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Magnifying Meditation's Benefits: On Interoceptive Attention among Healthy Older Adults

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Abstract

This study used a sample of novice, older adult meditators to test the significance of interoceptive attention to nasal respiratory sensation on the degree of magnification of the effects of meditation. A randomized controlled study was conducted with healthy older adults (*N*=4). Compared to an active control condition, nasal breathing participants showed an increase in mindfulness as reported with higher total scores on the post-Mindful Awareness Attention Scale (MAAS). Participants in the intentional nasal breathing group reported an increase in overall awareness of cognitive functioning and holistic interoception during daily activities- indicating the statistical significance of increased dispositional mindfulness when paired with intentional nasal breathing. Now more than ever, as our global population of older adults continues to increase, we need to bridge conversations about working memory and executive decision making as functions of mindfulness, magnifying effects of nasal breathing on limbic neuronic stimulation, as well as demonstrating effects extending to older adults. These three findings have important implications for the development of novel therapeutic approaches with people who experience cognitive impairment and such approaches lend themselves to potential reductions in health care costs.

Keywords: Focused attention meditation; dispositional mindfulness; breath awareness; present moment awareness; aging; cognitive functioning; nasal breathing; awareness; attentional networks.

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1. Introduction

Although the practice of meditation extends to about 5,000 years ago, it's only more recently, through secularization, where the United States has glommed onto the benefits of meditation. More often, the term that has been highly publicized is mindfulness and has been popularized as a way to be relaxed, less stressed, or more productive, to name a few. A Western conceptualization of mindfulness, rooted in psychological practices, exerted by Langer, suggests that we "pay attention on purpose, to the present moment, and non-judgmentally" [1]. Related to mindfulness, although slightly different, is the practice of meditation. To distinguish between the two, let us turn to Thich Nhat Hanh who once remarked, "Feelings come and go like clouds in a windy sky. Conscious breathing is my anchor," [2]. It could be said that the concept of mindfulness, with its quality of clear awareness, is analogous to floating feelings. Similarly, meditation, or consciousness (attention and awareness) could be said to be an anchor or technique of focused attention.

Typically, focused attention meditation (FAM) is promulgated as an easy and accessible method for meditating [3]. In the context of this research, meditation is not the absence of acting or simply sitting. Rather, meditation requires some degree of conscious effort. The mind must be calm, quiet and vigilant so as not to allow any distracting thoughts or desires to enter [4]. Although initially, it is presumed to be our own efforts that we rely upon to meditate, this is actually an illusion. It is our consciousness that meditates and is always meditating - we just need to allow our consciousness to play its role.

Before discussing the effects of FAM, and specifically how these effects interact with interoception and aging, it is important to offer an operational definition of awareness. Feldenkrais states "awareness is consciousness together with a realization of what is happening within it or of what is going on within ourselves while we are conscious," [5]. The author highlights this definition here, because in future clinical trials it will become evident that the possible magnifying power of specific mechanisms, interoceptive attention to respiratory sensation for example, cannot be singled out from the integrative functioning of other systems, in particular as we age. Awareness of, and attention to, rhythms of breathing become increasingly important as we age. Further, attention and awareness are in an iterative process with the practice of meditation – task specific practice strengthens attention and awareness and vice-versa.

Neuroimaging evidence supports the belief that practicing FAM leads to a honing of attentional focus acuity [6]. Additionally, FAM is associated with increased activity in the right dorsolateral prefrontal cortex, an area suggested to be responsible for "recurrent direction of attention" to specific self-selected information [7]. It has been suggested that with as little as 8-weeks of FAM training for naïve meditators, the left caudate/anterior insula involved in attention and corporeal awareness is activated [8]. Other research suggests a link between adopting a regular practice of meditation and not only quality of sleep, yet also increased cognitive functioning and connectivity during the daytime [9, 10]. In other words, it is not only the benefits one experiences while directly engaged in FAM, it is also the reverberating effects of the task, which extends into daily activities and overall systemic functioning.

Moreover, research has suggested superior cognitive abilities among older adult meditators versus non-

meditators. One study looked at meditators with 10 or more years of experience. After study subjects completed neuropsychological tests for assessment of short-term memory, perceptual speed, attention, and executive functioning, findings suggest meditators fair better on these tests compared to non-meditators with similar age and education background [11]. These findings fall short in advancing the effects of meditation by stopping before answering the how. How are the cognitive changes that result from engagement with meditation practices interacting with changes in other bodily systems: diaphragmatic breathing, cardiovascular, central nervous system, to name a few?

