

# The relations of stimulus independent thought, personality and mindfulness.

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## Abstract

When not focused on a task, our thoughts often show an internal focus independent of external stimuli. Research has shown that these stimulus independent thoughts (SIT) during mind wandering states systematically vary across individuals and appear consistent over time, possibly reflective of trait-like personal characteristics. The current study examined the relations of SIT and personality factors. More importantly, it investigated the role of dispositional mindfulness in the relationship between SIT and personality. A sample of college students (N=104, mean age=19.6) completed the Amsterdam Resting State Questionnaire to assess SIT during a resting state. In addition, they completed personality measures using the IPIPNEO-120 and the Mindful Attention and Awareness Scale. Results revealed significant correlations between personality factors and three dimensions of SIT: comfort, discontinuity of mind, and self, indicating that these dimensions of SIT reflect stable personal traits. Further, a disposition toward mindfulness appeared to mediate the relationship between SIT and some personality factors, suggesting that mindfulness partially accounts for the prevailing thought pattern an individual experiences during mind-wandering states. Given the clinical significance of two dimensions of SIT, discontinuity of mind and comfort, findings from this study provide empirical basis for practitioners to better identify and target individuals who may benefit the most from mindfulness practices.

**Keywords:** Stimulus independent thought, Mindfulness, Mind wandering, Personality, FFM.

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## What is Stimulus Independent Thought?

Mind wandering or stimulus independent thought (SIT), is a prominent phenomenon, comprising almost half of daily cognition [1] (46.9%). These terms, SIT and mind wandering, are often used interchangeably in the literature to describe a seemingly natural tendency of the mind to “wander” towards internal cognitions. These instances can occur with or without the presence of an external stimulus, and produce self-generated thoughts independent of present contexts [2-4]. The term SIT therefore highlights the internal, rather than external, focus of thought processes during mind wandering states [5].

Corroborating self-reports of SIT, advanced research techniques have revealed specific brain activity patterns during mind wandering episodes. For example, studies utilizing event-related potentials (ERPs) have shown that instances of mind wandering can be characterized by a reduced awareness of one’s external environment [6,7]. Further, fMRI reveals that when the mind wanders inwardly and attention becomes decoupled from the external environment, activities increase within specific brain regions. These regions include the medial prefrontal cortex (MPFC), the temporoparietal junction, the medial and lateral temporal lobes, the posterior cingulate cortex, and the lateral parietal lobes [8-10]. Combined, these

regions have been termed the default mode network (DMN), and activities within the network are commonly involved in metacognitive processes such as prospection, retrospection, and theory of mind reasoning [8,10-12].

Given the prominence of mental activities that engage the DMN, researchers are motivated to examine the specific content and function of SIT. Thought content during these mind wandering states can serve adaptive functions such as planning for future actions, understanding others’ perspectives, fostering creativity, solving problems, regulating emotions, and reflecting on the self [12-15]. Thus, it is considered beneficial to overall psychological well-being [3,16,17]. For example, Blouin-Hudon and Zelenski found that positive and constructive thought content, characterized by the ability to manifest creative mental images and to enjoy the internal processes overall, was associated with overall positive well-being [2]. On the other hand, the authors found that thought content that focused on achievements and failures, and characterized by guilty or negative thought processes, was associated with an overall negative well-being. It is important to distinguish these opposing thought processes as individual tendencies for one over the other may support or hinder clinical interventions.

Despite the adaptive functions SIT can serve, SIT that occurs within the presence of a task can be disruptive. As the DMN takes over, activation in task-related areas decreases [9,18], thus focus is diminished. This disruptive effect of SIT magnifies as the cognitive demand required for a given task increases [19]. If experienced in excess during daily tasks, SIT can become maladaptive, leading to performance decrements and task errors, [17,19,20]. Additionally, individual tendencies toward thought content that is focused on achievements and failures may lead to rumination, which is considered a precursor of depression [21]. For example, studies have shown that a negative mood is often coupled with high frequency of mind wandering, leading to task unrelated thoughts and task errors [1,17,19,22]. Further, disinterest in tasks are associated with excessive retrospective thoughts [1,15,23,24]. These associations increase the prospect of SIT becoming maladaptive, especially among clinical populations, and highlight the importance to achieve a better understanding about SIT in relation to other psychological constructs and individual characteristics, such as personality traits.

### **SIT Content and Personality Traits**

In addition to the influence of these state-like factors (i.e., external stimuli, current mood, and task interest) on the frequency and content of SIT, the literature shows that tendency to experience SIT is stable across various contexts and is moderated by personal trait-like factors [2,19,25]. These trait-like factors have recently been studied in relation to SIT occurrence, its content, and its function.

In the Five Factor Model (FFM; i.e., openness, agreeableness, conscientiousness, extraversion and neuroticism), certain personality factors have been shown to be related to specific SIT styles. For instance, neuroticism, often associated with sensitivity to negative emotions and low-self-esteem [26], is related to SIT content that is characterized by thoughts of guilt or failure, and hostility, while openness is related to thought content that is positive and constructive in nature [2]. On the other hand, conscientiousness, associated with attentional control and low impulsivity [26], can be linked to fewer instances of mind wandering [2].

