

Effect Of Cognitive Intervention On Sports Performance

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ABSTRACT

The present study is an experimental investigation to identify the cognitive aspects of sports performance. The cognitive parameters of attention, planning, decision making, set shifting, problem solving and memory are integral to sports performance and must be inculcated along with physical activity training (Cox, 1998). Reaction time is an excellent indicator of sensorimotor coordination and performance of an athlete (Yordanova, 2023; Balakrishnan, 2014). It determines the alertness of the athlete and should be kept minimal in certain tasks like driving, military activities, playing a sport, surgery, nursing, and guarding a security post where alertness is a primal. Reaction time indicates optimal sensory system, cognitive processing and motor performance. The reaction time is a voluntary response to an external stimulus consisting of a time lag between application of stimulus and appropriate motor response (Batra, 2013). It is expressed in milliseconds. It defines the speed of neurophysiological, cognitive, and information processes which are generated by stimulation of the athlete's sensory system. A sample of 60 sportspersons were taken for the study. The players were randomly assigned to Treatment (N₁ =30) and Control group (N₂=30). Group 1 received the treatment in form of cognitive task of Stroop color and word test (Golden and Freshwater, 2002) before their actual performance on Reaction time apparatus to determine simple reaction time for 15 trials spanning over 15 days. The color-word interference task is an instrument which indicates the interference control of the subject when presented with unexpected stimuli (Stroop, 1935). The Group 2 (Control Group) received no treatment and performed tasks pertaining to simple reaction time. The reaction time of all the 60 subjects for 15 days were recorded and their mean reaction time was taken as final score of each subject. The comparative data was analyzed using t -test with SPSS software. The study revealed significant group differences highlighting the role of cognitive variable of attention in determining the reaction time which is the underlying mechanism of performance of an athlete.

Keywords: Cognition, attention, reaction time, performance, sports.

INTRODUCTION

Sports performance is an outcome of multiple internal processes that occur in an individual. Cognition is the term for the high-order mental functions which occur as the synergistic functioning of brain, nervous system and effectors (Solso, 2005). Reaction time (RT) is a relevant cognitive function involved in performance in sports, academics and daily-life tasks (Theofilou, 2022). It can be defined as the 'time elapsed from appearance of a stimulus until an overt response is generated'. It is considered as measure to evaluate the capacity of cognitive system to process information (Reigal et al., 2019). From a physiological point of view this complex phenomenon depends on the speed of the sensorimotor cycle. It detects the initial stimulus, transfers the information through afferent nerves, generates response from the central nervous system (Adleman et al., 2016). Factors that determine the reaction time include the physical condition, fatigue, motivation, experience, age and gender along with dominant side of the body part with which one responds.

Even the characteristics of the stimulus for e.g. its intensity and duration are the determinants of reaction time (Jayaswal, 2016).

Research evidence studies the internal cognitive processes that determine the reaction time (Deary and Der, 2005). Among the executive functions; attention is the primal variable involved in an activity (Jehu et al., 2015). Attention involves the activation and selection processes of brain that are a derivative of anatomical and functional complexity of prefrontal cortex (Pinel, 2009). Attention is function of selective focus of mental activity on objects, with the aim to perceive and understand them for an effective organization of behavior. It involves ability to generate different responses in terms of arousal from a stimulus which can be selective, divided, alternating, or sustained attention (Petersen and Posner, 2012). Selective attention is an individual's ability to attend to specific stimuli and ignore others (Giuliano et al., 2014; Gomez-Ramirez et al., 2016).

It has been highlighted that sports performance is correlated with Reaction time (RT) (Jain et al., 2015, Walton et al., 2018). RT can be improved with training using different levels of interventions (Kirk et al., 2017). Sports activity allow use of various cognitive processes simultaneously that lead improvement in RT (Lynall et al., 2018). RT is important in individual sports such as athletics or swimming where it is necessary to respond quickly to initiate physical movement (Nuri et al., 2013). In collective sports, such as badminton, football, or basketball; RT is essential in situations, as the athletes need to make quick decisions to get successful in their actions (Ruschel et al., 2011; Mudric et al. 2015). Physical activity and exercise lead to development of cognitive functions specifically different aspects of attention (Kao et al., 2017). Athletic abilities in games require faster reaction times, precise eye-hand coordination, and speedy decision-making. The cognitive aspect of athletic profile should be part of psychological preparation of the players for any game (Greenwalt, 2023).

