A Correlational Study of Mindfulness and Cognitive Abilities in Young Adults

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Abstract

This research project explores the cognitive consequences of mindfulness practice in young adults. Our hypothesis states: *Mindfulness practice increases cognitive abilities and those who consistently practice mindfulness will score better on cognitive assessments.* We are taking a broad view of "cognitive consequences" to encompass effects on memory, attention, storage, and usage of knowledge. Cognitive processes encompass several interrelated components. Attention signifies the capacity to concentrate on a specific stimulus while filtering out distractions— a precursor to memory encoding. Within the realm of cognitive science, storage refers to an individual's cognitive limitations in working and long-term memory. What we consider to be mindfulness practices include meditation, journaling, yoga, therapy, breath work, and other creative outlets like drawing or singing. This connection is the subject of our examination.

By employing a correlational design study, we recruited 28 participants that fell between 18-25 years old. After the participants took the Stroop Effect Test and Number Memory Test online, we analyzed the findings through categorization of numbers of hours practiced and type of mindfulness practice. We found that participants who sporadically practice mindfulness had an average 7-second time difference between trials, whereas the participants who did not practice mindfulness had minimal time difference. Although our findings did not yield support for our hypothesis, they provided insights into interesting trends.

Purpose

Aims:

Our research delves into the multifaceted relationship between mindfulness practice and cognitive abilities in young adults. We aim to explore the impact of mindfulness on memory,

attention, storage, and knowledge utilization. We are taking mindfulness to be any one of a wide range of self reflection activities, including journaling, yoga, therapy, breath work, and other creative outlets such as drawing or singing. As long as you dedicate a chunk of time to yourself and your thoughts (free of outside distractions), we consider that mindfulness. The extent of how 'mindful' a participant is, is measured through their self reported hours of practice.

Specific Goals:

Our main goal is to measure mindfulness' impact on cognitive ability through the use of online cognitive assessments. One such assessment, the Stroop Test, reveals how individuals process information (further explanation can be found in the methods section). The other assessment we utilize is a number retention test which provides an understanding of the impact of mindfulness on both short-term and working memory.

Exploratory Implications:

The realm of our research extends beyond the listed specific goals to explore more far-reaching implications. Uncovering whether mind mindfulness may have broader applications beyond individual cognitive enhancement will help us decide its association in fields like education, psychology, and wellness.

Why this is important:

The significance of our research lies in its potential to shed light not only on general cognitive abilities, but also on the context of daily life. We take the position that mindfulness is an inherently positive practice. Even in the event that our study does not reveal a significant correlation between mindfulness and cognitive abilities, there are no adverse consequences to individuals dedicating time for self-reflection and mental well-being.

As our society becomes increasingly modern, we have grown increasingly distant from our intrinsic needs as humans, becoming enthralled with consumerism. Our findings may not only inform practical applications but also serve as the foundations for future theoretical applications for studies of our distinctly unique sentient species.

Background

Our hypothesis is supported by the academic literature we have listed below, providing insight into the benefits of mindfulness practice for cognitive abilities in young adults:

Examining the protective effects of mindfulness training on working memory capacity and affective experience (Jha et al., 2010) explains the benefits of mindfulness training in high-stress environments with a focus on the military. The study utilizes two groups within the military, one that utilized mindfulness training and one control group. The study found that the group who practiced mindfulness had higher results on working memory capacity showing significant cognitive benefits. The study could provide a more accurate measurement of working memory capacity by prolonging the experiment and by taking measurements throughout the study. This paper relates to our focus on college students who also operate in high-stress albeit academic environments. Since the findings of Jha's study showed decreased cognitive functional impairments in high-stress environments among the mindfulness group, it supports our hypothesis and approach.

Mindfulness Training Improves Attention: Evidence from Behavioral and Event-related Potential Analyses (Liu et al., 2023) is a correlational study on meditation and attentional capacity. The authors used a control group who did not conduct meditation and a mindfulness group who did engage in meditation. The study measured improvements in attentional capacity

using event-related potentials (ERPs) and a modified sustained attention response task (mSART). The study lasted for three weeks and selected 45 college students. The results showed that mindfulness was correlated with sustained attentional capacity via behavioral results. The study could have been improved by increasing the sample size of students while also randomly selecting them. Additionally, by focusing only on college-aged students, the sample size is biased toward the highly educated. This article supports our method of using groups that practice mindfulness and control groups. Additionally, it supports our hypothesis that mindfulness practice increases cognitive abilities.

