









Mind the unknown: Conceptual development and validation of the uncertainty mindset

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ABSTRACT

The prevailing assumption that uncertainty is something to be reduced and avoided fails to explain uncertainty-seeking behaviors, calling for a move away from the dominant *uncertainty reduction* perspective towards *uncertainty regulation*. In line with uncertainty regulation theory, we propose uncertainty mindset (UM)—i.e., one's basic belief about the nature of uncertainty—as a holistic construct encompassing the multi-faceted nature of uncertainty beliefs. Integrating two main strands of mindset research, we conceptualize UM as a formative construct combining beliefs about uncertainty as fixed, malleable, threat, and opportunity. Moreover, we acknowledge that these beliefs combine to a higher-level construct: uncertainty-as-enabling mindset, which predicts relevant preferences, attitudes, and behaviors. We validate a multi-faceted measure of UM with three studies, using a time-lagged design and a multi-country sample of $N = 1476$ adults. Results show that the four facets of UM exist as distinct, but that a higher-order construct is also viable, has discriminant and predictive validity, and generalizes across nations. The development of UM lays the basis for testing uncertainty regulation mechanisms and related cognitive and behavioral processes.

1. Introduction

Should I go to the same holiday destination next summer or try a new place? Should I look for a new job or just stick around? People are faced with countless daily decisions on how to deal with uncertainty. Uncertainty, defined as a state of not knowing for sure because of insufficient information in relation to a certain task (Grote, 2009), is a ubiquitous presence in all domains of human life. Whereas uncertainty has always been present in human endeavors, recent environmental, economic, and societal developments have further accentuated the need to cope with uncertainty (see <https://worlduncertaintyindex.com/>). The experience of uncertainty is not a mere reflection of the actual uncertainty in a person's environment, but rather it is a result of a person's sensemaking and enactment of their environment (Lipshitz & Strauss, 1997; Maitlis & Christianson, 2014). Because the experience of uncertainty is so prevalent and impactful, understanding how to navigate uncertainty is key to

successful psychological functioning.

Extant research has predominantly considered the experience of uncertainty as an aversive state that people strive to avoid (Carleton, 2016; FeldmanHall & Shenhav, 2019; Hogg, 2000; Kramer, 1999), as it engenders negative motivational (e.g., procrastination), cognitive (e.g., restricted information processing), and neurobiological (e.g., noradrenaline release) reactions (Hirsh et al., 2012; Jonas et al., 2014; Staw et al., 1981). Although the universality of uncertainty reduction went largely undisputed (e.g., Carleton et al., 2007; Norton, 1975), such perspective remains limited. Specifically, it fails to account for uncertainty-seeking behaviors, such as leaving one's job or travelling to a new place. Recent research suggests that sometimes people enjoy and actively seek situations linked with uncertainty, as doing so can satisfy curiosity, provide learning opportunities, and create the possibility of unexpected rewards (Bar-Anan et al., 2009; Griffin & Grote, 2020; Shen et al., 2015; Wilson et al., 2005). On that account, uncertainty regulation

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theory (URT; Griffin & Grote, 2020) postulates that people regulate uncertainty to a desired level, which can entail both reducing and seeking uncertainty, thereby extending the perspective of *uncertainty reduction* towards a more holistic approach to uncertainty—i.e., *uncertainty regulation*. However, the theory falls short of explaining how uncertainty preferences come about. Integrating URT with the mindset literature (e.g., Chiu, Dweck, et al., 1997; Crum et al., 2013), we argue that individuals' beliefs about the nature of uncertainty—i.e., their uncertainty mindset (UM)—are a primary influence of their uncertainty preferences, and thus guide their attitudes and behaviors around uncertainty.

