The Corinthian

Volume 18 Article 3

2017

Effects of Yoga on Perceived Stress Level and Cognitive Ability in College-Aged Females

Rachel V. Taylor
Georgia College and State University

Faith Flanders
Georgia College and State University

Allison Esposito
Georgia College and State University

Delaney Lister
Georgia College and State University

Lauren Williams
Georgia College and State University

Effects of Yoga on Perceived Stress Level and Cognitive Ability in College-Aged Females

Allison Esposito, Faith Flanders, Delaney Lister, Rachel V. Taylor, & Lauren Williams

Dr. Emily Simonavice
Faculty Mentor

INTRODUCTION

Yoga is an ancient Indian practice that has been utilized in various ways, for various reasons, among many groups of people for centuries (Tran, Holly, Lashbrook, & Amsterdam, 2001). Through breath-control exercises, postures, and meditation, yoga teaches participants to quiet the mind and concentrate (Tran, Holly, Lashbrook, & Amsterdam, 2001). These concepts of relaxing the mind are crucial to cognitive health but are often neglected or compromised when subjected to consistent, long term stress (Tennant, 2002). An example of long-term stress experienced by vast groups of people is the stress associated with being a college student, particularly a female college student. One can imagine the stress that these students are under to meet these "intensive" expectations, but Darling says it best when stating, "…female college students experience greater stress from quality of friendships, love relationships and relationships with parents [than their male classmates]" (Darling, McWey, Howard, & Olmstead, 2007). Females balance the stress of intensive scholastic obligations as well as the stress of daily tolls. Stress can have a negative effect on cognitive abilities, leaving a female student susceptible to poor performance in school (Tennant, 2002). College students often seek external help to aid in their abilities to sort through stress. One specific type of yoga is advertised as 'Restorative Yoga,' with the intention of helping the participants "decompress after a stressful day." These classes offer the benefit of the connection between the mind, body, and spirit through the healing power of yoga. Some yoga studios even tout

that life-changing yoga will give you the peace of mind you've been looking for. The practice of yoga has several proposed benefits, with stress-relief being one of the most prominent.

The significant possibility that yoga can be a restorative mechanism that facilitates stress release and improves skills related to concentration should not be overlooked as a potential activity to promote cognitive wellness. There is overwhelming evidence suggesting that an inverse relationship between life stress and cognitive ability exists due to the presence of intrusive thoughts, which can be defined as any distinct, identifiable cognitive event that is unwanted, unintended, and recurrent (Shipherd & Fordiani, 2015). Worrying about grades in school, worrying about the well-being of loved ones, or having fears that do not make rational sense but persist in one's mind are all examples of this type of cognitive disruption. Intrusive thoughts after some stressor are more likely to occur in individuals with weak inhibitory control and are often present in those who experience anxiety. An impaired ability to avoid intrusive thoughts may play a role in increased stress levels (Verwoerd & Wessel, 2007). Furthermore, psychological health issues, including impaired cognitive ability, may arise as a result of being subjected to consistent, long-term stress (Tennant, 2002). Stress can also have a detrimental effect on everyday cognitive function. Higher stress levels, measured via the Perceived Stress Survey (PSS), were found to be directly related to an increased number of everyday cognitive failures (Boals & Banks, 2012). However, it is suggested that the implementation of yoga in one's daily life may be a possible stress reduction method and may help to improve cognitive ability as it relates to school, daily activities, and life at home (Villate, 2015). While it is widely agreed that stress impedes cognitive ability, the relationship between perceived stress and response inhibition has not been given substantial attention. It is important to more clearly elucidate the effects that yoga can have on individuals' stress levels and cognitive performance, especially in female college students. In addition to stress reduction, the proposed effects of yoga on response inhibition also warrant discussion. Response inhibition, the cognitive component that is assessed via the Stroop Effect test (Stroop, 1935), refers to the suppression of actions that are inappro-