Mindfulness Meditation: Impact on Attentional Control and Emotion Dysregulation (Prakash, 2021) is an exploration of mindfulness meditation and its positive impacts on the elderly with a focus on MS patients. The study is a 5-year trial involving 120 older adults who are undergoing mindfulness training. These older adults are examined behaviorally and analyzed for neural correlates. The study showed benefits in cognitive, emotional, and brain health among older adults engaging in mindfulness training. One drawback of the paper is its lack of a control group of older adults, therefore lacking a baseline behavioral and neuronal level. Additionally, Prakash's study is still ongoing and the data is not complete. Nevertheless, this paper has influenced our work, as both we and this study use the Stroop Effect Test.

Trait Mindfulness Is Associated With Less Amyloid, Tau, and Cognitive Decline in Individuals at Risk for Alzheimer's Disease (Strikwerda-Brown, et al., 2023) describes the benefits of mindfulness practice when dealing with neurodegenerative diseases such as Alzheimer's. Importantly, the study posits that mindfulness acts as a protective factor when dealing with Alzheimer-related cognitive decline. The experiment collected a myriad of data including a mindfulness questionnaire, longitudinal cognitive assessments, and PET scans from a population

of 261 adults without Alzheimer's who did have a family history of the disease. The results showed decreased cognitive decline and less amyloid and tau in the brain. The only criticism we have for the study is its reliance on a questionnaire. There are inaccuracies due to the difficulty of self-reporting. This article supports our hypothesis, and although we criticize its use of a questionnaire, it is the method of data collection that we use in our study.

Brief Mindfulness Meditation Improves Emotion Processing (Wu et al., 2019) focused on the benefits of mindfulness on emotional regulation in low-income 18-25-year-olds. Wu utilized a short 15-minute mindfulness training course which was optimized for students with limited time and money. After taking the course, students were measured for emotional memory, emotional intensity, and emotional attention to negative stimuli. 46 students broke up into two groups, one of which was a control. The non-control group saw significant benefits from mindfulness training and greater emotional memory. The drawback to this study is the short nature of the mindfulness training and the following tests. For accurate results, sustained mindfulness practice is likely needed. Wu's conclusion supported our hypothesis and the age group studied is useful for our research. We believe that our study will increase awareness regarding the benefits of mindfulness on mental well-being specifically in college-aged students.

The literature we have examined emphasizes the benefits brought by mindfulness onto an individual's cognitive abilities, reinforcing our hypothesis that consistent mindfulness practice leads to enhanced cognitive skills. The studies by Jha et al. and Liu et al. highlight the positive effects of mindfulness practice on attention and working memory, supporting our investigation of cognitive abilities in young adults. While we chose to focus on college-aged adults, Prakash's work delves into the effects of meditation and mindfulness on older adults, further expanding our

knowledge base on neurodegenerative conditions and mindfulness. This led us straight to Strikwerda-Brown et al.'s work where it is explained that mindfulness can be used as a tool to halt cognitive decline. Wu et al's study, like ours, focuses on adults of 18-25 years, and their exploration of mindfulness on emotional regulation provides even more support for our hypothesis. Despite limitations in each of the studies, the overall evidence resonates with our aim to investigate how mindfulness practices affect one's cognitive abilities.

Methods

Participants

We recruited a diverse sample of young adult participants aged 18-25 through social media platforms and word of mouth. Our outreach efforts garnered responses from 28 correctly-aged participants. Participants were informed of the study's objectives and were also provided informed consent prior to their involvement.

Research Design

Our research design takes the form of a correlational study. A correlational study allows room for establishing connections between mindfulness practices and cognitive abilities without imposing interventions or needing to manipulate the variables directly.