1.1. Uncertainty regulation theory

URT (Griffin & Grote, 2020) extends the *uncertainty reduction* perspective, moving towards a more holistic approach to uncertainty—i.e., *uncertainty regulation*. The theory postulates that people do not necessarily minimize or avoid uncertainty, but rather regulate uncertainty to a desired level. Whether uncertainty is sought after or avoided depends on a comparison between one's preference for uncertainty and one's perception of extant uncertainty in a given situation. Based on this comparison, individuals would regulate uncertainty through opening behaviors—e.g., exploring learning opportunities (Schulz & Gershman, 2019)—or closing behaviors—e.g., exploiting existing knowledge (Winet et al., 2022). URT aligns with cognitive research on the exploration-exploitation dilemma (Schulz & Gershman, 2019) and acknowledges proximal (e.g., uncertainty-related attitudes such as uncertainty avoidance and need for closure) and distal (e.g., personality and fundamental self-appraisals such as core self-evaluations) individual differences in the motivation to reduce uncertainty (Hofstede & McCrae, 2004; Jung & Kellaris, 2004). However, URT provides little detail on how uncertainty appraisals and preferences arise, pointing rather generically to “trait and state uncertainty-related attitudes and abilities” (Griffin & Grote, 2020, p. 751)—a gap partially filled by the ARTU model (Kruglanski et al., 2025), which shows how both positive and negative responses to uncertainty are shaped by past experiences. Integrating these theoretical perspectives, we argue that basic beliefs about uncertainty are a critical antecedent of how uncertainty is perceived, evaluated and reacted upon.

1.2. Mindsets

Mindsets are beliefs or core assumptions that individuals use to make sense of experiences and direct their behavior (Crum et al., 2013; Dweck, 2006; Dweck & Yeager, 2019). Mindsets have a regulatory function and build the foundation of appraisals, attitudes, and behaviors (Feldman, 2017). Early mindset research focused on beliefs about the malleability or fixedness of individual characteristics, such as intelligence or personality (Chiu, Hong, & Dweck, 1997; Dweck et al., 1995), and discovered that a belief that intelligence or personality are malleable—referred to as a growth mindset (Dweck, 2016)—is positively associated with the capacity of individuals to be agentic and change themselves when motivated to do so (Dweck, 2006). Subsequently, the literature broadened by (1) comprising target entities outside of the person, such as individuals' jobs (Berg et al., 2023), and general aspects of situations, such as stress and paradoxical task demands (Crum et al., 2013; Miron-Spektor et al., 2018), and (2) extending the focus of beliefs beyond the fixed-malleable dichotomy to, for example, beliefs about whether an entity possesses beneficial or harmful characteristics (Crum et al., 2013, 2017). Recent research has pointedly started to consider the interplay of different mindsets as well (Burnette et al., 2025; Yeager et al., 2022).

1.3. Uncertainty mindset

Acknowledging the regulatory nature of mindsets and linking

mindset research with URT, we propose the concept of uncertainty mindset (UM)—a set of beliefs that an individual holds about the nature of uncertainty—as a key component of uncertainty regulation. Unlike previous uncertainty conceptualizations and measurements, which focused on the negative-to-neutral side of uncertainty (Gerlach & Pfrombeck, 2025; for an exception, see Kruglanski et al., 2025), we envision UM as a broader construct that captures beliefs about uncertainty more holistically. Specifically, we conceptualize UM as a composite mindset comprising the facets of fixed and malleable and of threat and opportunity that have been featured in extant mindset research (e.g., Crum et al., 2013, 2017; Yeager et al., 2022).

A mindset about uncertainty as malleable (fixed) refers to the extent that individuals believe they can (not) control the extent of uncertainty they experience in a given context (Norton, 1975). Importantly, because mindsets are subjective beliefs (Dweck, 2006), a fixed or malleable UM does not necessarily represent the objective possibility for individuals to change or control uncertainty, but rather a subjective perception thereof. A fixed UM implies accepting uncertainty as given, and may be linked to anxiety and general arousal in situations of high uncertainty due to a sense of lacking control (Mauro et al., 1992). Seeing uncertainty as malleable should instead be related to a proactive regulation of the experienced uncertainty. As suggested by URT (Griffin & Grote, 2020), this may result in uncertainty seeking when uncertainty is seen as desirable (e.g., asking one's boss to be transferred to a new project, or approaching a stranger at a party), as well as in reduced feelings of stress and more satisfaction with life thanks to higher perceptions of control, which may also foster achievement motivation (Karaman & Watson, 2017).

