

The impact of meditation on cognitive flexibility: A critical review and the case for investigating True Self Meditation

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Abstract

Cognitive flexibility, the capacity to adapt thinking and behavior in response to changing environmental demands, is a critical component of psychological resilience and executive functioning. Meditation, particularly attention-based practices, has been associated with improvements in core cognitive processes, such as sustained attention, emotion regulation, and metacognitive awareness. Neuroimaging and behavioral evidence suggests that meditation activates neural networks involving the prefrontal cortex, anterior cingulate cortex, and limbic regions, which are crucial for set-shifting, adaptive learning, and executive control. While much of the current literature centers on Mindfulness Meditation, this focus has primarily served as a foundational framework for understanding meditation's cognitive effects. Other meditation modalities remain comparatively less explored in

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scientific literature, particularly in Western academic contexts.

True Self Meditation (TSM), a practice rooted in systematic emotional and cognitive reflection, represents a compelling but under-recognized area for investigation. TSM involves the active identification and systematic discarding of maladaptive emotional images, promoting positive, resilient cognitive patterns. Existing research suggests that TSM may directly target cognitive flexibility mechanisms by engaging neural processes related to memory storage, emotional regulation, and executive functioning. Moreover, TSM-based interventions have demonstrated significant improvements in psychological well-being, social adjustment, and neurocognitive activation. While a substantial body of self-report and observational research - particularly within South Korea - has examined TSM's psychological outcomes, limited work has investigated its neurocognitive mechanisms or broader applicability across diverse populations. This review synthesizes existing research on TSM's potential impact on cognitive flexibility, focusing on neural mechanisms and methodological strengths and weaknesses in the literature.

Addressing these gaps could offer valuable insight into how specific meditation practices differentially influence cognitive functioning. Future research should prioritize experimental, neuroimaging, and longitudinal approaches to clarify TSM's cognitive effects and potential as a targeted intervention. Expanding TSM's research will help capture the diversity of meditative practices and their unique contributions to cognitive and clinical outcomes.

Keywords: Cognitive flexibility, Meditation, Metacognition, True Self Meditation, Neuroplasticity

Introduction

Cognitive flexibility, the ability to adapt one's thinking and behavior to environmental demands, is essential for emotion regulation, problem-solving, and overall psychological well-being (Martin & Rubin, 1995). It is a core aspect of executive functioning and plays a significant role in emotion regulation and adaptive decision-making. Cognitive flexibility includes the capacity to view difficult situations as controllable (Korhan et al., 2021), consider multiple interpretations of human actions and life events (Dennis & Vandal Wal, 2010), and create alternatives to difficult situations (Ay, 2023). Individuals with higher cognitive flexibility are better able to match strategies to situational demands, identify ineffective strategies, and modify their behavior and mindset to achieve desired outcomes (Stange, Alloy, & Fresco, 2017). Furthermore, individuals with higher cognitive flexibility tend to demonstrate greater resilience to life stressors and improved overall well-being (Koster et al., 2011). In contrast, cognitive inflexibility can lead to maladaptive emotional regulation strategies, such as rumination (Aldao & Nolen-Hoeksema, 2012; Aldao, Sheppes, & Gross, 2015), and is commonly linked to various mental health issues, particularly major depressive disorder (MDD). Individuals with MDD often exhibit impaired cognitive flexibility when responding to both general stimuli and negative stimuli (Kashdan & Rottenberg, 2010; Zheng et al., 2024).

Cognitive flexibility is not a fixed trait; rather, it can be enhanced through targeted interventions, including attentional training methods such as meditation (Niering et al., 2023). Meditation has garnered significant attention for its ability to improve various aspects of cognitive functioning – such as attention, memory, and executive control – all of which are essential components of cognitive flexibil-

ity. Meditation can strengthen neuroplasticity and improve connectivity in brain regions critical for attention, emotion regulation, and self-awareness (Brandmeyer, Delorme, & Wahbeh, 2019; De Benedittis, 2015). These processes are foundational for cognitive flexibility, as they promote greater metacognitive awareness and adaptive behavioral responses to changing situations.