priate in a given context and that interfere with goal-driven behavior (Mostofsky & Simmonds, 2008). Effective control of response inhibition is suspected to be strongly correlated with satisfactory performance on the Stroop Effect test. The cognitive mechanism behind response inhibition is called directed attention. This can become fatigued when it is under constant demand or stress and can decrease mental effectiveness (De Young, 2014). However, meditation, which is a large component of yoga, appears to reduce directed attention fatigue (Kaplan, 2001). Meditation has also been found to stimulate a physiological relaxation response as well as play a role in improved reaction time scores on the Stroop Effect test. Intelligence Quotients (IQ) and scores for cognitive functions have shown significant improvement while stress levels have decreased in response to meditation in past studies (Singh, Sharma, & Talwar, 2012). Given the positive results that have been reported regarding yoga, meditation, and cognitive abilities, it can be suspected that these results may benefit college females with their higher perceived stress levels. Therefore, the purpose of the present study was to determine if perceived stress level and response inhibition scores differ in female college students who regularly participate in yoga compared to female college students who do not. It was expected that more yoga experience would have a positive effect on response inhibition and a lower perceived stress level score in female college students.

METHODS

Overview of Study:

College-aged females ranging from 19 to 24 years of age were recruited to participate in this study. Subjects filled out a personal information sheet followed by a perceived stress level questionnaire to measure the amount of yoga each participant performed and to assess their perceived stress level, respectively. Once these documents were complete, participants were then asked to relax in a seated, quiet position for five minutes. Subjects then completed a computerized Stroop Effect test, which was composed of three modules that measured each individual's cognitive ability. The research project implemented a cross-sectional design, with the in-

dependent variable being past yoga experience (no previous experience and regular yoga participation) and the dependent variables being perceived stress level and response inhibition (speed and accuracy) score of the Stroop Effect test (Bayard, Erkes, & Moroni, 2011).

Subjects:

Participants were recruited through approved flyers posted around local venues. The project enlisted the participation of 30 college-aged females (19-24 years old), with an average (±SD) age of 20.9 ± 0.89 years. To be eligible for the study, females had to be enrolled in college or university during the duration of the study. Females with all spectrums of yoga experience (advanced to novice yogis) were welcomed. Males who inquired about participating in the study were the only individuals who were denied participation due to predetermined acceptance criteria.

Procedures and Data Collection:

Interested, eligible individuals were sent an email with pre-test instructions prior to their data collection appointment. Participants were asked to get at least six to eight hours of sleep the night before their appointment and refrain from caffeine consumption four hours prior to their appointment time; the testing location was also included. Upon arrival, each subject completed an informed consent document and were assigned an identification code to ensure confidentiality during the data collection portion of the study. All procedures were approved by the Georgia College Institutional Review Board. After completion of the informed consent document, participants were asked to complete two additional forms: 1) information sheet (age, yoga experience, medication usage for concentration disorders, etc.) and 2) perceived stress level survey. After completing these documents, participants were instructed to sit quietly, wearing noise cancelling headphones, with no distractions for five minutes to become acquainted with their surroundings. After five minutes of rest, the participant began the computerized Stroop Effect test. Participants were instructed to read all directions carefully and were given a vague description

of the contents of the test. Once the researcher exited the room, the participant completed the three modules of the computerized Stroop Effect test, each becoming progressively more difficult to complete. The first module included colored squares that appeared on the screen; the participant then selected the correct color of the square using the number keys 1, 2, 3, or 4 on the keyboard. The second module was a sequence of words written in the same color ink that the color word was written in. The participant was asked to select the correct color based on what the word read using the number keys 1, 2, 3, or 4 on the keyboard. The final module was a sequence of words written in different colors than what they read (i.e. the word "blue" written in red ink). The participant selected the color they read via the number keys 1, 2, 3, or 4 and not the color in which the word was written. After the completion of the Stroop Effect test, the participant was thanked for their time and participation and was dismissed.

Statistical Analysis:

All the data collected were analyzed using the Statistical Package for the Social Sciences software version 22.0. An independent t-test was conducted to determine if there was a difference between novice and advanced yogis as it relates to perceived stress levels and response inhibition scores (with both speed and accuracy taken into consideration) on the Stroop Effect test. For all analyses, the alpha level was set at $p<0.05$.