Because fixed and malleable UM refer to perceived control but not on whether uncertainty is seen as beneficial or harmful, we complement them with the beliefs of uncertainty being a threat and an opportunity. A threat UM should be linked to withdrawal behaviors and cautious decision-making (Lipshitz & Strauss, 1997; Staw et al., 1981). Although some research argued for a ubiquitous threatening nature of uncertainty (Kramer, 1999), we propose that there exist individual differences in the extent to which uncertainty is appraised as threatening. For example, findings from cognitive neuroscience indicate that uncertainty can serve as a cue for novel experiences and learning opportunities with potential rewards (Bar-Anan et al., 2009; Schulz & Gershman, 2019; Wilson et al., 2005). People may prefer such novel experiences in general, or they may do so in particular situations. An opportunity UM should be linked to lower discomfort (see Van Harreveld et al., 2009) and reduced anxiety and stress, and foster the focus on the positive sides of experiencing uncertainty, leading to more exploration. Positive sides include the thrill stemming from novel experiences (e.g., dating a new person), the satisfaction of one's curiosity (e.g., through travelling), and the potential rewards from high-uncertainty activities (e.g., entrepreneurship).

Importantly, although the literature suggests that these mindsets map on two continua (growth: fixed-malleable, and challenge: threat-opportunity), we acknowledge on the one hand that each of them can exist distinctively from the others and, on the other hand, that the four facets may be combined into an overall construct. Two main reasons support examining the distinctiveness of the four facets. First, uncertainty is a broad and ubiquitous phenomenon (FeldmanHall & Shenhav, 2019; Kramer, 1999; Lipshitz & Strauss, 1997): As it encompasses many simultaneous experiences, it affords the co-existence of seemingly paradoxical beliefs. For instance, when travelling to a new place, one may hold a strong belief that uncertainty is both malleable (e.g., one can reduce it by researching the destination and learning the local language) and fixed (e.g., as social dynamics or cultural costumes are only learned through immersion). Second, people are known to accommodate apparently contrasting lay beliefs. For example, threat and opportunity appraisals are known to exist rather independently (Neel et al., 2023), and fixed and malleable beliefs about the nature of experiential targets such as creativity and aging are relatively independent (Karwowski, 2014; Weiss & Diehl, 2021).

Regarding the combination of the four facets into a higher-level unique construct, we follow recent research that has explored how various components of mindsets work together (Berg et al., 2023; Yeager et al., 2022). We specifically conceptualize UM as a latent construct with the four facets as formative indicators, because the four facets are “defining characteristics of the construct [rather than] manifestations of it” (MacKenzie et al., 2005, p. 713). Specifically, we expect each facet not only to exist distinctively, but also to provide distinctive meaning to the higher order construct. Further, we argue that the various facets interact in specific ways. For example, Yeager et al. (2022, p. 513) see growth mindset about general ability and stress-as-enhancing mindset as “intertwined and complementary elements of a coherent whole”, as targets can be seen as distressing and non-functional, or as helpful and controllable. In line with their synergy argument and with URT (Griffin & Grote, 2020), we assume that having high malleable and opportunity paired with low fixed and threat UM—i.e., an “uncertainty-as-enabling” mindset—should allow more functional responses to uncertainty in situations with high exogenous uncertainty where opening behaviors are required. The opposite pattern—i.e., an “uncertainty-as-disabling” mindset—should be linked to relatively more positive outcomes in situations that are more certain, as it encourages following known routines that have been successful in previous situations and may engender lower anxiety. In other words, the stronger the uncertainty-as-enabling mindset, the higher the chance that one will perceive less uncertainty than desired, and thus, engage in opening behaviors. On the contrary, when one holds an uncertainty-as-disabling mindset, one will tend to perceive more uncertainty than desired. Here, individuals may feel trapped and experience anxiety and withdrawal when uncertainty is present (Staw et al., 1981), but also perform more effectively in situations of characterized by low uncertainty.

