The Relationship between Mindful Awareness and Cognitive Performance among U.S. Military Service Members and Veterans

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Mindfulness training has been shown to reduce stress and improve performance. The purpose of this study was to investigate the relationship between mindfulness and cognition in U.S. military service members and veterans (n = 236). Volunteers completed the Mindful Attention Awareness Scale (MAAS), Five Facet Mindfulness Questionnaire (FFMQ), and two attention and memory measures: the running memory continuous performance task (CPT) and the standard continuous performance task (SCP). MAAS scores were negatively correlated with mean RT on both the CPT and SCP (r's = -.14 and -.18, respectively, $p < .05$). FFMQ scores were positively correlated with correct responses (r = .15) and throughput scores (r = .14) on the CPT and negatively correlated with mean RT on the SCP (r's = -.15, $p < .05$). Greater mindfulness was associated with better performance on two sustained attention tasks, suggesting mindfulness is linked with improved management of continuous information, without distraction or impulsive reaction.

INTRODUCTION

Mindfulness is non-judgmental, present-moment awareness of events (Kabat-Zinn, 1994). Although traditionally studied in the context of stress and coping, recent evidence suggests a link between mindfulness and cognitive performance. Understanding the relationship between mindfulness and cognition has important implications for bolstering military service members' cognitive fitness.

Jha and colleagues (2010) compared cognitive performance in military and civilian participants before and after completing an 8-week mindfulness training program. Their critical finding was that participants who maintained regular practice of mindfulness techniques had higher working memory span task scores relative to those who did not practice regularly (Jha et al., 2010). Although they concluded mindfulness training enhanced working memory, it is worth noting that working span task performance was measured as a function of recall, rather than processing ability. This is an important point, as working memory involves both processing and storage of information (Baddeley, 1986).

The purpose of this study was to examine the relationship between dispositional mindfulness and cognition in a sample of U.S. military active duty and veteran personnel. It was expected that higher levels of mindfulness would be associated with better memory performance and faster response times on the cognitive tasks.

METHOD

Participants

U.S. military active duty service members and veterans (n = 236) were recruited as research volunteers from Joint Base San Antonio and the surrounding vicinity. Volunteers were recruited for a larger study focusing on the effectiveness of Mindfulness-Based Stress reduction. The study was approved by an Institutional Review Board and research volunteers read and completed an informed consent form prior to participation. Volunteers were not compensated for their participation.

Instruments

Demographics survey. The demographic survey included volunteers' age, race/ethnicity, gender, education, marital status, military status, deployment (i.e., whether or not they had deployed, time since deployment, duration of deployment), and the amount time the respondent spent on active duty.

Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003). The MAAS is a 15 item questionnaire used to determine a respondent's present level of awareness of their current state. For each statement, respondents select a response option that best reflects their current experience where 1 = "almost always" and 6 = "almost never". A summary score was calculated from responses. The MAAS has been found to be both a valid and reliable measure (Carlson & Brown, 2005). Normative data for community adults and college students are N=436, MAAS mean = 4.20 ± .69 and N = 2277, MAAS mean = 3.83 ± .70, respectively (Brown & Ryan, 2003; Carlson & Brown, 2005)

Five Facet Mindfulness Questionnaire (FFMQ) (Baer et al., 2006). The FFMQ is a 39-item self-report questionnaire that is designed to measure five dimensions of mindfulness: observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience. Respondents rate each statement on a five-point Likert scale ranging from 1= "never" or "very rarely true", to 5= "very often" or "always true. The FFMQ has been found to be both reliable and valid (Baer et al., 2008; Neuser, 2010).

Running Memory Continuous Performance Task (CPT). The CPT measures attention, concentration and working memory, and requires users to hold the target letter in memory. Users are presented with sequences of digits and must decide if the current character matches/does not match the preceding character (See Figure 1).

