



Effect of yogic education system and modern education system on memory

R Rangan, HR Nagendra, and G Ramachandra Bhat

Department of Yoga Research, Shri Vivekananda Yoga Anusandhana Samsthana (SVYASA), Bangalore, India
Address for correspondence: Dr. R Rangan, 167, North Chithra Street, Srirangam, Trichy - 620 006, India. E-mail: valmiki1977@yahoo.com

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Abstract

Background/Aim:

Memory is more associated with the temporal cortex than other cortical areas. The two main components of memory are spatial and verbal which relate to right and left hemispheres of the brain, respectively. Many investigations have shown the beneficial effects of yoga on memory and temporal functions of the brain. This study was aimed at comparing the effect of one Gurukula Education System (GES) school based on a yoga way of life with a school using the Modern Education System (MES) on memory.

Materials and Methods:

Forty nine boys of ages ranging from 11-13 years were selected from each of two residential schools, one MES and the other GES, providing similar ambiance and daily routines. The boys were matched for age and socioeconomic status. The GES educational program is based around integrated yoga modules while the MES provides a conventional modern education program. Memory was assessed by means of standard spatial and verbal memory tests applicable to Indian conditions before and after an academic year.

Results:

Between groups there was matching at start of the academic year, while after it the GES boys showed significant enhancement in both verbal and visual memory scores than MES boys ($P < 0.001$, Mann-Whitney test).

Conclusions:

The present study showed that the GES meant for total personality development adopting yoga way of life is more effective in enhancing visual and verbal memory scores than the MES.

Keywords: Gurukula education system, memory, vedic chanting, yoga

INTRODUCTION

It is important to improve modern education with its increasing levels of academic achievement among students. This paper examines the traditional Gurukula Education System (GES) for ways in which its practices might contribute advantageously to the Modern Education System (MES). The concern of this paper is with the development of memory.

GES is a learning system based on the Vedas which includes many yogic practices. It has more element of yoga than the MES. In the words of an ancient Indian saint Vasishta, yoga is any effort to calm the mind.[1] GES has many practices in general to calm the mind like *asanas*, chanting of *mantras*, meditation, and *puja*. Generally when the mind is calm and clear memory improves.[2] Therefore, it is hypothesized that the GES can improve memory. In the Indian tradition it is held that recitation of *mantra* with resonance, a vital practice in GES, helps improve memory.[3] This is still a topic to be researched. The present research study was aimed to compare the effect of GES on verbal and spatial memory with MES.

Outside the context of education, studies have been conducted on many different yogic practices. These include *asana*, *pranayama*, vedic chanting, and meditation, and reveal that as an intervention such techniques can be used to enhance cognitive abilities, like attention, concentration,[4] and planning.[5] There are a few papers analyzing the effect of yoga which include physical postures and meditation on memory. Seashore tonal memory test conducted by Pagano and colleagues,[6] among a nonmeditator group, inexperienced meditator group, and an experienced meditator group showed that the meditators in general were significantly better in both pretest and post-test performance than the nonmeditators, and experienced meditators were significantly better than the inexperienced ones. These results suggest that the Transcendental Meditation (TM) facilitates memory of right hemispheric functioning. College students instructed in the TM technique displayed significant improvements in performance over a two-week period on a perceptual and short-term memory test involving the identification of letter sequences presented rapidly. They were compared with subjects randomly assigned to a routine of twice-daily relaxation with their eyes closed and to subjects who made no change in their daily schedule.[7] Kember[8] showed through the psychological tests that college students were able to enhance spontaneous organization of their memory. The practice of TM improved the verbal memory of the high school students.[9]

In a study conducted on students attending a 10-day nonresidential personality development camp, students learned the practice of integrated approach of yoga. Participants were tested on audio, visual, audiovisual, and short-and long-term memory scores before and after the yoga practice. The result showed significant improvements in all these memory scores. Visual-verbal test, visual-spatial test, audiovisual test, and audio memory test were conducted for two groups of 38 children each, in which one of the groups attended a 10-day yoga training camp before and after the camp. The yoga group showed a significant improvement.[10]

In a 10-day yoga camp the subjects were assessed at the beginning and end using the standard Wechsler memory scale. The diverse aspects of the memory ranging from visual reproduction to digit span were increased significantly following ten days of yoga training.[10]

