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Research Paper

Unraveling the Interplay among Meta Cognition, Mind Wandering, Mindful Attention Awareness and Cognitive Failure: A Moderated Mediation Approach

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ABSTRACT

Everyday cognitive failures can impair effective functioning and may reflect difficulties in self-regulation and attentional monitoring. Although metacognitive awareness has been linked to better cognitive control, limited research has examined the mechanisms through which it reduces cognitive failures, particularly in the Indian context. The present study investigated whether mind wandering mediates, and mindful attention awareness moderates, the relationship between metacognitive awareness and cognitive failure among Indian adults (N= 466; M=254, F=212; 18–55 years). Participants completed the Metacognitive Awareness Inventory, Cognitive Failures Questionnaire, Mind Wandering Questionnaire, and Mindful Attention Awareness Scale. Moderated mediation analysis revealed that greater metacognitive awareness predicted fewer cognitive failures partly through reduced mind wandering, with this protective indirect effect becoming stronger at higher levels of mindful attention awareness. Findings further suggest that metacognitive awareness alone may be insufficient for effective attentional regulation without present-moment awareness, highlighting mindfulness as an important attentional platform for reducing everyday cognitive errors.

Keywords: *Metacognition, Mind Wandering, Mindfulness, Cognitive Failure*

Everyday functioning relies heavily on the efficient coordination of attention, memory, and action. Relatively mild errors are common during day-to-day activities: a person might forget to do something, put something down in an odd place, or read something without understanding what has been read. These everyday mistakes are generally referred to as cognitive failures, which are defined as lapses of attention, memory, perception or action (Broadbent, Cooper, Fitzgerald, & Parkes, 1982). On their own, cognitive failures are harmless but combined, they may adversely affect day-to-day functioning and performance, as well as health and safety (Wallace & Vodanovich, 2003). In addition, considering the relationships between common cognitive failures and stress, inefficient performance of tasks, and low subjective well-being, it is clear that these cognitive failures are not only central to human cognition but are also relevant to people psychologically in everyday life (You et al., 2021).

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The most important psychological factor likely to prevent cognitive failures is metacognitive awareness. This is defined as the ability to reflect upon, monitor, and regulate one's own cognitive processes (Flavell, 1979; Efklides, 2006). This ability includes knowledge of one's cognitive abilities and awareness or control of cognitive activities in combination with planning, monitoring, evaluation, and improvement of one's behavior. This is often achieved upon detecting discrepancies or errors. For example, if one knows that they tend to forget deadlines, they might use reminders or other organizational systems. More metacognitive awareness has been associated with greater attentional control, memory control, and lower rates of cognitive failures in daily life (Schraw & Dennison, 1994). However, this relationship may not be entirely direct, possibly being mediated by other cognitive processes.

One such process is mind wandering, where attention spontaneously redirects from the main task to task-unrelated thoughts, worries or mental imagery (Smallwood & Schooler, 2006). Although minds wander and this appears to be an important part of human cognition, and minds may serve useful functions like creativity, problem solving and future planning, excessive or poorly regulated mind wandering correlates with poorer performance on a task, poor working memory, poor comprehension and more cognitive failures and errors in everyday life (Mrazek et al., 2012; Smallwood & Schooler, 2015). Thus, habitual mind wandering may compromise sustained attention by making one more prone to cognitive lapses and erring in goal-directed behavior. From this perspective, individuals who have high metacognitive awareness, may better reorient attention to relevant task information, which reduces mind wandering and its consequences. Hence, mind wandering may be a mechanism through which metacognition exerts an influence on cognitive failures.

However, a successful use of metacognitive skills is not solely dependent on knowledge and regulation, but also requires the ability to notice attentional shifts when they occur. In this context, mindful attention awareness is of particular relevance, which is the dispositional tendency to attend to and experience present moment events with awareness, openness, and nonjudgment (Brown & Ryan, 2003). Attention regulation is a central aspect of mindfulness. It refers to the sensitivity to present-moment experiences and the awareness of the shifting focus of attention (Kabat-Zinn, 2003). Individuals high in mindful attention awareness are more likely to have awareness of their attention straying from the task and to redirect their attention accordingly.

