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Trait Absorption: Correlates And Role In A Mindfulness-Based Intervention For Social Anxiety

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Trait absorption: correlates and role in a mindfulness-based intervention for social anxiety

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APPROVAL PAGE

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COMPLIANCE PAGE

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ABSTRACT

Trait absorption, defined by Tellegen and Atkinson (1974) as “a disposition for having episodes of ‘total’ attention that fully engage one’s representational … resources”, has been explored in connection to placebo response, mystical experience, religiosity, and synesthesia. However, absorption has not been explored as a predictor of psychotherapeutic outcomes. Over the course of two studies, we sought to gain an understanding of absorption’s trait-level associations, as well as its role as a predictor of social anxiety reduction after a brief mindfulness paradigm. Namely, we hypothesized that individuals higher in trait absorption would experience larger reductions in social anxiety after a brief mindfulness meditation session. When controlling for state anxiety at pre-mindfulness baseline, we did not find absorption to be a significant predictor of anxiety reduction. However, we found absorption to be associated with lower proneness toward anxiety induction during a brief speech task. We also found trait absorption to be associated with other trait-level constructs (e.g. openness to experience, anxiety, mindfulness facets) to similar degrees across two demographically distinct samples.

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Throughout the rise of evidence-based psychotherapeutic and pharmacotherapeutic treatments for mood disorders, the problem of small effect sizes and large inter-individual differences in efficacy has plagued attempts to design “magic bullet” clinical mental health treatments (Preskorn, 2014; Tajika et al., 2015). To this end, inter-individual predictors of psychotherapeutic efficacy have become the subject of great interest, with extensive research dedicated to uncovering the demographic, behavioral, and genetic factors accounting for patients’ varied response. The recent boom in network analysis and “precision mental health” modeling testifies to a shift toward treating each individual as a causal network of his or her own, rather than a case of a particular disorder with its own one-size-fits-all gold standard treatment (Bickman et al., 2016; Fisher et al., 2017). However, of late, personality-level factors have tended to receive short shrift. This has not always been the case.

In the mid-20th century, one such widely-considered personality-level factor was hypnotic suggestibility, that is, the trait-level construct measuring how easily one can be effectively hypnotized—with hypnosis itself explored as a therapeutic intervention for a wide range of conditions (Lynn & Rhue, 1991). However, Tellegen and Atkinson (1974) noted the limitations of hypnotic suggestibility as a construct measured by the Stanford Hypnotic Susceptibility Scales and ramified in later analyses—not least among these limitations, their computation of a hypnotic suggestibility variable without the context of “known major personality dimensions as reference variables” (p. 269). To reconceptualize the main themes of hypnotic suggestibility within the scheme of

major personality dimensions, Tellegen and Atkinson conducted a novel factor analysis of items mostly derived from existing hypnotic suggestibility scales, and obtained only one higher-order factor associated with Hypnotic Susceptibility (Shor & Orne, 1962) and Hypnotic Depth (Field, 1965). This higher-order factor, which included such loadings as Reality Absorption, Fantasy Absorption, Dissociation, and Devotion-Trust, emerged from the analysis alongside Stability and Introversion—leading to its characterization by Tellegen and Atkinson as a dimension of personality independent of these two other major dimensions.

Tellegen and Atkinson (1974) operationalized this newly-identified personality dimension as “absorption”, initially defining it as “a disposition for having episodes of "total" attention that fully engage one's representational (i.e., perceptual, enactive, imaginative, and ideational) resources” (p. 268). In this account, absorption—as it differs from one individual to another—manifests in both cognitive terms (“the ability to operate diverse representational modalities synergistically … ‘syngnosia’” … a distinctive cognitive style) and motivational-affective terms (“a desire and readiness for object relationships … that permit experiences of deep involvement”) (p. 275). Here, Tellegen and Atkinson also make sure to emphasize the dual trait-state quality of absorption—that is, that different trait levels of trait absorption lead to different frequencies and depth of state-level absorption—but opt not to operationalize the latter (a business left to Pekala, 1991, and Hall et al., 2016).

Later seminal papers opted for more concise framing, with a later examination by Tellegen (1981) describing individuals higher in absorption as

tending toward “experiential” engagement with objects of attention—non-volitional, “flow”-like, and deep—rather than the “instrumental” engagement characteristic of effortful, “goal-directed” behavior (p. 222). Meanwhile, Roche and McConkey (1990) describe absorption simply as “a characteristic that involves an openness to experience emotional and cognitive alterations across a variety of situations” (p. 91).

To this day, trait-level absorption is measured using either the 34-item Tellegen Absorption Scale (1974), or its descendant, the Modified Tellegen Absorption Scale (MODTAS; Jamieson, 2005), which identifies five primary factors: synesthesia, altered states of consciousness, aesthetic involvement in nature, imaginative involvement, and extrasensory perception. In the case of the original scale, which we will refer to throughout the length of this study, the 34 items are framed as binary true/false statements.

From the beginning of its history in the personality literature, absorption has been described in connection to the better-known major personality dimension of openness to experience. Tellegen and Atkinson’s original factor analysis includes openness to experience (not yet defined in Big Five personality dimension terms) as a primary factor loading for trait absorption (1974). In fact, trait absorption is in older circulation than openness to experience as conceived and refined by McCrae and Costa (1987), who drew upon absorption-related items in the formulation of the openness to experience construct (Glisky et al. 1991). As such, absorption appears to be strongly associated with certain facets of openness, namely Fantasy and Aesthetics, but not with others (Radtke &

Stam, 1991). Moreover, not only did Glisky et al. (1991) find a strong overall correlation between overall absorption and openness to experience (r = .68), but they also identify absorption—or something very close to it—as one of openness to experience's two primary factors, alongside an unrelated factor called "liberalism", more connected to intellectual curiosity and political liberalism (Camfield, 2008). Taking their analysis of absorption and openness to experience one step further, they call into question the coherence of the "openness to experience" dimension in personality—and instead suggest the inclusion of absorption and liberalism as independent primary personality dimensions (Glisky & Kihlstrom, 1993).

Proceeding from observations that absorption is positively correlated with both increased positive and negative emotionality, Lilienfeld (1997) found trait absorption to be significantly associated with both "anxiety sensitivity" and recent history of panic attacks. Meanwhile, Wolfradt and Meyer (1998) found strong positive associations between absorption and both state and trait anxiety in a mixed sample of normal and anxious adults. On the other hand, in a study of meditators, Davidson et al. found no significant association between trait absorption and trait anxiety (1976). This mixed picture invites further investigation.

Meanwhile, one especially rich line of inquiry has focused on the relationship between absorption (and its close cousin, hypnotic suggestibility) on one hand, and mindfulness and meditation on the other. Davidson et al. (1976) found a linear relationship between TAS score and level of meditation experience

(control, beginner, short-term, and long-term), a finding supported by Berkovich-Ohana and Glicksohn (2017), but neither analyzed measures of trait-level mindfulness. Additionally, using a structural model of mindfulness and meditation depth during meditative experiences, Holzel and Ott (2006) found absorption to be strongly associated with meditation depth and moderately with overall mindfulness. Raz and Lifshitz's volume, "Hypnosis & Meditation", meanwhile, notes that despite several common underpinnings, hypnotic/high-absorption states and meditative/high-mindfulness states are phenomenologically distinct, and not clearly correlated with one another (2016). To this point, Sheldon et al. (2014) quantify the "experiential incompatibility of mindfulness and flow absorption", noting a significant *negative* relationship between mindfulness (as measured by the Mindful Attention and Awareness Scale) and absorption (as proxied, inexactly, by the Absorption subscale of the Flow Short Scale).

