Effects of Yoga Based Practices on Sustained Attention

Yoga based practices (YBP) are a broad set of exercises that focus on movement, balance, and breathing techniques. Although various forms of yoga have been practiced for centuries, only in recent decades has there been a scientific interest in their beneficial outcomes. An increasing number of studies find a relationship between YBP and physiological, neural, and behavioral measures (Gard, Noggle, Park, Vago, & Wilson, 2014). Pre-post studies have shown that individuals who participate in YBP experience benefits such as stress reduction (Rocha, et al., 2012), improved executive functioning (Gard, Taquet, et al., 2014) and other various biological factors (Gard, Noggle, et al., 2014). These benefits, combined with the relatively low cost of YBP, suggest that yoga-based interventions have considerable potential to improve many aspects of both physical and mental health. However, for such improvements to be realized, we need more empirical studies to identify the specific benefits individuals can expect to experience from participating in different types of YBP.

Several populations are especially prone to participate in YBP interventions because of its beneficial effects. Specific populations that have been shown to experience benefits from participating in YBP include military veterans with chronic low-back pain (Groessl, 2008), low income older adults (Groessl, Schmalzl, Mazzi, & Iszak, 2013) and healthy middle-aged adults (Rocha et al., 2012). It is estimated that close to 15 million American adults participate in YBP on a regular schedule and indicate positive experiences with their practice (Saper, Eisenberg, Davis, Culpepper, & Phillips, 2004). As the popularity of YBP in adult populations grows, the need for scientific research expands as well.

College students are a unique population in which to measure outcomes associated with YBP. Incoming students often experience hardships during their transition from high school

success to the expectations of university learning (Cohen & Sherman, 2014; Yeager, et al., 2016). One specific challenge is a tendency for attention in classes to decline over time; this decline in attention produces negative academic consequences and may be an early indicator of dropout from college (Eastwood, Frischen, Frackowiak, & Grasby, 2012; Xu, 2016). Thus, interventions to improve sustained attention may help college students to avoid both short-term and long-term negative outcomes.

In cognitive psychology, sustained attention is defined as the ability to remain concentrated on repetitive tasks for extended periods of time (Manly, Galloway & Hawkins, 1999). These repetitive tasks are closely tied to the ability to perform well as a student in a university setting (Wei, Wang, & Klausner, 2012). The cognitive processes associated with sustained attention are important for learning in the classroom and are essential for self-regulation of academic tasks (Zimmerman, 2001).

Yoga based interventions may have the potential to help college students improve their sustained attention abilities. Some past research in adult populations has found that YBP improves sustained attention (Schmalzl, et al., 2018; Vineetha, et al., 2018), but other studies have found no effect (MacCoon, MacLean, Davidson, Saron, & Lutz, 2014). It is possible that specific features of YBP, rather than YBP in general, are beneficial for sustained attention. Schmalzl and colleagues found that a YBP intervention that emphasized breathing increased sustained attention more than a YBP intervention that emphasized movement. However, one limitation of this study is that it lacked a control group. The lack of a control group makes it difficult to infer whether the YBP intervention was the cause of the improvement.

Another important aspect of many YBP interventions is mindfulness meditation (Boccio, 2004). Mindfulness involves paying attention to the current moment without judgement

(Academic Mindfulness Interest Group, 2006). A substantial body of research supports a link between mindfulness meditation practices and sustained attention (e.g., Schmertz, Anderson & Robins, 2009; Valentine & Sweet, 1999). To create effective yoga-based interventions, it is important to evaluate the role of mindfulness as distinct from other components of YBP.

In the present study, we seek to understand how specific components of YBP and mindfulness relate to sustained attention among college students in a randomized controlled trial. Additionally, because YBP and mindfulness are both related to conscientiousness, it is necessary to measure this personality trait when investigating the effects of YBP and mindfulness (Thompson & Waltz, 2007).

Method

Participants

We recruited participants from a large state university. To be eligible for the study, we required that participants be over the age of 18, have never participated in YBP or mindfulness meditation, have no chronic health conditions, and be enrolled full time at the university. Participants received information about the study via campus flyers and announcements in classrooms, approved by the university's Institutional Review Board. We offered a $20.00 incentive to college students who completed the entirety of the study.

Materials

One trained yoga and mindfulness instructor conducted all of the YBP and mindfulness meditation sessions, to prevent differences in instructor style or ability. All sessions were conducted in the university's fitness center, which was centrally located on campus. In the breath-focused intervention, the instructor led a variety of yoga breathing exercises for which participants remained still. In the movement-focused intervention, the instructor guided

participants through a series of movements but did not explicitly mention breath. Each session lasted 30 minutes; participants completed one session per week for 8 weeks.