Variables

The independent variable in this study is the level of mindfulness practice among participants. We have categorized this variable into three groups:

1. Those who engage in consistent and continuous mindfulness practices.
    a. As defined by >5 hours/week

2. Those who sporadically practice mindfulness.
    a. As defined by <5 hours/week
3. Those who do not engage in mindfulness practices.
    a. As defined by 0 hours/week

The dependent variable is participants' cognitive abilities. This is measured through cognitive assessments designed to measure specific abilities in information processing and memory:

1. Interactive Stroop Effect Test
    a. This test assessed the participants' ability to inhibit cognitive interference during stimulus processing, particularly focusing on attention.
2. Number Memory Test
    a. This test evaluated the impact of mindfulness on short-term and working memory.

To investigate the consequences of mindfulness practices we had participants take the two cognitive assessments and report their scores. These assessments are two online open sources: the University of Washington's Interactive Stroop Effect Test and Human Benchmark's Number Memory Test.

Using the results from the Interactive Stroop Effect Test, we assessed the ability of participants to inhibit the cognitive interference occurring while processing a specific stimulus (color) feature that impedes the simultaneous processing of a second stimulus attribute (the word). Our hypothesis applies here such that faster times will be correlated with more consistent mindfulness practice.

The outcomes of the Number Memory Test provide an understanding of the impact of mindfulness on short-term and working memory. There's a common baseline: the average person

can remember seven digits at a time; this baseline will serve as a reference point against which the data from our three participant groups can be meaningfully compared.

Analysis

We used standard forms of exploratory data analysis, including calculating measures such as means, medians, and standard deviations for continuous variables (e.g., hours of mindfulness practice per week) and frequency distributions for categorical variables (e.g., responses to demographic questions that explore possible confounds). We employed data visualization to identify patterns and visually explore the relationships between mindfulness practices and cognitive abilities.

Using the results from the Interactive Stroop Effect Test, we assessed the ability of participants to inhibit the cognitive interference occurring while processing a specific stimulus (color) feature that impedes the simultaneous processing of a second stimulus attribute (the word). The first trial of the Stroop Test contains words in which the color of the word and the word itself are the same. The second trial contains words with mismatched colors. On average, the second trial takes significantly longer for participants, which illustrates that when words and colors are mismatched, the information takes longer to process owing to the interference generated by the competing signals.

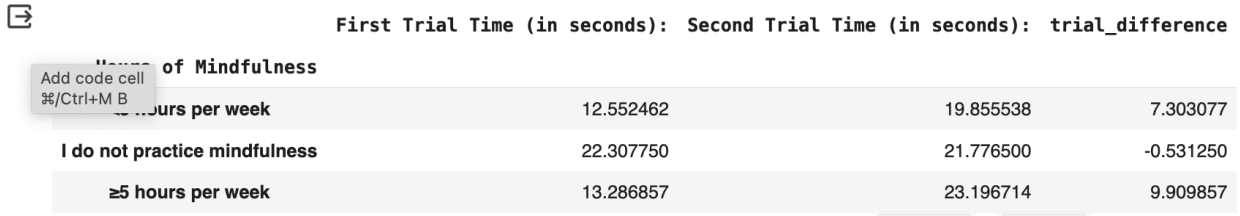
We assessed our hypothesis by calculating the difference between participants' first and second trial times and compared those differences across the three groups of participants. If our hypothesis was proven, those who practice consistent mindfulness would show smaller differences between their trail times, proving enhanced cognitive abilities.

The outcomes of the Number Test provide an understanding of the impact of mindfulness on short-term and working memory. There is a commonly known baseline for this assessment: the average person can remember seven digits at a time. This baseline will serve as a reference point against which the data from our three participant groups can be meaningfully compared. If our hypothesis held true, we would see those who practice consistent mindfulness will have reached a higher level on the assessment, proving enhanced cognitive abilities.

Results

After filtering out those who didn't meet our participant criteria (those outside of our target age range of 18-25), and those who didn't report correctly (failed to submit a value for one or more trials), we calculated the difference between the first and second trials. Grouping by the participants' mindfulness practice type, we calculated the average differences between trial times in the Stroop test. Those who don't practice mindfulness had the most similar times across the two trials, those who sporadically practice mindfulness had a 7 second difference between their trial times on average, and those who consistently practice had about a 10 second difference.