Metacognitive awareness provides the cognitive means to monitor and control cognitive processes, but is only effective if individuals are capable of detecting attentional lapses in real-time. Those with high mindful attention awareness are better able to detect attentional drift during the present moment and utilize metacognitive strategies to redirect their attention, which in turn minimizes mind wandering. Alternatively, those with lower levels of mindful attention awareness may have metacognitive knowledge but not be aware of when their attention starts to drift, which may increase the duration of mind wandering and the likelihood of cognitive failures. Therefore, mindful attention awareness may moderate the relationship between metacognitive awareness and attentional control. This integrative perspective is in line with theoretical models that propose that metacognition and mindfulness are two complementary forms of cognitive regulation, with metacognition regulating cognition via evaluation and control processes, and mindful attention awareness providing the attentional basis for self-regulation (Teasdale et al., 2002; Lyons & Zelazo,

2011). Thus, both may regulate mind wandering and, as a result, cognitive failures in daily life.

Rationale of the Study

The constructs of metacognitive awareness, mind wandering, mindful attention awareness, and cognitive failures have either not been studied together in this way to our knowledge, or they have been studied only pairwise: metacognition and mindfulness (Brown & Ryan, 2003) mind wandering and cognitive performance (Schraw & Dennison, 1994 Smallwood et al., 2007). However, no empirical study examined mind wandering as something that mediates between metacognitive awareness and cognitive failures, and very few empirical studies examined how mindful attention awareness interacts as a moderator on mind wandering. A moderated mediation model of the indirect effect of metacognitive awareness on cognitive failures through mind wandering conditioned on levels of mindful attention awareness can elucidate the process of cognitive failures. It may also help understand whom metacognitive skills are most relevant for regarding cognitive failures, as much of the research concerning these constructs has been based on Western and student samples. Hence, testing the moderated mediation model in India, which is a culturally and socioeconomically diverse country, can provide much needed evidence-based insights to improve attentional control, self-regulation and everyday cognitive performance.

Aim

To examine the relationships among metacognitive awareness, mind wandering, mindful attention awareness, and cognitive failures in a diverse sample of Indian adults.

METHODOLOGY

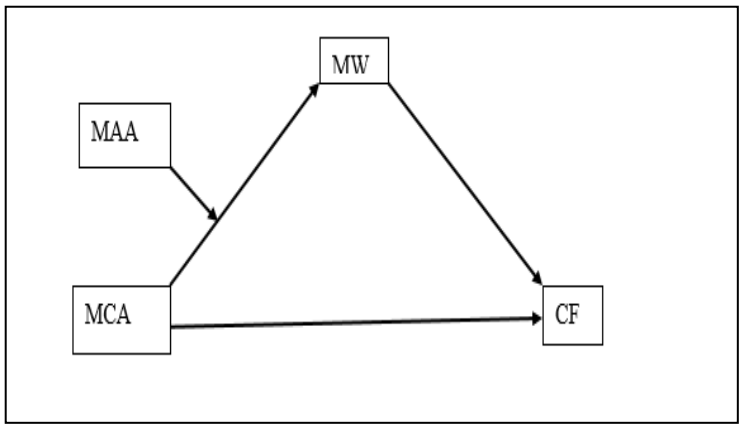
Objectives

- To assess the direct relationship between metacognitive awareness and cognitive failures.
- To investigate whether mind wandering mediates the association between metacognitive awareness and cognitive failures.
- To examine whether mindful attention awareness moderates the relationship between metacognitive awareness and mind wandering, forming a moderated mediation model.

Hypotheses

- **H_1:** Individuals with higher metacognitive awareness will report fewer cognitive failures.
- **H_2:** Mind wandering will mediate the relationship between metacognitive awareness and cognitive failures
- **H_3:** Mindful attention awareness will moderate the relationship between metacognitive awareness and mind wandering.

