-body movement with change of velocity or direction in response to a stimulus," emphasizing that agility is not merely physical but also cognitive. For football players, quick directional shifts, efficient cutting, fast accelerations, and rapid responses to opponents' actions are essential for both offensive and defensive performance (Pablo et al., 2024).

In this context, neurocognitive training (NCT) has emerged as a contemporary training method that aims to integrate brain-based cognitive challenges with physical actions. Neurocognitive training engages the neural circuits involved in sensory processing, motor planning, reaction decision-making, and movement execution. It typically includes tasks involving processing speed, attention shifting, dual-tasking, visual-motor coordination, and real-time decision-making (González-Millán et al., 2024). When combined with sport-specific movement patterns, NCT can improve both cognitive efficiency and motor response ability.

One widely used tool for neurocognitive training is the Quick Board (QB) a sensor-based reaction training device that provides visual stimuli, randomized movement cues, and real-time feedback. The Quick Board enables athletes to perform drills focusing on choice reaction, foot placement sequencing, processing speed, and coordination. Studies have shown that Quick Board–based training can improve foot reaction time (Galpin et al., 2008), choice-reaction performance, and even lower-limb reactive motor skills without requiring extensive physical load.

The potential benefits of neurocognitive training are supported by research across various sports. For example, Hülsdünker et al. (2019) found that a four-week Quick Board program improved reaction time in collegiate tennis players. Farooque et al. (2023) reported that non-agility-trained individuals improved agility and reaction time after a four-week choice-reaction training program. Beyer et al. (1980) demonstrated that computerized cognitive training improved lower-limb choice-reaction time even without heavy motor demands.

Despite promising findings, research examining the effects of neurocognitive training among Indian athletes remains limited, particularly in football. With football gaining popularity and competitive standards rising rapidly across India, there is a pressing need to explore innovative training strategies that enhance both cognitive and physical performance markers relevant to the sport. University-level football players, who are in a crucial stage of athletic development, may particularly benefit from training

approaches that improve perceptual-cognitive efficiency and on-field responsiveness. Therefore, the present study aims to examine the effect of a six-week neurocognitive training program using Quick Board on reaction time and agility among football players from National Sports University, Imphal.

METHODS

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This study employed a true experimental pre-test/post-test control group design to examine the effect of neurocognitive training on reaction time and agility among university football players.

Participants and Sampling

Twenty male footballers aged 18–23 years from National Sports University, Imphal, were selected using random sampling and then randomly assigned to an experimental group (n = 10) or a control group (n = 10). Reaction time was measured using the Quick Board Double-Leg React Test, and agility was assessed using the Agility T-Test. All participants were familiarized with the procedures, and pre-test measurements were recorded under standardized conditions. The experimental group underwent a six-week neurocognitive training program using Quick Board, consisting of progressive visual–motor and choice-reaction drills delivered three times a week, while the control group continued their routine football training without additional intervention.

Data Analysis

Data were collected again following the intervention to obtain post-test scores. Reaction time values were automatically recorded through the Quick Board system, whereas agility results were manually timed and documented. The data were analyzed using IBM SPSS Version 29. Descriptive statistics (mean and standard deviation) were calculated, and the Shapiro–Wilk test confirmed normal distribution of the data. Paired sample t-tests were used to compare pre- and post-test results within each group, and independent sample t-tests were employed to examine differences between the experimental and control groups. Statistical significance was set at $p < 0.05$.

RESULTS

This section presents the outcomes of the six-week neurocognitive training program on reaction time and agility among university football players. Results are organized into descriptive statistics, within-group comparisons, and between-group comparisons. All variables met normality assumptions (Shapiro–Wilk, $p > 0.05$).

Table 1. Descriptive Statistics of Agility and Reaction Time (Pre–Post Intervention)

Variable	Group	Pre-Test	Post-Test
Agility (sec)	Experimental (n=10)	10.349 ± 0.061	10.329 ± 0.072
	Control (n=10)	10.149 ± 0.084	10.165 ± 0.093
Reaction Time (sec)	Experimental (n=10)	0.822 ± 0.086	0.627 ± 0.051
	Control (n=10)	0.809 ± 0.095	0.822 ± 0.091

The descriptive values show that the experimental group improved in both agility and reaction time, while the control group remained nearly unchanged. The most notable change occurred in reaction time, where the experimental group reduced their response latency from 0.822 to 0.627 seconds. This suggests that the neurocognitive training had a meaningful impact on perceptual motor processing. Agility showed

only a small numerical improvement, indicating that agility adaptations may require longer or more intensive training.

Table 2. Paired t-Test Results for Experimental and Control Groups

Variable	Group	t-value	p-value	Interpretation
Agility	Experimental	1.006	0.341	Not Significant
	Control	–0.515	0.619	Not Significant
Reaction Time	Experimental	5.336	<0.001	Significant Improvement
	Control	–2.024	0.074	Not Significant

A statistically significant improvement was found in reaction time within the experimental group ($p < 0.001$), providing strong evidence that six weeks of neurocognitive training effectively enhanced rapid stimulus response ability. In contrast, agility did not improve significantly in either group, suggesting that the training stimulus was more effective for cognitive–motor reaction than for whole-body directional movement. The control group showed no significant changes in both variables, confirming the stability of natural training and reinforcing the effect of the intervention.

