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The Effect of Inverted Yoga Positions on Short-term Memory

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ABSTRACT

A brief yoga sequence consisting of three inverted positions was designed to test the hypothesis that inverted yoga positions positively influence memory and attention due to increased blood flow to the brain. Three hundred participants were divided into four treatments utilizing a Solomon Four (Trochim, 2005) design (yoga pre/post, yoga post, control pre/post, and control post). All participants completed a short-term memory test of a series of words read aloud at the conclusion of the treatment condition; number of words recalled was the dependent variable. One week separated the pre- and post-test for the pre/post conditions. A 2 x 2 factorial ANOVA was conducted to evaluate the effect of the testing and treatment. There was no significant difference between the control group and the experimental group. In this study, the practice of inverted yoga positions did not influence short-term memory. Any improvement appeared to be the result of being exposed to the pretest rather than the participation in yoga.

Introduction

Yoga is a very ancient practice that originated in India; the term refers to union or communication. For many, yoga is viewed as a physical, mental, and spiritual discipline that confers a sound body and a sound mind (Mohan, 2002). Allegedly, the practice of yoga can help a person achieve his or her full potential and help increase spiritual consciousness. Two of the physical aims in yoga are breathing techniques and posture, while one of the mental aims is the ability to maintain cognitive control, specifically in the areas of attention, memory, and arousal control. One common claim is that yoga helps clear the mind and this may have an effect on the ability to attend to relevant stimuli and recall information subsequently (Heriza, 2004).

Yoga has become a very popular recreational activity for many Americans. A relationship between the practice of yoga and benefits related to mental health and overall wellness is

apparent (Schaeffer, 2002). Specifically, inverted yoga positions have been associated with claims of increased memory and attention due to increased blood flow to the brain. For example, Schaeffer (2002) claimed "yoga can prevent memory lapses by calming you and enhancing your concentration. It can also improve your powers of recall by increasing circulation to your brain." Specifically, two inverted poses are suggested, the Open-Legged Forward Bend and Threading the Needle (see Figures 1 and 2). More inverted poses including the headstand and child's pose are cited as ways to "nourish the brain by increasing circulation of blood and oxygen" ("Improving Memory," 2005). Many people are doing yoga daily and reporting feeling its positive effects in their daily activities. Claims that yoga and meditation increase memory and recollection are common ("Improving Memory," 2005).

Professional athletes are turning to yoga as a way to improve their mental and physical performance. For example, in 2004 major league catcher Mike Piazza was in the spotlight in the *New York Times* not for baseball, but for his dedication to a healthy lifestyle that included daily yoga sessions, intended to stretch and strengthen his body and prevent injury (Jenkins, 2004).

Besides anecdotal claims and undocumented success stories that can be found online and in popular health and fitness journals, several researchers have taken the time to conduct research on the interaction of yoga and memory. While some studies have reported positive effects of short-term and long-term yoga training, others have had inconclusive results.

The effect of yogic exercises on the mind is said to have immediate effects. Kocher (1979) used both meaningful words and nonsense syllables to test immediate (short-term) verbal memory abilities before and after a one-month period of yoga training for college-aged males and females. The results, though incomplete, suggested that yoga did facilitate immediate memory performance more than the absence of yoga, and that the benefit was greater for males than for females.

Peck and Kehle (2005) found that elementary school children who engaged in 30 minutes of yogic practices (by following a videotaped yoga session) twice a week for three weeks increased their time on task (paying attention to the teacher or task at hand) during the three week period and at a later follow-up date, while their classmates' time on task remained essentially unchanged. Similar work by Manjunath and Telles (2004) studied the performance scores of children aged 11 to 16 years on verbal and spatial memory tests for two groups, one attending a yoga camp and the other a fine arts camp. Both groups were tested initially and after 10 days of their respective interventions. At the final assessment, the yoga group showed a significant increase (43%) in spatial memory while the fine arts (and a control group) showed no change. The results suggest that yoga practice, including physical postures and yoga breathing improve delayed recall of spatial information.

Anantharaman and Kabir (1984) reported that memory span and attention measured before and after yoga training changed positively as a result of yoga training. Yoga has also been utilized with limited positive results in rehabilitation with mentally retarded individuals (Pathak & Mishra, 1984) and in training visual perceptual sensitivity (Manjunath & Telles, 1999).

Jensen and Kenny (2004) studied the effect of yoga on the attention and behavior of boys

with Attention-Deficit hyperactivity Disorder (ADHD). Boys diagnosed with ADHD were assigned to a yoga or control group, which included 20 yoga sessions and cooperative activities, respectively. Both groups were assessed pre- and post-intervention on the Conners' Parent and Teacher Scales-Revised: Long (Conners, 1997) and the Test of Variables of Attention (Greenberg, Cormna, & Kindschi, 1997). Significant improvements from pre-test to post-test were found for the control group, but not the yoga group on several subscales of the Conners' Teacher Rating Scales, while the opposite effect was present on several subscales of the Conners' Parents Rating Scales. Some of the results of this study suggest that yoga may have merit as a complementary treatment for boys with ADHD already stabilized on medication, particularly for its evening effect when medication effects are absent.