Finally, evidence has been marshaled for trait absorption's biological basis. Using a sample of 336 individuals, Ott et al. (2005) found that subjects with the T102C polymorphism—a mutation in the gene that codes for 5-HT2AR (5-hydroxytryptamine receptor 2A) binding capacity—scored significantly higher in absorption, while an interaction effect was found whereby participants with the T102C polymorphism *and* the Val158Met polymorphism (part of the gene that codes for COMT, or Catechol-O-methyltransferase, production) score even higher in trait absorption. Meanwhile, on the brain level, Grant et al. (2013) found that in both meditators and non-meditators, higher trait absorption was associated with increased cortical thickness in several regions involved in

cingulo-fronto-parietal attention networks. A wider literature, somewhat beyond the scope of this review, deals with the structural and functional correlates of hypnotic and meditative states, although Cojan et al. (2015) describe contrasting patterns of brain network activity in high- versus low-hypnotizability subjects during a standard attention task (Landry et al., 2017).

Beyond the trait level, absorption has also been associated with such phenomenological constructs of interest as synesthesia, religiosity, and personal mystical experience (Roche & McConkey, 1990; Levin et al., 1998; Coleman et al., 2019). Meanwhile, a growing literature has identified absorption as a strong independent predictor of both mystical-type experiences and challenging experiences after the ingestion of a psychedelic drug (Russ et al., 2018; Haijen et al., 2018). Curiously, typical drugs in this class are either active at the 5-HT2A receptor site or metabolized by COMT—polymorphisms for the production of which have been linked to higher trait absorption—and have been demonstrated to enhance suggestibility, a construct closely related to absorption (Lopez-Gimenez & Gonzalez-Maeso, 2018; Cuyas et al., 2011; Carhart-Harris et al., 2014).

Notably, absorption has also been examined as a possible factor in differential strength of placebo response, the hypothesis being that individuals higher in trait absorption would be more prone to take seriously the suggestion that a sham medical intervention will have healing effects. For example, in a study that measured placebo response to a sham treatment for multiple sclerosis symptoms, Owens and Menard (2011) found trait absorption to be significantly

positively associated with placebo response, independent of positive expectancy—an association they linked to high absorption scorers' "enhanced self-regulation capacities", which "might be engaged toward a therapeutic outcome" (p. 818). In an attempt to test a similar account of absorption's relationship to placebo response, Whalley et al. (2007) found absorption to be unrelated to participants' placebo response to a sham analgesic hand cream, leading them to suggest that expectancy and subtle differences in context might swamp any trait-level inter-individual differences in placebo response. Clarifying the nature of the relationship between absorption and placebo response, as well as its variability across contexts, is a task that remains open to future researchers.

Based on a review of sources, however, there seems to be a gap in the literature when it comes to the role of absorption as a moderator of *psychotherapeutic interventions*' effectiveness (Tellegen, 1981). Compared to pharmacological and somatic interventions, psychotherapies involve a great deal of conscious ideation and participation, which one could imagine might be conditioned by trait-level differences in openness to immersion in new states and relationships. More specifically, it is possible that individuals higher in absorption are disposed toward deeper engagement with the therapeutic exercises, frames of mind, and interpersonal relationships that comprise psychotherapy for a variety of different disorders and psychopathologies. Finally, to the extent that the efficacy of various psychotherapeutic (and even pharmacotherapeutic) interventions for mood disorders might be mediated by placebo response, trait

absorption might in turn be an individual-level moderator of this effect. Screening for absorption might prove to be a high-impact way to predict the effectiveness of certain therapeutic programs—and with a robust body of data, it might even be possible to assign individuals to different treatment regimens depending in part on their baseline level of absorption. Generally speaking, we expect that individuals higher in trait absorption will respond more strongly to psychotherapeutic interventions than individuals lower in trait absorption—keeping in mind the possibility that this effect might vary considerably depending on the intervention.

While our question of interest applies to a broad range of interventions and targets, we decided to explore this hypothesis in the context of a mindfulness-based intervention for anxiety, and more particularly, social anxiety. First, we were motivated to explore the relationship between absorption and mindfulness meditation-based interventions specifically, given the role played by the capacity for full attentional engagement and an "experiential set" in meditative experiences, as well as the recent mainstreaming of mindfulness practices and therapeutic interventions (Raz & Lifshitz, 2016). While it is possible that trait absorption moderates responses to a range of different therapeutic interventions, by way of absorption in therapeutic tasks and games of all kinds, or therapeutic alliance, a focus on absorption's relationship to the internal, attentional processes of mindfulness allows us to get more directly at the cognitive core of absorption, as characterized by Tellegen and Atkinson (1974). In addition, we aimed to investigate this relationship in the case of a mindfulness-based intervention for

anxiety, given the complex literature on trait absorption's relationship to anxiety sensitivity (demonstrated by Lilienfeld, 1997) and trait anxiety (claimed by Wolfradt and Meyer, 1998, but doubted by Davidson et al., 1976) and yet, the absence of experimental data linking trait absorption to post-therapeutic changes in state anxiety. Specifically, we chose to focus on *social* anxiety, given the total absence of published literature on the specific relationship between absorption and proneness to anxiety in interpersonal contexts—and the conspicuous rarity of work on absorption in social context, more generally.

Moreover, we also encountered a robust literature describing effective mindfulness-based interventions for both social anxiety and generalized anxiety—most of which did not require the presence of a clinically-trained therapist to carry out (Goldin & Gross, 2010; Orsillo & Roemer, 2005). Of particular interest, several of these followed a brief mindfulness paradigm and showed promising short-term anxiety-reducing effects, setting a precedent for mindfulness-based anxiety reduction interventions that can be conducted within a single lab session (Call et al., 2014; Chen et al., 2013). Given the diversity of mindfulness practices, and their non-comparability in a therapeutic context, we also aimed to compare the efficacy of multiple types of guided mindfulness meditation in our study. Namely, we chose one guided meditation focused on thoughts, and another focused on breath—two common approaches to mindfulness meditation whose efficacy and mechanisms have not been extensively compared.

Following these considerations, we set about testing the question of whether trait absorption moderates the effects of guided mindfulness meditation on state (social) anxiety. The key manipulation took the form of an 8-minute guided mindfulness meditation (of one type or another), with an 8-minute relaxing music session as control (the former, borrowed from Bravo et al., 2018; the latter, adapted from Carpenter et al., 2019). In the interest of limiting lab sessions to 30 minutes, we decided to measure absorption and other trait-level variables in an initial at-home session and to take state-level measures of anxiety and other variables of interest at different timepoints of interest during the lab session.

In the process of modeling our experimental intervention, we also considered the possibility that trait absorption might be associated at baseline with either trait anxiety, trait mindfulness, or both. In the case of the former, evidence from the literature is mixed; in the case of the latter, not properly examined on a trait level (Wolfradt & Meyer, 1998; Raz & Lifshitz, 2016). In order to accurately gauge the baseline relationship between these traits of interest, validate existing statistics on absorption's trait-level associations, and expand the map of absorption's trait-level associations to new territory unaccounted for in the published literature, we decided to conduct an exploratory, general-population study of absorption's associations with a broad battery of different trait-level constructs. Among these were openness to experience and anxiety, both associated with trait absorption in the literature, and five-facet mindfulness, cognitive fusion, and rumination, until now, not formally measured in relation to trait absorption.

For our first study, an exploratory correlational survey, we hypothesized that trait absorption will show a medium-to-strong association with trait openness to experience, and a weak association with trait anxiety, based on the aforementioned literature.