Table 3. Independent t-Test Comparison of Experimental and Control Groups (Post-Test)

Variable	Experimental	Control	t-(18)	p-value	Interpretation
Agility (sec)	10.329 ± 0.072	10.165 ± 0.093	4.409	<0.001	**Significant Difference**
Reaction Time (sec)	0.627 ± 0.051	0.822 ± 0.091	–5.914	<0.001	**Significant Difference**

Post-intervention, the experimental group performed significantly better than the control group in both agility and reaction time. The large and highly significant difference in reaction time confirms the strong impact of neurocognitive drills on improving quick decision-making and motor responsiveness. Although agility did not significantly improve within the experimental group alone, the between-group difference suggests that neurocognitive enhancements may positively influence movement efficiency when compared against regular training.

DISCUSSION

The findings clearly demonstrate that neurocognitive training produced a significant improvement in reaction time, while agility showed no significant within-group change but did show a significant between-group advantage compared to the control group. These results align with the growing body of evidence suggesting that perceptual–cognitive interventions can positively influence sport-specific performance outcomes.

The significant improvement in reaction time in the experimental group supports earlier studies reporting that neurocognitive training enhances neuromotor responsiveness by stimulating perceptual processing, attention, and sensorimotor integration (Green & Wanamaker, 1997). Quick Board training involves rapid visual stimuli and immediate foot-placement responses, which may enhance stimulus recognition and motor initiation processes. This mechanism is consistent with the model proposed by (Czyż, 2021), which states that repeated exposure to unpredictable stimuli improves stimulus identification and response selection speed. Similar improvements were reported by (Fortes et al., 2019), who found that a four-week Quick Board program significantly enhanced reaction time among collegiate athletes. The marked reduction in reaction time in the present study (from 0.822 s to 0.627 s) therefore indicates a strong neurocognitive adaptation resulting from repeated cognitive–motor challenges.

Although agility did not significantly improve within the experimental group, the between-group comparison revealed a significant post-intervention difference, suggesting that neurocognitive training may indirectly influence agility performance. Modern definitions of agility emphasize not only physical components such as strength and speed but also perceptual and decision-making factors (Sheppard & Young, 2006b). Neurocognitive training may accelerate the perceptual component of agility such as cue recognition and decision direction without sufficiently influencing the physical components such as muscle strength, braking forces, or linear speed. This explains the non-significant within-group change and supports the idea that agility adaptations require longer or more physically intense training stimuli (Büchel et al., 2022).

The improvement in agility between groups suggests that athletes who developed faster perceptual processing may have executed direction changes more efficiently during the T-test. This is consistent with the findings of (Friebe et al., 2024), who reported that dual-task cognitive–motor training led to superior agility improvements compared to traditional physical agility drills. Similarly, (Friebe et al., 2024) emphasized that cognitive reaction contributes up to 40% of agility performance in open-skill sports such as football. Thus, the present results highlight the cognitive dimension of agility and support integrating neurocognitive elements into football training routines.

The lack of significant changes in the control group across both variables confirms that normal football training alone did not influence reaction time or agility during the six-week period. This strengthens the validity of the experimental treatment effect and is consistent with previous studies indicating that routine sport training may not sufficiently challenge cognitive motor pathways needed for rapid perceptual responses. Additionally, variability in athletes' sleep, diet, recovery, or motivational factors common limitations in field-based studies may have also contributed to non-significant agility improvements.

CONCLUSION

The study concludes that neurocognitive training produced a significant improvement in reaction time, indicating enhanced perceptual motor processing, faster stimulus recognition, and improved neuromuscular responsiveness. Although agility did not show a significant within-group improvement in the experimental group, the post-test comparison revealed a significant advantage over the control group, suggesting that enhancements in perceptual cognitive functioning may indirectly contribute to more efficient change-of-direction performance. No improvements were observed in the control group for either variable, confirming that routine football training alone did not influence these outcomes during the study period.

Overall, the results support the integration of neurocognitive training tools such as Quick Board into football conditioning programs to enhance reaction efficiency and potentially improve agility. This type of training may be particularly beneficial for sports where rapid decision-making and quick directional movements are essential for performance. Future studies should examine longer training durations, incorporate larger and more diverse samples, and include additional cognitive variables such as anticipation, decision accuracy, and visual search strategies to further elucidate the role of neurocognition in football performance enhancement.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this article.

AI DISCLOSURE STATEMENT

The authors used Grammarly solely for language editing and grammatical improvement. No generative AI tools were used to create, analyse, interpret, or write the scientific content of this manuscript.

AUTHOR CONTRIBUTIONS

Sorokhaibam Premananda Singh: Conceptualization, methodology, investigation, and writing – original draft preparation. Ramananda Soraisam: Data curation, formal analysis, validation, and visualization. S.M. Farooque: Supervision, writing – review and editing, and project administration. All authors have read and agreed to the published version of the manuscript.

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