Figure 1 Hypothesized Model



MCA: Metacognitive Awareness; MAA: Mindful Attention Awareness; MW: Mind-wandering; CF: Cognitive Failure

Sample

The study included 466 Indian adults aged 18–55 years (M = 254; F = 212). Participants were recruited from urban, semi-urban, and rural areas across India to ensure a broad socio-demographic representation. Recruitment was conducted through a combination of online platforms (e.g., social media and community forums) and offline outreach (e.g., colleges, workplaces, and community centers) to capture diverse adult experiences. A purposive sampling technique, a non-probability method commonly used in social science research to select individuals meeting specified criteria, was employed to enroll participants who met the inclusion criteria and provided informed consent for participation.

Inclusion / Exclusion Criteria

Individuals aged between 18-55 yrs, with fluency in English and/or Hindi, and willingness to give informed consent were included in this study. Whereas, those having any neurological or psychological disorders were excluded from this study.

Measures

- **Metacognitive Awareness Inventory (Schraw & Dennison, 1994):** The MAI consists of 52 items designed to measure two broad dimensions of metacognition: knowledge of cognition and regulation of cognition. Responses are recorded on a 5-point Likert-type scale, with higher scores indicating greater metacognitive awareness. The scale has demonstrated excellent internal consistency, with reported $\alpha = .95$**.**
- **Mind Wandering Questionnaire (Mrazek et al., 2012)**: The MWQ is a unidimensional self-report measure consisting of 5 items, assessing the frequency of task-unrelated thoughts during everyday activities. Items are rated on a 6-point Likert-type scale, with higher scores reflecting a greater tendency toward mind wandering. The MWQ has demonstrated good internal consistency, with reported reliability estimates of approximately $\alpha = .83$**.**
- **Mindful Attention Awareness Scale (Brown & Ryan, 2003)**: The MAAS comprises 15 items and measures the dispositional tendency to attend to present-moment experiences in a mindful manner. It is a unidimensional scale, with items rated on a 6-point Likert-type scale. Higher scores indicate greater levels of mindful

attention awareness. The scale has shown good internal consistency, with reported α = .82.

- **Cognitive Failures Questionnaire (Broadbent et al., 1982):** The CFQ consists of 25 items that measure the frequency of everyday lapses in attention, memory, perception, and motor functioning**.** Responses are recorded on a 5-point Likert-type scale**,** with higher scores indicating greater frequency of cognitive failures. The CFQ has demonstrated satisfactory internal consistency, with reported α = .87**.**

Research Design

The study followed a correlational research design, as it aimed to examine the associations and indirect effects among multiple psychological variables without manipulating any conditions. It allows the researcher to explore the strength and direction of relationships among predictors, mediators, and the outcome variable within a natural setting.

Procedure

Rapport was established with the participants and they were briefed about the study Consent was taken from them. The participants completed the survey online or on paper (offline) following standardized instructions clearly mentioned. Demographic information and all self-report questionnaires were obtained anonymously. All guidelines for research with human subjects were followed.

Statistical Analysis

Data were first screened for completeness, missing values, and outliers, followed by preliminary descriptive statistics to examine the distribution, central tendency, and variability of the study variables. Correlational analyses were performed to explore associations among metacognitive awareness, mind wandering, mindful attention awareness, and cognitive failures. To test the hypothesized moderated mediation model**,** in which mind wandering mediated the relationship between metacognitive awareness and cognitive failures, and mindful attention awareness moderated this pathway, Hayes' PROCESS macro (Model 7) was employed with bootstrapping (5,000 samples) to obtain bias-corrected confidence intervals.

RESULTS

This section presents the results of the analyses conducted to test the study hypotheses. The findings are organized and reported in the tables below.