Most current studies on effects of meditation tend to land on a continuum from long-term meditators to specific 8-week trainings. Studying findings are limited to noting the cognitive changes of meditation. Smaller yet is a subset of meditation studies looking at the effects of specific mechanism on how these changes occur. To date, the author is unaware of studies that have investigated single exposure time-in-point effects of meditation with detailed follow-up occurring several weeks post-initial exposure – particularly among a group of older adults. Moreover, there needs to be even greater investigation into the mechanisms responsible for creating the cognitive changes reported as a result of meditation [12]. Research has established a clear link on cognitive changes among meditators; now we must turn to how these changes occur and in what ways these changes lend themselves to novel therapeutic developments [13].

Intentional Nasal Breathing as an Enhancing Mechanism on Effects of Meditation

Often diminished in psychological research of self-regulation and meditation studies is the significance of interoception [14]. At a basic level, we understand how our rhythm of breathing affects memory. In the nasal breathing and cognitive functioning literature, there is widespread concurrence that brain changes occur significantly on the inhale versus the exhale. A major finding suggests dramatic differences in brain activity in the amygdala and hippocampus with inhalation versus exhalation [15]. Evidence suggests that it is precisely on the nasal inhalation that stimulates neurons in the olfactory cortex, amygdala and hippocampus (integral to the functioning of the limbic system). It seems particularly relevant to the investigation of the positive effects of meditation, to explore the integration of cognitive and emotional processing that occurs when inhalation is a mediating variable with the potential to increase the mechanisms of attention and awareness. While there are divergent theories on the functional significance of nasal inhalation, most agree that on the inhale there are synchronizing brain oscillations across the limbic system. Further, research suggests interoceptive attention alters meditation training [16]. In other words, the effects of breath awareness and meditation are intricately connected in an iterative process whereby each informs and strengthens the other [12]. Focusing on the strengthening power that breath awareness has on increasing the benefits of meditation, has implications for developing future therapeutic approaches and for understanding neuroplastistic responses in people affected by various forms of dementia.

Examining the impact of meditation training on various cognitive components, in particular the mechanisms of attention and awareness, is greatly illuminated by the role of interoceptive attention to nasal respiration. For example, does one's degree of trait mindfulness change when engaged in nasal breathing during the meditation session? Is this change mirrored in state mindfulness? Compared to the attention and awareness literature,

predominately focused on trait mindfulness, fewer studies directly examine the impact of mindfulness on executive functioning, and the available results are mixed.

2. Materials and Methods

The author utilized a pre/post-test design series of delivering a single-factor self-report measure, the Mindful Awareness Attention Scale (MAAS), to understand the impact of exposure to brief meditation training and the possible magnifying effects of nasal breathing on moment-to-moment mindfulness throughout the day, among healthy community dwelling adults' ages 60 and greater [17]. As has been critiqued elsewhere, use of the MAAS fails to account for the acceptance component of mindfulness [18]. Nonetheless, this scale is an adequate measure for this study for several reasons: ease of use, unambiguous language, time efficient, easily distributable, question formatting and scale response match.

The author hypothesized that intentional nasal breathing will increase the effects of meditation as measured by attention and awareness. The author expected post-MAAS participation to decrease substantially at the four-week follow-up point, predominately due to the fact that people voluntarily responded to an email containing a link to the post-MAAS questionnaire. Furthermore, reviews have long suggested that the effects of meditation are most greatly evident in the changing of brain waves over a much longer period of time, certainly greater than four weeks.

The author advertised an "Introduction to Meditation and Mindfulness Workshop" at a local YMCA. On the day of the workshop, the author used a single-factor structure to measure dispositional mindfulness, specifically attention and awareness. Administration of self-reported MAAS questionnaires occurred in an exercise room with all workshop attendees present. Measures were later scored according to the test creators' guidelines, producing either mean or total scores for further analysis. In an attempt to measure dispositional mindfulness, the author selected the MAAS for its strong psychometric properties. Additionally, the author of this study is secondarily curious about testing the validity of this scale with a sample population only tested once previously [19]. Open and receptive awareness and attention to what is taking place in the moment were measured using the total score on the MAAS. With a possible score ranging from 15 to 90, scoring for a mean for each participant, with a higher score indicating greater attention and awareness.

