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Comparative effect of alternate nostril breathing on auditory and visual reaction time

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ABSTRACT

The present work was planned to determine if alternate nostril breathing (ANB) has any effect on central neural processing, by studying its effect on reaction time. In present study 20 male and 20 female, young medical students were practiced ANB for 3 months. Outcome assessments of auditory reaction time (ART) and visual reaction time (VRT) were performed at baseline and after the 3 month of ANB training. There was a statistically significant (P<.001) decrease in both ART and VRT. This decrease in ART and VRT after ANB practices may be due to increased mental alertness, a balancing effect of ANB on the functional activity of the left and right cerebral hemisphere or increased corticotrophin releasing hormone and cortisol secretion in response to a challenge. This is of applied value in situations requiring faster reactivity such as in day today driving, sports and in specialized surgery.

INTRODUCTION

Yogic techniques are known to improve one's overall performance. Pranayama (breathing exercise) is known to be a part of yogic techniques. The beneficial effects of different Pranayama are well reported and have sound scientific basis.[5, 17, 23] Different types of Pranayama (breathing exercises) produce different physiological responses in normal young volunteers.[18, 23] Savitri Pranayama, Kapalbhati, Bhastrika Pranayama and Alternate nostril breathing (ANB) are well known among them. These breathing exercises are reported to influence cardio-respiratory and autonomic functions,[12, 17, 19, 23, 25] also help in reducing the scores of anxiety[8] and stress.[5]

Reaction time (RT) is an indirect index of the processing ability of central nervous system and a simple means of determining sensory motor association and performance.[11] RT involves central neural mechanisms and its study is of considerable physiological interest. It is sensitive and reproducible test and its measurement can be done with simple apparatus and set up. It has also been suggested that RT can be used as a simple and objective method to determine the beneficial effects of yoga training.[20] Recent studies showed various pranayamic practices reduce the reaction time.[2, 20, 21] As no such study has been done to see the effect of ANB on RT, the present research work has been taken to study the comparative effectiveness of ANB pranayama on auditory reaction time (ART) and visual reaction time (VRT).

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MATERIALS AND METHODS

The present study was conducted in Department of physiology, RMCH, Bareilly on forty, 1st year MBBS students. Detailed information was collected on pre-designed pro forma. Complete general, anthropometries and systemic examination were carried out. Subjects with previous yogic training or regular athletic activity were excluded from study. After briefing about the study protocol, consent was obtained. These two groups of male (n=20) and female (n=20) students performed alternate nostril breathing (anuloma viloma) pranayama for 3 months on alternate day basis for 15 minutes in peaceful, lighted and well- ventilated hall between 7.00 AM to 8.00 AM at room temperature. Clothing was minimal and very loose. The ART and VRT were recorded initially at the onset of the study (Baseline reading) and again after 3 months of pranayamic training.

The Practice of Alternate Nostril Breathing was done by the method described by Burke[9] with a slight modification of one minute rest after every 3 minutes of pranayama and this practice was done for 15 minutes.

An electronic instrument (Fig. 1 and Fig. 2) was used to measure reaction time both auditory and visual, whose sensitivity was to take readings from 0 to 999 milliseconds (ms). This instrument consisted of 4 boards. One board was on the examiner's side (which subjects cannot see) in which there were 3 switches: first switch was to change the circuit between auditory or visual signal productions, second switch was to open the circuit as opted by first switch and third switch was to reset the LCD counter. Second board had the LCD for counting the reaction time (0 to 999 ms).The third board had a buzzer and a bulb. The second and third boards were placed in between the subject and the examiner. The fourth board on the subject's side had a switch to break the circuit after receiving the stimulus either auditory or visual. All the switches used in instrument were micro-switches that were very sensitive to touch.

No warning signal was given and to avoid the effect of lateralized stimulus, visual and auditory signals were given from the front of the subjects who were instructed to use their dominant hand while responding to signal.

To record the auditory reaction time, subjects were blindfolded and instructed to cut off the circuit by pressing the switch as soon as they hear the buzzer. The observer selects the auditory circuit by the switch provided and switches on this circuit at varying time intervals to avoid guess work by subject. As soon as subject hears the sound, he cut off the circuit by pressing the switch. The subsequent time taken was recorded as auditory reaction time (ART) of that particular subject. Three such readings of each subject were taken and the mean was calculated.