In addition to these larger personality factors, research has also examined distinct personality characteristics (e.g. self-directedness and cooperativeness), and revealed associations with specific phenotypes of SIT. Utilizing a proxy measure of the Cloninger's Temperament and Character Inventory [27,28] (IPIP-TCI), Diaz et al. examined such personality characteristics in relation to SIT content as assessed by the Amsterdam Resting State Questionnaire (ARSQ 2.0) [25]. Identifying ten dimensions of thought content (e.g. planning, thoughts of self, or feelings of comfort<sup>1</sup>), the ARSQ 2.0

<sup>1</sup> The ARSQ 2.0 identifies 10 dimensions of thought: *comfort* (i.e., feeling relaxed), *discontinuity of mind* (e.g. I had difficulty holding onto my thoughts), *sleepiness* (e.g. I felt sleepy), *planning* (e.g. I thought about things I need to do), *theory of mind* (e.g. I placed myself in other people's shoes), *self* (e.g. I thought about my behaviors), *somatic awareness* (e.g. I was conscious about my body), *visual thought* (e.g. I thought in images), *verbal thought* (e.g. I had silent conversations) and *health concern* (e.g. I thought about my health).

quantitatively evaluates possible SIT content during a resting state. Results have revealed significant negative correlations between personality characteristics such as self-directedness and dimensions from the ARSQ 2.0 such as thoughts of *self*, *discontinuity of mind* (i.e. scattered thoughts), and *planning*. Additionally, a significant positive correlation was found between self-directedness and feelings of *comfort* during the resting state. Diaz and et al. discussed this finding with regard to the model of behavior regulation [25,29], providing evidence that a tendency to exert control over one's own thoughts and behaviors was associated with lower frequency of SIT during a resting state, but a greater chance for a relaxed feeling. These findings extend from previous correlations found between personality factors and SIT content [2].

These relationships highlight important differences in thought processes among individuals. Concentrating on these relationships leads to recognition that specific individual characteristics factor in to overall thought processes, and thus overall well-being. This, in turn, can lead to improved identification of individualized interventions for those dealing with low self-esteem, depression, or even poor attentional control.

### **The Role of Mindfulness**

Apart from both state-like and trait-like factors, what else can lead to differences in SIT experiences, levels of psychological well-being, and clinical outcomes? Recently, the literature examined the role of mindfulness and its utility in the clinical setting. Mindfulness is defined as an enhanced state of awareness and attention to the present moment [13,30]. It is considered a construct in opposition to mind wandering in that mindful individuals are not easily distracted by irrelevant stimuli, and thus less likely to lose focus or control of current experiences [5,31]. It typically requires curiosity, openness, and acceptance of experiences [32]. In fact, dispositional mindfulness, as assessed by the Mindful Attention and Awareness Scale [30] (MAAS) has been found to be a valid predictor of errors on the Sustained Attention to Response Task (SART), with low levels of dispositional mindfulness leading to more errors on the SART and high levels of dispositional mindfulness leading to fewer errors on the SART [5,33,34].

Practicing mindfulness has been found to improve sustained attention and executive control, working memory, neural connectivity and self-referential processes [20,35,36], as well as to decrease levels of stress [37]. As such, many researchers have focused on individual differences in mindfulness and how a propensity to be mindful may relate to mental and physical health [13,30]. Specifically, mindfulness, as a state of meta-awareness, may directly relate to specific thought content that prevails in mind wandering states, fostering the adaptive functions that SIT may serve, and lessening its maladaptive effects. For example, as ruminating on past events during mind wandering states is maladaptive, and has been shown to be linked to deficits in overall psychological well-being [17,21], many therapeutic

approaches for depression and anxiety involve mindfulness techniques in an attempt to decrease these ruminative behaviors [30,38]. Over time, practicing mindfulness enables individuals to direct their attention away from negative thought patterns and to refocus on the present moment [30,38]. As a result, these techniques help to improve emotion regulation and to counter stress-related health issues [5,37].

Although everyone has the capability to practice mindfulness, it has been shown that individual differences exist with regard to willingness and ability to sustain conscious attention to the present moment [30]. Mindfulness has been shown to be correlated with personality factors [30,38,39]. Specifically, openness, agreeableness, and conscientiousness are associated with better mindfulness skills, possibly due to the associations of these personality traits with tolerance to new ideas, attentiveness to inner feelings, and self-regulation [38]. In contrast, neuroticism is negatively associated with mindfulness as mindfulness is typically associated with a reduced negative affect [32,40]. Lastly, there are mixed findings regarding the relation between extroversion and mindfulness [38,40]. As discussed above, thought patterns during mind wandering states seem to reflect, to a certain extent, stable trait-like personal characteristics [2,19,25]. Given the associations between mindfulness and personality factors and the significance of mindfulness practices in regulating one's thoughts and emotions, the present study aimed to uncover whether and how mindfulness might be able to account for the relationship between one's personality and the prevailing thought patterns during mind wandering states. These associations may lead to better prediction about how a disposition toward mindfulness, in relation to personal characteristics, may affect SIT experience and overall psychological well-being. Certain patterns of SIT, such as *discontinuity of mind* (as assessed by the ARSQ), have been shown positively correlated to anxiety and depression [41]. Findings from the current study may improve identification of individuals who may benefit most from therapy that utilizes mindfulness techniques. Therefore, understanding the relations among SIT, personality, and mindfulness may have important clinical implications for the development of diagnostic and intervention strategies.