No one was disqualified from participating in the workshop. Some people who attended the workshop, declined to participate in the research project. All workshop participants were exposed to the same information independent of participation in the study. The author of this paper, who also conducted the workshop, recruited the support of two non-partisan parties. First, with the author absent from the room, an employee of the YMCA was instructed to ask the group: "I am looking for a total of 5 volunteers who are willing to receive specific instruction on incorporating a breathing technique for the duration of this workshop. If you are willing to participate, please meet me out in the hall to receive instructions and then you will return to this room where the workshop will proceed." Second, this employee recorded the initials and birthdate of the five volunteers and gave this information to a second YMCA employee who locked this information in a file cabinet. Four weeks after the workshop, an email was sent to all workshop attendees inviting them to complete the MAAS. As noted

above, this study represents one piece of a much larger study examining the combinatory effects of engagement and exposure to specific mechanisms and the possible magnifying power of these mechanisms on the positive effects of focused attention meditation.

The author employed a double-blind, randomized controlled trial design, whereby each diagnostic group (no breathing instruction vs. intentional nasal breathing) (N=4) was provided identical meditation instruction. Participants from the no breathing instruction and intentional nasal breathings groups were intermixed within the intervention of a 60-minute "Introduction to Meditation and Mindfulness Workshop." Both groups were blind to this classification to reduce stereotype threat and poor performance due to expectations related to diagnostic assignment [20]. The workshop facilitator (who is also the author of this paper) was blind to the participants who engaged in nasal breathing during the workshop (as noted above by leaving the room).

3. Results

As previously noted, 21 people participated in the workshop and 13 people completed pre-MAAS questionnaires. Of the 13 questionnaire takers, 4 met age-inclusion criteria for this current study. Subjects provided their email addresses at the workshop. The MAAS was e-mailed to all study participants 4-weeks following the initial workshop. Completion of the survey was purely voluntary and no forms of incentives were offered to any participants for their participation in any phases of the study. Of the workshop's total 21 attendees, 61% completed the MAAS prior to the workshop beginning. Of the MAAS completers, 4 met the inclusion criteria (age greater than 60) for the current study.

There were no significant group differences at baseline in age, with a mean of 72.5, or in gender with a 50/50 split between male and female. In the first data set, the sample SD = 0.88, whereas the σ_M = 0.544. In terms of attrition, two participants failed to complete the post-MAAS, with responses representing one participant from each of the healthy control no breath instruction and one from the intentional nasal breathing group. The second data set (N = 2), comprised from post-MAAS responses, offered a sample SD = 0.70, whereas the σ_M = 0.50.

When analyzing the raw data, the participant who self-selected the nasal breathing group showed a difference of 4 total points between pre/post-test MAAS results, indicating increased mindfulness compared to the no breath instruction group that self-reported an increase as well, although amounting to a two total point increase. All significant correlations were in an expected direction. Most notable was the scoring of a single question: "I tend not to notice feelings of physical tension or discomfort until they really grab my attention." This was the lowest ranking questioning receiving an "almost always" and "very frequently", scoring 1and 2 respectively. The author wonders about test subjects' attention and awareness of physical ease or comfort. If the questions were worded using positive language, presence versus absence of mindfulness, would scores differ?

In line with this study's originally suggested hypothesis, interoceptive attention is magnified under breath awareness meditation conditions. However, it is important to note that the magnitude of associations among the selected dispositional mindfulness questionnaire and attention to nasal respiration reflects previous findings and confirms a dismissal or absence of the component of acceptance – a major key to practicing mindfulness. It

could be suggested that these findings are in conflict: a mindfulness scale that measures the degree of precise absence of mindfulness paired with suggested heightened interoceptive awareness. From the author's perspective, a subject's reporting of nasal inhalation awareness trumps an instrument that has been criticized for measuring the absence of mindfulness and question wording that heavily relies on negative language. As other studies have suggested a link between breath awareness and meditation practices, using fMRI scans, by revealing increased activation of Wernicke's area – a region of the brain that is important for language processing (both written and spoken or signed) [12]. With language areas activated, the posterior superior temporal lobe, it can be suggested that test subjects have a heightened awareness of question wording in the MAAS, thereby strengthening the subjects' responses.

4. Conclusion

Despite the relative infancy of literature demonstrating important cognitive changes in the brains of healthy novice meditating older adults, the discrepancies in objectively measuring the integration of mechanisms on the effects of meditation render an incomplete understanding of the mechanisms by which such effects occur. There is relatively new interest in understanding the how of these cognitive changes. In the current study, the author specifically focused on interoceptive attention to respiratory sensation as a way of evidencing the purported increased attention and awareness effects of focused attention meditation, by examining two data sets. The author did so in a sample of healthy adults' ages 60 and greater. The author's secondary hypothesis that total dispositional mindfulness and age have a direct relationship was revealed in a subgroup of the sample meeting inclusion criteria, although findings were based on too small of a sample to report statistical significance. Further, results are not included because the author is concerned that inference from such a small sample may bias future findings. Therefore, the subsequent discussion of results focuses on the author's primary hypotheses collapsing across diagnostic groups and looking solely at intervention effects.