UM taps into fundamental beliefs about uncertainty as enabling or disabling. Thereby, it complements and is distinct from existing uncertainty-related constructs, because it has a different target to focus on preference and comprises multiple facets of neutral valence (see Supplementary Materials 2 for a more detailed discussion). We also predict that a high (uncertainty-as-enabling) UM will positively correlate with exploration-related attitudes and behaviors, such as learning goal orientation (Elliot & McGregor, 2001). Moreover, given the prevalence of uncertainty in the contemporary socio-cultural environment (Magni et al., 2024; Phillips-Wren & Adya, 2020), higher UM should relate positively to positive affect and life satisfaction, and negatively to negative affect, dissatisfaction, and stress. To test our assumptions, we develop a scale to measure UM and test its structure, distinctiveness, predictive power, and generalizability across three studies.

2. Overview of studies

Following established practices in the field, we engaged in a systematic process to develop and validate a scale to measure UM with reference to general life.² After generating an initial pool of items, we sought feedback on the items in a workshop with field experts, particularly focusing on the clarity and conceptual overlap of items, and put the retained items through a multi-study validation process. This included exploratory factor analysis (EFA) in Study 1, which led us to drop some items, and confirmatory factor analysis (CFA) and validity tests in Study 2 to test the robustness, distinctiveness, and impact of UM. Finally, in Study 3 we translated the original English scale into German,

² Because people's beliefs about uncertainty may vary in relation to the nature of the situations they encounter (e.g., see risk preferences; Blais & Weber, 2006), we also collected a second set of items with instructions focusing on the work domain, though we focused the scale validation on the general life domain, in line with other constructs development processes (Gerlach & Pfrombeck, 2025; Lievens et al., 2022). Work domain results are presented in Supplementary Materials 7.

Italian, and Chinese to test the cross-language generalizability of its validity, measurement, and factor structure.

2.1. Transparency and openness

In our research, we adhered to the guidelines of transparency and openness promotion and followed JARS (Appelbaum et al., 2018). We obtained ethical approval for the studies from the review board of our home institution. All data, code, result files, and study materials are available at: <https://osf.io/8rmsk/>. In the sections below, we discuss sample size rationales, data exclusions, and the measures used in our studies. We used IBM SPSS Statistics (v 29.0) for reliability analyses, correlation and regression tests, and EFA, and R (v 4.3.2) *lavaan* package (Rosseel, 2012) for ANOVA and CFA. The studies included no manipulations and were not pre-registered due to the exploratory nature of the construct development process.

3. Study 1

In Study 1, we generated a pool of items for the UM scale and conducted initial tests on the factor structure of the new scale.

3.1. Methods

3.1.1. Item development

We followed established practices to generate items for the assessment of UM (Hinkin, 1995) and developed items through an iterative process that incorporated a review of existing uncertainty-related and mindset scales (Chiu, Dweck, et al., 1997; Crum et al., 2013), to ultimately achieve content validity for the UM (Midkiff et al., 2018). Mirroring development of existing mindset scales (Crum et al., 2013; Macnamara & Burgoyne, 2023), we created 19 item pairs of opposing statements (e.g., “When I experience uncertainty, I cannot really do much to change it.” vs. “When I experience uncertainty, I can do something to change it.”) representing the fixed and malleable facets and 25 pairs for the threat and opportunity facets. We then recruited six experts on the development and usage of psychological scales from our personal network and asked them to assess to what extent each item (1) represented the intended construct, (2) was clear and comprehensible, and (3) was internally consistent with the other items in the same subscale. After excluding items that did not meet those criteria, the retained set for UM consisted of 28 items (six pairs of items for fixed and malleable and eight pairs for threat and opportunity) and is reported in Table 1.

3.1.2. Test of factor structure

To examine the factor structure, we recruited 141 English-speaking working adults (56% female, 44% male; $M_{age} = 30.96$, $SD_{age} = 10.21$) aiming to achieve the five-participants-per-item threshold suggested by common practice (Wirth & Edwards, 2007). Of these, 41 were recruited through personal networks, and 100 from Prolific Academic (Palan & Schitter, 2018) and compensated £1.36.