Telles demonstrated that special physical postures (*asanas*), voluntary regulation of breathing (*pranayama*), and maintenance of silence and visual focusing exercises (*tratakas*) improve memory in school children.[10] Uninostril breathing facilitates the performance on spatial and verbal cognitive tasks, said to be right and left brain functions, respectively. Since hemispheric memory functions are also known to be lateralized, Naveen *et al.* assessed the effects of uninostril breathing on the performance in verbal and spatial memory tests. School children ($N = 108$, whose ages ranged from 10-17 years) were randomly assigned to four groups. Each group practiced a specific yoga breathing technique: (a) right nostril breathing, (b) left nostril breathing, (c) alternate nostril breathing, or (d) breath awareness without manipulation of nostrils. These techniques were practiced for ten days. Verbal and spatial memory was assessed initially and after ten days. An age-matched control group of 27 children were similarly assessed. All four experimental groups showed significant increases in spatial test scores at retest, but the control group showed no change. Average increase in spatial memory scores for the trained groups was 84%. It appears

yoga breathing increases spatial rather than verbal scores, without a lateralized effect. Voluntary regulation of breathing (*pranayama*) improves the performance of spatial memory.[11] These studies suggest that yoga techniques can improve the spatial and verbal memories. Visual memory increases through the practice of yoga. Dynamic *asana* practices were given to the school children for nine days. When measured, the visual memory showed an improvement.[12]

Memory is the capacity to retain acquired information. One of the important aspects of memory is declarative or explicit memory, that is, memory that can be brought to conscious awareness. Memory of verbal and visual material is an important domain of explicit memory.[13] Anterior areas of the temporal cortex are involved in representation of verbal conceptual knowledge organized categorically.[4] Lesions in the left temporal lobe disrupt verbal memory and the lesions in the right temporal lobe disrupt visuo-spatial memory.[5] Excisions of left hippocampal structures impair verbal memory to a greater extent. However, the impairment of visuo-spatial memory is less clearly lateralized.[14]

According to yogic lore, memory is laid down from prior experiences and is a process of information storage. Memory is one of the five modifications of mind. The four others are right knowledge, wrong knowledge, imagination, and deep sleep. Each brings its own memories. These form imprints in various layers of mind, some superficial and some deep rooted. According to the ancient scriptures, there is always a possibility of transformation of memories. According to the *Upanishads* the personality has five sheaths – *Annamaya Kosha* (sheath of the physical body), *Pranamaya Kosha* (sheath of vital energy), *Manomaya Kosha* (mental sheath), *Vijnanamaya Kosha* (sheath of discriminative intelligence), and *Anandamayakosha* (sheath of bliss). Every cell possesses memory on a physical level. Through the influence of the higher sheaths the cells of the physical structure can be transformed. On the vital level, baser instincts can undergo change. On the psychic level, transformation in the thinking patterns and emotions is possible. In the intellectual sheath, one experiences the recollection, remembrance, reconsidering, reverting, and forgetting of various values. For example, a value in life to amass wealth will be changed to do good to others. In the sheath of bliss one experiences the complete freedom of memory.[10]

Modern methods to develop memory include the logical method (observing meanings and connections such as similarities and contrasts), rational memory (to be attentive to the meaning of the lesson), over learning (learning a lesson beyond the point which the learner can reproduce without committing an error), spaced learning (with breaks in between), unspaced learning (without breaks), and mnemonics (artifices to simplify memorizing a series of disconnected facts). Yogic methods to develop memory include deepening perception, increasing the attention span, activating dormant areas of the brain, and replacing useless memories with useful ones.[10]

The tests for spatial and verbal memory are standardized tests for measuring verbal and spatial memory.[15] The present study assesses the effect of a one-year yoga intervention on boys in a GES school compared to a matched control group of boys in a MES school.

MATERIALS AND METHODS

Subjects

Two residential schools, one MES and the other GES, providing similar ambiance and daily routines were chosen. Both the residential schools had similar natural surroundings with an atmosphere congenial for learning. Out of the 110 students in the yoga-based gurukula (GES) and 500 students studying in the MES, a group of 49 healthy boys between 11 and 13 years from each school were one-to-one matched for age, family atmosphere, and socioeconomic background.

The boys' health statuses were assessed by a doctor based on their personal history and a general clinical examination; any of the subjects having congenital defects or on medication known to affect cognitive abilities were excluded from the study. The students in the GES school were all freshers and had received a similar modern education up till that time, when, being interested in GES they had chosen the gurukula school. An independent samples 't' test on the baseline data as described in [Table 1](#), showed no significant differences ($P > 0.05$) between the two groups for any of the demographic parameters.