For our second, experimental study, we hypothesized that individuals higher in trait absorption would experience a greater reduction in anxiety after a brief mindfulness intervention. We also hypothesized that higher state absorption during this intervention, as measured by the Absorption subscale of Pekala's Phenomenology of Consciousness Inventory, would experience a greater reduction in anxiety symptoms. In addition, we hypothesized that higher state mindfulness during the intervention, as measured by the Toronto Mindfulness Scale (TMS), would be associated with a greater reduction in anxiety symptoms. Most fundamentally, we expected participants in the active conditions (i.e. either of two types of mindfulness meditation) to experience a greater increase in state mindfulness and a greater reduction in state anxiety than participants in the control condition (i.e. relaxing music). Finally, we hypothesized that our two distinct population samples would exhibit trait-level associations similar in direction and magnitude.

Method: Study 1

Participants. 202 participants were recruited through Amazon's Mechanical Turk platform, given no more information about the task than "Complete questionnaires about your attitudes and behavior". Recruitment criteria were a United States location, having been approved for over 50

Mechanical Turk tasks in the past, and having been approved for over 95% of tasks completed on Mechanical Turk.

Materials.

Table 1

Measures Taken During Study 1

	Sample Items	Original Study
TAS (Tellegen Absorption Scale)	"Sometimes I feel as if my mind could envelop the whole world." "Things that might seem meaningless to others often make sense to me."	Tellegen and Atkinson, 1974
STAI (Spielberger State-Trait Anxiety Inventory): Trait anxiety items	"I feel nervous and restless" "I have disturbing thoughts"	Spielberger, 1983
BFI (Big Five Inventory): Openness measures	"Is curious about many different things" "Is inventive"	John et al., 1991
FFMQ (Five Facet Mindfulness Questionnaire)	"I watch my feelings without getting lost in them" "I can usually describe how I feel in the moment in considerable detail"	Baer et al., 2006
CFQ (Cognitive Fusion Questionnaire)	"I tend to get very entangled in my thoughts" "I get upset with myself for having certain thoughts"	Gillanders et al., 2014
RRS (Ruminative Response Scale)	How often do you: "Think 'Why can't I get going?'" "Think about how sad you feel?"	Nolen-Hoeksema and Morrow, 1991

Tellegen Absorption Scale (TAS). Developed by Tellegen and Atkinson, this scale was designed to measure individuals' tendency to become deeply engaged with objects of attention, emotions, or states of mind (1974). It consists of 34 statements, which respondents are asked to describe as either "True" or "False". A response of "True" is scored as 1 point, and response of "False" is scored as 0 points; item responses were summed; a higher score indicates higher trait absorption.

Spielberger State-Trait Anxiety Inventory (STAI). Developed by Spielberger as a self-report measure, this scale is designed to capture both state- and trait-level anxiety, each with their own set of anxiety-relevant statements (1983). Given its focus on trait-level associations, the present study uses the portion of the STAI aimed at capturing trait-level anxiety, and excludes questions aimed at measuring state-level anxiety. The 20 items were scored on a four-point Likert scale with options "Almost never", "Sometimes", "Often", and "Almost always". For items indicative of anxiety, "Almost always" scored 4 points and "Almost never" scored 1 point, while for items contraindicative of anxiety, "Almost never" scored 4 points and "Almost always" scored 1 point. All item responses were summed; a higher score indicates higher trait anxiety.

Big Five Inventory (BFI). John, Donahue, and Kentle developed the BFI as a self-report measure for capturing openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (1991). The present study uses only the 10 items measuring openness to experience. These items, which take the form of third-person statements about the respondent's

self, were scored on a five-point Likert scale with options “Disagree strongly”, “Disagree a little”, “Neither agree nor disagree”, “Agree a little”, and “Agree strongly”. For items indicative of openness to experience, “Agree strongly” scored 5 points and “Disagree strongly” scored 1 point, while for items contraindicative of openness to experience, “Disagree strongly” scored 5 points and “Agree strongly” scored 1 point. All item responses were summed; a higher score indicates higher openness to experience.

Five Facet Mindfulness Questionnaire (FFMQ). Introduced by Baer et al. to capture mindfulness and its five cardinal facets (i.e. observing, describing, acting with awareness, nonjudgment, and nonreactivity), this scale consists of 39 items, divided across five sub-scales (2006). Each item is a self-referential statement scored on a five-point Likert scale, from “Never or very rarely true” (1 point) to “Very often or always true” (5 points). All item responses were summed both in aggregate and within individual subscales; a higher score indicates higher trait mindfulness, or enrichment for any particular facet of mindfulness.

Cognitive Fusion Questionnaire (CFQ). This questionnaire was developed by Gillanders et al. to capture the degree to which an individual is high in cognitive fusion; in other words, how much one feels “hooked” by or identified with his or her “thoughts, beliefs, memories, and self-stories” (2014). The CFQ consists of 7 items, each scored on a 7-point Likert scale from “Never true” (1 point) to “Always true” (7 points). All item responses were summed; a higher score indicates higher cognitive fusion.

Ruminative Response Scale (RRS). Nolen-Hoeksema and Morrow (1991) developed this scale with the aim of capturing "ruminative response"—the degree to which an individual copes with depressed mood by ruminating (1991). The RRS consists of 22 items, each scored on a 4-point Likert scale from "Almost never" (1 point) to "Almost always" (4 points). All item responses were summed; a higher score indicates a higher propensity toward rumination.

Procedure. Participants answered a series of questionnaires adapted from standard personality batteries measuring trait-level absorption, anxiety, openness to experience, mindfulness, cognitive fusion, and rumination (Table 2). The combined survey was hosted on Qualtrics and distributed through Amazon's Mechanical Turk. Meaningful engagement was gauged by three attention checks (e.g. "Please select the response, "Always true"), as well as submission of a code provided at the very end of the survey. Participants gave their signed consent, and were allocated a maximum of 40 minutes to complete this procedure.

Results: Study 1

Of the 202 participants recruited on Amazon Mechanical Turk, 11 were excluded from data analysis for either failing an attention check (n = 8) or failing to provide the correct code generated by Qualtrics at the end of the survey (n = 3).

Sixty-seven percent of participants identified as male, 32% identified as female, and 1% identified as nonbinary. 76% identified as white, 11% identified as Asian, 7% identified as black or African-American, 4% identified as Hispanic

or Latino, and less than 1% each identified as Native American and mixed. The mean age of participants was 35.9, with a range of 20 to 66.

Descriptive statistics for all of the trait-level variables measured can be found in Table 2.

Table 2

Descriptive Statistics, Study 1

Measure	*M*	*SD*	Minimum	Maximum
Absorption	15.95	8.36	0	34
Openness to Experience	37.05	7.75	12	50
Anxiety	43.09	13.54	20	76
Rumination	44.15	16.72	19	87
Cognitive Fusion	23.02	11.15	7	48
Mindfulness	131.34	21.33	74	191
Observing	26.06	6.48	8	39
Describing	27.39	7.06	8	40
Acting With Awareness	28.48	7.05	9	40
Nonjudgment	27.91	8.14	8	40
Nonreactivity	21.51	5.60	7	35

Correlational Analyses

A series of correlations were performed in order to determine any relationships among the variables measured in the exploratory survey. Pearson correlations were calculated for all variable pairs, and in the case of the FFMQ, correlations were taken for both the aggregate mindfulness score and each of its five factors (i.e. observing, describing, acting with awareness, nonjudgment, and nonreactivity).

A table of correlation coefficients can be found in Table 3.