Here are the averages for each trial and the difference between the trials grouped by hours of mindfulness practice:



Hours of Mindfulness	First Trial Time (in seconds):	Second Trial Time (in seconds):	trial_difference
<5 hours per week	12.552462	19.855538	7.303077
I do not practice mindfulness	22.307750	21.776500	-0.531250
≥5 hours per week	13.286857	23.196714	9.909857

Here are the medians for each trial and the difference between the trials grouped by hours of mindfulness practice:

Hours of Mindfulness	First Trial Time (in seconds):	Second Trial Time (in seconds):	trial_difference
<5 hours per week	12.600	21.0000	7.0000
I do not practice mindfulness	13.315	16.2655	-0.1645
≥5 hours per week	13.339	25.2060	11.8670

While our hypothesis posited a positive correlation between consistent mindfulness practice and enhanced cognitive abilities, the initial findings yielded unexpected patterns. It is interesting that the group which does not practice mindfulness had such a low trial difference time, since the Stroop Test usually results in two distinctly different times between trials.

In exploring what could have happened, we examined the reports of those who do not practice mindfulness:

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stroop_test_df[stroop_test_df['Hours of Mindfulness'] == 'I do not practice mindfulness']
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	Hours of Mindfulness	First Trial Time (in seconds):	Second Trial Time (in seconds):	trial_difference
9	I do not practice mindfulness	13.201	12.898	-0.303
20	I do not practice mindfulness	53.000	45.000	-8.000
21	I do not practice mindfulness	9.601	9.575	-0.026
22	I do not practice mindfulness	13.429	19.633	6.204

These participants have greatly varying time differences overall. While our hypothesis wasn't supported by our data, it's curious why they had such differing results than the other groups.

Discussion

Our research experiment boasts strengths that demonstrate its validity. Running parallel to our definitive research question we present a hypothesis with the anticipation of positive correlation between mindfulness practices and increased cognitive abilities. Utilizing cognitive assessments we were able to obtain data on the participants' attention and memory. Providing a diverse array

of mindfulness practices and categorizing participants grants us a deeper understanding into how practicing mindfulness may affect one's cognitive abilities. Furthermore, the study's solid foundation in literature review consolidates its findings, leveraging academic support to affirm our hypothesis.

Limitations

Our experiment presents with some limitations, greatest being the small sample size. With a larger participant population, the data would become more reliable and more representative of larger populations of young adults. Other confounding variables we identified that could have affected the results include:

Baseline Intelligence: Whether or not an individual practices mindfulness, they might have enhanced cognitive abilities. We collected information on where participants fell on a GPA scale, so future research could separate mindfulness groups while controlling for baseline intelligence using GPA as a measurement to match.

Sampling Bias: Since participants were recruited through social media and word of mouth, there's a potential for sampling bias. Those who are active on social media or more connected within their networks may be overrepresented, affecting the generalizability of the findings.

Self-Reporting: The data collected from participants relied on self-reports, which can introduce response bias. Participants may provide what they think are desirable answers or inaccurately report their mindfulness practices and cognitive test results.

Subjective Definitions: The categorization of participants into different mindfulness practice groups (consistent, sporadic, or non-practice) may be subjective, as it relies on their self-reported hours of practice. There's room for interpretation and misclassification. Variations in practice intensity or methods might impact cognitive outcomes differently.

Short-Term Nature: The study was cross-sectional, providing a snapshot of participants' mindfulness practices and cognitive abilities at one point in time. It doesn't account for potential long-term effects or changes over time.

While the data trends deviated from what we hypothesized, since those who consistently practice mindfulness didn’t score better on cognitive assessments than individuals who either don’t practice or sporadically practice mindfulness, we can perhaps bring up other important questions: Why did the average difference in trial times vary greatly between those who practice mindfulness and those who do not? Why did those who sporadically practice perform slightly better on cognitive exams than those who consistently practice? Further research into these areas will hopefully eventually answer these questions.

Sources

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