In sum, the present study investigated the relationship between SIT content and the Big Five personality factors, expanding upon the previous work of Diaz et al. [25]. It also examined the role of mindfulness in relation to SIT content and personality factors. Based on findings of past research [2,25,37,38,40], we hypothesized that personality factors such as openness, agreeableness, and conscientiousness are positively associated with the adaptive dimensions of SIT as assessed by the ARSQ 2.0, including *theory of mind*, *self*, *planning* and *comfort*, but negatively associated with the maladaptive dimensions of SIT including *discontinuity of mind* and *somatic awareness*. In contrast, neuroticism would show an opposite pattern: positive association with *discontinuity of mind* and *somatic awareness*, but negative association with *theory of mind*, *self*, *planning* and *comfort*.

With regard to the role of mindfulness, we employed partial correlation analyses to determine whether mindfulness would account for the relations between personality factors and the different dimensions of SIT. We hypothesized that mindfulness may be a mediator between personality factors and SIT content, contributing to promoting the adaptive aspects of SIT and mitigating the maladaptive aspects of SIT.

## Method

### Participants

One hundred and twelve students from a mid-sized college in the Northeastern United States participated in this study. Eight participants were excluded from data analysis. These participants either did not comply with the no cellphone policy, as explained in the consent process, or manually skipped the resting period. The remaining 104 participants (54 female), aged 18-32 years ( $M=19.57$ ; two participants did not specify age), were included for data analysis. About 54% identified as White, 20.2% Asian, 14.4% African American, 6.7% Hispanic, and 4.8% specified as other, or did not want to specify.

### Measures

#### The mindful attention awareness scale (MAAS):

This 15-item scale assesses the core characteristics of mindfulness: frequency of mindfulness states, awareness of the present moment, sustained attention, self-reflectiveness, emotion regulation, and overall well-being. Participants indicate the extent to which each statement applies to him or her on a 6-point Likert scale ranging from "almost always" to "almost never," with higher scores indicating greater levels of mindfulness. Internal consistency of the scale ranged from .80 to .90 across populations of college students and adults, and test-retest reliability is 0.81 [30,32,42].

**The IPIP-NEO-120:** The short version of the IPIP-NEO [27,43] contains 120 items that assess the Big Five personality factors (i.e., openness, agreeableness, conscientiousness, extraversion, and neuroticism). Evaluated against the copyrighted NEO-PI-R [44], the average construct validity across the five factors is 0.69 [45]. Reliability ranges from 0.81 to 0.95 across the five factors [43]. The public access assessment can be accessed here: <http://www.personal.psu.edu/~j5j/IPIP/ipipneo120.htm>.

**The ARSQ 2.0:** This 54-item scale contains 10 dimensions of thought content: discontinuity of mind, theory of mind, comfort, sleep, planning, self, somatic awareness, visual thought, verbal thought and health concerns [25]. Participants rate each statement on a 5-point Likert scale pertaining to their thought patterns during a short resting state. Response options range from "Completely Disagree" to "Completely Agree". A sum of scores for each dimension is computed; higher scores indicate a greater tendency toward the specified dimension of SIT. Test-retest reliability for all dimensions remained high for up to 31 months of testing.

## Procedure

In contrast to previous studies conducted by Diaz et al. [25,41], the current study was conducted in person, rather than online. This was done in order to ensure participants had no external distractions, (e.g. use of a cellphone), and that each participant completed the required resting period.

At the time of the study, each participant entered the lab and was greeted by the researcher. All electronic devices were turned off and placed on the table behind the participant along with the participant's belongings. After the participant was seated in front of the computer screen, the researcher verbally provided information regarding the study, with the informed consent information also displayed on the screen for him or her to view. Headphones were then provided. By clicking *continue* at the end of the consent page, the participant agreed to participate in this study, and the researcher left the room.

Instructions and measures of the study were presented using Qualtrics Online Survey software. First, the MAAS and IPIP-NEO-120 were presented on the screen, with order counterbalanced across participants. After completing these two scales, on-screen instructions directed the participant to remain seated and relaxed with his or her eyes closed. Participants were instructed to allow their thoughts to wander for a 5-minute resting period. This procedure to induce a state ideal for mind wandering to occur is modeled after procedures used in past literature [5,25,41] to elicit a resting state and feelings of relaxation and mindfulness. The researcher monitored the participant from the opposite room to ensure that the participant did not manually skip the on-screen timer for the 5 min resting period. A beeping sound through the headphones signaled the conclusion of the resting period.