The same instructor also led the mindfulness lessons. Each mindfulness lesson lasted 30 minutes and consisted of a five-minute presentation about principles of mindfulness (a different principle for each lesson) and 25 minutes of guided mindful meditation. Participants assigned to the mindfulness intervention conditions completed one session per week for 8 weeks.

Measures

Sustained attention. We measured sustained attention using the Response Inhibition Task (RIT; MacLean et al., 2010). The RIT is a widely used measure of sustained attention; it requires individuals to discriminate the lengths of visually presented lines. These visually presented lines are known as the "target". The target is visually represented for less than a second on the screen and participants are told to left click the computer mouse when they see the target. The task is 30 minutes in length and measures the percentage of trials in which individuals correctly left click when the line is presented. Additionally, participants get a lower score for false clicks (when the participant clicks the mouse even when no target was presented). Higher scores indicate better sustained attention. All participants sat with their heads exactly one foot from the computer to minimize any possible effects associated with closeness to the screen. If participants normally wore corrective lenses, we asked them to wear them for the trials to ensure they had the best visibility to see the targets.

Conscientiousness. To assess participants' levels of conscientiousness, we used a measure from the International Personality Item Pool (Goldberg, 1999). This measure is based on Goldberg's (1992) study of the markers of the Big Five personality characteristics. It consists of 10 statements (e.g., "I… am always prepared.") and participants indicate the degree to which

each statement escribes them on a scale from 1 = “not at all true of me” to 7 = “very true of me.” According to previous research, the scale has good internal consistency reliability ($\alpha = .79$) and shows acceptable convergence with other measures (Goldberg, 1999).

Procedures

After we established that participants met the eligibility criteria, we explained the requirements of the study and obtained their written informed consent to participate. Participants then completed a questionnaire about their demographic information and a personality measure. After participants completed the questionnaire, they completed the RIT mentioned in the *Materials* section as a baseline measure.

We then randomly assigned participants to either an 8-week movement based YBP intervention, an 8-week breath focused YBP intervention, or a waitlisted control group. Those in the waitlisted control group had the opportunity to participate in the YBP intervention of their choice at the end of the 8-week study period; we obtained a commitment from each of them to avoid beginning any form of YBP during those first 8 weeks. Additionally, within each intervention condition and the waitlist control group, we randomly assigned participants to receive weekly mindfulness lessons or no mindfulness lessons.

Participants in the waitlisted control group who were not assigned to the mindfulness lessons received information about returning for a follow-up assessment in 8 weeks. Participants in the waitlisted control group who were assigned to the mindfulness lessons attended one 30-minute training session each week for 8 weeks; participants in all other conditions attended one 30-minute mindfulness and one YBP session each week for 8 weeks. Participants received regular reminders about their scheduled sessions via text message, and there were multiple

sessions of each type offered each week, so that participants who missed a session could make it up.

At the end of the 8-week intervention all participants returned to the testing center to retake the RIT. We then calculated the difference between their pre- and post-intervention scores to indicate improvement (or lack thereof). We provided participants with their compensation, explained the goals of the study, and instructed those who had been in the waitlisted control group about how they could take advantage of the YBP interventions if they wished.

References

Academic Mindfulness Interest Group. (2006). Mindfulness-based psychotherapies: A review of conceptual foundations, empirical evidence and practical considerations. *Australian and New Zealand Journal of Psychiatry, 40*(4), 285-294.

Boccio, F. J. (2004). *Mindfulness yoga.* Boston, MA: Wisdom.

Cohen, G. L., & Sherman, D. K. (2014). The psychology of change: Self-affirmation and social psychological intervention. *Annual Review of Psychology, 65,* 333-371.

Coull, J. T., Frith, C. D., Frackowiak, R. S. J., & Grasby, P. M. (1996). A fronto-parietal network for rapid visual information processing: a PET study of sustained attention and working memory. *Neuropsychologia, 34*(11), 1085-1095.

Eastwood, J. D., Frischen, A., Fenske, M. J., & Smilek, D. (2012). The unengaged mind: Defining boredom in terms of attention. *Perspectives on Psychological Science, 7*(5), 482-495.

Wei, F.-Y. F, Wang, Y. K., & Klausner, M. (2012) Rethinking college students' self-regulation and sustained attention: Does text messaging during class influence cognitive learning? *Communication Education,*61(3), 185-204.

Gard, T., Noggle, J. J., Park, C. L., Vago, D. R., & Wilson, A. (2014). Potential self-regulatory mechanisms of yoga for psychological health. *Frontiers in Human Neuroscience, 8*, 770.

