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Study on complex attention between yoga and non-yoga female group

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Abstract
Background: Complex attention reflects the ability to control, shift, and divide attention focus, allowing for the manipulation of information and execution of multiple steps to accomplish a goal. Regular yoga practice may influence complex attention.
Aim of the study: The present study was aimed to compare the complex attention between yoga and non-yoga group of female subjects.
Methods: A total 33 voluntary female subjects were selected for this study. To achieve the aim of the study, 12 subjects were taken from yoga group (n=12) and 21 subjects from non-yoga group (n=21). The age range of the subjects was 16-18 years. Yoga group underwent yoga practices regularly whereas non-yoga group follow their normal life. To collect the data paper pencil test was taken. Complex attention was measured by the following assessment namely six letter cancellation test, digit letter substitution test, digit symbol substitution test, digit span forward test, digit span backward test, trail making test part –A and B.
Results: The present study showed that yoga group was significantly better than non-yoga group of female subjects on six letter cancellation test, digit letter substitution test, digit symbol substitution test, digit span forward test, digit span backward test and trail making test part –B respectively.
Conclusion: On the basis of the result it may be concluded that the female yoga group is better than the female non-yoga group in complex attention.

Keywords: Complex attention, yoga, non-yoga

Introduction

Attention is an essential element of cognition and has been characterized in two ways, that is, either as a resource or capacity or as a skill of resource deployment various brain areas mediate attention, different ones being responsible for different types of attention.

Complex attention refers to an extension of traditional attention mechanisms used in neural networks, particularly in the field of natural language processing (NLP). Attention mechanisms enable models to focus on different parts of the input sequence when processing it. They have been successful in various NLP tasks such as machine translation, text summarization and question answering.

Complex attention refers to the cognitive ability to selectively focus and sustain attention on relevant stimuli while filtering out distractions. It involves various neurocognitive domains working together to facilitate attentional processes. Here are some key neurocognitive domains that play a role in complex attention: executive function, working memory, inhibition, sustained attention, selective attention, attentional switching and alertness. These neurocognitive domains works like a racing bike to facilitate complex attention processes, allowing individuals to focus, sustain attention, filter distractions and switch attention when necessary. Impairment or damage in any of these domains can lead to attentional difficulties, such as attention deficit hyperactivity disorder (ADHD) or attentional deficits resulting from neurological conditions or brain injuries.

Complex attention introduces a complex valued attention mechanism, where attention weights are represented as complex numbers. In traditional attention mechanisms, attention weights are computed by comparing a query with each element of the input sequence individually. Complex attention can be used in different ways, depending on the specific design and task.

These complex attention weights can then be used to compute a weighted sum of the input elements, similar to traditional attention mechanisms. Complex attention reflects the ability to control, shift, and divide attention focus, allowing for the manipulation of information and execution of multiple steps to accomplish a goal. Regular yoga practice may influence complex attention. Yoga exercise has been found to be a feasible school intervention for children with emotional and behavioural disorders and can be effective in ameliorating the symptoms that also pervasively occur in children with ADHD, such as inattention and bad adaptive skills in class (Steiner *et al*., 2013) [26]. Different from normal physical exercise, yoga practicing steers individuals to master certain breathing techniques, postures, and cognitive control which can help promote self-control, attention, body awareness, and stress management (Kimbrough, Balkin & Rancich, 2007) [27]. Yoga shows promise as an intervention for a variety of social, emotional, behavioral, and cognitive ailments (Diamond & Lee, 2011) [14]. Although Physical activity intervention has been found to derive positive changes in behavioural structures and cognitive function among children with ADHD, which are reflected in reduced impulsivity, anxiety, and improved attention (Chang *et al*., 2014; Huang *et al*., 2014; Smith *et al*., 2013; Verret *et al*., 2012) [10, 22, 30, 31]. The reported benefits of yoga include increased slow-frequency brain wave activity (Arambula *et al*., 2001) [1]; and significant decrement of cortisol and increment in brain-derived neurotropic factor (BDNF), serotonin, and dopamine (Pal *et al*., 2014) [32]. In essence, the practice of yoga exercise elicits reduced activation of the sympathetic nervous system and increased activation of the parasympathetic nervous system resulting in a sense of equilibrium into the body and mind, and increased emotional self-regulation (Streeter *et al*., 2012) [29].

Yogasanas, or yoga postures have been practiced for centuries and are known to have various positive effects on physical, mental and emotional well-being. When it comes to complex attention, which involves the ability to sustain attention, change focus and manage multiple stimuli simultaneously, yogasanas can have several beneficial effects.