Upon the beeping sound, on-screen instructions directed the participant to click *continue* at the bottom of the screen to complete the ARSQ 2.0. The study ended with demographic questions assessing age, gender, ethnicity, and education level. Then, the researcher approached the participant to address any questions and concerns, and participation ended.

## Results

### Correlations between SIT dimensions and personality factors

Diaz et al. [25,41] utilized a confirmatory factor analysis to identify 30 of the 54 ARSQ items to evaluate the ten dimensions of SIT, with the three highest-loading items representing each dimension. Although we administered the full 54-item scale, we adopted the 30-item model for analyses. (Preliminary analyses utilizing all 54 items revealed significant correlations between the same variables as utilizing the 30-item model). The total score of the three items corresponding to each dimension was computed for each participant. Table 1 presents means and standard deviations of the 104 participants. In addition, for each participant, scores of personality and mindfulness were also computed based on responses to the IPIP-NEO-120 and the MAAS (Table 1).

Correlation analyses examined the relationship between the Big Five personality factors and the ten dimensions of SIT. Table 2 displays correlation coefficients ( $n=104$ ). Three of the ten dimensions showed significant correlations with personality factors. Specifically, *discontinuity of mind* was positively correlated with neuroticism,  $r=0.284, p=0.004$ . *Self* was positively correlated with openness,  $r=0.233, p=0.017$ . *Comfort* showed a positive correlation with extroversion,  $r=0.209, p=0.03$ , conscientiousness,  $r=0.202, p=0.04$ , and agreeableness,  $r=0.341, p=0.0004$ , but a negative correlation with neuroticism,  $r=-0.324, p=0.0008$ .

### Mindfulness as a mediator

The role of mindfulness was then assessed in relation to personality factors and the ten dimensions of SIT. First, correlation analyses confirmed that mindfulness was related

Table 1. Means and standard deviations of participant scores.

Dimensions of SIT Content (ARSQ 2.0)		
	<u>M</u>	<u>SD</u>
Discontinuity of Mind	8.76	2.64
Theory of Mind	9.04	3.05
Self	9.89	2.76
Planning	10.28	2.88
Sleepiness	8.55	3.27
Comfort	11.24	2.30
Somatic Awareness	7.99	2.99
Health Concern	5.33	2.34
Visual Thought	9.99	3.59
Verbal Thought	8.12	2.91
Personality Factors (IPIP-NEO-120)		
	<u>M</u>	<u>SD</u>
Openness	81.07	11.43
Agreeableness	88.38	11.71
Conscientiousness	89.58	11.28
Extroversion	83.17	11.20
Neuroticism	65.80	13.18
Mindfulness (MAAS)		
	<u>M</u>	<u>SD</u>
Overall Mindfulness	58.05	10.17

Table 2. Correlations of ARSQ 2.0 dimensions and personality factors (IPIP-NEO-120).

	N	E	C	O	A
Discontinuity of Mind	0.284** <sup>1</sup>	-0.078	-0.056	-0.065	0.050
Theory of Mind	-0.099	0.028	0.057	0.122	0.019
Self	0.166	-0.152	-0.110	0.233*	-0.053
Planning	-0.16	-0.041	-0.003	-0.075	-0.042
Sleepiness	0.181	-0.189	-0.035	-0.113	-0.003
Comfort	-0.324**	0.209* <sup>1</sup>	0.202* <sup>1</sup>	0.038	0.341**
Somatic Awareness	-0.058	-0.151	0.025	0.080	-0.024
Health Concern	0.045	-0.131	-0.088	0.058	-0.113
Visual Thought	-0.089	0.095	-0.159	0.076	-0.170
Verbal Thought	0.103	-0.052	0.038	0.153	0.093

\* $p<0.05$ , \*\* $p<0.01$ ,  $n=104$ , N: Neuroticism, E: Extroversion, C: Conscientiousness, O: Openness, A: Agreeableness

<sup>1</sup>Correlation was no longer significant after controlling for mindfulness

**Table 3.** Correlations of mindfulness (MAAS) with personality factors (IPIP-NE)-120 and SIT content (ARSQ 2.0).

Personality Factor	Mindfulness
Neuroticism	-0.492**
Extroversion	0.314**
Conscientiousness	0.355**
Openness	0.078
Agreeableness	0.332**
<b>ARSQ 20.0 Dimension</b>	
Discontinuity of Mind	-0.306**
Theory of Mind	0.134
Self	-0.103
Planning	0.007
Sleepiness	-0.058
Comfort	0.162
Somatic Awareness	-0.131
Health Concern	-0.228*
Visual Thought	-0.020
Verbal Thought	-0.172
* $p < 0.05$ ** $p < 0.01$	

to four personality factors and two SIT dimensions (Table 3). Specifically, mindfulness was significantly correlated with neuroticism, extroversion, agreeableness, and conscientiousness. Additionally, mindfulness negatively correlated with dimensions of *discontinuity of mind* and *health concern*. Based on these confirmed correlations, we conducted partial correlation analysis to test whether mindfulness, relating to four personality factors, would account for the correlations between personality factors and SIT.