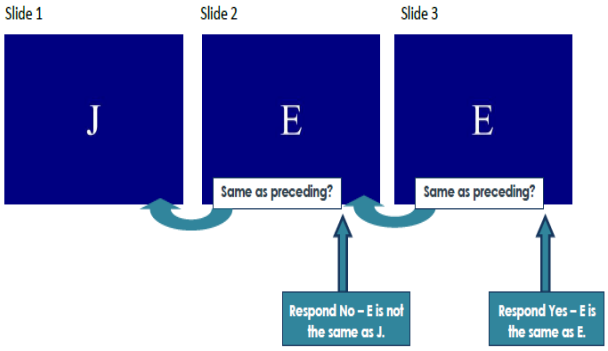

Figure 1. The ANAM CPT.

Standard Continuous Performance Task (SCP). The SCP measures sustained attention, concentration, and working memory. For this task, the user must identify a target (e.g., "B") from presented randomized sequences of characters. Presentation rate was self-paced.

For both the CPT and SCP measures, key performance metrics were: number of correct responses, incorrect responses, and mean response time (RT). For the CPT, throughput scores (the number of correct responses per unit of the available response time) are available and were analyzed.

Statistics. All data analyses were conducted with IBM SPSS Statistics for Windows (Version 21, Armonk, NY: IBM Corp, Released 2012). A p-value of .05 was used to determine significance.

RESULTS

Data from volunteers that scored two standard deviations above or below the mean CPT score for all participants (n = 11) were omitted from the analyses of that task. Volunteer's demographics are available in Table 1.

Table 1. Demographics of the volunteers.

Demographic	*Mean / #*	*%*
Age (yrs)	48.13	--
Gender		
Male	126	52.5
Female	110	45.8
Race		
African-American	60	25.0
Native American	4	1.7
Caucasian	126	52.5
Hispanic	41	17.1
Asian	4	1.7
Other	1	.4
Education		
HS/GED	16	6.7
Some college/AA	78	32.5
Bachelors	58	24.2
MA/Ph.D.	70	29.2
Other professional degree	14	5.8
Marital status		
Married	133	55.4
Divorced	51	21.3
Widowed	3	1.3
Single/separated	41	17.1
Partnered w/sig. other	8	3.3

Volunteer's military service demographics are available in Table 2.

Table 2. Volunteers' military service.

	Mean / #	*% / SD*
Military service		
Active service	80	33.3 %
Veteran	156	65.0 %
Deployed	141	58.8 %
Time in service (yrs.)	15.15 yrs.	± 8.56
Years since deployment	10.93 yrs.	± 11.61
Months deployed	8.70 mos.	± 5.18

Note. SD = standard deviation.

Of the demographic measures, age was correlated with the MAAS and FFMQ action scores; time-in-service was correlated with the MAAS and all FFMQ scores, except for FFMQ observe; and education was correlated with the MAAS and FFMQ action. When controlling for age using partial correlation, time-in-service was correlated with all mindfulness measures, except for FFMQ observe ($p < .05$). When controlling for time-in-service, age was no longer significantly associated with any measure of mindfulness ($p > .05$).

Mindfulness measures and performance tasks. Table 3 shows the means and standard deviations for the mindfulness measures. Table 4 shows the mean and standard deviation for scores on the performance tasks. The average percent correct on the CPT was 79.60% (SD = 15.44) and average percent correct on the SCP was 99.08% (SD = 3.18).

Correlations between mindfulness measures and performance tasks. Tables 5 and 6 display the correlations between the mindfulness measures and performance tasks. Number correct and throughput scores on the CPT were positively correlated with FFMQ describing and throughput was positively correlated with FFMQ non-judging of inner experiences. Response time (RT) was significantly negatively correlated with MAAS scores. For the SCP scores, RT was significantly negatively correlated with scores on the MAAS and FFMQ describing, acting with awareness, and non-reactivity.

Table 3. Means and standard deviations for the two mindfulness measures.