The same procedure was repeated by choosing the visual circuit instead of auditory circuit, where the subject is instructed to use ear plug and responds by pressing the switch as soon as he visualizes the lighted bulb (40 watt). The subsequent time taken is the visual reaction time (VRT) of that particular subject. Three such readings of each subject were taken and the mean was calculated.

The initial readings were taken and then compared with that of final readings at the end of 3 month training in both male and female groups. The paired t-test was used for statistical analysis, a P-value of <0.05 was considered

Fig 1: Reaction time measuring instrument

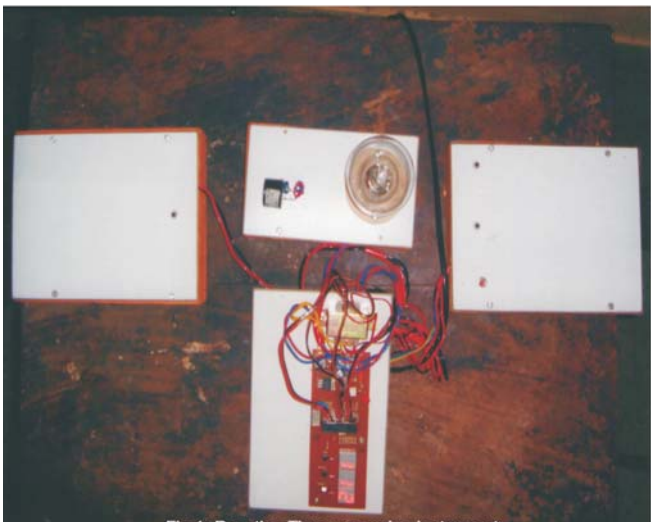
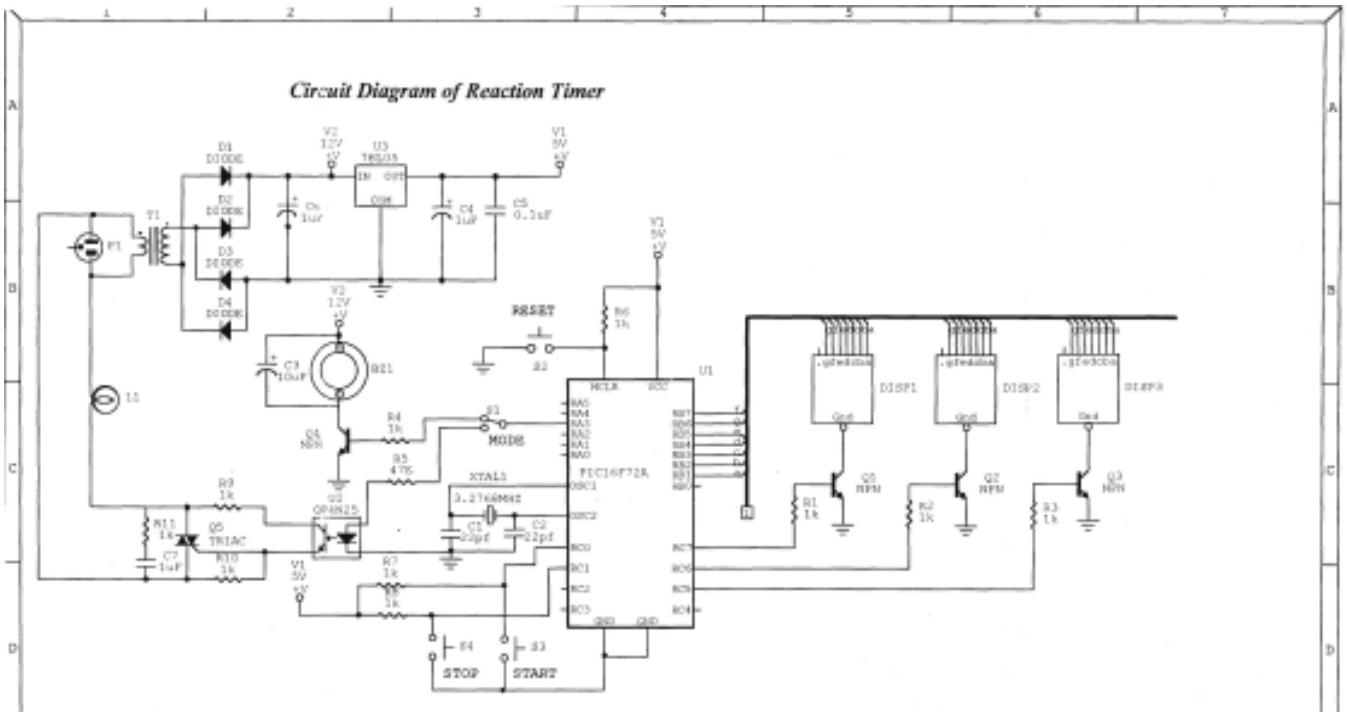