Partial correlation analyses revealed a mediating effect of mindfulness. After controlling for mindfulness, neuroticism no longer significantly correlated with *discontinuity of mind*,  $r(101) = 0.161$ ,  $p = 0.105$ . Additionally, extroversion and conscientiousness no longer significantly correlated with *comfort*,  $r(101) = 0.168$ ,  $p = 0.089$  and  $r(101) = 0.156$ ,  $p = 0.116$ , respectively. In contrast, even with mindfulness being partial out, these correlations remained significant: agreeableness and *comfort*,  $r(101) = 0.309$ ,  $p = 0.002$ , neuroticism and *comfort*,  $r(101) = -0.284$ ,  $p = 0.004$ , and openness and *self*,  $r(101) = 0.243$ ,  $p = 0.013$ .

## Discussion

This study examined the relationship of personality factors, disposition toward mindfulness and SIT content during a resting state. Analyses revealed associations between personality factors and three dimensions of SIT as assessed by the ARSQ 2.0 [25]. Specifically, all personality factors, except openness, were related to the degree to which an individual expressed a general feeling of *comfort* during a short resting state. Neuroticism was associated with *discontinuity of mind*; and openness was associated with thoughts concerning *self*, supporting previous findings [2]. Further, partial correlation analyses revealed that a disposition toward mindfulness appeared to mediate the relationship of *comfort* with both extroversion and conscientiousness, as well as the relationship of *discontinuity of mind* with neuroticism.

Below, we discuss the findings with regard to these three dimensions of SIT, *comfort*, *discontinuity of mind* and *self*, and the implications of their associations with personality factors and mindfulness.

### Relations of SIT, personality and mindfulness

*Comfort* was positively correlated with agreeableness, conscientiousness and extroversion, but negatively associated with neuroticism. These associations between *comfort* and personality factors support the notion that at least some dimensions of SIT reflect trait-like personal characteristics, and may be stable over time [2,19,25]. This also supports the view that agreeable or conscientious individuals may be able to easily adapt to any new environment (e.g. a lab setting), and be able to find comfort in his or her surroundings [46]. Further, a feeling of *comfort* during a resting state could be a positive indicator of psychological well-being. For example, Diaz et al. [41] reported that *comfort* was negatively associated with measures for anxiety and depression. In the current study, *comfort* was negatively correlated with neuroticism, a personality trait often associated with depression and anxiety [26]. These findings indicate that a neurotic personality may show difficulty focusing on the present and enjoying the moment, which are often symptomatic of anxiety and depressive disorders [47].

Mindfulness did not appear to account for the correlation between *comfort* and neuroticism, suggesting that there may be other factors contributing to the connection between this personality trait and a general negative evaluation of one's current mental or physical state. This may indicate that mindfulness, as a meta-awareness mechanism, provides only a prerequisite for cognitive and emotional regulation. These regulation skills may be the essential condition to achieving feelings of serenity and control over one's thought during a relaxed state. Neurotic traits may make it more difficult for these individuals to practice and maintain a mindful, restful state. On the other hand, mindfulness did contribute to the positive correlations of *comfort* with extroversion and conscientiousness. That is, a mindful disposition might be a partial reason that extroverted and conscientious individuals are more likely to have a positive evaluation about their current state [40]. This may also shed light on the mixed findings of the relationship between extroversion and mindfulness [38,40] and SIT style [2]. Future research is needed to explore the prospect that these individuals are easy candidates to reap the benefits of mindfulness practice and training of regulation skills.

*Discontinuity of mind* appears as a maladaptive dimension of SIT, characterized by rapidly changing thoughts. Diaz et al. reported a positive association with measures for depression and anxiety [41]. In the current study, we found that *discontinuity of mind* was positively associated with neuroticism. That is, individuals with a neurotic personality trait were more likely to experience sporadic thoughts during a resting state. As discussed earlier, this might be due to the association of a neurotic personality with difficulty focusing

on the present and enjoying the moment, and feelings of anxiety [2,26,41,47]. Sporadic thoughts related to many different aspects of these individuals' lives may have seeped through when these participants tried to rest and relax, which again has been reported to be associated with deficits in overall psychological well-being [21]. Again, this highlights the importance of individualized intervention to lessen the burden of these maladaptive thought processes.