RESULTS

A total of 30 females volunteered to participate in the study (n=30). Of these subjects, 40% were advanced yogis (n=12) and 60% were novice yogis (n=18). The average (±SD) age in years of the participants was 20.9 ± 0.89. Males who inquired about participating in our study were the only individuals that were denied participation due to predetermined acceptance criteria. All 30 participants completed the study in its entirety and were used for all data analyses.

No results for average reaction time or percent accuracy

were found to be significant between advanced yogis and novice yogis. An independent t-test revealed novice yogis achieved an average (±SD) reaction time in milliseconds of 767.58 ± 123.36ms, 741.61 ± 117.61ms, and 865.43 ± 159.48ms in block one, two, and three, respectively. Advanced yogis achieved an average (±SD) reaction time in milliseconds of 765.74 ± 74.96, 700.49 ± 53.34, and 847.70 ± 95.85 in block one, two, and three, respectively. See **Figure 1** for a visual depiction of the results between average reaction time for the two groups tested. The independent t-test also revealed that novice yogis had an average (±SD) percent accuracy score of 97.73 ± 2.19%, 98.33 ± 1.14%, and 96.85 ± 2.15% for block one, two, and three, respectively. Advanced yogis had an average (±SD) percent accuracy score of 97.99 ± 1.53, 97.57 ± 1.68, and 96.46 ± 2.14 for block one, two, and three, respectively. See **Figure 2** for a report on average percent accuracy regarding advanced and novice yogis.

The difference between average perceived stress scores (PSS) in advanced versus novice yogis was found to contain no significance ($p \leq 0.06$). The average (±SD) PSS for novice yogis was 17.28 ± 4.20 while that for advanced yogis was 21.59 ± 7.96. See **Figure 3** for a visual depiction of PSS in advanced versus novice yogis.

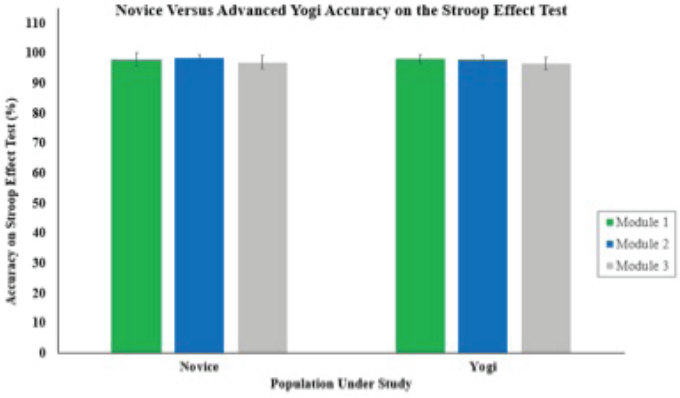

Figure 1: Novice vs. Yogi Average Accuracy (%) on the Stroop Effect Test* (N=30)
*Stroop Effect Test consists of three modules, each getting progressively more difficult. Scores ranged from 0%-100%.

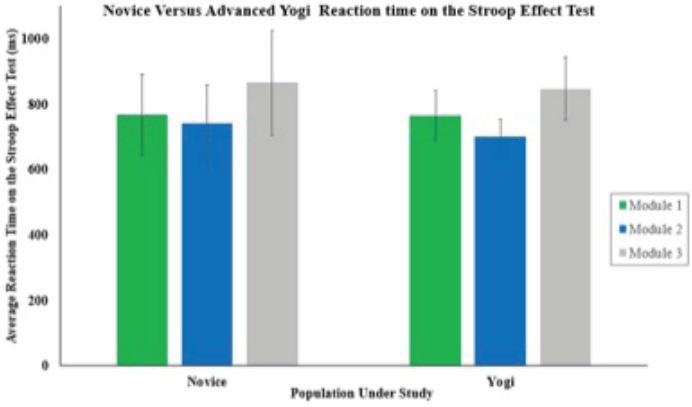

Figure 2: Novice vs. Yogi Average Reaction Time* (N=30)
*Stroop Effect Test consists of three modules, each getting progressively more difficult. Scores ranged from 0%-100%.