Table 3

Trait Correlations, Study 1

	ABS	OE	ANX	RUM	CF	MND	OBS	DES	AWA	NJ
OE	.43***									
ANX	.18*	-.26***								
RUM	.40***	-.07	.77***							
CF	.33***	-.15*	.79***	.77***						
MND	.01	.37***	-.65***	-.53***	-.68***					
OBS	.62***	.36***	.07	.27***	.18*	.29***				
DES	.04	.31***	-.42***	-.28***	-.37***	.78***	.24***			
AWA	-.27***	.09	-.57***	-.58***	-.65***	.73***	-.11	.45***		
NJ	-.39***	.12	-.62***	-.69***	-.80***	.66***	-.29***	.33***	.63***	
NR	.18*	.29***	-.42***	-.22**	-.34***	.60***	.20**	.41***	.18**	.21**

Legend: ABS (Absorption), OE (Openness to Experience), ANX (Anxiety), RUM (Rumination), CF (Cognitive Fusion), MND (Mindfulness), OBS (Observing), DES (Describing), AWA (Acting with Awareness), NJ (Nonjudgment), NR (Nonreactivity).

Some of the most noteworthy correlations are summarized here. Trait anxiety, cognitive fusion, and rumination were strongly positively intercorrelated. All three of these variables were negatively correlated with trait mindfulness. Conversely, openness to experience was found to be moderately positively correlated with trait mindfulness. Meanwhile, trait anxiety and cognitive fusion were both negatively associated with openness to experience.

Trait absorption showed a unique pattern of associations; notably, roughly similar-sized positive correlations with both openness to experience and the aforementioned set of variables— rumination, cognitive fusion, and trait anxiety— with which openness to experience showed negative associations. Trait

absorption was found to be positively correlated with openness to experience, rumination, cognitive fusion, and trait anxiety. However, absorption was not found to be associated with overall mindfulness, as measured by the FFMQ.

A subscale approach to capturing mindfulness and its correlates yielded a distinctive picture. While anxiety, cognitive fusion, and rumination were all moderately-to-strongly negatively correlated with trait mindfulness, this finding only consistently generalized to four of the FFMQ's five facets: describing, acting with awareness, nonjudgment, and nonreactivity. The remaining facet, observing, was instead positively associated with cognitive fusion and rumination. Meanwhile, openness to experience—while moderately positively correlated with overall mindfulness—showed a significant positive association with only three of its facets: observing, describing, and nonreactivity. Finally, despite absorption's apparent lack of association with overall mindfulness, it was found to be significantly positively associated with observing and nonreactivity, but significantly negatively associated with acting with awareness and nonjudgment.

Meanwhile, in line with a literature that identifies observing as the most problematic facet of the FFMQ model, we found observing to be more weakly correlated with overall mindfulness (r = .29, as compared to r = .60 to .78) than any of its four counterparts (Lilja et al., 2013; de Bruin et al., 2012; Gu et al., 2016). It additionally stood out as the only FFMQ facet positively associated with absorption, rumination, and cognitive fusion, and the only facet not negatively associated with trait anxiety.

Discussion and rationale for Study 2

Our results support and clarify previous findings showing a significant positive association of absorption with both openness to experience and trait-level anxiety. Notably, however, when the anxiety-linked variables rumination and cognitive fusion were added to the analysis, we found a considerably stronger association of these (as compared to anxiety) with absorption—comparable in size to absorption's medium-strength association with openness to experience. This is particularly interesting given the mild *negative* association between openness to experience on one hand, and rumination and cognitive fusion on the other—a pattern that might owe more to the dimensions of openness to experience associated with intellectual curiosity and lower need for orderly thought, than with those associated with absorption (Glisky et al.,1991). Meanwhile, absorption's lack of association with overall mindfulness is consistent with a literature that sets apart absorption/hypnosis and mindfulness phenomenologically, but its widely variable pattern of associations with mindfulness facets, including a strong positive association with observing, and a medium negative association with nonjudgment, is novel and worth investigating further.

The distinctive pattern of trait-level associations with trait absorption that we found in the correlational analyses of Study 1 helped to justify investigating trait absorption as a unique predictor of responses to a brief experimental intervention—above and beyond, for instance, the better-studied, related construct of openness to experience. In the interest of time, we decided to retain most, but not all, of the trait measures from Study 1, with the aim of both

accounting for them in our predictive model and testing the generalizability of Study 1's correlational findings to a different sample. We hypothesized that our two distinct population samples would exhibit trait-level associations similar in direction and magnitude. We also hypothesized that controlling for all other trait-level variables, that individuals higher in trait absorption would experience a greater reduction in anxiety after a brief mindfulness intervention.

Method: Study 2

Participants. The participants for this study were 81 undergraduate students from a medium-sized Southeastern university. All participants were required to be at least 18 years of age. Participants were recruited through the university's online research participation system and were compensated with course credit for their participation. All procedures were approved by the university's Protection of Human Subjects Committee and gave their informed consent prior to participating.

Materials.

Table 4

New Measures Taken During Study 2

	Sample Items	Original Study
STAI (Spielberger State-Trait Anxiety Inventory): State anxiety items	"I am presently worrying over possible misfortunes" "I feel nervous"	Spielberger, 1983
PCI (Phenomenology of Consciousness Inventory)	"I was not distracted, but was able to become completely absorbed in what I was experiencing" "I was able to concentrate quite well and was not distracted"	Pekala, 1991

TMS (Toronto Mindfulness Scale)	"I was more concerned with being open to my experiences than controlling or changing them." "I remained curious about the nature of each experience as it arose."	Lau et al., 2006

Tellegen Absorption Scale (TAS). This scale is described above in the materials list for Study 1 (1974).

Big Five Inventory (BFI). This scale is described above in the materials list for Study 1 (1991).

Spielberger State-Trait Anxiety Inventory (STAI). Described above in the materials list for Study 1, in Study 2, the STAI was used to capture state-level anxiety, with questions aimed at measuring trait-level anxiety excluded (1983).

Five Facet Mindfulness Questionnaire (FFMQ). This scale is described above in the materials list for Study 1 (2006).

Mindfulness meditation videos. "Listening & Thoughts" and "Breathing Anchor" are two guided meditation recordings from the collection accompanying Williams and Penman's *Mindfulness: A Practical Guide to Finding Peace in a Frantic World* (2011). Each recording is approximately eight minutes long. The former recording guides listeners through a meditation on thoughts and feelings, while the latter recording guides listeners through a meditation on breath and bodily sensations.

Phenomenology of Consciousness Inventory (PCI). Introduced by Pekala in *Quantifying Consciousness* (1991), the PCI is intended to measure

alterations in consciousness after hypnotic induction or related procedures. Each item comprises two opposing statements separated by a seven-point Likert-type scale; selecting a number closer to 0 endorses the statement on the left, while selecting a number closer to 6 endorses the statement on the right. We follow Hall, Schubert, and Wilson in using the two items of the PCI's absorption sub-dimension as a measure of state-level absorption (2016).

Toronto Mindfulness Scale (TMS). Developed by Lau et al. as a means of measuring state-level mindfulness before and after mindfulness interventions, the TMS consists of 13 items divided between two subscales, "curiosity" and "decentering" (2006). Items were scored on a five-point Likert scale, ranging from 0, which represented "Not at all", to 4, which represented "Very much". All item responses were summed both in aggregate and within individual subscales; a higher score indicates higher state mindfulness, or enrichment for any particular facet of state mindfulness.

***Mindfulness experience question*.** Participants were asked "How much experience do you have with mindfulness or meditation practices?" Available responses ranged from "A great deal" to "None at all"; the former was coded as a 4, while the latter was coded as a 1.

Expectancy question. After being instructed that they would be listening to an approximately ten-minute video clip as intently as they could, participants were asked "How much do you expect that listening to this audio clip will make you less anxious?" Available responses ranged from "A great deal" to "None at all"; the former was coded as a 4, while the latter was coded as a 1.