Mindfulness	*Mean*	*SD*
MAAS	3.76	1.02
FFMQ		
Observe	24.92	6.49
Describe	26.12	7.64
Action	25.23	7.47
Non-discriminate	26.47	7.38
Non-react	20.38	5.43

Note. SD = standard deviation.

Table 4. Means, standard deviations, and ranges for the two cognitive measures.

Measure	*Mean*	*SD*
CPT		
# correct	63.63	12.36
# incorrect	7.43	8.08
Throughput	75.53	23.10
Mean RT (msec's)	639.80	94.39
SCP		
# correct	199.13	4.50
# incorrect	1.33	4.78
Mean RT	449.40	105.08

Note. SD = standard deviation.

Table 5. Pearson correlations between mindfulness and CPT scores.

	MAAS	FFMQ				
CPT	*MAAS*	*Obs*	*Des*	*Act*	*NonJ*	*NonR*
# correct	-.02	.00	.15*	.10	.13	.08
# incorrect	.07	.00	-.06	-.02	-.01	.00
Throughput	.02	.00	.14*	.10	.14*	.07
Mean RT (msec's)	-.14*	-.09	-.10	-.11	-.10	-.11

*p < .05. *Obs* = observing, *Des* = describing, *Act* = acting with awareness, *NonJ* = non-judgment, *NonR* = non-reactivity.

Table 6. Pearson correlations between mindfulness and SCP scores.

	MAAS	FFMQ				
SCP	*MAAS*	*Obs*	*Des*	*Act*	*NonJ*	*NonR*
# correct	-.09	-.02	-.04	-.08	.01	-.02
# incorrect	.13	.03	.04	.08	-.03	.03
Mean RT (msec's)	-.18**	-.06	-.15*	-.15*	-.05	-.15*

**p < .01, *p < .05. *Obs* = observing, *Des* = describing, *Act* = acting with awareness, *NonJ* = non-judgment, *NonR* = non-reactivity.

DISCUSSION

This study investigated dispositional mindfulness and two measures of continuous cognitive performance among active and former U.S. military service members. The mean MAAS score for participants in this study was slightly lower than normative values of mindfulness in community adults, but close to normative data for college students (Brown & Ryan, 2003; Carlson & Brown, 2005). Scores on the FFMQ in this study were consistent with those found in other studies (Baer et al., 2008). Discrepancies may be due to the diverse sample in this study, while other studies appear to be more homogenous (Brown & Ryan, 2003).

The relationship between age and mindfulness has mixed results, as Baer and colleagues found age to be related to FFMQ acting with awareness only (Baer, et al., 2008), while Hohaus and Spark found all five FFMQ subscales were positively related to age (Hohaus & Spark, 2013). This study found that while higher mindfulness scores were associated with older age, the relationship dissipated to non-significant levels when controlling for time-on-active duty. This study also found higher mindfulness scores were associated with higher educational levels, supporting findings by Baer and colleagues (Baer et al., 2008). Reflection has long been used in higher education learning, which may enhance one's mindfulness through introspective abilities (Lowe & Kerr, 1994).

This research demonstrated positive relationships between mindfulness and performance on the running memory CPT. Higher FFMQ describe and non-judging scores were associated with correct responses per unit of time, while MAAS scores were correlated with faster decision making speed. *Describing* refers to one's ability identify internal experiences with appropriate verbiage, while *non-judging* refers to an individuals' not being critical of inner thoughts, emotions, or sensations (judging as good or bad). Being able to identify, but not judge one's internal experiences, may speed decision making, while judging one's experiences may slow decision making while an individual assesses his responses and performance. These results on a running memory sustained attention task build on prior studies showing improvements in working memory (Jha et al., 2010) and visuospatial attention (Malinowski et al, 2017) following mindfulness training, possibly explaining how certain aspects of mindfulness influence performance.