Results from the current study support previous findings of a negative correlation between neuroticism and mindfulness [32,40]. Furthermore, disposition toward mindfulness appeared to mediate the relationship between *discontinuity of mind* and neuroticism. Partial correlation analysis revealed that, after controlling for mindfulness, *discontinuity of mind* was no longer significantly correlated with neuroticism. This suggests that lack of meta-awareness might be the primary reason that individuals with a neurotic personality tend to experience more fragmented and intrusive thoughts during a resting state. This finding suggests that these individuals may possibly benefit the most from training in mindfulness techniques, even though it may be difficult for them. In addition, past research also suggests that individuals with a neurotic personality tend to have intense negative emotional reactions to situations [47]. Therefore, as a prerequisite for emotional regulation, practicing mindfulness may be beneficial not only in reducing sporadic thoughts among these individuals, but also in improving their overall psychological well-being.

Lastly, thoughts concerning *self* were found positively correlated to openness. This finding is in line with past reports that the personality trait openness involves attentiveness to one's inner feelings [38,46]. That is, this dimension of SIT as assessed by the ARSQ 2.0 again reflects, to a certain degree, one's stable personal characteristics. However, mindfulness did not appear to account for this connection between *self* and openness. In fact, in the current study, there was no association found between mindfulness and openness, contradicting an earlier report [40]. These mixed findings merit further investigation.

### **Categorization of SIT dimensions**

As introduced earlier, the ARSQ 2.0 delineates ten dimensions of SIT content during a short resting state: *discontinuity of mind*, *theory of mind*, *self*, *planning*, *sleepiness*, *comfort*, *somatic awareness*, *health concern*, *visual thought* and *verbal thought*. The authors of the ARSQ 2.0 argue that SIT, as assessed by this scale, reflects stable trait-like characteristics. Empirical evidence, including our findings to an extent, supports this notion. That is, findings of the current study, and the study conducted by Diaz et al. [25,41] seem to suggest that some of the dimensions might be more reflective of an individual's personal traits, such as *comfort*, *discontinuity of mind* and *self*, while dimensions such as *health concern*, *sleepiness* and *planning*, may be more reflective of state-like factors. Specifically, in the present study *comfort*, *discontinuity of mind* and *self* were the only

dimensions associated with personality factors. Likewise, Diaz et al. [25], found *discontinuity of mind* and *comfort* to each be associated with five of the seven temperaments and characters as assessed by the IPIP-TCI [27], while *self* associated with four of the seven temperaments and characters.

In future research, it may be useful to group specific ARSQ 2.0 dimensions into more general categories based on the underlying common factors suggested by extant studies. For example, it seems reasonable to group the ten dimensions of the ARSQ 2.0 into three categories. First, *discontinuity of mind*, *comfort* and *self* respondents to provide general evaluations about their physical and psychological states. As shown in prior research, these general evaluations may be reflective of stable personal traits. Second, *visual thought* and *verbal thought* require respondents to indicate the mode of their thought content or processes. These dimensions may shed light on understanding individual thinking styles. Finally, the rest of the dimensions, including *theory of mind*, *planning*, *sleepiness*, *somatic awareness* and *health concern*, tap into specific thought content and bodily experience. They are most likely situationally dependent, reflective of transient factors that can vary from situation to situation. In fact, some dimensions in this category indeed showed lower levels of test-retest reliability [25]. Further research is certainly necessary to evaluate this categorization and the underlying mechanisms of the different dimensions of SIT.

### **Limitations**

Finally, there are a few limitations to note about the current study. Foremost, this study utilized a convenience sample of undergraduate students, with a smaller sample size than previous studies [2,25,30,41]. However, despite a smaller sample, the strength of the correlations between SIT dimensions and personality factors revealed in the present study were comparable to reports by Diaz et al. [25]. Even stronger correlations between personality and dimensions of SIT content may be possible with a larger sample. Additionally, while the age range of this sample was relatively narrow, few studies have shown large differences in specific thought content between young and old individuals. Rather, age differences appear in relation to past- or future-oriented thought [48,49] and frequency of mind wandering states [4]. These are constructs that were not examined in the current study; we however acknowledge the need for further research on developmental trajectory that characterizes one's mind wandering states.

The current study assessed SIT during a short 5-minute resting period. Although this was modeled after previous research [25], this is a rather small time capsule with which we intended to peek into a person's mental world. A longer duration or a repetition of resting periods may help to better understand individual differences or fluctuation in cognitive dimensions of SIT. Lastly, although both the current study and past research found evidence for stability of certain dimensions of the ARSQ, future researchers should be

reminded that thought content during mind wandering episodes will always vary based on recent events or moods in an individual's life. Furthermore, the saliency of internal cognition will determine whether or not one can stay relaxed and focused on personal thoughts or if attention is pulled elsewhere, possibly to more salient external stimuli [4]. Results should always be interpreted with this in mind. For example, in the current study, the category of dimensions concerning general evaluations of an individual's state appeared most relevant to assessing trait-like factors. However, those dimensions that tap into specific thought content and bodily experiences might be more informative for researchers who focus on the effects of situational factors on one's cognitive and affective states.