Sahasi (1984) utilized five cognitive tests (color cancellation, digit forward, digit backward, recognition, and visual retention) to study the effects of yoga over the timespan of an academic year for 12 year old participants. Results showed improvement on most tests from the beginning to the end of the school year both for a group that regularly participated in yoga and a group that did not. However, the statistical analysis provided did not directly compare the control and experimental groups, stating only that the mean score of the experimental group was "slightly higher" than that of the controls. Similarly, Naveen, Nagarathna, Nagendra, and Telles (1997) found that uninostril breathing as part of a yoga technique increased spatial memory scores by 84%, but did not cause an increase in verbal memory scores.

As indicated by the research cited, the effects of yoga on memory and attentional capacity are inconclusive at best. Many researchers combined traditional yoga poses with meditation or other forms of exercise; some did not directly compare experimental groups with control groups; and in some instances, control groups did not exist. Lastly, much of the existing yoga research is centered geographically in a region known for its belief in the physical, mental, and spiritual benefits of yoga. This fact may introduce a bias on the part of the investigators or participants.

The ability to select and process relevant information quickly is essential for the performance of almost every sport skill, and the use of short-term memory is paramount as well. For example, the act of a quarterback throwing a football to a wide receiver involves many decisions that must be made in just a few seconds (e.g. whether to stay in place or move to avoid being tackled, which receiver to use, whether to throw the ball to the hands or above the receiver's head, and the multiple decisions related to the exact execution of the throw itself). Every time the quarterback throws a ball, more information is gathered to be stored in long-term memory. That information, of course, when needed to execute a movement in a game situation, is made available by retrieving it into short-term memory. However, the use of short-term memory itself is required for many movement skills. Learning to perform a dance routine or any sequence of movements requires extensive use of short-term memory. The ability to hold information in "working memory" enables us to learn both physical and cognitive information.

Without memory, intentional skillful movement would not be possible. However, the effectiveness of short-term memory processes (such as rehearsal and encoding) is often decayed in sport situations due to high arousal and anxiety. Many athletes attempt to combat variations in arousal by engaging in relaxation techniques including visualization, relaxation, meditation, and specific forms of breathing. The purpose of this study was to examine directly the relationship

between the practice of three inverted yoga positions and short-term verbal memory by using a Solomon Four design with a large number of participants.

Method

Participants

Participants were 300 (156 female, 144 male) volunteer college students from one Texas university (*M* age = 22.95, *SD* =5.28). None reported health problems or any physical limitations. No participants had prior experience with yoga. Participation in the study was voluntary, and the protocol was approved by the appropriate Institutional Review Board.

Experimental Design

Participants were randomly divided into 4 groups using a Solomon 4 Design. The four groups were as follows: yoga post-test only (Y1), yoga pre-test and post-test (Y2), control post-test only (C1), and control pre-test and post-test (C2).

Procedures

For the Y1 and Y2 groups, the yoga intervention was provided by a group fitness instructor trained to lead a series of three inverted positions. All participants were led through a series of three inverted yoga positions, with at least 5 slow breaths in each position.

Participants were led through the positions using the following script.

[Open-Legged Forward Bend]
1. Stand tall with your feet about three feet apart. Pivot on the balls of your feet to turn your heels out slightly. Imagine you are squeezing a beach ball between your thighs throughout this pose; this will help you keep your balance. Lift your chest toward the ceiling and inhale.
2. Exhale as you slowly bend forward from your hips with a flat back until you can touch the floor with the palms of your hands, keeping them shoulder-width apart, as pictured. You may need to stack books on the floor in front of you and rest your hands on them. Inhale and lengthen your spine.
3. Exhale and lower your torso toward your knees. Look at the wall behind you. Bend your elbows to point toward that wall. If you're very flexible, you may be able to move your hands in line with your toes, and your head may touch the floor, as pictured. Otherwise, let your torso and head hang loosely. Press your shoulders away from your ears. Hold for 5 deep breaths.
4. To release, put your hands on your hips, press down into your feet, and maintain a flat back as you return to the standing position. Step your feet together and pause for several breaths.

[Threading the Needle]
1. Start in Table pose, with your hands directly under your shoulders and your

knees directly under your hips.
2. Slide your left hand forward a few inches along the floor. Lift your right hand and turn it over so your palm faces up, and turn your fingertips to point to the left.
3. Imagine that your right arm is the thread: Slide your right arm along the floor as far as you can through the needle, the space between your left hand and left knee. Lower your right ear and shoulder to the floor, as pictured. If this is too difficult, instead lower your right forearm to the floor and turn your head to look over your left shoulder. Take 5 deep breaths. Release any tension in the muscles you aren't using, especially your facial muscles.
4. If you want a more advanced stretch, lift your left arm straight overhead. Turn your head to the left to look up at it. Lower your left hand to the floor.
5. To release, press down into your left hand as you lift with your abdominal muscles to return to Table pose. Repeat steps 2 to 4 on the opposite side.