Table 1

Demographic data of boys studying in MES and GES schools

Assessments

The subjects were told that the memory tests were for their self-assessment to understand the benefit they derived from the course. They were subsequently given a report, so they were enthusiastic and interested. They were not given further details about the study. For both verbal and spatial tests a correct response was scored as '1' and an incorrect one brought them a '0'. A practice trial showed that many subjects got a maximum score (with no scope for further change) when a free recall test was used, so for the actual assessment a delayed recall test was used, as this is known to be more difficult.[15] However, there was no special interest in assessing the effect of interference on recall.

Standard tests of Baddley were used to assess the spatial and verbal memories.[15] Twenty subjects were assessed at a time while seated approximately a meter apart to avoid distraction and interference. The test material, in the form of slides, was projected on a screen, allowing 10 seconds for each slide. After 10 slides had been shown, a mathematical problem (e.g., $7-4+9-3+6-5-8+2$) was projected on the screen. Immediately after this, subjects were asked to recall and write down (or in the case of spatial memory, to draw) within 60 seconds the ten test items which had been showed to them. To test verbal memory standard nonsense syllables of three letters, e.g., XOL, were selected from a prepared list. The test for spatial memory consisted of ten simple line drawings. Geometrical or other shapes which could be described verbally, e.g., a square or a circle, were not used. The drawings were very simple and easy to reproduce. The tests were only conducted before and after the academic year.

Masking

One-to-one matching of students was done under the guidance of a statistician. Demographic data were collected by trained persons not involved in the design of the study. The spatial and verbal memory test assessments were carried out under the guidance of a psychologist by trained persons who had not been involved in the selection process and did not know the design of the study. Teachers at the two schools were not involved in making the assessments. There were no interactions between the GES and MES schools as they were in different locations more than 100 kilometres apart. Furthermore, no one at either school knew the identity of the other school.

Intervention

The GES school used an educational program with integrated yoga practices, while the MES provided a conventional modern education program. The GES program included yogic postures (*asanas*), voluntary regulated breathing (*pranayama*), meditation (*dhyana*), recitation of mantras (*japa*), yogic prayers, worship (*puja*), and yogic games (a set of games which not only gives stimulation but also relaxation and generally calms the mind). In contrast, the MES program

included physical exercises, mathematical puzzles, music, prayer, and normal sports. The daily routine of the two schools match as shown in [Table 2](#).

Table 2
Daily routine in the two residential schools

Data analysis

The predata of the two groups were compared by independent samples 't' test. The Kolmogorov test of normality showed that the predata were not normally distributed. Hence, nonparametric tests were used in the analysis. Within groups, the pre-post data were analyzed using the Wilcoxon signed ranks test, while between groups the pre-post data were analyzed using the Mann-Whitney U test. SPSS 10.0 was used for analysis.

RESULTS

Matching baseline memory score data [[Table 3](#)] shows that the boys in the two groups selected for study were well matched and homogeneous. Both groups of students performed similarly on the pretest at the start of the academic year (predata). An independent sample's 't' test found no significant difference between the GES and MES groups. The Wilcoxon signed ranks test comparing the pre-post values within the groups showed that improvements in both groups were significant at $P < 0.05$. The GES boys showed highly significant greater improvements than MES boys in both spatial and verbal memory scores ($P < 0.05$, Mann-Whitney U test) as can be seen in [Table 4](#).

Table 3
Effect of GES on spatial and verbal memory test as compared to that of MES

Table 4
Age effect of GES on spatial and verbal memory test as compared to that of MES

DISCUSSION

Both groups improved, but the GES school students did so more than the MES students. Reasons for improvements in memory are focused here. Differences over the year are first considered, then possible reasons why the observed differences might have occurred. Finally, the limitations of the study are considered.

Differences over the year

1. The observed increase in memory scores in both GES and MES groups might be expected. They should occur in any good education system. However, the GES group showed significantly higher memory enhancement than the MES group – the null hypothesis that boys from both groups would score equally was not upheld.
2. Both groups showed greater memory enhancement over the year-long study, than that

produced by a 10-day yoga intervention in a residential setup.[12] The GES maintains growth of memory capacity. Nine days practice of left-nostril breathing four times a day for 15 minutes, asanas, and special quiz and group discussions, yogic games, and chanting mantras once in a day for 45 minutes produced 10.02% improvement. The year-long education intervention produced 31.002% improvement in the GES group, and 20.134% in the MES group.