Table 1 Mean and Standard Deviation of the study variables

	Mean	**Std. Deviation**	**Skewness**		**Kurtosis**	
	Statistic	**Statistic**	**Statistic**	**Std. Error**	**Statistic**	**Std. Error**
MCA	41.64	8.81	-0.76	0.13	-0.17	0.25
MW	15.93	5.44	0.03	0.13	-0.55	0.25
MAA	59.17	13.14	0.12	0.13	0.02	0.25
CF	64.26	17.13	0.10	0.13	0.42	0.25

MCA: Metacognitive Awareness; MAA: Mindful Attention Awareness; MW: Mind-wandering; CF: Cognitive Failure

Table 1 gives the basic summary of all four variables. MCA had a mean of 41.64 and standard deviation of 8.81, MW with a mean of 15.93 and standard deviation of 5.44. MAA with a mean of 59.17 and standard deviation of 13.14, while CF had a mean of 64.26 and

standard deviation of 17.13. Skewness and kurtosis values for all variables are close to zero, suggesting roughly normal score distributions in the sample.

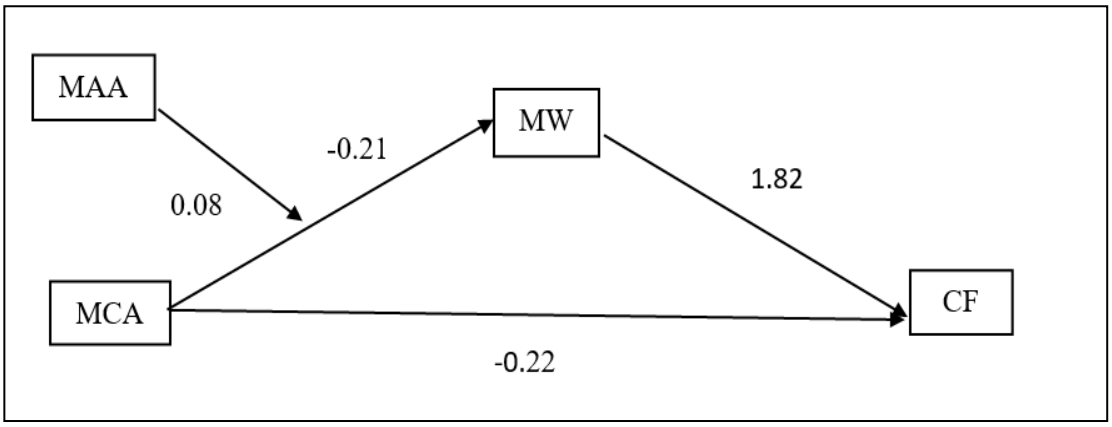
Table 2 Correlations among the Variables

	MCA	MW	MAA	CF
MCA	-			
MW	-0.324**	-		
MAA	0.267**	-0.502**	-	
CF	-0.303**	0.617**	-0.579**	-

*MCA: Metacognitive Awareness; MAA: Mindful Attention Awareness; MW: Mind-wandering; CF: Cognitive Failure; **significant at 0.01 level*

Table 2 reports the correlations among MCA, MW, MAA, and CF. MCA shows negative correlations with MW (-0.324**) and CF (-0.303**), and a positive correlation with MAA (0.267*). MW has a negative correlation with MAA (-0.502**) and a strong positive correlation with CF (0.617**), whereas MAA has a strong negative correlation with CF (-0.579**).

Figure 2 Hypothesized Model (with statistical values)



MCA ->MW: β= -0.21, p<0.001, MW->CF: β= 1.82, p<0.001, MCA->CF: β= -0.22, p<0.001, Interaction (MCA×MAA->MW): β= 0.08, p<0.001, MCA: Metacognitive Awareness; MAA: Mindful Attention Awareness; MW: Mind-wandering; CF: Cognitive Failure

Table 3 Regression Model Predicting Mind-wandering (MW; Mediator)

Predictor	t	p	LLCI	ULCI
MCA	1.74	0.08	-0.03	0.47
MAA	0.85	0.39	-0.11	0.27
MCA X MAA	-2.79	0.00	-0.01	-0.00

MCA: Metacognitive Awareness; MAA: Mindful Attention Awareness

Table 3 presents the regression model where MW is predicted from MCA, MAA, and their interaction MCA × MAA. MCA has t = 1.74 and p = .08 with a confidence interval from -0.03 to 0.47, which shows non-significant effect on MW. MAA has t = 0.85 and p = .39 with a confidence interval from -0.11 to 0.27, indicating no significant unique effect on MW. The interaction MCA × MAA is significant with t = -2.79, p<0.001 and confidence interval from

-0.01 to -0.00, meaning the impact of MCA on MW changes depending on the level of MAA.