[Child's Pose]
Sit the hips back into the heels and extend the arms forward. Rest the forehead onto the floor. Relax the neck, face and shoulders. Keep the arms stretched and the fingers spread. Take 10 to 15 deep, slow breaths.

During the positions, the instructor monitored participants for correct posture and made verbal and visual corrections as necessary. All participants completed the positions and breathing without complication, as instructed. No participants complained of any pain or discomfort during or after participation in the yoga sequence.

The pre-tests and post-tests consisted of a memory span test. After the yoga intervention, the participants heard a list of 14 words read aloud by the investigator at a rate of one word per second. At the end of the list, participants wrote down as many of the words as they could recall, in any order (within one minute). Participants were led through the memory span test using the following script.

I am going to read aloud a list of words. When I get to the end of the list, I will say "write them down." At that time, please write down as many of the words as you can remember. You do not have to write them down in the order they were read.

The Y1 group participated in the yoga intervention and memory span test one time. The Y2 group participated two times, one week apart. The C1 and C2 groups received the memory span test alone once and twice (separated by one week) respectively. Different lists were used for the pre and post-test for the Y2 and C2 groups. Three lists (A, B, and C) were counterbalanced between groups to ensure that the lists were similar in difficulty.

An advantage of the Solomon Four design is the ability to assess for a testing threat (the pretest) as well as a treatment effect (yoga) (Trochim, 2005). The Solomon Four design is designed to deal with a potential testing threat (when the act of taking a test affects how people score on a retest or posttest). Two of the four groups receive a treatment and two do not. Further, two of the groups receive a pretest and two do not. One way to view this is as a 2x2 (Treatment Group X Measurement Group) factorial design. Within each treatment condition we have a group that is pretested and one that is not. By explicitly including testing as a factor in the design, we are able to assess experimentally whether a testing threat is operating (Trochim, 2005). A 2 x 2 factorial ANOVA was conducted to evaluate the effect of the testing and treatment.

Results

A Solomon Four design was utilized to assess the effect of yoga on memory. There was no statistically significant interaction between testing and treatment, $F(1, 296) = .81$, $p > .05$. There was also no significant difference between control group and experimental group, $F(1, 296) = .16$, $p > .05$. Effect size was very small, $d = .07$, indicating a small degree of practical significance. A testing effect was evident, $F(1, 296) = 7.79$, $p < .05$. Effect size was approaching the moderate range, $d = .46$, indicative of a testing effect nearly one-half of a standard deviation unit. Table 3 displays descriptive statistics. Figure 4 is a graphical display of the results, indicative of a testing effect with no significant differences between the treatment and control groups.

Discussion

In this study, the practice of inverted yoga positions did not enhance short-term memory performance. Any improvement appears to be the result of being exposed to the pretest rather than the participation in yoga.

The strength of this study, compared to previous studies, relies on a strong design with the ability to assess change in memory scores as well as evaluate the effect of the pretest. Another strength of this study is the number of participants and the age group utilized. Previous studies with children, individuals already practicing yoga, and mentally retarded individuals may have inadvertently introduced uncontrollable variables. In addition, this study introduced only one treatment (three inverted yoga positions) instead of a number of variables (e. g. breathing techniques, meditation, yoga psoes, etc) which may have confounded results in previous studies. In short, yoga made no difference in short-term verbal memory. However, this does not conclude the debate on the benefits of yoga.

One limitation of this study is the fact that it is indeed a short-term study and does not measure the effects of participation in yoga on a long-term basis. A common belief in sport psychology is that if a relaxation or focusing technique works for the athlete, he/she should use it. This study certainly does not address that suggestion, but instead, attempts to answer a very specific question:

Does the practice of three inverted yoga positions have an effect on short-term verbal memory?

Future directions

Yoga may provide benefits to some individuals because they believe it is providing a benefit. This is a fairly common phenomenon in sport performance. LeUnes and Nation (2002) acknowledge procedures such as yoga, zen, and meditation as potential methods for increasing relaxation by excluding distracting images from consciousness. By restricting the range of mental activity (and hopefully increasing the ability to attend to relevant stimuli while ignoring irrelevant stimuli), performance in any psychomotor activity should be enhanced, with a more pronounced effect for those activities with more cognitive components. However, it is nearly impossible to determine if changes in performance are due to the practice of such relaxation procedures or to other factors, such as physical practice, improved technique, or improved efficiency of movement, to name a few.

While many questions remain to be answered about the potential of yoga as a means for increasing concentration, attention, and memory in athletic performance, it does appear that inverted yoga poses do not impact verbal short-term memory for individuals not practiced in yoga. It is hoped that this study begins to shed some light on the benefits that practicing yoga does and does not provide. Further research should be conducted to examine the following issues: the effects of other types of exercise on short-term memory, the effects of yoga practice on short-term memory for individuals who practice yoga on a regular basis, and the effects of yoga on short-term memory for individuals involved in sport-related memory tests (for example, memorizing positions of players on a field or court). To bridge the gap between research and practice for mental interventions such as yoga is challenging, but the need for more quality research is necessary and exciting, as the potential for performance enhancement through non-physical training has never been more promising.

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