While much of the existing meditation research focuses on Mindfulness Meditation (MM), other forms of meditation, such as True Self Meditation (TSM), have received comparatively less scholarly attention, particularly in Western academic contexts. TSM is a structured method centered on identifying and discarding maladaptive emotional images to cultivate clarity and resilience. Although a substantial body of self-report and observational research on TSM has emerged over the past two decades in South Korea, its underlying neurocognitive mechanisms and applicability across diverse populations remain under-examined in Western science. This review aims to (1) synthesize existing research on meditation and cognitive flexibility, (2) highlight methodological strengths and weaknesses in current studies, and (3) identify critical gaps in the literature, with a particular emphasis on expanding the empirical understanding of TSM within cognitive and clinical research frameworks. The paper seeks to justify the need for further empirical studies on TSM to clarify its cognitive effects and broaden the scope of meditation research beyond MM.

Theoretical Framework

Neural correlates

Cognitive flexibility is primarily associated with the prefrontal cortex (PFC), which plays a key role in goal-directed behavior, adaptive decision-making, and cognitive control. Functional neuroimaging studies consistently show that the lateral PFC is activated during tasks involving set-shifting, while the orbitofrontal cortex is involved in reversal learning - both critical processes in cognitive flexibility (Hampshire & Owen, 2006). For example, a lesion study utilizing the Wisconsin Card Sort Task (Grant & Berg, 1948), a widely-used measure for cognitive flexibility that involves extra-dimensional set-shifting, found that ventrolateral PFC lesions (Brodmann's area 12/47) significantly impaired performance (Dias, Robbins, & Roberts, 1996).

In addition to the PFC, other brain regions contribute to cognitive flexibility. The anterior cingulate cortex (ACC) monitors conflict and facilitates adaptive responses to changing demands. ACC activation has been observed in tasks that involve detecting errors or shifts from the status quo and adjusting behavior accordingly (Ullsperger et al., 2014; Zühlsdorff et al., 2022). The posterior parietal cortex (PPC), which is responsible for attentional shifting, is also activated during cognitive flexibility tasks. As shifting attention between tasks is a central component of cognitive flexibility, the PPC helps direct attention from one task to another, enabling the brain to adjust behavior in response to new conditions (Dajani & Uddin, 2017).

Further, performance in attention switching tasks has been shown

to be predicted by white matter integrity in the basal ganglia, a structure closely connected to the PFC via fronto-striato-thalamic circuits (Alexander et al., 1986). Higher white matter integrity in the basal ganglia correlates with stronger connectivity to other brain regions, such as the PFC, facilitating more efficient and effective shifts in attention (van Schouwenberg et al., 2014).

Disruptions in the functional connectivity among these regions are commonly observed in individuals with depression, anxiety, and other disorders characterized by cognitive inflexibility, highlighting the importance of these neural structures in adaptive cognitive processing.

Meditation and cognitive flexibility

Meditation, especially attentional practices, specifically focuses on regulating attention and fostering meta-awareness. These practices engage the prefrontal cortex (PFC) and other neural networks involved in attention regulation, enhancing the ability to monitor and modulate cognitive and emotional states (Dahl, Lutz, & Davidson, 2015). Functional neuroimaging studies suggest that meditation, particularly attentional practices, affects the medial PFC, a region implicated in monitoring internal states and aligning thoughts with goal-directed behaviors (Sperduti, Martinelli, & Piolino, 2012). This enhanced monitoring is thought to contribute to the improvement of cognitive flexibility by facilitating greater awareness of thought processes and enabling more effective cognitive control.

One of the most widely practiced meditation methods, Mindful-

ness Meditation (MM), improves cognitive flexibility by enhancing attentional control and metacognitive awareness, which reduces rigid, maladaptive thinking patterns (Kabat-Zinn, 2003; Moore & Malinowski, 2009). MM-based practices are theorized to enhance metacognitive monitoring and attentional control by fostering non-judgmental awareness of the present moment. These practices have been linked to improvements in sustained attention, selective focus, and executive functions such as self-regulation, adaptive problem-solving, modification of learning strategies, and behavioral inhibition (Tang, Hölzel, & Posner, 2015; Raffone & Srinivasan, 2017).

Additionally, meditation practices rooted in Buddhist traditions, such as Samatha and Anapanasati meditation, have been shown to enhance cognitive flexibility by improving introspective accuracy and adaptive learning strategies, respectively (Baird et al., 2014; Uopasai, Bunterm, & Tang, 2022). In contrast, Transcendental Meditation (TM), another widely practiced form of meditation, has not been found to significantly impact cognitive performance (Canter & Ernst 2003). One possible explanation for this finding is that TM is not categorized as an attentional practice; rather, it involves the repetition of mantras to induce a state of effortless flow, which may not require active regulation of attention or concentration (Mosini et al., 2019). This distinction highlights that not all meditation practices engage the same cognitive mechanisms or yield comparable cognitive outcomes. Thus, it is important to investigate whether specific types of meditation may more efficiently and effectively target par-

ticular cognitive processes, such as cognitive flexibility, depending on their underlying mechanisms.