3. Verbal memory showed greater improvements than spatial memory in both groups. This may be attributed to several factors. Education systems may be generally more oriented toward intellectual development, that is, more toward left brain than right.[16] During growth the logical left brain grows faster than the right.

The pre-post changes in both groups after an academic year showed significant increase in memory scores. However, GES group showed greater increase in memory scores than MES group. Several factors could have contributed to the increase in memory scores of the GES. Boys from GES scored better than MES in verbal memory, also rejecting the null hypothesis that GES can develop only the visual memory more than MES and not the verbal memory.

Growth of right hemisphere through the practice of asana and pranayama was speculated by the studies conducted by Naveen[11] and Shatrughan.[12] However, the Naveen study[11] excluded ovals and circles from the picture memory test, to make it more challenging; the present study included them. The Kory study[9] speculates that internal use of a mantra in TM may improve left hemisphere, as it improves verbal memory. In present day GES, mantra recitation is practiced more than pranayama and asanas, so growth of the verbal memory in GES students may be expected to be greater than growth of spatial memory.

4. Baseline data show scores on spatial memory increasing with age. Retest scores showed that improvements also increased with age: GES boys scored significantly better than MES boys on both verbal and spatial memory at all age levels, except for the 11-year olds on spatial memory, where the difference between the two did not reach significance.
5. Greater improvements with age were also found on verbal memory. Pre-post differences were more for verbal than for spatial memory in all age groups. Differences between the GES and MES groups reached significance in all of them. Verbal memory increased more in the 12- and 13-year olds than in the 11-year olds. In contrast, spatial memory differences were greater for the 11-year olds than the 12- and 13-year olds. However, since there were only six students in each 11-year groups, this may not be robust.

Reasons why the differences occurred

Key features of the two educational systems and their impact on students

The two educational systems are different in every respect, not just in their overall aims, but also in their detailed content. The differences observed on memory tests should therefore not be surprising. When we look at the actual content of the curricula and extra-curricula activities, this will become clearer. The key features of each system were given in the Intervention section and presented in terms of daily routine in [Table 2](#).

Considering these in more detail indicates why the MES and GES schools should have produced the different results observed. The GES curriculum includes yoga *asanas*, *pranayama* breathing exercises, meditation, *mantra* recitation, devotional songs, *puja*, and yogic games. In contrast, the corresponding aspects of the MES program comprise physical exercises, mathematical puzzles, music, daily prayers, and conventional sports.

In contrast to physical exercises, yoga *asanas* and *pranayama* produce relaxation at the physical level, while simultaneously enlivening the vital level; mathematical puzzles enliven the mind and may

be frustrating, while *dhyana* is calming to the mind; devotional songs may have a different effect from ordinary music, while the actions and feelings associated with *puja* are different from mere repetition of prayers; in contrast to physical sports, yogic games stimulate and also relax and expand the mind to a state of greater freedom.

In GES schools, the specific purpose of incorporating these yogic features into student life is to learn to perform all actions against a backdrop of the stress-free states of mind detailed in yoga philosophy. No such purpose is contained in the aims of MES schools. The intention is that such stress-free patterns of functioning should carry over into all activities: academic tests, examinations, and professional life in later years. On this basis different results can be expected.

Specific reasons why GES boys should have scored better

Reduction in anxiety by specific anxiety reducing yoga practices and counseling

Anxiety mars memory development.[2] Both schools were chosen to have good atmospheric ambience in natural surroundings with equal effects on memory. The GES includes yoga practices with anxiety reducing effects that are already well known.[17] A study on three schools in Taiwan has shown that (yoga-based) TM reduces state-trait anxiety in high school children.[18] GES provides an atmosphere in which students are less anxious. Moreover, teachers' personal care of students by practices like counseling is included to a greater extent in GES than MES. GES teachers are vedic scholars qualified to impart various vedic and yogic anxiety reducing techniques such as counseling according to students' mental makeup. Learning vedic *mantras* has the effect of training consciousness and regulating and balancing the brain physiology.[19] This may be one reason for the growth of memory among GES students as memory improves with balance of mind.

Specific techniques used in GES schools for enhancement of memory

In GES, students are taught several techniques to memorize *mantras*. For beginners these consist of *sande* and *tiruve*. In *sande*, teachers train students to memorize mantras by repeating them two or three times. In *tiruve* students chant the *mantras* themselves in the way they have been trained: initially, ten repetitions per day, for ten days, then one repetition per day for two or three months, a practice known as *avrutti*. Finally, they chant each memorized *mantra* at least once per month. *Avrutti* compares well with Tony Buzan's Mind Map Organic Study Technique (MMOST).[20]

Other techniques of a more advanced kind, featuring redundancy, are also used to preserve vedic *mantras*. These include *ghana*, *jata*, *krama*, and *pada*. It is traditionally thought that when used regularly, these techniques strongly develop students' verbal memory. Vedic pundits have preserved the vedic *mantras* throughout history using these techniques alone, accurately maintaining each word's pronunciation, and intonation. All these assist in developing students' verbal memory.