Analyses of the SCP scores indicated that increased overall mindfulness (MAAS) and three of five subcomponents of the FFMQ were significantly associated with faster decision-making speed on a standard continuous performance task. *Describing* was defined previously. *Acting with Awareness* is paying attention while taking action, rather than reacting mindlessly and *non-reactivity* refers to the ability to be aware of ones' thoughts and emotions without immediately rejoining in response. Acting with thought and deliberation, but without becoming entrenched in ones' emotions and thoughts, appears to have sped responses to the continuous monitoring and response task.

Interestingly, the relationship between task scores and mindfulness scores differed for the MAAS and FFMQ. This suggests that these two mindfulness measures may differ in their psychometric properties. Whereas the MAAS measures the current state of mindfulness (Brown & Ryan, 2003), the FFMQ measures elements of mindfulness (Baer, et al., 2006). In the present study, MAAS scores were negatively correlated with mean RT on both cognitive tasks, suggesting that increased mindfulness enhances the rate at which information is processed. The relationships between the FFMQ and the continuous performance tasks suggest that specific mindful factors (e.g., describing experiences, acting with awareness, non-judging, and non-reactivity) may reduce competing thoughts (and self-judgements) that can impede processing.

Taken collectively, these findings suggest an important link between mindfulness and performance on tasks requiring sustained attention, concentration, working memory, and decision speed.

LIMITATIONS

This research was conducted with U.S. military service members and veterans which may limit the generalizability of the findings to other populations. Self-report data and correlational statistics restricts causal inferences from the outcomes.

CONCLUSION

The outcomes of the present study highlight an important, if understudied, link between mindfulness and cognition. Greater mindfulness was associated with better performance and faster processing speed on two cognitive measures of sustained attention, working memory, and concentration. One explanation for these findings is that mental clarity afforded by mindful awareness enhances information encoding, storage, and processing in working memory.

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DISCLAIMER

The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Army, Department of Defense, or the U.S. Government.

REFERENCES

Baddeley, A. (1986). Working memory. Oxford University Press: Oxford, UK.

Baer, R. A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. C*linical Psychology: Science & Practice*, *10*, 125-143.

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*, 27-45.

Baer, R.A., Smith, G.T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., Walsh, E., Duggan, D., & Williams, J.M.G (2008). Construct Validity of the Five Facet Mindfulness Questionnaire in Meditating and Nonmeditating Samples. *Assessment*, *15*, 329-342.

Brown, K.W. & Ryan, R. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. Journal of Personality and Social Psychology, 84, 822-848.

Carlson, L. & Brown, K.W. (2005). Validation of the Mindful Awareness Attention Awareness Scale in a cancer population. *Journal of Psychosomatic Research*, *58*, 29-33.

Hohaus, L.C., & Spark, J. (2013). 2672-Getting better with age: Do mindfulness and psychological well-being improve in old age? European Psychiatry, 28, 1.

Jha, A.P. Stanley, E.A., Kiyonaga, A., Wong, L., & Gelfand, L. (2010). Examining the protective effects of mindfulness training on working memory capacity and affective experience. *Emotion, 10,* 54-64.

Kabat-Zinn, J. (1994). *Wherever you go, there you are: Mindfulness meditation in everyday life*. New York: Hyperion.

Lowe, P.B. & Kerr, C.M. (1998). Learning by reflection: The effect on educational outcomes. Journal of Advanced Nursing, 27, 1030-1033.

Malinowski, P., Moore, A.W., Mead, B.R., & Gruber, T. (2017). Mindful aging: The effects of regular brief mindfulness practice on electrophysiological markers of cognitive and affective processing in older adults. Mindfulness, 8 (1), 78-94.

Neuser, N.J. (2010). Examining the Factors of Mindfulness: A Confirmatory Factor Analysis of the Five Facet Mindfulness Questionnaire (Doctoral dissertation, Pacific University). Retrieved from: http://commons.pacificu.edu/spp/128.