True Self Meditation

True Self Meditation (TSM) mirrors cognitive restructuring processes by prompting individuals to actively identify and systematically discard maladaptive thought patterns rather than passively observing them. TSM presents a scientific framework for mental cleansing, explaining that an individual's life experiences are stored as emotional images, which in turn influence thoughts, mindsets, and behaviors. These emotional images are systematically discarded across seven guided levels (see Table 1), ultimately allowing the individual to recover their true self (Woo, 2005; Woo, 2008; Woo, 2011; Woo, 2013). Throughout its development, TSM underwent several name changes, including Mind Subtraction Meditation, Maum Meditation, and Finding Your True Self Meditation, which may cause some confusion in the existing literature. However, all refer to the same underlying method now unified under the term True Self Meditation.

<Table 1> The 7 Levels of True Self Meditation

Level	Title	Description
Level 1	Discarding remembered thoughts	Confirming the Universe is one's self
Level 2	Discarding images of myself and human relationships	Confirming there are no false minds

Level 3	Discarding the body	Confirming the Universe exists within one's self
Level 4	Discarding the body and the Universe	Confirming the original Soul and Spirit
Level 5	Discarding the body and the Universe	Confirming the original Soul and Spirit and the world of the original Soul and Spirit
Level 6	Eliminating one's self and becoming the Universe	Becoming the original Soul and Spirit
Level 7	Discarding the illusionary world and the self that is living in the world	Reach true completion

At the neurophysiological level, these images are gathered through the five senses into the thalamus, where the information is organized to be sent through the respective neural circuits by the limbic system. The hippocampus stores and processes these memories, while the amygdala judges the stability and emotions linked with each of those memories, sending it to the basal ganglia to use these judgments to alter behavior (Baek, 2017). As the limbic system plays the largest role in the storage and processing of memories and events, it is also the most activated during TSM: the hippocampus identifies the images to be discarded, the amygdala releases the emotional responses embedded in these images, and the basal ganglia facilitates the actual elimination process (Baek, 2017).

Through cleansing the negative subjective mindsets and false perceptions, individuals can develop positive, resilient cognitive patterns reflective of the true mind (Yun, 2014). This active removal process fundamentally involves the identification of mental representations and pattern recognition (Kim, 2017), suggesting that

TSM may engage cognitive flexibility mechanisms more directly than other forms of meditation. By systematically eliminating the emotions embedded in each memory, individuals can fully discard dysfunctional thoughts and maladaptive behavioral tendencies (An, 2006).

Emerging research has identified several positive effects associated with TSM. A TSM-based intervention with breast cancer survivors significantly reduced symptoms of depression, anxiety, perceived stress, and sleep disturbance, while improving overall quality of life (Yun et al., 2017). Similarly, an eight-week school-based TSM intervention focusing solely on the first level demonstrated improvements in school adjustment among elementary school students (Yoo & Lee, 2013). A separate school-based study utilizing the same duration of TSM practice revealed significant improvements in social anxiety, aggression, and salivary cortisol levels (Yoo et al., 2016). A separate TSM-intervention targeting teachers revealed significant reductions in depressive symptoms, paranoia, obsessive-compulsive behaviors, interpersonal sensitivity, anxiety, somatization, and hostility (Lee, 2012). Participation in a one-week intensive TSM retreat led to significant increases in emotional well-being and reductions in negative affect. Among adolescents, a 12-week intervention resulted in a reduction in smartphone addiction tendencies, alongside improvements in self-control and problem-focused coping (Choi et al., 2020). Weekly TSM interventions produced significant increases in academic attention in pre-teens (Yun et al., 2020). A TSM-based

healing program for firefighters struggling with posttraumatic stress disorder also found significant decreases in symptoms and maladaptive ruminations (Kim, Lee, & Yoo, 2019).