Table 4 Conditional Effects of MCA on MW at Levels of MAA

MAA Level	Effect	t	p	LLCI	ULCI
Low (46.02)	-.0639	-1.78	0.07	-0.13	0.01
Medium (59.17)	-.1385	-4.86	0.00	-0.19	-0.08
High (72.32)	-.2316	-4.93	0.00	-0.32	-0.13

MCA: Metacognitive Awareness; MAA: Mindful Attention Awareness; MW: Mind-wandering

Table 4 shows the conditional effects of MCA on MW at three specific levels of MAA (Low, Medium, High). At low MAA (score 46.02), MCA has t = -1.78, p=0.07 with a confidence interval from -0.13 to 0.01. At medium MAA (59.17), t = -4.86, p<0.001 and confidence interval from -0.19 to -0.08. At highest level of MAA (72.32), MCA shows a strong effect on MW with t = -4.93, p<0.001 and confidence interval from -0.32 to -0.13, reflecting that the negative association between metacognitive awareness and mind-wandering became progressively stronger at higher levels of mindful attention awareness.

Table 5 Regression Model Predicting Cognitive Failure (CF; Outcome Variable)

Predictor	t	p	LLCI	ULCI
MCA	-2.65	0.00	-0.39	-0.06
MW	13.36	0.00	1.55	2.09

MCA: Metacognitive Awareness; MW: Mind-wandering

Table 5 is the regression model predicting CF as the outcome from MCA and MW. MCA has t = -2.65, p <.001 with confidence interval from -0.39 to -0.06, showing that higher MCA is significantly related to CF. MW has t = 13.36, p< .001 with confidence interval from 1.55 to 2.09, meaning MW is a strong and significant predictor of CF. Together these results indicate that MW plays a major role in explaining variance in cognitive failures, beyond the contribution of MCA.

Table 6 Conditional Indirect Effects (MCA->MW->CF) at levels of MAA

MAA Level	Effect	LLCI	ULCI
Low (46.02)	-0.12	-0.27	0.02
Medium (59.17)	-0.25	-0.36	-0.15
High (72.32)	-0.42	-0.62	-0.23

MCA: Metacognitive Awareness; MAA: Mindful Attention Awareness; MW: Mind-wandering; CF: Cognitive Failure

Table 6 displays the conditional indirect effects of MCA on CF through MW (MCA → MW → CF) across low, medium, and high levels of MAA. For low MAA (46.02), the confidence interval ranges from -0.27 to 0.02, which includes zero and indicates a non-significant indirect effect at this level. For medium MAA (59.17), the confidence interval ranges approximately from -0.36 to -0.15, suggesting a meaningful indirect effect of MCA on CF via MW when MAA is moderate. For high MAA (72.32), the confidence interval ranges roughly from -0.62 to -0.23, reflecting a stronger conditional indirect effect, meaning MCA influences CF through MW most clearly when MAA is high.

Table 7 Direct effect of MCA on CF

	Effect	t	p	LLCI	ULCI
MCA->CF	-0.22	-2.64	0.00	-0.38	-0.05

MCA: Metacognitive Awareness; CF: Cognitive Failure

Table 7 presents the direct effect of MCA on CF, with an effect value of -0.22 (t=-2.64, p<0.001), indicating a statistically significant negative relationship. The bootstrapped lower and upper confidence limits range from -0.38 to -0.05, falling entirely on the negative side without crossing zero. This pattern confirms a significant direct effect, meaning higher metacognition is directly associated with lower cognitive failure.