## Conclusion

As mindfulness techniques continue to gain precedence in treatment methods for depression and anxiety, it is important to determine who would most benefit from these techniques. Specifically, it is clear that the mechanism by which these techniques promote overall psychological well-being vary among individuals based on personal characteristics. The current study revealed associations between certain personality factors and individual's self-reported thoughts regarding their psychological and physical states. Further, the current study found disposition toward mindfulness as a mediator for some of these associations. As practiced mindfulness appears as a popular therapeutic technique for reducing stress and ruminative thought patterns, as well as improving emotion regulation [5,37,38], it is important to investigate if this technique is applicable throughout the clinical population. Results from this study show that different state-like factors among individuals may make it more difficult for some individuals to benefit from mindfulness than others. Specifically, individuals with a neurotic personality trait may not benefit as easily from mindfulness training, and may need assistance from additional therapeutic approaches. The findings from the current study further support the notion of trait-like individual differences in thought patterns during mind wandering episodes, and the important role of mindfulness in accounting for individual differences in people's self-perceptions and evaluations.

## References

1. Killingsworth MA, Gilbert DT. A wandering mind is an unhappy mind. *Science*. 2010;330(6006):932.
2. Blouin-Hudon EC, Zelenski JM. The daydreamer: Exploring the personality underpinnings of daydreaming styles and their implications for well-being. *Consciousness Cogn*. 2016;44:114-29
3. Immordino-Yang MH, Christodoulou JA, Singh V. Rest is not idleness: Implications of the brain's default mode for human development and education. *Perspectives on Psychological Science*. 2012;7(4):352-64.
4. Maillet D, Schacter DL. From mind wandering to involuntary retrieval: Age-related differences in spontaneous thought. *Neuropsychologia*. 2016;80:142-56.
5. Mrazek MD, Smallwood J, Schooler JW. Mindfulness and mind-wandering: Finding convergence through opposing constructs. *Emotion*. 2012;12:442-8.
6. Barron E, Riby LM, Greer J, et al. Absorbed in thought: The effect of mind-wandering on the processing of relevant and irrelevant events. *Psychological Science* 2011;22(5):596-601.
7. Kam JWY, Dao E, Farley J, et al. Slow fluctuations in attentional control of sensory cortex. *J Cogn Neurosci*. 2010;23(2):460-70.
8. Christoff K, Gordon A, Smallwood J, et al. Experience sampling during fMRI reveals default network and executive system contributions to mind wandering. *Proc Natl Acad Sci*. 2009;106(21):8719-24.
9. Fox MD, Abraham ZS, Vincent JL, et al. The human brain is intrinsically organized into dynamic, anticorrelated functional networks. *Proc Natl Acad Sci U S A*. 2005;102:9673-8.
10. Spreng RN, Grady CL. Patterns of brain activity supporting autobiographical memory, prospection, and theory of mind, and their relationship to the default mode network. *J Cogn Neurosci*. 2009;22(6):1112-23.
11. Buckner RL, Carroll DC. Self-projection and the brain. *Trends Cogn Sci*. 2007;11(2):49-57.
12. Schooler JW, Smallwood J, Christoff K, et al. Meta-awareness, perceptual decoupling and the wandering mind. *Trends Cogn Sci*. 2011;17:319-26.
13. Rews-Hanna JR, Kaiser RH, Turner AE, et al. A penny for your thoughts: Dimensions of self-generated thought content and relationships with individual differences in emotional well being. *Front Psychol*. 2013;4(900).
14. Poerio GL, Totterdell P, Emerson LM, et al. Love is the triumph of the imagination: Daydreams about significant others are associated with increased happiness, love and connection. *Consciousness Cogn*. 2015;33:135-44.
15. Stawarczyk D, Majerus S, Maj M, et al. Mind-wandering: Phenomenology and function as assessed with a novel experience sampling method. *Acta Psychologica*. 2011;136(3):370-81.
16. Baird B, Smallwood J, Schooler JW. Back to the future: Autobiographical planning and the functionality of mind wandering. *Conscious Cogn*. 2011;20(4):1604-11.
17. Smallwood J, Fitzgerald A, Miles L, et al. Shifting moods, wandering minds: Negative moods lead the mind to wander. *Emotion*. 2009;9(2):271-6.
18. Smith SM, Fox PT, Miller KL, et al. Correspondence of the brain's functional architecture during activation and rest. *Proc Natl Acad Sci*. 2009;106:13040-5.