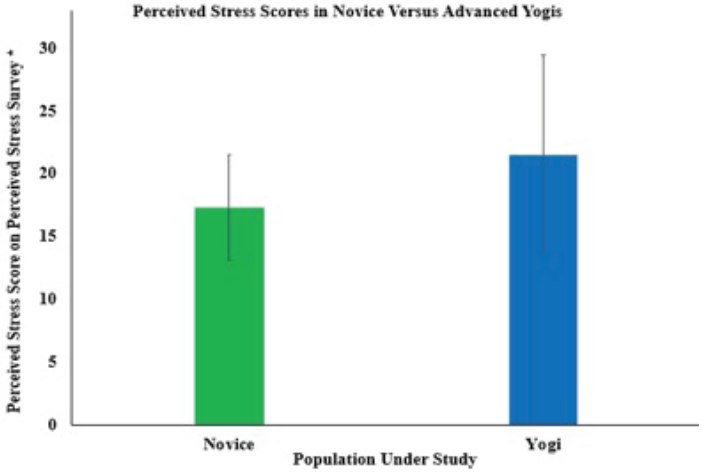

Figure 3: Novice vs. Yogi Perceived Stress Scores* (N=30)
* Perceived stress scores were calculated out of the highest number that could be recorded, 40. The higher the score, the more stressed an individual perceived to be.

DISCUSSION

The purpose of this study was to determine if there was a difference in perceived stress scores as well as response time and accuracy on a Stroop Effect test between female college students that regularly participate in yoga (advanced yogis) and those that do not (novice yogis). It was hypothesized that advanced yogis would have faster reaction times and greater accuracy on the Stroop Effect test, while also having lower perceived stress scores. Data collection and analysis resulted in failure to reject the null hypotheses. No significant difference was found between the two different groups that were tested. Thus, it was concluded that yoga experience does not directly affect an individual's perceived stress level nor does it make an individual's response inhibition quicker or more accurate.

There was no significant difference found between the advanced yogis and novice yogis in terms of reaction time and percent accuracy of the Stroop Effect test. Furthermore, the difference found in the overall stress scores between groups was not found to be significant. These findings vary from the study conducted by Singh, Sharma, and Telwar (2012) who found a significant difference using the Stroop Effect test when analyzing long and short-term effects of meditation on 34 male college students. Regarding the short-term effects, there was an improvement in the psychological relaxation response and Stroop Effect test scores when analyzing reaction times. When looking at the long-term effects of meditation there was a significant improvement in IQ and scores regarding cognitive function along with a decrease in participants' stress levels. One difference in Singh et al. and the present study was the inclusion of the sex of the participants. Singh et al. only granted male volunteers participation while the present study granted only female volunteers participation. Furthermore, the procedures in the Singh et al. study differed from the present study. Singh et al. had each participant perform meditation for a month to retrieve their results, whereas the current study was an acute study, based on one group of female college students who participated in yoga regularly and one group who did not. These differences may be a few of the reasons the results varied between the current study and the study

that investigated immediate and long-term effects of meditation on acute stress reactivity, cognitive functions, and intelligence.
There were a few limitations in the study that may have hindered the attainment of statistically significant results. Most of the subjects that were tested were exercise science students, or students involved in health sciences (20 out of the 30 participants). Because health science students made up most of the subject population, unintended comparisons may have been made. What came to fruition was the unintended comparison of students who exercise frequently (but may not be practiced in yoga) with students who may not exercise frequently (but are practiced in yoga). Yoga is described as having a "combined set of principles and exercises that can greatly benefit you and help you to deal with stress" (Deekshitulu, 2012). These combined sets of principles and exercises, however, include breathing exercises, stretching exercises, a fitness program, and meditation practice. Just because yoga contains these elements, does not mean these elements are not included in alternative forms of exercise as well. In short, advanced yogis who do not participate in other modes of frequent exercise should have been compared to both populations who are novice yogis and do participate in frequent exercise and who do not participate in frequent exercise. This would have allowed the researchers to determine if it was yoga that was manipulating the perceived stress scores and cognitive abilities, or if it was the exposure to frequent exercise in general that was affecting perceived stress scores and cognitive abilities.