Procedure. Participants completed the study in two separate sessions. During Session 1, administered online through Qualtrics, participants gave their informed consent and then completed a series of personality inventories measuring trait-level absorption, anxiety, openness to experience, and mindfulness. Participants were signed up for a Session 2 slot, no sooner than 48 hours after completing Session 1. Upon arriving to the lab for Session 2, participants gave their informed consent and completed a series of inventories assessing state-level absorption, mindfulness, and anxiety **(Timepoint 1)**. After completing these baseline assessments, participants were brought to a room and told that they would be required to give a speech for up to five minutes on a controversial topic, which would be video-recorded and ultimately viewed and rated for its quality—a paradigm introduced by Amir et al. (2008). Participants were then presented with a list of three controversial topics, expected to induce momentary social anxiety—abortion, corporal punishment, and the American healthcare system—and asked to choose any one of the topics. They were given two minutes to prepare for the speech, as well as paper and a pen to take notes, but were told that they would not be able to consult their notes during the speech. After two minutes, these materials were collected, and participants were instructed to stand in front of a video camera. The experimenter recorded the participant's speech and turned it off after five minutes, or whenever the participant was finished. At the end of the speech, participants were brought back to the original room, and once again completed a series of inventories assessing state-level absorption, mindfulness, and anxiety **(Timepoint 2)**.

Participants were then informed through Qualtrics that they would be completing an eight-minute listening task, with the aim of reducing anxiety. Depending on the condition, participants either listened to a control recording of relaxing “meditation” music (“Vayu” by Realizer; Relayer, 2019), a guided eight-minute mindfulness meditation recording titled “Listening and thoughts”, or a guided eight-minute mindfulness meditation recording titled “Breathing anchor”. Participants in the two mindfulness meditation conditions were briefly informed that they would be engaging in a mindfulness meditation task with the aim of reducing anxiety, and asked 1) how much experience they had with mindfulness or meditation practices (mindfulness experience), and 2) if they believed that the listening task would lower their anxiety levels (expectancy). At the end of this procedure, all participants once again completed a series of inventories assessing state-level absorption, mindfulness, and anxiety **(Timepoint 3)**. Participants were then debriefed and dismissed.

Results: Study 2

Of 134 participants who completed the at-home survey portion of the study, 84 arrived for the lab session. Additional participants were scheduled for the lab session, but due to coronavirus-related closure of the lab building, these sessions were canceled, and subjects were compensated for their intended participation. Three lab participants were excluded: 1 because of participant error, 1 because of headphone malfunction, and 1 elected to leave out of fear that the speech task would induce a panic attack. Only participants who completed the full lab session were included in analyses.

77% of participants identified as female, 22% as male, and 1% as transgender. 72% identified as white, 19% identified as Asian, 10% identified as black or African-American, 10% identified as Hispanic or Latino, and 1% identified as Native American. The mean age of participants was 19.1, with a range of 18 to 22.

Trait-level descriptive statistics and trait correlations are reported in Tables 5 and 7, respectively. Descriptive statistics for experimental variables, by condition, can be found in Table 6. Correlations between experimental variables and trait-level variables can be found in Table 8.

Table 5

Descriptive Statistics (Trait Variables), Study 2

Measure	*M*	*SD*	Minimum	Maximum
Absorption	17.02	7.06	3	34
Openness to Experience	35.63	6.69	21	50
Anxiety	46.05	11.32	25	70
Mindfulness	119.75	20.23	42	160
Observing	25.49	6.20	12	38
Describing	25.11	6.84	5	40
Acting With Awareness	24.26	6.15	5	38
Nonjudgment	25.33	6.76	10	40
Nonreactivity	19.56	5.09	8	32
Mindfulness Experience	2.01	0.73	1	4

Table 6

Descriptive Statistics (Experimental Variables), Study 2

Measure	Condition 1 (Thoughts) *M (SD)*	Condition 2 (Breathing) *M (SD)*	*Active (1 + 2)* *M (SD)*	Condition 3 (Control) *M (SD)*
State Anxiety 1	39.39 (12.20)	38.59 (9.41)	39.00 (10.83)	38.04 (8.85)
State Anxiety 2	46.32 (13.08)	48.15	47.22 (12.33)	44.88 (12.69)

		(11.68)		
State Anxiety 3	35.50 (10.79)	34.11 (11.03)	34.82 (10.83)	37.77 (11.52)
Anxiety Δ 1-2	6.93 (8.97)	9.56 (9.39)	8.22 (9.19)	6.85 (12.27)
Anxiety Δ 2-3	-10.82 (10.90)	-14.04 (9.91)	-12.40 (10.45)	-7.12 (7.69)
State Mindfulness 1	19.93 (8.27)	19.89 (6.48)	19.91 (7.37)	22.58 (7.75)
State Mindfulness 2	21.96 (9.75)	20.89 (12.17)	21.44 (10.92)	21.96 (10.74)
State Mindfulness 3	27.93 (9.77)	29.96 (10.19)	28.94 (9.94)	20.54 (10.20)
Mindfulness Δ 1-2	2.04 (8.04)	1.00 (11.22)	1.53 (9.65)	-0.62 (8.59)
Mindfulness Δ 2-3	6.48 (7.01)	9.07 (8.17)	7.78 (7.65)	-1.42 (11.44)
State Absorption 1	9.50 (2.80)	9.81 (2.37)	9.65 (2.58)	8.65 (2.58)
State Absorption 2	10.04 (3.83)	10.07 (3.76)	10.05 (3.76)	10.12 (4.83)
State Absorption 3	8.57 (3.84)	9.11 (3.31)	8.84 (3.57)	9.23 (4.34)
Absorption Δ 1-2	0.54 (3.40)	0.26 (4.32)	0.40 (3.85)	1.46 (5.19)
Absorption Δ 2-3	-1.46 (4.35)	-0.96 (3.38)	-1.22 (3.88)	-0.88 (3.57)
Expectancy	2.21 (.83)	2.22 (.75)	2.22 (.79)	2.12 (.82)

Table 7

Trait Correlations, Study 2

	ABS	OE	ANX	MND	OBS	DES	AWA	NJ
OE	.32**							
ANX	.10	-.17						
MND	.01	.33**	-.67***					
OBS	.44***	.49***	-.06	.38***				
DES	-.04	.41***	-.48***	.80***	.27*			
AWA	-.20	.01	-.44***	.72***	.01	.47***		
NJ	-.20	.06	-.52***	.68***	-.14	.43***	.46***	
NR	.06	.10	-.70***	.66***	.11	.37**	.38**	.42***

Legend: ABS (Absorption), OE (Openness to Experience), ANX (Anxiety), MND (Mindfulness), OBS (Observing), DES (Describing), AWA (Acting with Awareness), NJ (Nonjudgment), NR (Nonreactivity).

Manipulation Checks

This study hinged on two manipulations—the speech task and the mindfulness meditation session—accomplishing their intended effects. The speech task was conceived of as a "state anxiety induction", while the listening session was intended both as a "state anxiety reduction" and a "mindfulness induction". For the listening session, we were interested in determining whether both a brief mindfulness meditation session (as provided in the two active conditions) and a brief relaxing music session (as provided in the control condition) reduced anxiety and induced mindfulness, as well as whether these effects differed significantly between the active and control conditions.