Executive functions are those skills that allow individual to set goals and carry out planning and thought shifting along with inhibiting responses, behaviors, and emotions (Salthouse 2009). This activity leads to autonomous goal-directed behaviors. These functions are integrated by the prefrontal cortex (Pinel, 2009). Attention is a psychological function of Executive processes of brain. Low attention span could affect the focus on the stimulus, selection, and blocking of unnecessary information further effecting RT to execute tasks (Doiphode & Vinchurkar, 2020).

OBJECTIVES OF THE STUDY

1. To study the effect of cognitive intervention on reaction time of sportspersons.
2. To examine the group differences among Experimental and Control groups due to cognitive intervention of attention task on reaction time.

Hypotheses:

H1: There are significant group differences among Experimental and Control groups of sportspersons on variable of Reaction time.

H2: There is significant intervention effect of Stroop task on Reaction time of the sportspersons in Experimental group.

METHODOLOGY

Sample:

Sample of the study consists of 60 sportspersons of various games. There were 30 sportspersons in the experimental group and 30 sportspersons in control group using random assignment. Their age range is 18-25 years. They were selected from Govt. Arts and Sports College Jalandhar using convenience sampling. Informed consent was taken from all players before start of the study.

Tools Used for Data Collection:

1. Reaction Time apparatus (Medicaid systems)

Reaction time was measured by the dominant hand with the Medicaid Audio-Visual reaction time apparatus, in a lab. The instrument is designed to measure response time in milliseconds (ms). It provides two modes of stimuli- Audio and Visual. Each subject was introduced with the apparatus and subject apprehensions were sorted by providing preliminary practice sessions. Readings for visual or audio reaction time for each subject were noted for each day for 15 consecutive days. The mean of 15 trials was taken as the value for reaction time and was noted in the subject's profile.

2. Stroop test (Golden and Freshwater, 1978; Stroop 1935)

The Stroop effect is derived in 1935 from John Ridley Stroop. It demonstrates interference between two different cognitive processes: automatic (reading) and controlled response (name of the color). The traditional task is presenting the participants with different words printed in different ink colors. The task is to name the ink color rather than reading the word. The interference and inhibition are assessed in the task, where the subject has to suppress a habitual response of reading the color name rather than unusual one of reading the incongruent ink color in which the names are printed. The number of items correctly answered in span of 45 seconds was the score taken for the final trial. The task was introduced as an intervention to the

Experimental group(n=30) for 15 days along with physical training. The same task was given to Control group only for one trial for one reading.



Fig. 1. Stroop task illustration (adapted from Manual of test; Golden and Freshwater,2002)

Procedure of Data Collection:

The visual reaction time of each individual was recorded at start of the study. The subjects were randomly allotted to Experimental and Control groups using lottery method of sample allocation. There were thirty subjects allocated to each group. The experimental group was subjected to Stroop task activity for fifteen days but the control group was given this activity only on last day of the physical training. Reaction time (RT) of each subject was recorded for 15 days and mean reaction time (MRT) was calculated for subjects in both the groups. In the experimental group; pre and post -intervention scores were compared across the study. Even the control groups RT scores were compared across the interval of 15 days.

RESULTS AND DISCUSSION

The data obtained was further analyzed to derive the descriptive statistics. The mean and standard deviation derived is used to compute the t-ratio of the two comparative groups: Experimental and control groups.

Table 1. Mean and SDs of the variables at the start of study.

Variables	Group I Experimental (N=30)		Group II Control (N=30)		t	p value
	Mean	SD	Mean	SD		
Mean Reaction time (ms)	410.11	21.87	411.29	21.80	-1.29	0.58

As per Table 1. The mean reaction time (in milliseconds) is 410.11 for the Experimental group (n=30). The mean reaction time is 411.29 for control group. The t -ratio is -1.29 which is insignificant. Hence, both the groups have no differences in terms of mean reaction time at the start of the study. The groups are almost similar when matched upon the mean reaction time at the initial phase of the study.

Table 2 Mean and SDs of the Reaction time and Attention, Pre-test and Post-test in Experimental group (after Stroop intervention activity for 15 days)

Variables	Pre-Stroop training (N=30)		Post-Stroop training (N=30)		t	p value
	Mean	SD	Mean	SD		
Mean Reaction time (ms)	410.11	21.87	353.21	15.69	-11.77	0.01
Stroop score (15 trials)	40	-----	51	-----	-----	-----

The mean reaction time for the Experimental group when compared across time gap of 15 days along with Cognitive activity of Stroop task everyday along with physical training is as follows as given in Table 2: The mean reaction time at the start of the training is 410.11 ms and post -Stroop training is 353.21ms for the experimental group. The t-ratio for the comparative means obtained is -11.77 which is significant at 0.01 level. Hence, the intervention has led to change (improvement) in reaction time score. It is important to note that lesser the time taken to respond more is the speed of information processing in the brain and nervous system and better performance (Pinel ,2009; Cox ,1998). The attention scores from the Stroop task have been noted in the form of the correct answers in 45 seconds. The Stroop score was 40 at start of the trials and gradually the score increased up to 51in experimental group. It was also noted that errors while game and task gradually reduced at the end of 15-day trials.