Fig 2: Circuit of reaction time instrument



statistically significant. RT analysis excluded erroneous key presses.

RESULTS

All the students were unmarried and Hindu. 75% (30) students were vegetarian, and the remaining 25% (10) gave history of taking non-vegetarian diet occasionally. Anthropometric data of subjects are summarized in Table 1.

None of the subject gave any history of yogic training or physical exercise of any kind. Also no history of any addiction (alcohol, guthka or cigarette smoking) is found.

Paired't' test was used to analyze the data. For statistical analysis, the software SPSS version 17.0 was used. The confidence interval of 95% was set for all comparisons and a P valve of less than 0.05 was accepted as indicating significantly difference between the compared values. Data are expressed by using mean and standard deviation.

Before ANB, in males ART was 148.45 ± 25.788 ms and after performing three months training, ART decreased to 124.05 ± 17.626 ms, the decrease being statistically very highly significant (P<0.001). (Table 2)

Before ANB, in females ART was 161.65 ± 27.976 ms and after performing three months training, ART decreased to 132.85 ± 15.421 ms, the decrease being statistically very highly significant (P<0.001). (Table 2)

Before ANB, in males VRT was 171.75 ± 29.041 ms and after performing three months training, VRT decreased to 133.50 ± 16.710 ms, the decrease being statistically very highly significant (P<0.001). (Table 3)

Before ANB, in females VRT was 176.55 ± 23.692 ms and after performing three months training, VRT decreased to 141.10 ± 16.553 ms, the decrease being statistically very highly significant (P<0.001). (Table 3)

DISCUSSION

Patanjali, first exponent of yoga described yoga as the restraint (nirodha) of processes (vritii) of the mind (chitta). In simple words yoga is a journey towards self-perfection. Improvement is the first

step toward perfection thus yoga is a course in self-improvement.[6] Since yoga aims at perfection/ improvement of body and mind, it is obvious to study this progress towards improvement in objective reproducible changes in physiological parameters.

ANB is a pranayamic technique in which alternate nostril breathings are performed in controlled manner. It has been found that changes in breathing period produced by voluntary control of inspiration are significantly correlated to changes in RT.[13] As no study has been done to see the effect of ANB on reaction time, so the results could also be compared to report available on effect of pranayama other than ANB on reaction time as both are fairly similar.

Only one previous study had shown a decrease in ART and VRT that was not statistically significant[19] after training of slow and fast pranayama that could be due to short term training of only 3 weeks. This was proven by our study that undergoes for prolonged period of 3 months.

We found a statistically significant decrease in ART and VRT after three months training of ANB pranayama which is also in line with many previous studies on different pranayama training and reaction times.[1, 2, 16, 20, 21] This decrease in RT after pranayamic practices is attributed to various factors like specific training which increases the performance involves speed and accuracy.[24] Yogic persons in spite of being in physically relaxed state[3] were found to be in increased mental alertness.[27, 28, 32, 33] A preponderance of alpha waves in EEG of yogis had been observed that explains greater arousal in yogis.[3] In a previous study the mean power in the beta bands and partially in the alpha band increased during ANB irrespective of the type of nostril breathing. In addition, hemisphere asymmetry in the beta 1 band decreased in the second half of ANB suggesting that ANB has a balancing effect on the functional activity of the left and right cerebral hemisphere.[26] The previous studies had shown a faster rate of information processing and improved concentration in persons practiced pranayama was due to their ability to ignore external stimuli or disturbances.[6] There is also lower rate of mental fatigability and increased perceptual accuracy in yogic trained persons as suggested by increased critical flicker fusion frequency[30] (the frequency at which a flickering stimulus is perceived to be steady).