The speech task significantly induced state anxiety, with an average increase of 7.78 points on a scale from 20 to 80 (t = 6.85, p < .001) between timepoint 1 and timepoint 2. Meanwhile, the mindfulness meditation session (active conditions) significantly reduced anxiety between timepoint 2 and timepoint 3, with an average decrease of 12.4 points on the same scale (t = -8.80, p < .001), as did the control activity (relaxing music), with an average decrease of 7.12 points (t = -4.72, p < .001). There was, however, a significant difference between the magnitude of state anxiety reduction from timepoint 2 to timepoint 3 in the active versus the control conditions, with nearly twice as large an effect in the active conditions (t = -2.56, p = .013).

The mechanism by which this reduction in state anxiety between timepoint 2 and timepoint 3 was accomplished is illustrated by our manipulation check of "mindfulness induction". In the active conditions, participants experienced a significant increase in state mindfulness between timepoint 2 and timepoint 3—on average, 7.78 points on a scale from 0 to 52 (t = 7.47, p < .001). In the control condition, however, no significant change in mindfulness was observed—on average, there was a 1.42-point decrease in state mindfulness (t = -.63, p = .532). We thus observed a significant difference in the mindfulness-inducing effects of the active versus control conditions (t = 3.72, p = .001).

Comparing Different Mindfulness Conditions

We were also interested in determining whether the two active mindfulness conditions—"Listening and thoughts" and "Breathing anchor"—differed in their anxiety reduction and mindfulness induction effects. We observed a possible difference in the average state anxiety reduction between the two conditions, with "Listening and thoughts" associated with an average decrease of 10.82 points, and "Breathing anchor" associated with an average decrease of 14.04 points. However, this difference did not achieve statistical significance (t = 1.15, p = .257).

Similarly, we observed a difference in the average state mindfulness induction between the two conditions, with "Listening and thoughts" associated with an average increase of 6.48 points, and "Breathing anchor" associated with an average increase of 9.07 points. However, this difference also did not achieve statistical significance (t = -1.25, p = .216).

Factors Predicting State Anxiety Change

Regression

A multiple regression was performed to test for predictors of state anxiety change between timepoint 2 (end of speech task) and timepoint 3 (end of listening task), among participants from all three conditions. Regression factors included state mindfulness at timepoint 3, expectancy, as well as a battery of trait-level factors, including absorption, openness to experience, anxiety, and trait mindfulness facets observing, describing, acting with awareness, nonjudgment, and nonreactivity. All regression weights and significance levels can be found in Table 8.

Table 8

Regression Coefficients, 1

	Unstandardized *B*	*SE*	Standardized *Beta*	*t*	Sig.
(Constant)	-11.59	14.32		-.81	.421
Absorption	.37	.17	.26	2.13	.036
Openness	.14	.20	.10	.73	.465
Anxiety	-.02	.14	-.02	-.15	.883
Expectancy	-2.17	1.37	-.17	-1.58	.118
Observing	-.38	.21	-.24	-1.82	.073
Describing	.13	.21	.09	.62	.539
Acting With Awareness	.03	.21	.02	.15	.885
Nonreactivity	.54	.28	.28	1.93	.057
Nonjudgment	-.01	.19	-.01	-.05	.963
State Mindfulness 3	-.36	.10	-.39	-3.59	.001

Overall, this multiple regression model significantly predicted change in state anxiety (R^2 = .31, *Adjusted* R^2 = .21, F = 3.12, p = .002).

Critically, the only two factors that proved to be significant predictors of state anxiety change between timepoints 2 and 3 at $p < .05$ were state mindfulness at timepoint 3 and trait absorption. State mindfulness at timepoint 3 predicted a greater reduction in state anxiety (B = -.39, t = -3.59, p = .001), while trait absorption predicted less reduction of state anxiety (B = .26, t = 2.13, p = .036). In addition, trait mindfulness facet nonreactivity (B = .28, t = 1.93, p = .057) was a marginally significant predictor of less state anxiety change between timepoints 2 and 3, while the observing facet of trait mindfulness (B = -.24, t = -1.82, p = .073) was a marginally significant predictor of greater state anxiety change.

A follow-up correlational analysis dealt with the association between absorption and state anxiety change between timepoints 2 and 3, broken down by active versus control listening conditions. Partial correlations were obtained, controlling for the effects of expectancy, openness to experience, anxiety, and trait mindfulness facets observing, describing, acting with awareness, nonjudgment, and nonreactivity. Notably, the significant association noted in the initial regression analysis held true for participants in the active listening conditions (r = .30, p = .038), while no such association was detected for participants in the control listening condition (r = .03, p = .918).

Relationship between Study 1 and Study 2 correlations

A series of Fisher-z transformations were performed in order to test whether the trait correlations found in the undergraduate Study 2 sample significantly differed from those found in the general population Study 1 sample.

Correlations among absorption, openness to experience, trait anxiety, and trait mindfulness were compared, as well as correlations between absorption and the trait mindfulness facets observing, describing, acting with awareness, nonjudgment, and nonreactivity. The only trait correlations which differed significantly between the Study 1 and Study 2 samples were the mindfulness facets observing (z = 2.08, p = .033) and nonjudgment (z = 1.97, p = .049), which were related more strongly to absorption in the Study 1 sample than in the Study 2 sample.

Absorption and state anxiety at timepoint 2

In addition to exploring the relationship between trait absorption and change in state anxiety from timepoint 2 to timepoint 3 (a proxy for the effectiveness of the listening session), we examined the relationship between trait absorption and state anxiety at timepoint two, at the conclusion of the "anxiogenic" speech exercise and immediately before the "anxiolytic" listening session.

A partial correlation between trait absorption and state anxiety at timepoint 2 was taken, controlling for openness to experience, trait anxiety, and the trait mindfulness facets observing, describing, acting with awareness, nonreactivity, and nonjudgment yielded a significant negative association (r = -.27, p = .021), such that individuals higher in trait absorption experienced less anxiety after the speech exercise. By contrast, when the corresponding partial correlations were taken, no significant association was found between trait absorption and either state anxiety at timepoint 1 (baseline), or state anxiety at timepoint 3.

To further explore this pattern, we added state anxiety at timepoint 2 to our set of regression factors for the dependent variable state anxiety change from timepoint 2 to timepoint 3. At this point, we found that state anxiety at timepoint 2 absorbed much of the previously-observed independent effect of absorption, given their moderate negative intercorrelation. All regression weights and significance levels can be found in Table 9.

Table 9

Regression Coefficients, 2

	Unstandardized *B*	*SE*	Standardized *Beta*	*t*	Sig.
(Constant)	7.54	12.37		.61	.544
Absorption	.12	.15	.08	.77	.443
Openness	.13	.16	.09	.80	.425
Anxiety	.24	.12	.28	1.99	.051
Expectancy	-1.59	1.14	-.13	-1.39	.170
Observing	-.09	.18	-.06	-.48	.631
Describing	.05	.18	.04	.31	.760
Acting With Awareness	-.16	.17	-.10	-.91	.369
Nonreactivity	.46	.23	.24	1.98	.052
Nonjudgment	-.10	.16	-.07	-.64	.527
State Mindfulness 3	-.36	.08	-.39	-4.28	.000
State Anxiety 2	-.54	.10	-.66	-5.66	.000

More than even state mindfulness during the listening session (B = -.39, t = -4.28, p < .001), state anxiety at timepoint 2 proved to be a significant predictor of reduction in anxiety from timepoint 2 to timepoint 3 (B = -.66, t = -5.66, p < .001), such that individuals higher in state anxiety immediately before the listening exercise experienced larger decreases in anxiety. Trait anxiety (B = .28, t = 1.99, p = .051) and nonreactivity (B = .24, t = 1.98, p = .052) were both

marginal predictors of less anxiety reduction over the course of the listening exercise. Trait absorption, however, did not hold up as a significant independent predictor of state anxiety change in this expanded analysis (B = .08, t = .77, p = .443). Overall, this multiple regression model significantly predicted change in state anxiety, and provided a substantially better fit than our initial model, which did not include state anxiety at timepoint 2 (R^2 = .53, *Adjusted* R^2 = .46, F = 7.03, $p < .001$).