Though most of the existing research on TSM focuses primarily on self-report data, there are still some studies that incorporate experimental data as well. One paired-difference study with adults found significant decreases in cholesterol levels and diastolic blood pressure in a healthy control group. Consistent TSM practice also significantly decreased systolic blood pressure in adults suffering from elevated blood pressure, as well as levels of gamma-glutamyl transpeptidase (γ -GTP), an enzyme reflecting chronic inflammation, in adult men (Yun et al., 2020). Moreover, a functional neuroharmony brainwave study found that neural structures involved in attention, stress resistance, responsiveness to illness, and overall executive function were significantly activated during TSM practice (Lee et al., 2015). Adolescents practicing TSM showed significant decreases in alpha-2 brainwave activity, indicating improved attention and concentration, along with notable brainwave shifts in the frontal region - an area linked to higher-order cognitive processing (Lee et al., 2012).

These findings provide preliminary evidence that TSM not only influences psychological outcomes but may also enhance core cognitive processes tied to adaptive functioning. Despite these promising results, TSM remains relatively understudied compared to other meditation practices. The majority of existing research has focused

primarily on outcome measures rather than elucidating the underlying mechanisms driving these changes. However, based on the structure of TSM and the observed benefits, it can be predicted that TSM may have robust effects on improving cognitive functioning overall. Because TSM is an active, attentional practice that requires individuals to concentrate on recalling life experiences and intentionally discard associated thoughts and emotions, it inherently demands high levels of concentration and executive control. Therefore, consistent practice of TSM may strengthen overall cognitive abilities, particularly cognitive flexibility.

Moreover, the systematic removal of emotionally charged thought patterns may disrupt maladaptive rumination cycles, thereby facilitating more adaptive emotional regulation. Given that cognitive inflexibility and poor executive control are common deficits in various clinical populations, the mechanisms inherent to TSM could hold profound implications beyond general well-being. Although much of the research thus far has focused on school-based interventions, TSM has the potential to be adapted for broader clinical application, offering a novel, mechanism-driven approach to enhancing cognitive and emotional functioning in individuals with compromised psychological health.

Critical Gaps in Literature

Despite promising evidence linking meditation to improved cognitive flexibility, current research suffers from several critical lim-

itations. Much of the Western literature has centered on MM, which, while foundational in meditation research, has constrained the field's theoretical breath. MM emphasizes nonjudgmental awareness of present experiences, whereas other modalities, such as TSM, engage fundamentally different mechanisms. Specifically, TSM involves the active identification and discarding of maladaptive thought patterns. This process resembles cognitive restructuring, suggesting that TSM may more directly target mechanisms underlying cognitive flexibility. Despite two decades of research conducted primarily in South Korea demonstrating TSM's benefits for well-being, social adjustment, and self-awareness, few studies have examined its neurocognitive effects or relevance in diverse populations outside of South Korea.

One major limitation in the literature is the lack of experimental studies directly investigating TSM's cognitive and neural effects using objective measures. Most existing work relies heavily on self-report outcomes (e.g., stress reduction, emotional well-being) through surveys and is rarely supplemented by behavioral tasks or neuroimaging measures that can illuminate underlying mechanisms. This absence limits the field's ability to identify how and why TSM promotes adaptive neurocognition nor the specific neurocognitive mechanisms involved in TSM. Without this understanding, it will be difficult to understand the depth of TSM's impacts.

Furthermore, most studies of TSM have been conducted in school or community settings, often without rigorous experimental designs, limiting generalizability to adult clinical or neurodiverse

populations that may benefit from mechanism-based interventions. Another critical gap is the scarcity of longitudinal or neuroimaging research tracking TSM's impact on attention, executive function, and emotion regulation over time. Without such studies, it remains unclear whether TSM's proposed cognitive restructuring effects are mediated by measurable changes in executive control, set-shifting, or related neural networks.

Future research should therefore prioritize addressing these critical gaps by designing studies that apply standardized behavioral tasks and neuroimaging methods to test TSM's effects on overall neurocognition, particularly on cognitive flexibility - one perceived major mechanism related to TSM. Rather than relying on MM as a comparative framework, future work should focus on understanding the unique mechanisms within TSM itself, such as emotional image discarding, memory processing, and self-concept transformation, and investigate how such mechanisms contribute to neural, cognitive, and clinical outcomes. Longitudinal designs with appropriate control groups will be necessary to establish causal mechanisms, while techniques such as fMRI or EEG could identify the neural pathways engaged by TSM, particularly within attentional, limbic, and prefrontal networks.