Because the subjects were mostly exercise science or health science majors (20 total participants), it was assumed that they were exposed to exercise more than the average individual. To properly expand the diversity of the subject population, a broader variety of the student populations should have been reached and asked to participate in the study. In future studies, it would be beneficial to have participants from a variety of academic majors chosen for the study. Future studies should rid bias by broadcasting equal representation throughout the entire subject population (the university). Another limitation to the study may have been the test timing during the day. Every subject had a different time denoted to her

describing when she could participate in the study. To maintain consistency, there should have been a strict morning, afternoon, or night-time testing period. This should be implemented in future studies so that a person who feels less stressed in the morning can be tested in the morning before day time stressors could impact the patient. There are other outside influences that could alter stress levels. Because the tests were administered to students, it is important to know the timeline in which this testing period took place. Many individuals were amidst midterms or final projects. Testing stress levels at the end of a college semester could sway results because higher work-loads in school could influence how a student perceives their stress levels. For example, a participant arrived to the present study and claimed that she had just taken a biology test. Factors such as these should be noted as limiting the best possible results for individual testing subjects.

CONCLUSION

This study showed no significant difference between advanced yogis and novice yogis in terms of accuracy scores and reaction times via the computerized Stroop Effect test. The scores relating to perceived stress level scores in advanced yogis and novice yogis were deemed insignificant ($p=0.06$). A novice yogi's athleticism, sample population size, sample population academic involvement, and daily environmental stressors could have altered the results and/or could have been unanswered questions that the test administrators did not include in the study itself. This was, and will continue to be, a multi-dimensional topic; something that future studies should be prepared to address when conducting further research.

REFERENCES

Boals, A., & Banks, J. B. (2012). Effects of traumatic stress and perceived stress on everyday cognitive functioning. *Cognition & Emotion, 26*(7), 1335-1343. doi:10.1080/02699931.2011.651100

Darling, A., McWey, L.M., Howard, S.N., Olmstead, S.B. (2007). College student stress: The influence of interpersonal relationships on sense of coherence. *Stress and health, 23*, 215-229.

De Young, R. (2014). Using the stroop effect to test our capacity to direct attention: A tool for navigating urgent transitions. *Localization Papers*. Retrieved from http://www.snre.umich.edu/eplab/demos/st0/stroopdesc.html

Deekshitulu, B. (2012). Stress and yoga. *Yoga & Physical Therapy, 2*(2), 1-4. Doi:10.4172/2157-7595.1000109

Harmony Hot Yoga (2015). Welcome to Harmony Hot Yoga and Aerial Center. Retrieved from http://www.harmonyhotyoga.com/voted-best-yoga-studio-2016

Kaplan, S. (2001). Meditation, restoration, and the management of mental fatigue. *Environment & Behavior, 33*(4), 480.

Mostofsky, S. H., & Simmonds, D. J. (2008). Response inhibition and response selection: Two sides of the same coin. *Journal of Cognitive Neuroscience, 20*(5), 751

Shipherd, J. C., & Fordiani, J. M. (2015). The application of mindfulness in coping with intrusive thoughts. *Cognitive and Behavioral Practice, 22*, 439-446. doi:10.1016/j.cbpra.2014.06.001

Singh, Y., Sharma, R., & Telwar, A. (2012). Immediate and long-term effects of meditation on acute stress reactivity, cognitive functions, and intelligence. *Alternate Therapies in Health & Medicine, 18*(6), 46-53.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*(6), 643.

Tennant, C. (2002). Life events, stress and depression: a review of recent findings. *The Australian and New Zealand Journal of Psychiatry, 36*(2), 173-182.

Tran, M.D., Holly, R.G., Lashbrook, J., Amsterdam, E.A. (2001). Effects of yoga practice on the health-related aspects of physical fitness. *Official Journal of the American Society for Preventive Cardiology. 4*, 165-170.

Verwoerd, J., & Wessel, I. (2007). Distractibility and individual differences in the experience of involuntary memories. *Personality and Individual Differences, 42*, 325-334.doi:10.1016/j.paid.2006.07.014

Villate, V. M. (2015). Yoga for college students: An empowering form of movement and connection. *Physical Educator, 72*(1), 44-66.