Holistic personality development as the main aim of GES

Holistic personality development is achieved through repetitive recitation of vedic *mantras*, which GES students do in a group every day. Vedic *mantras* are highly rhythmic, and fill the body uniformly with their resonance. Any rhythmic resonance of this kind has the power to make the mind relaxed and peaceful,[21] improving memory and eliminating psychological blockages. GES use of *bhajan* and *puja* in its science of emotion culture helps develop peace and relaxation, also possibly improving students' memory.[2]

Further possible reasons why GES boys scored better on short term enhancement of memory

- a. Growth is continuously monitored in GES.

- b. Yoga techniques used short term and are made more attractive by regularly introducing new, subtler techniques to avoid monotony and boredom.
- c. An atmosphere supporting continuous improvement is provided by group effects of team efforts.

Possible reasons why GES students should have performed better on verbal memory than spatial memory compared to MES students

Blakeslee[16] stated that the left hemisphere is more involved with verbal memory, while the right hemisphere is more concerned with recall of nonverbal, spatial information. Elements of *jnanayoga* can assist in improving left hemisphere function, and its associated verbal memory. More of these are contained in the GES curriculum than in MES: for example, three major aspects of *jnanayoga* – *shravana* (hearing lectures from the teacher and interacting with him), *manana* (contemplation and understanding through question, enquiry, and analysis), and *nidhidhyasana* (various techniques like meditation which promote observation of the student's internal and external nature). *Shravana* involves learning vedic *mantras* by repeatedly hearing them from the teacher (in GES the students are not generally allowed to learn the *mantras* from a book, normally they learn by listening to their teachers). *Manana* means repeating *mantras* to be memorized every day by oneself. *Nidhidhyasana* means meditating on the *mantras*. All these practices present in GES tend to increase the power of verbal memory, particularly *shravana*.

GES teachers are particular about asking questions, which develop thinking ability, the *manana* aspect, in students. In GES, individual instruction of each student by their teachers develops analytical abilities to a greater extent than in MES. This is an associated left hemisphere function. Innovative techniques used in GES increase students' inquisitiveness, for example, observation of the growth of plants right from the day the seed is sown – experimentation or *nidhidhyasana*.

Possible reasons why GES boys improved more than MES on spatial memory scores

Yoga techniques tailored to different age groups to bring about total personality growth

To enhance right hemisphere function, various creative arts can be taught. In both GES and MES such arts are taught, like music and dance. Yet, the GES group showed a more significant result. This may be because the creative arts taught in GES have the capacity to calm the mind more. For example, in GES in South India, traditional Karnatic music is taught, which has the capacity to make the mind peaceful. In contrast, in MES schools popular music is mainly taught. Becoming calmer and more peaceful makes a person more artistic and creative. Through creative and artistic practices right hemisphere use becomes nourished. Though MES students are exposed to various arts in the external world, such as TV and other media, they did not perform the spatial memory test as well as the GES students. This may be because TV, etc. generally tend to speed the mind up. On the other hand, the GES students though less exposed to multimedia creative arts, are trained in tranquility, which integrates right hemisphere function.

Naveen *et al.*[11] found improved spatial memory following *pranayama* performance. The GES students' more significant result on the spatial memory test may also have been due to their regular *pranayama* practice.

Use of Sanskrit as the principal medium of instruction

The physiological and psychological effects of reading Sanskrit are similar to those experienced during TM.[19] Students of GES learn the language of Sanskrit and use it as their medium of instruction. This might also have helped them achieve increased balance of mind and improved memory, especially as higher standards of language use were involved, including writing and analysis skills.

Limitations of the study

The present study only assessed the students twice. A single academic year constituted the intervention. No periodical assessments were conducted, meaning that the study could not investigate any immediate effects of the GES curriculum. Also, the study's time span did not cover the whole seven years of GES. Further studies should assess both the immediate effects of the GES regime on memory, and also the whole time span of GES education.

A further valuable project would be to investigate how gurukula students utilize their improved memory capabilities in social and professional life after completing their education.

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