In our study we have also found that ART and VRT was more in females than in males this is in conformity with previous studies.[4, 10, 22] This probably attributed to the differences in processing strategy in males and females.[1]

A decrease in RT is known to improve the sensorimotor performances. Thus RT could be used either for screening the large population for physical fitness,[7] in sports physiology[14] or as a therapeutic intervention in certain type of medical conditions like depression, cardiovascular diseases and diabetes etc[18] or to train mentally retarded children and older sports persons who have prolonged RT[29] or as an index of cortical arousal.[21]

In yoga practitioners, there is increased CRH (corticotropin releasing hormone) and cortisol secretion in response to a challenge than the control subjects[15, 31] but the baseline levels during rest are reduced.[6] So when a challenge is presented in form of pressing the key as soon as possible in response to light or buzzer there is increased CRH and cortisol secretion. While testing ART / VRT, the individual being tested is in a state of stress/ challenge as he/she has to press the key in the shortest possible time in response to an auditory /visual signal. To do so the nerve impulse has to be processed faster in the auditory/visual neuronal pathways and its association fibers to frontal cortex. The reaction time also depends on the quick activity of skeletal muscle. Both these factors depend on the blood flow to the particular organ i.e. central nervous system and skeletal muscle. Yoga has been shown to increase cerebral[6] and skeletal muscle blood flow by increase in cortisol level during stress/ challenge. So we want to hypothesize that this dual action of ANB both on CNS as well as skeletal muscle are the possible mechanisms that lead to markedly decrease reaction time as compared to

control subjects. Further studies are required to substantiate this.

CONCLUSION

So, this decrease in reaction time after ANB practice is may be due to

1. Physiologically relaxed state but increased mental alertness.

2. Ability to ignore or inhibit extraneous stimuli.

3. A balancing effect on the functional activity of the left and right hemisphere.

4. Increased CRH and cortisol secretion in response to a challenge.

This shortening of RT is of applied value in situations requiring faster reactivity regarding serious safety concern such as in day today driving to avoid road traffic accidents, sports, for recommendation of safety limits, machine operations and in specialized surgery. So we suggest that the pranayama techniques like alternate nostril breathing may be used as an effective means of training in people involving such tasks.

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Table 1: Anthropometric data of the volunteers

	Male (Mean ± S.D.)	Female (Mean ± SD)
Age (Yrs)	22.8 ± 1.609	22.4 ± 1.698
Height (cm)	166.2 ± 3.833	156.15 ± 2.641
Weight (kg)	59.5 ± 4.548	53 ± 3.974

SD = Standard Deviation, Yrs = Years, cm = Centimeter and kg = Kilogram.

Table 2: Comparison of auditory reaction time in males and females before and after the 3 months of ANB practice

	Before ANB (ms)	After 3 months of ANB practice(ms)	Significance
Male (Mean ± S.D.) (n=20)	148.45 ± 25.788	124.05 ± 17.626	HS
Female (Mean ± S.D.) (n=20)	161.65 ± 27.976	132.85 ± 15.421	HS

ANB = Alternate nostril breathing, ms = millisecond and HS = Highly significant (P<.001).

Table 3: Comparison of visual reaction time in males and females before and after the 3 months of ANB practice

	Before ANB (ms)	After 3 months of ANB practice (ms)	Significance
Male (Mean ± S.D.) (n=20)	171.75 ± 29.041	133.50 ± 16.710	HS
Female (Mean ± S.D.) (n=20)	176.55 ± 23.692	141.10 ± 16.553	HS

ANB = Alternate nostril breathing, ms = millisecond and HS = Highly significant (P<.001).