Table 8 Index of Moderated Mediation

	Index	Boot SE	Boot LLCI	Boot ULCI
MAA	-0.01	0.00	-0.02	-0.00

MAA: Mindful Attention Awareness

Table 8 provides the index of moderated mediation for MAA in the model MCA → MW → CF. The index value is -0.01 with a bootstrap standard error of 0.00, summarizing how strongly the indirect effect of MCA on CF via MW changes as MAA changes. The bootstrapped lower and upper confidence limits range from -0.02 to 0.00, barely touching zero but largely on the negative side. This pattern supports the presence of moderated mediation, meaning the mediation pathway through MW is dependent on the level of MAA.

DISCUSSION

The study tested a moderated mediation model in which metacognitive awareness was hypothesized to have both direct and indirect effects on cognitive failure through mind wandering. Furthermore, mindful attention awareness was hypothesized to moderate the relationship between metacognitive awareness and mind wandering. The results provided further support for the notion that cognitive regulation is not the result of separate mechanisms, but rather is based on a combination of higher-order awareness and attentional control mechanisms. Overall, the findings support the hypothesis that a higher level of metacognitive awareness offers some protection from everyday cognitive breakdowns, particularly when that awareness is based on mindful attention to present-moment experience.

The authors found that there was a relation between metacognitive awareness and mind wandering, but that the relation was indirect: the influence of metacognitive awareness on mind wandering was moderated by the awareness of experience. The authors concluded that metacognitive awareness of one's cognitive activity is insufficient for regulating attention in the absence of the awareness of experience. According to classical metacognitive theories, control processes in monitoring require knowledge of the current state of the mind (Flavell, 1979; Nelson & Narens, 1994). Being limited in terms of attentional awareness may impair an individual from noticing cognitive drift and weaken the effectiveness of metacognitive perception for regulating mind wandering.

Conditional effects analyses support this interaction, showing that at low levels of mindful attention awareness, metacognitive awareness is only weakly associated with mind wandering, indicating that people may be aware of a proclivity to mind wander but lack the ability to identify when their mind has wandered. At moderate and high levels of mindful

attention awareness, metacognitive awareness was positively associated with decreases in mind wandering. This is consistent with results showing mindfulness improves meta-awareness, the ability to notice what is happening in one's mind and how it is changing (Schooler et al., 2011; Smallwood & Schooler, 2015). Mindfulness appears to allow attentional disengagement and reorienting to occur earlier and optimize the efficiency of metacognitive strategies when they are engaged.

Past research has shown that mindfulness training increases sustained attention, working memory capacity, and executive control, which contribute to the top-down control of distraction from task-unrelated thoughts (Jha et al., 2007; Mrazek et al., 2012; Morrison et al., 2014). Here we show that mindfulness increases the ability to stop mind wandering and improves the helpful influences of metacognitive awareness on attentional control. This ties in with the idea that mindfulness provides the attentional "platform" for metacognitive control processes.

Mind wandering subsequently emerged as a strong and reproducible predictor of cognitive failure, thereby confirming mind wandering as a principal cause of quotidian cognitive failures (i.e., attentional lapses, lapses of memory, and errors of action) that people experience in everyday life (Broadbent et al., 1982). Mind wandering has been associated with increased errors, diminished vigilance, and impaired task performance in the lab (McVay & Kane, 2010; Kane et al., 2017) and everyday life (Ralph et al., 2019). Once attention has moved away from those demands, cognitive control likely suffers, resulting in an increased likelihood of making mistakes. These results support this body of literature, and suggest that mind wandering is an important mechanism through which higher-order cognitive factors influence functional outcomes.

Metacognitive awareness accounted for variance in cognitive failure even after mind wandering was controlled, suggesting metacognition promotes cognition via mechanisms beyond mind wandering and attentional control. Beliefs about cognitive processes may support monitoring of performance, error prediction, and strategy shifting. People with metacognitive awareness are better able to recognize errors, use alternative strategies, and correct mistakes (Efklides, 2008; Fernandez-Duque et al., 2000; Dunlosky & Metcalfe, 2009). Such processes may be a protective mechanism that stops cognitive dysfunction before it manifests as an overt error in behavior.