General Discussion

We undertook two studies—one focused on trait correlations, and one focused on absorption as a moderator of intervention response—toward the end of better situating absorption on the map of personality dimensions, as well as connecting it to clinical applications. In our correlational analyses, we found links between absorption and openness to experience, rumination, cognitive fusion, trait anxiety, and certain facets of mindfulness, across two distinct population samples. Our experimental manipulation, which focused on absorption's role as a moderator of a brief mindfulness meditation session's effect on social anxiety, yielded a number of interesting finds as well—chief among them, an unexpected association between higher trait absorption and lower proneness to anxiety induction.

With regard to our main hypothesis—that higher absorption would be associated with greater anxiety reduction—our experimental data yielded a nuanced picture. Initially, we believed that our regression analysis of state anxiety change from timepoint 2 (pre-mindfulness intervention) to timepoint 3

(post-mindfulness intervention) amounted to not a simple refutation of our main hypothesis, but rather, confirmation of its inverse. Given that the regression controlled for trait anxiety, we were reasonably sure that this effect could not be explained by any underlying positive trait-level association between absorption and anxiety. At this point, we were left to wonder whether this unexpected inverse association was a genuine property of trait absorption, or an artifact of experimental design.

One explanation we explored was centered on the medium-sized association we found in Study 1 between absorption and rumination. In this scenario we speculated that individuals higher in absorption might possibly ruminate on the anxious experience of giving a speech for longer than individuals lower in absorption, thus inhibiting or counteracting any anxiolytic effect of the brief mindfulness intervention.

However, upon analysis, this explanation gave way to another. We found that in fact, higher-absorption individuals experienced *lower* state anxiety at timepoint 2 (post-speech), rather than *higher* state anxiety, as predicted by the rumination hypothesis. When we controlled for this average difference in state anxiety at timepoint 2, the effect of absorption on state anxiety change from timepoint 2 to timepoint 3 effectively vanished. In essence, we found that the apparent “inverse” of our hypothesized result could be seen as an artifact of differences in state anxiety post-speech. Notably, we also found that trait absorption was not significantly related to state anxiety at timepoint 1 (pre-speech), which suggested that the association at timepoint 2 reflected a

meaningful relationship between trait absorption and the anxiogenic effects of the speech exercise. In this light, individuals higher in trait absorption appear to experience less of an increase in anxiety during a brief speech task designed to induce anxiety, as compared to individuals lower in trait absorption.

This association suggests that high-absorption individuals might approach otherwise stressful tasks such as a public speech exercise in a mode of immersive, “experiential” engagement described by Tellegen, rather with an “instrumental set”, characterized by deliberate planning and self-consciousness (1981). It stands to reason that full imaginative immersion in the task of preparing and delivering a speech on a controversial topic would be protective against the anxiety often generated by self-conscious participation in an externally-imposed high-pressure activity. In this context, the widely-discussed “flow” construct might help to explain the distinct, less-anxiogenic experiences of high-absorption individuals during this task.

Flow, as famously characterized by Csikszentmihalyi in “Flow: The Psychology of Optimal Experience”, overlaps conceptually with absorption to a great degree—but unlike absorption, is generally discussed in terms of a state, rather than a trait (1990). The characteristics of flow states, as summarized by Jackson et al. (1998) include “a challenge-skill balance, merger of action and awareness, clear goals, unambiguous feedback, concentration on the task at hand, loss of consciousness, time transformation, and an autotelic (intrinsically rewarding) experience.” Curiously, absorption appears to share many of these

characteristics, but not all of them: as states of absorption are quintessentially non-goal-directed, “challenge-skill balance” is not a relevant facet of them.

In Csikszentmihalyi’s original scheme, flow states are most possible within a narrow “band” of high-challenge, high-skill situations, occupying an intermediate place between anxiety and boredom (1975). By contrast, performance anxiety more often results when a person’s skills do not meet the demands of a high-challenge situation. However, other flow researchers have taken up measuring the relationship between flow states and anxiety, rather than merely assuming them to be adjacent territories on a map. Jackson et al. (1998) found specific dimensions of state anxiety to be negatively associated with both trait and state flow in professional athletes, while both Cohen and Bodner (2018) and Kirchner et al. (2008) found significant negative associations between trait flow and music performance anxiety in amateur and professional musicians. While flow has historically been measured in the context of skilled, competitive challenges, rather than brief speech paradigms, it stands to reason that a similar effect might be at work behind the differential responses to our anxiety induction paradigm.

In order to better corroborate this account, it will be necessary for researchers to first, continue to test the relationship between trait absorption and anxiety induction under pressure across a range of scenarios, and second, to focus on classic paradigms from flow research. Namely, in order to more confidently hypothesize that higher trait absorption protects people against spikes in anxiety during a stressful task, and that this relationship is mediated by

higher levels of flow, state measures of flow need to be taken alongside trait measures of absorption and state measures of anxiety, and deployed in a context that is known to be implicated in flow states.

We are left with the conclusion, on the other hand, that absorption does not appear to be meaningfully related to our original dependent variable of interest—intervention response—at least in the context of our experimental design. It is possible that mindfulness meditation does not depend on the same internal factors as placebo response or psychedelic experience, two domains in which absorption has shown promise as a predictive factor. Given the documented links between trait absorption and hypnotizability, the phenomenological distinctions between mindfulness states and hypnotic states, as summarized in Raz and Lifshitz (2016), as well as our finding that trait absorption and trait mindfulness are entirely uncorrelated, it is possible that differences in absorption simply have little to do with individual propensity for mindfulness. In addition, it is possible that our quest for trait-level predictors of anxiety change through a brief mindfulness intervention was misguided in the first place. In fact, the only two significant predictors of intervention response were state mindfulness at timepoint 3 (during/after listening session) and state anxiety at timepoint 2 (post-speech); no trait-level factors proved significant.

It is worth further investigating whether the lack of association between absorption and therapeutic response persists across other experimental designs, clinical interventions (brief and extended) other than mindfulness, and targets other than social anxiety. Our interest in absorption as a predictor of therapeutic

outcomes drew on the idea that many factors behind pharmacotherapeutic and psychotherapeutic interventions for mood disorders and other ailments might be implicated by absorption, including therapeutic alliance, cognitive reframing exercises, and emotional availability (Ardito & Rabellino, 2011; Mennin et al., 2013; Samoilov & Goldfried, 2000). Given the initial evidence for absorption as a predictor of both placebo response and response to psychedelics, an up-and-coming mental health treatment modality, it is important to continue trait-level factors that impact therapeutic response, including absorption (Owens & Menard, 2011; Russ et al., 2018).

Manipulation checks and the validity of brief paradigms.

Beyond the specific implications of our experimental findings for our initial hypothesis about absorption, as well as future absorption research, our manipulation checks seem to confirm the basic efficacy of our anxiety induction and mindfulness induction/anxiety reduction manipulations. First, to ensure an even basis for comparison, we confirmed that participants in the three conditions were on average equal on measures of trait anxiety and trait absorption.

Overall, irrespective of trait-level predictors, participants experienced a significant increase in state anxiety from timepoint 1 (pre-speech) to timepoint 2 (post-speech), yielding a medium-large effect size (Cohen's *d* = .76). This supports the continued use of Amir et al.'s (2008) five-minute controversial speech paradigm for future research that depends on the induction of state anxiety, and particularly social anxiety.