Gard, T., Taquet, M., Dixit, R., Hölzel, B. K., de Montjoye, Y. A., Brach, N., ... & Lazar, S. W. (2014). Fluid intelligence and brain functional organization in aging yoga and meditation practitioners. *Frontiers in Aging Neuroscience, 6,* 76.

Goldberg, L. R. (1992). The development of markers for the Big-Five factor structure. *Psychological Assessment, 4,* 26-42.

Goldberg, L. R. (1999). A broad-bandwidth, public domain, personality inventory measuring the lower-level facets of several five-factor models. In I. Mervielde, I. Deary, F. De Fruyt, & F. Ostendorf (Eds.), *Personality Psychology in Europe,* Vol. 7 (pp. 7-28). Tilburg, The Netherlands: Tilburg University Press.

Groessl, E. J., Schmalzl, L., Mazzi, M., & Iszak, F. (2013). Yoga for low-income older adults: Silver age yoga. *Journal of Yoga & Physical Therapy*, *3*(1), 1.

Groessl, E. J., Weingart, K. R., Aschbacher, K., Pada, L., & Baxi, S. (2008). Yoga for veterans with chronic low-back pain. *The Journal of Alternative and Complementary Medicine*, *14*(9), 1123-1129.

MacCoon, D. G., MacLean, K. A., Davidson, R. J., Saron, C. D., & Lutz, A. (2014). No sustained attention differences in a longitudinal randomized trial comparing mindfulness based stress reduction versus active control. *PloS One*, *9*(6), e97551.

MacLean, K. A., Ferrer, E., Aichele, S. R., Bridwell, D. A., Zanesco, A. P., Jacobs, T. L., ... & Wallace, B. A. (2010). Intensive meditation training improves perceptual discrimination and sustained attention. *Psychological Science*, *21*(6), 829-839.

Manly, T., Robertson, I. H., Galloway, M., & Hawkins, K. (1999). The absent mind: Further investigations of sustained attention to response. *Neuropsychologia*, *37*(6), 661-670.

Rocha, K. K. F., Ribeiro, A. M., Rocha, K. C. F., Sousa, M. B. C., Albuquerque, F. S., Ribeiro, S., & Silva, R. H. (2012). Improvement in physiological and psychological parameters after 6 months of yoga practice. *Consciousness and Cognition*, *21*(2), 843-850.

Saper, H. B., Eisenberg, D. M., Davis, R. B., Culpepper, L., & Phillips, R. S. (2004). Prevalence and patterns of adult yoga use in the United States: results of a national survey. *Alternative Therapies in Health & Medicine*, *10*(2), 44-49.

Schmalzl, L., Powers, C., & Henje Blom, E. (2015). Neurophysiological and neurocognitive mechanisms underlying the effects of yoga-based practices: towards a comprehensive theoretical framework. *Frontiers in Human Neuroscience*, *9*, 235.

Schmalzl L, Powers C, Zanesco A, Yetz N, Groessl E, & Saron C (2018). The effect of movement-focused and breath-focused yoga practice on stress parameters and sustained attention: A randomized controlled pilot study. *Consciousness & Cognition, 65,* 109-125.

Schmertz, S. K., Anderson, P. L., & Robins, D. L. (2009). The relation between self-report mindfulness and performance on tasks of sustained attention. *Journal of Psychopathology and Behavioral Assessment*, *31*(1), 60-66.

Thompson, B. L., & Waltz, J. (2007). Everyday mindfulness and mindfulness meditation: Overlapping constructs or not? *Personality and Individual Differences*, *43*(7), 1875-1885.

Valentine, E. R., & Sweet, P. L. (1999). Meditation and attention: A comparison of the effects of concentrative and mindfulness meditation on sustained attention. *Mental Health, Religion & Culture*, *2*(1), 59-70.

Vineetha, V., Vinutha, S., Karthiyanee, K., Kumar, A., Nagendra, H. R., & Ganpat, T. S. (2018). Yoga therapy for sustained attention. *Archives of Medicine and Health Sciences*, *6*(1), 70.

Xu, Y. J. (2016). Attention to retention: Exploring and addressing the needs of college students in STEM majors. *Journal of Education and Training Studies*, *4*(2), 67-76.

Yeager, D. S., Romero, C., Paunesku, D., Hulleman, C. S., Schneider, B., Hinojosa, C., … Dweck, C. S. (2016). Using design thinking to improve psychological interventions: The case of the growth mindset during the transition to high school. *Journal of Educational Psychology*, *108*(3), 374–391.

Zimmerman, B. J. (2001). Theories of self-regulated learning and academic achievement: An overview and analysis. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives*, 1–37. Mahwah, NJ: Erlbaum.