19. McVay JC, Kane MJ, Kwapil TR. Tracking the train of thought from the laboratory into everyday life: An experience-sampling study of mind wandering across controlled and ecological contexts. *Psychon Bull Rev.* 2009;16(5):857-63.
20. Mrazek MD, Franklin MS, Phillips DT, et al. Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychol Sci.* 2013;24(5):776-81.
21. Berman MG, Peltier S, Nee DE, et al. Depression, rumination, and the default network. *Soc Cogn Affect Neurosci.* 2010;6:548-55.
22. Seli P, Cheyne JA, Xu M, et al. Motivation, intentionality, and mind wandering: Implications for assessments of task-unrelated thought. *J Exp Psychol.* 2015;41(5):1417-25.
23. Poerio GL, Totterdell P, Miles E. Mind-wandering and negative mood: Does one thing really lead to another? *Consciousness Cogn.* 2013;22(4):1412-21.
24. Smallwood J, Nind L, O'Connor RC. When is your head at? An exploration of the factors associated with the temporal focus of the wandering mind. *Consciousness Cogn.* 2009;18(1):118-25.
25. Diaz BA, Van der Sluis S, Benjamins J, et al. The ARSQ 2.0 reveals age and personality effects on mind-wandering experiences. *Front Psychol.* 2014;5:271.
26. McCrae RR, Costa PT. Joint factors in self-reports and ratings: Neuroticism, extroversion and openness to experience. *Pers Individ Diff.* 1983;4:245-55.
27. Goldberg LR, Johnson JA, Eber HW, et al. The international personality item pool and the future of public-domain personality measures. *J Res Pers.* 2006;40:84-96.
28. Gow AJ, Whiteman MC, Pattie A, et al. Goldberg's 'IPIP' Big-Five factor markers: Internal consistency and concurrent validation in Scotland. *Pers Individ Diff.* 2005;39(2):317-29.
29. Cloninger CR, Svrakic DM, Przybeck TR. A psychobiological model of temperament and character. *Arch Gen Psychiatry.* 1993;15(12):975-90.
30. Brown KW, Ryan RM. The benefits of being present: Mindfulness and its role in psychological well-being. *J Pers Soc Psychol.* 2003;84(4):822-48.
31. Mrazek MD, Phillips DT, Franklin MS, et al. Young and restless: Validation of the mind-wandering questionnaire (MWQ) reveals disruptive impact of mind-wandering for youth. *Front Psychol.* 2013;4.
32. Baer RA, Smith GT, Hopkins J, et al. Using self-report assessment methods to explore facets of mindfulness. *Assessment.* 2006;13(1):27-45.
33. Robertson IH, Manly T, Rade J, et al. 'Oops!': Performance correlates of everyday attentional failures in traumatic brain injured and normal subjects. *Neuropsychologia.* 1997;35(6):747-58.
34. Smallwood J, Davies JB, Heim D, et al. Subjective experience and the attentional lapse: Task engagement and disengagement during sustained attention. *Consciousness Cogn.* 2004;13:657-90.
35. Kilpatrick LA, Suyenobu BY, Smith SR, et al. Impact of mindfulness-based stress reduction training on intrinsic brain connectivity. *NeuroImage.* 2011;56(1):290-98.
36. MacLean KA, Ferrer E, Aichele SR, et al. Intensive meditation training improves perceptual discrimination and sustained attention. *Psychological Science.* 2010;21(6):829-39.
37. Creswell JD, Taren AA, Lindsay EK, et al. Alterations in resting state functional connectivity link mindfulness meditation with reduced interleukin-6: A randomized controlled trial. *Biol Psychiatry.* 2016;78(10).
38. Baer RA, Smith GT, Allen KB. Assessment of mindfulness by self-report: The Kentucky inventory of mindfulness skills. *Assessment.* 2004;20(3):191-206.
39. Baum C, Kuyken W, Bohus M, et al. The psychometric properties of the Kentucky inventory of mindfulness skills in clinical populations. *Assessment.* 2010;17(2):220-9.
40. Giluk TL. Mindfulness, big five personality, and affect: a meta-analysis. *Pers Individ Diff.* 2009;47: 805-11.
41. Diaz BA, Van der Sluis S, Moens S, et al. The Amsterdam resting-state questionnaire reveals multiple phenotypes of resting-state cognition. *Front Hum Neurosci.* 2013;7.
42. MacKillop Jerson EJ. Further psychometric validation of the mindful attention awareness scale (MAAS). *J Psychopathol Behav Assess.* 2007;29:289-93.
43. Johnson JA. Measuring thirty facets of the five factor model with a 120-item public domain inventory: Development of the IPIP-NEO-120. *J Res Pers.* 2014;51:78-9.
44. Costa PT, McCrae RR. Revised NEO personality inventory (NEO PI-R™) and NEO five-factor inventory (NEO-FFI): Professional manual. Psychological Assessment Resources, Odessa, FL. 1992.
45. Maples JL, Guan L, Carter NT, et al. A test of the international personality item pool representation of the revised NEO personality inventory and development of a 120-item IPIP-based measure of the five-factor model. *Psychol Assess.* 2014;26(4):1070-84.
46. McCrae RR, John OP. An introduction to the five-factor model and its applications. *J Pers.* 2006;60(2):175-215.
47. Lahey BB. Public health significance of neuroticism. *Am Psychol.* 2009;64(4):241-256.
48. Giambra LM. Daydreaming characteristics across the



life-span: Age differences and seven to twenty year longitudinal changes, individual differences in conscious experience. *John Benjamins, Amsterdam*. 2000;147-206.

49. Jackson JD, Weinstein Y, Balota DA. Can mind-wandering be timeless? Atemporal focus and aging in mind-wandering paradigms. *Front Psychol*. 2013;4:742.

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