Moreover, the comparison of active mindfulness and control relaxing music conditions produced a pattern of results that we anticipated, with respect to mindfulness induction and anxiety reduction. A single, eight-minute guided mindfulness session produced a large increase in state mindfulness (Cohen's *d* = 1.02) from timepoint 2 (post-speech) to timepoint 3 (post-listening session), while an eight-minute session of listening to relaxing music led to a non-significant reduction in state mindfulness. However, both the mindfulness and relaxing music conditions significantly reduced state anxiety from timepoint 2 to timepoint 3—although there was a medium-sized difference (Cohen's *d* = .57) in favor of the mindfulness condition's efficacy, when compared.

First, these findings strengthen the case for brief mindfulness interventions (as brief as eight minutes) as effective tools for state mindfulness induction and state anxiety reduction. Second, they support the use of relaxing music as a control for mindfulness induction, but not necessarily for anxiety reduction. Third, they suggest the possibility that if only eight minutes are available to deploy an anxiogenic intervention, guided mindfulness meditation is likely to be more effective than relaxing music. Finally, they provide evidence that the anxiogenic effects of mindfulness meditation are mediated by the induction of state mindfulness, while the anxiogenic effects of listening to relaxing music are unrelated to the induction of state mindfulness.

In addition, while we did not find a significant difference in mindfulness-inducing and anxiety-reducing effects between the "Breathing Anchor" and "Listening & Thoughts" conditions, the former condition appears to have on

average both induced mindfulness (Cohen's *d* = .34) and reduced anxiety (Cohen's *d* = .31) to a larger degree than the latter condition. However, as the main focus of our between-groups design was to compare a mindfulness intervention to a relaxing music "control" session, only one-third of the total sample was assigned to each of the mindfulness groups. In addition, the campus shutdown associated with the COVID-19 pandemic limited us to a sample size of 81, despite having booked 130 subjects for lab sessions.

With a larger sample size, it would be possible to detect whether the apparent small-medium differences between two different mindfulness meditation conditions were indeed significant. While the mindfulness-inducing and anxiety-reducing effects of different forms of mindfulness meditation have been compared in meta-analyses, there is unique value in comparing the mindfulness-inducing and anxiety-reducing effects of equally brief single-session mindfulness meditations, recorded as part of the same series. If indeed the "Breathing Anchor" meditation induces mindfulness and reduces anxiety to a greater degree than the "Listening & Thoughts" meditation, it would lend support to a wealth of literature and traditions supporting the efficacy of forms of mindfulness that focus on the breath, and the added depth of practices with a somatic component.

Correlational findings and implications.

Both our original study, conducted online using a general-population sample recruited through Amazon Mechanical Turk, and the trait component of our second study, conducted with undergraduates, provided a wealth of correlational data to corroborate against existing research on the trait-level links

between absorption, openness to experience, anxiety, and mindfulness. Of primary interest were the connections of absorption to each of these latter three.

We found absorption and openness to experience, grouped together so often enough that the former has been proposed as one of the latter's two primary factors, to be moderately positively correlated (r = .32 to .43). Notably, however, this association was considerably weaker across two samples than the association found by Glisky et al. (1991). While absorption and openness to experience likely draw on many of the same foundations, the only *moderately* positive association between these two traits, as well as their distinct patterns of association with other measured traits, reiterates the importance of treating absorption as a personality factor in its own right.

We also found a weak positive trait-level association between absorption and anxiety (r = .10 to .18), despite the inverse association between openness to experience and anxiety. This suggests that while the component of openness to experience characterized by Glisky et al. (1991) as "liberalism" seems to be protective against anxiety, the component of openness to experience better characterized as absorption, associated with imaginative depth, more intense emotionality, and an "experiential set", seems to predispose people toward anxiety. This seems to corroborate the findings of both Lilienfeld (1997) and Wolfradt and Meyer (1998), though the association appears to be considerably more modest than what the latter researchers purported. The fact that trait absorption is modestly associated with trait-level anxiety, but apparently protective against spikes in state anxiety during a stressful task, is difficult to

account for simply, and reinforces the picture of a complex relationship between anxiety and the mode of attentional engagement that characterized high-absorption individuals.

In addition, we found absorption to be unassociated with mindfulness as described in aggregate by the Five Face Mindfulness Questionnaire, despite finding a correlation between openness to experience and mindfulness. On the other hand, absorption was moderately to strongly positively correlated (r = .44 to .62) with observing, a facet of mindfulness which entails "noticing or attending to internal and external experiences"—in fact, to a greater degree than any other trait correlate measured (Lilja et al., 2013). On the other hand, absorption was negatively correlated with acting with awareness (r = -.20 to -.27), as well as nonjudgment (r = -.20 to -.39).

This pattern of associations, once mindfulness is disaggregated into five facets, reveals important details about the construct overlap—and lack thereof—between absorption and mindfulness, as commonly defined. Someone who tends to be higher in absorption is likely to be especially vividly attentive to specific internal and external sensations and objects. However, the "experiential set" associated with absorption is characterized by a lack of executive-level, deliberate reflection (acting with awareness) or detachment from an object of attention or interaction (nonjudgment).

The one facet of mindfulness significantly positively associated with absorption, observing, has been described as the exception among the FFMQ's five facets, for demonstrating weak correlations with the four other facets, and

with mindfulness overall. We find additional confirmation for this pattern, wherein observing is the only one of five facets not at least moderately positively associated with the others, and the only one to be moderately (r = .29 to .38), rather than strongly, associated with overall mindfulness. Perhaps, on a phenomenological level, observing has more to do with absorption than it does with other commonly-characterized elements of mindfulness; at face value, our correlational data supports this interpretation.

Curiously, we also found absorption to be moderately positively associated with both rumination and cognitive fusion—despite the strong negative association between these latter two and mindfulness, and their strong positive association with anxiety (with which absorption is only weakly correlated). This pattern seems to suggest a unique relationship, or perhaps unique construct overlap, between absorption and these two traits. While mindfulness is associated with an ability to step back from thoughts, emotions, and sensations, and simply note them, cognitive fusion is typified by an inability to separate from these internal processes, and rumination is characterized by a tendency to repetitively dwell on them. Absorption, while framed by researchers in more positive terms than cognitive fusion or rumination, is also characterized by an instinctive inability to separate oneself from objects (including thoughts), to compartmentalize streams of sensory data, and to focus attention instrumentally, toward goals.

We also note that our analyses of absorption's trait-level correlations show a remarkably consistent pattern across two distinct population samples, offering well-powered support for the stability of these associations.

The continued importance of studying absorption.

Ultimately, while the initial, simple hypothesis linking higher trait absorption to greater intervention efficacy was not supported, we believe that this pair of studies offers important insights about the correlates of trait absorption, hints about its protective effects in high-pressure situations, possibly linked to flow, as well as additional support for previously-tested brief paradigms for anxiety induction and mindfulness induction.

Moreover, on a methodological note, we demonstrate the importance of mapping the construct overlap between absorption, openness to experience, the observing facet of mindfulness, cognitive fusion, and flow, and clarifying the important areas of distinction between these constructs.

The study of individual differences in cognitive-experiential style remains an underappreciated line of research in both basic and applied psychology research, and with the rise of therapies and psychotechnologies focused on experiential engagement with mind and body, understanding who a practice will work for, and when, is of the essence. Trait absorption—a well-characterized personality dimension linked to serotonin receptor binding polymorphisms, placebo response, synesthesia, religiosity, and proneness to mystical experience—can be a modest starting point for the further exploration of how consciousness factors into well-being and the treatment of psychopathology.

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