Table 3. Mean and SDs of the Reaction time and Attention, Pre-and Post- in Control group(after gap of 15 days with No intervention)

Variables	Pre-test (N=30)		Post-test(N=30) Without intervention		t	p value
	Mean	SD	Mean	SD		
Reaction time	411.29	21.89	409.76	21.12	-1.67	0.67
Stroop score (1 trial)	40	-----	41	-----	-----	-----

As per Table 3. The mean reaction time for the Control group is 411.29 at the start of the study. The mean reaction time for the same group after 15 days is 409.76. The t-ratio is -1.67 which is insignificant. It conveys that there is no significant change in the mean reaction time of the players of the control group. The Stroop score of one trial of attention test is 41. No attention training was provided to the participants of the control group.

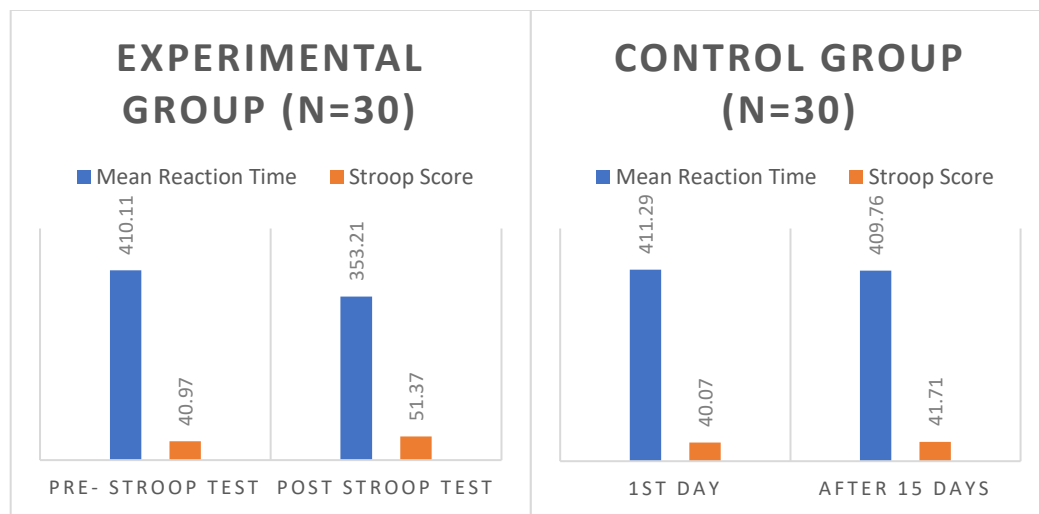


Fig. 2 Graphical representation of Experimental and Control group scores of Reaction time and Attention task.

The comparative differences among the experimental and control group can be inferred from the graphs illustrated in Fig 2. The post-training effects can be derived from the scores of the subjects at beginning and last day of 15 days consecutive trials.

It is noteworthy that the Experimental group was introduced with an intervention of Stroop task for 15 days along with physical activity training. The mean reaction time has improved in the experimental group. Stroop task is a cognitive task that trains the mental processes to inhibit those responses which are not required and produce only the desirable responses (Salthouse, 2009). Attention is the primal process of all kinds of cognitive activity. It makes the physical movements conscious and planned if we learn to regulate it during physical training. On the other hand, there was no intervention for the control group. They were just doing regular physical training practice but no cognitive task was part of the training regime. Hence there was negligible variation in mean reaction time across 15 days trials. Hence, the results obtained in the study are in line with H1 and H2.

CONCLUSION:

In the light of results obtained, following conclusions can be drawn:

1. It is imperative to operationalize the reaction time in players as a measure of game performance.
2. The cognitive aspects of attention are contributing to improvement in reaction time of the players.
3. Cognitive intervention in various techniques should be part of the physical activity training for the players.
4. Sports performance is an overt behavioral aspect which can be improved by studying the various internal physiological and cognitive aspects as part of psychological preparation of players.

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