These findings provide strong evidence for the integrative role of mindful attention awareness, considering the mediating effect of mind wandering in the association between metacognitive awareness and cognitive failure was not important at low levels of mindfulness but meaningful and strengthened at moderate and high levels of mindfulness. This result also underlines the role of MAA in the modulation of MCA via attentional pathways. Indeed, without an adequate amount of MAA, MCA seems to remain inactive and hypothetical, while on the contrary metacognitive strategies can be activated in real time when one attends to their experience.

In addition, the important moderated mediation index indicates that the strength of the indirect effect changes with the level of mindful attention awareness, with the protective indirect effect of metacognitive awareness being stronger at higher levels of mindfulness. This result is consistent with integrative self-regulation models of self-control that stress the influence of attentional stability, monitoring and control (Bishop et al., 2004; Teper et al.,

2013), and also with neurocognitive evidence that mindfulness is associated with the efficient functioning of brain networks involved in executive attention and cognitive control (Tang et al., 2015; Fox et al., 2016).

These findings support the view that metacognitive monitoring and regulation occur through relational processes, with the meta-knowledge and regulatory mindset offered via metacognitive awareness, and the moment-by-moment awareness provided via mindful attention awareness, both being essential in detecting and correcting attentional lapses. It follows that combining the positive effects of mindfulness training with metacognitive training often results in stronger and more persistent results than either of these approaches delivered alone (Bellinger et al., 2015; Zenner et al., 2014; Roemer et al., 2015).

Implications

The findings of the study have both theoretical and practical implications: Theoretically, the current study contributes to the previous literature on metacognition and mindfulness by revealing that mindfulness and metacognition may not be independent of one another. This is consistent with the view that cognitive control arises from overlapping monitoring, attentional, and regulatory processes rather than being a unitary mechanism isolated from other functions.

In day to day life, the empirical findings can be interpreted to suggest that cognitive failure reduction efforts may be improved by improving attention and metacognitive abilities. For instance, training individuals to have metacognitive knowledge may not be effective if they do not also accrue attentional awareness to implement the metacognitive strategy effectively. Mindfulness-based interventions integrated with metacognitive training may make attention more stable, reduce mind wandering, and may even improve cognitive reliability in daily life. This could particularly be helpful in the domains of learning, healthcare, and professional life, all of which are often cognitively demanding, and in which cognitive failures can have serious consequences.

Limitations and Future Directions

Despite its contributions, the present study has several limitations that also point toward important directions for future research. The cross-sectional design restricts causal interpretations of the relationships among metacognitive awareness, mindful attention awareness, mind wandering, and cognitive failure; thus, longitudinal and experimental approaches are needed to establish temporal precedence and causal mechanisms. In addition, the exclusive reliance on self-report measures may have introduced common method variance, suggesting that future studies should integrate behavioral tasks, experience-sampling or ecological momentary assessment methods, and neurocognitive indicators to obtain more robust and ecologically valid assessments. Furthermore, mindfulness was operationalized mainly through mindful attention awareness, even though mindfulness is a multidimensional construct; examining specific facets such as acting with awareness, non-reactivity, and non-judging may provide a more nuanced understanding of their distinct roles in metacognitive regulation. Finally, extending this research to diverse populations and applied contexts, including educational, clinical, and occupational settings, would enhance the generalizability and practical applicability of the present findings.

CONCLUSION

The present study demonstrates that metacognitive awareness plays a crucial role in reducing cognitive failure, both directly and indirectly through mind wandering. Importantly, this indirect pathway is contingent upon mindful attention awareness, such that metacognitive awareness is most effective in reducing mind wandering—and consequently cognitive failure—when individuals are more mindful and attentive to the present moment. These findings advance understanding of the cognitive mechanisms underlying everyday cognitive lapses and highlight the synergistic relationship between metacognition and mindfulness in promoting adaptive cognitive functioning.

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Conflict of Interest

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