Yogasanas require maintaining a specific posture and focusing on breath, body alignment and sensations. Regular practice can enhance the ability to concentrate and sustain attention which can be beneficial for complex attention tasks. It involves mindfulness movement and the synchronization of breath with physical postures. This cultivates body awareness and helps to tune in to the present moment. Increased body awareness can contribute to better attention control and improved ability to manage multiple stimuli simultaneously. Yogasanas often involve moving through various postures and transitioning between them. This requires cognitive flexibility, the ability to switch between different mental sets and adapt to changing demands. Regular practice of yogasanas can enhance cognitive flexibility which is essential for complex attention tasks that require shifting focus. Stress can impair attentional performance, making it difficult to focus on complex tasks. By reducing stress, yogasanas can help optimize attentional functioning. Yogasanas emphasize the integration of mind and body connection which can facilitate better coordination and efficient information processing which can positively impact complex attention tasks. Prolonged mental effort can lead to mental fatigue, impairing complex attention. Engaging in yogasanas can lead to improved attentional performance afterward.

Complex attention has been explored in various research papers and it has shown promising results in tasks such as machine translation, document classification and sentiment analysis. However, it is still an active area of research and its applications and effectiveness may vary depending on the specific task and dataset.

Aim of the study

The present study was aimed to compare the complex attention between yoga and non-yoga group of female subjects.

Materials and Methods

Selection of Subjects

To achieve the aim of the study, 33 female subjects were taken from Howrah district of West Bengal for this study. The subjects were participated in this study voluntarily. 12 subjects were taken from Vivekananda Yoga Vyama Prashikshan Kendra and Maheswar Yoga and Naturopathic Kendra, as yoga group. Also 21 subjects were taken from Amta Balika Vidyalaya and Amta Pitambar High School, as non-yoga group. The age range of the subjects was 16-18 years. Yoga group underwent yoga practices regularly whereas non-yoga group follow their normal life.

Researchers provide comprehensive information about the present study to potential participants. All participants must be fully informed about the study including the aims, methods, advantages, safeguards against discloser and other incentives offered in connection with the study by the researchers. The information presented to participants was clear and understandable language. The researchers confirmed that participants had the capacity to understand the information provided. None of the participants in the study were subjected to coercion, pressure, or improper influence. Participants were free to drop out of the study at any point and did not face any repercussions for doing so. The ability of potential volunteers to provide informed consent must be evaluated by researchers. All subjects read and signed a written consent form as proof of their informed consent. They also signed their parents in the consent form. This form served as documentation that the participant gave informed consent and that the researcher had supplied all necessary data.

Criteria measure

To collect the data paper pencil test was taken. Complex attention was measured by the following assessment namely six letter cancellation test, digit letter substitution test, digit symbol substitution test, digit span forward test, digit span backward test, trail making test part –A and B. All data were collected over 4-5 days. Data were collected daily for three hours in the morning and evening. Students were very attentive and cooperative in providing their data. All methods were carried out in accordance with relevant guidelines and regulations.

Statistical Techniques

To assess the comparison between yoga group and non-yoga group female subjects on complex attention of neurocognitive domain, the descriptive statistics, the graphical representations and independent t-test was employed. The level of significant was set at 0.05 level.

All experimental protocols were approved by Visva-Bharati Board of Studies (Physical Education and Sports Science) committee and Visva-Bharati Research Board. In this committee external experts were included from various institutions.

Results

The findings pertaining to descriptive statistics of yoga and non-yoga female groups on complex attention of neurocognitive domains has been presented in Table 1.

Table 1: Descriptive statistics of yoga (N=12) and non-yoga (N=21) female group on complex attention of neurocognitive domains

Neurocognitive Domains	Tests	Groups	Mean	SEM (±)	SD (±)	Sk	Ku
Complex Attention	Six Letter Cancellation Test	Yoga Group	27.00	0.98	3.41	-0.40	-0.56
		Non-Yoga Group	21.86	1.24	5.69	-0.54	0.06
	Digit Letter Substitution Test	Yoga Group	56.33	2.77	9.59	0.41	0.21
		Non-Yoga Group	47.19	2.77	12.71	1.15	1.60
	Digit Symbol Substitution Test	Yoga Group	57.83	2.00	6.91	0.43	-1.56
		Non-Yoga Group	47.43	2.81	12.87	0.48	-0.56
	Digit Span Forward Test	Yoga Group	12.67	0.53	1.83	-1.34	3.59
		Non-Yoga Group	8.48	0.26	1.21	0.06	-0.05
	Digit Span Backward Test	Yoga Group	8.08	0.58	2.02	-2.83	9.07
		Non-Yoga Group	5.10	0.36	1.64	-0.24	-0.84
	Trail Making Test Part - A*	Yoga Group	24.90	5.86	20.30	3.21	10.73
		Non-Yoga Group	24.11	1.13	5.17	0.62	1.92
	Trail Making Test Part - B*	Yoga Group	32.21	2.17	7.51	1.46	1.75
		Non-Yoga Group	49.81	3.05	13.98	-2.28	6.69

An * denotes that "lower score is better", otherwise higher scores are better
Abbreviations: SEM = Standard Error of Mean, SD = Standard Deviation, Sk = Skewness, Ku = Kurtosis

Table 1 presented that the descriptive statistics of yoga and non-yoga female groups on complex attention. The mean score of six letter cancellation test of yoga group and non-yoga group were 27.00±3.41 and 21.86±5.69. The mean score of digit letter substitution test and digit symbol substitution test of yoga group and non-yoga female group were 56.33±9.59 & 47.19±12.71 and 57.83±6.91 & 47.43±12.87. Also the mean score of digit span forward test and digit span backward test were 12.67±1.83 & 8.481.21 and 8.08±2.02 & 5.10±1.64. Again the mean score of trail making test part-A and trail making test part-B were 24.90±20.30 & 24.11±5.17 and 32.21±7.51 & 49.81±13.98 respectively.