In addition, researchers should explore how TSM interacts with individual differences in emotional regulation, cognitive rigidity, or baseline executive functioning to determine which populations might benefit most from this intervention. Finally, clinical and ed-

ucational applications of TSM would benefit from evidence-based, mechanistically informed protocols that go beyond generalized assumptions about meditation and instead draw directly from the distinct psychological and neural processes that TSM engages. Addressing these gaps will not only refine the scientific understanding of meditation but also broaden the scope of cognitive and mental health interventions grounded in diverse contemplative traditions.

Conclusion

Meditation practices have demonstrated positive effects on cognitive flexibility. However, the field has largely emphasized a narrow subset of meditation types, leaving other practices like TSM underrepresented in neurocognitive and clinical research, especially in Western contexts. Given TSM's theoretical alignment with cognitive restructuring and self-reflective processes, it holds great promise for improving cognitive flexibility and mental health outcomes. While substantial observational and self-report research on TSM exists, especially in South Korea, its neurocognitive mechanisms remain insufficiently explored. Filling this research gap through rigorous experimental designs and neuroimaging studies will not only deepen our understanding of TSM's cognitive effects but may also pave the way for developing novel, targeted mental health interventions. By broadening meditation research to include diverse and underrecognized practices like TSM, future studies can better capture the multifaceted ways in which contemplative techniques support adaptive cognition.

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초록

명상이 인지적 유연성에 미치는 영향: 비관적 문헌 고찰과 마음수련 명상 연구의 필요성

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인지적 유연성은 변화하는 환경적 요구에 따라 사고와 행동을 융통성 있게 조절하는 능력으로, 심리적 회복탄력성과 실행 기능의 핵심 요소이다. 특히 주의 기반의 명상은 지속적 주의, 감정 조절, 메타인지적 인식과 같은 핵심 인지 기능의 향상과 관련이 있는 것으로 보고되어 왔다. 신경영상 및 행동 연구는 명상이 전전두엽, 전대상피질, 변연계와 같은 신경 네트워크를 활성화하며, 이러한 영역은 세트 전환, 적응적 학습, 실행 통제에 관여하는 것으로 알려져 있다. 현재까지의 연구는 주로 마음챙김 명상을 중심으로 이루어져 왔으며, 이는 명상의 인지적 효과를 설명하는 이론적 틀을 제공해왔다. 그러나 다른 형태의 명상은 상대적으로 과학적 탐구의 대상이 되어온 바가 적으며, 특히 서구 학계에서는 더욱 그러하다.

마음수련 명상은 체계적인 정서 및 인지적 성찰을 기반으로 하는 명상 기법으로, 과학적 탐색이 요구되는 잠재력 있는 영역이다. 마음수

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련 명상은 개인의 부적응적인 정서적 이미지들을 인식하고 이를 체계적으로 제거하는 과정을 통해 긍정적이고 회복탄력적인 인지 패턴을 형성하도록 돕는다. 기존 연구에 따르면 이 명상은 기억 저장, 정서 조절, 실행 기능과 관련된 신경 기제를 활성화함으로써 인지적 유연성 향상에 직접적으로 기여할 수 있는 가능성을 지닌다. 또한, 마음수련 명상 기반 증재는 심리적 안녕감, 사회적 적응, 신경인지 활성화 측면에서 유의미한 효과를 보인 바 있다. 특히 한국 내에서는 자기보고식 및 관찰 기반 연구를 통해 그 심리적 효과가 다수 검증되어 왔으나, 신경인지적 기제나 다양한 인구집단에 대한 적용 가능성은 제한적으로 탐색되어 왔다.

본 리뷰는 마음수련 명상이 인지적 유연성에 미치는 잠재적 영향을 신경 메커니즘 중심으로 고찰하고, 관련 문헌의 방법론적 강점과 한계를 종합적으로 분석한다. 이러한 연구적 공백을 메우는 것은 특정 명상 기법이 인지 기능에 미치는 차별적 영향을 이해하는 데 중요한 통찰을 제공할 수 있다. 향후 연구는 마음수련 명상의 인지적 효과를 보다 명확히 규명하기 위해 실험적 설계, 신경영상 기법, 종단적 접근을 우선적으로 적용해야 할 것이다. 본 명상 기법에 대한 연구 확장은 다양한 명상 방식의 인지 및 임상적 기여를 보다 정교하게 이해하는 데 기여할 것이다.

주제어 : 인지적 유연성, 명상, 메타인지, 마음수련 명상, 신경가소성