The current findings contribute to the body of growing evidence that fails to disprove the positive impact of specific mechanisms on cognitive effects of meditation among older adults. It is suggested the effects of nasal breathing on increasing attention and awareness will vary as a function of length of exposure to meditation practice, independent of baseline cognitive functioning. The reason for no oversight of daily meditation practices is due to future research goals aimed at developing a cost effective self-administered therapeutic approach.

The current study does suggest that a brief introduction to meditation practices, followed by 4 weeks of loosely structured daily meditation, absent any external oversight (all daily practices where done or not done based on each individual's preferences – it was suggested to participants to engage in a daily meditation practice following the workshop), and combined with intentional nasal breathing are sufficient activities to produce increases in attention and awareness in healthy older adults [21]. Furthermore, by interpreting the results from the two data sets, the findings suggest a strong likelihood that nasal breathing inhalation directly bolsters the effect of meditation training, as evidenced by an increase in attention related to errors without a concomitant increase in a negative affective response to those errors. The author acknowledges the functional significance of this specifically chosen mechanism and recognizes other such mechanisms must be tested before drawing

further conclusions. Three examples of other mechanisms that should be tested for their degree of enhancement of meditation effects are the inclusion of 432 mHz music, nature [22, 23] and group versus individual meditation sessions. These findings are consistent with the primary hypothesis, and are consistent with what one would predict based on the notion that FAM, by its very nature, focuses one's attention. Obtaining these results in a population of novice meditators, who are also ages 60 and greater, is particularly intriguing. Most notably, although the decline of human's performance monitoring systems are debatable; this study's results demonstrate functional plasticity in the attention system coupled with increased awareness. While many other studies have shown functional (and structural) brain changes following eight weeks of mindfulness training, there still remain questions about objectivity when studying mindfulness or meditation, with these questions being exacerbated by the shortened duration of meditation exposure. The incorporation of nasal breathing instruction, in addition to pre/post-delivery of MAAS was an attempt to add robustness to objective measures of meditation effects, moving beyond the *what* of meditations effects and beginning to explore the *how* of these effects. Additionally, the majority of studies tend to recruit young and middle age adults, whereas this study focused solely on older adults. Other research on the effects of meditation, in particular neuroplasticity in older adults, suggests the greatest effect to occur over longer periods of time or training [24]. The fact that this study was able to detect significant effects in 4-weeks reinforces the significance of these findings and offers fodder for future research endeavors. It is important to note the possibility of positivity bias in examining the pre/post test results [25]. As has come into question with other meditation and mindfulness studies, the process of using a self-reporting tool can lead research participants to error on the side of the presumed wanted results. The shortness of this study is of particular significance due to the relatively small body of literature examining the changes in older adults who engage in short-term meditation programs [26, 27]. According to developmental literature, emotion regulation and age have a direct relationship. Put differently, as we age, the ability to regulate emotions also increases [24, 28].

Limitations and future directions

While the current results show short-term training effects after 4-weeks, the long-term impact – and presumably preventative benefits – remains currently unknown. Future replications of this study should include a plan for collecting longitudinal data, because research suggests it is the long-term effects of meditation that are most significant in generating positive effect on cognitive functioning. Moreover, while a rigorous randomized controlled double-blind trial design with repeated measures effects was employed in this study, the small sample size used indicates the need for future replications with larger samples to ascertain the reliability of the observed effects. Additionally, the current sample was comprised of a relatively homogeneous group of healthy (i.e., no cognitive outliers), age greater than 60, predominately Caucasian, gym membership holding individuals. While this homogeneity supported the internal validity of the prescribed design, questions remain regarding the generalizability to more diverse samples, which should also be addressed in all future replications of this work. The current results suggest an increase in dispositional mindfulness for study subjects who engaged in interoceptive attention to nasal respiratory sensation system. These preliminary findings add to the emerging body of literature illuminating the specific mechanisms by which the cognitive effects of meditation are magnified when combined with intentional nasal breathing. Moreover, observing these positive effects in older adults (including those who may be at risk for cognitive shifts specifically related to dementia) supports the

utility of pursuing non-pharmacologic therapeutic approaches, relying instead on tools we already have (i.e., breath capacity, agency, awareness, attention, etc.). Further, investigation into other specific magnifying mechanisms other than the breath (e.g., nature) have far reaching implications, extending beyond individuals affected by dementia to directly impacting incurred costs of the U.S. healthcare system.

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