Graphical representation of yoga (N=12) and non-yoga (N=21) group of female subjects on complex attention of neurocognitive domains were presented in Figure 1.

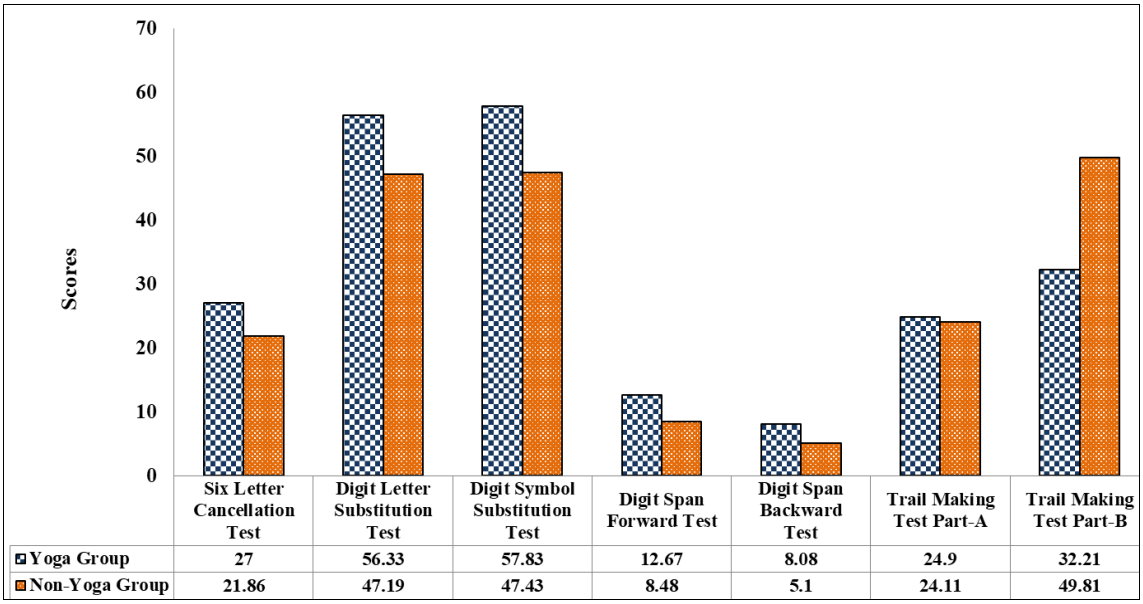

Fig 1: Graphical representation yoga (N=12) and non-yoga (N=21) female group on complex attention of neurocognitive domains

The findings relating to comparison between yoga and non-yoga female groups on complex attention of neurocognitive domains has been presented in Table 2.

Table 2: Independent t-test between yoga and non-yoga female groups on complex attention of neurocognitive domains

	Tests	Groups	DF	Mean Difference	Std. Error Difference	t-ratio	Sig. level (2-tailed)
Complex attention	Six letter cancellation test	Yoga / Non-Yoga	31	5.14	1.81	2.84*	.008
	Digit letter substitution test	Yoga / Non-Yoga	31	9.14	4.23	2.16*	.039
	Digit symbol substitution test	Yoga / Non-Yoga	31	10.40	4.03	2.58*	.015

	Digit Span Forward Test	Yoga Non-Yoga	31	4.19	0.53	7.94*	.000
	Digit Span Backward Test	Yoga Non-Yoga	31	2.99	0.65	4.63*	.000
	Trail Making Test Part –A	Yoga Non-Yoga	31	0.78	4.63	0.17	.867
	Trail Making Test Part –B	Yoga Non-Yoga	31	17.59	4.37	4.02*	.000

*. Significant at 0.05 level

Table 2 indicated that the comparison of yoga and non-yoga female group on complex attention of neurocognitive domains. It also showed that the t-value between yoga and non-yoga female groups on six letter cancellation test, digit letter & digit symbol substitution test, digit span forward & backward test and trail making test part-A & part-B was 2.84 (>0.05), 2.16 (>0.05), 2.58 (>0.05), 7.94 (>0.05), 4.63 (>0.05), 0.17 (<0.05) and 4.02 (>0.05) respectively.

Conclusion

On the basis of the result it may be concluded that the female yoga group is better than the female non-yoga group in complex attention of neurocognitive domains.

Data Availability Statement

The data that supports the findings of this study are available from the corresponding author upon reasonable request. Researchers interested in accessing the data may contact Ms. Kaberi Ghosh at kaberighosh147@gmail.com. The purpose of the data use was to compare the complex attention between yoga and non-yoga group of female subjects. We'll give you the materials and information you need to make your work reproducible.

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