3.2. Results

We present descriptive statistics and correlations in Table S2. We ran a series of EFAs with principal axis factoring and oblique rotation (see detailed results in Supplementary Materials 1). For each of these we examined solutions both with the number of factors extracted based on the latent root criterion (Eigenvalue ≥ 1) and constraining the number of factors in line with our theoretical framing. Based on these analyses and on other robustness checks (e.g., different extraction methods), we decided to drop one pair of items in the fixed-malleable set and two pairs in the threat-opportunity set due to low factor loadings (< 0.40) and cross-loadings (see Table 1), leaving a final set of 22 items.

Examining the factor structure of the retained items, we found that

Table 1
Uncertainty mindset items and factor loadings (Study 1).

Items	Factor Loadings			
	1	2	3	4
<i>Fixed</i>				
<i>In life...</i>				
1	Even if I collect more information, I cannot change the amount of uncertainty.	-0.64		
2	I cannot control the uncertainty I experience.	-0.72		
3	When I experience uncertainty, I cannot really do much to change it.	-0.70		
4	I believe I cannot change the uncertainty that I experience.	-0.75		
5	The amount of uncertainty is not under my control.*	-0.60		
6	When there is uncertainty, I cannot make a difference with my actions.	-0.62		
<i>Malleable</i>				
<i>In life...</i>				
1	If I collect more information, I can change the amount of uncertainty.	0.69		
2	I can control the uncertainty that I experience.	0.53		
3	When I experience uncertainty, I can do something to change it.	0.62		
4	I believe I can change the uncertainty that I experience.	0.64		
5	The amount of uncertainty is under my control.*			-0.60
6	When there is uncertainty, I can make a difference with my actions.	0.68		
<i>Threat</i>				
<i>Uncertainty in life...</i>				
1	Creates threats.		0.43	
2	Can inhibit my personal development.		0.68	
3	Should be avoided.*		0.50	
4	Can inhibit my curiosity.		0.62	
5	Can impair my learning.		0.68	
6	Reduces my motivation to do my best.		0.66	
7	Is a threat to the achievement of my life goals.		0.62	
8	Can impair my wellbeing.*		0.57	0.46
<i>Opportunity</i>				
<i>Uncertainty in life...</i>				
1	Creates opportunities.	0.75		
2	Can help my personal development.	0.72		
3	Should be sought after.*	0.43		
4	Can stimulate my curiosity.	0.74		
5	Provides opportunities to learn.	0.66		
6	Motivates me to do my best.	0.74		
7	Is an opportunity to achieve my life goals.	0.74		
8	Can enhance my wellbeing.*	0.54		

Note. $n = 141$. Items with * were dropped after EFA (Study 1). All items were rated on a 7-point agreement Likert scale. Extraction: Principal Axis Factoring; Rotation: Oblimin. Only factors loadings higher than 0.4 are shown. F = Fixed, M = Malleable, T = Threat, O = Opportunity, L = Life Domain.

the best model was a four-factor structure with items pertaining to the fixed, malleable, threat, and opportunity facets of the UM loading on separate factors. Because the fixed and malleable facets appeared to potentially load on a single factor (see Table 1), we conducted the Fornell and Larcker (1981) test to examine whether the subscales formed distinct facets. Results suggested that the fixed and malleable facets were distinct ($AVE = 0.50, r^2 = 0.48$), as were the threat and opportunity facets ($AVE = 0.42, r^2 = 0.25$), because the AVE (average variance extracted) was higher than the squared correlation of the extracted factors. The same pattern emerged for the overall UM scale compared to a two-factor solution with fixed-malleable and threat-opportunity subscales ($AVE = 0.37, r^2 = 0.32$). We then tested the reliability for the overall scale (UM-as-enabling) as well as the four facets, and all exhibited excellent reliability ($\alpha_{\text{fixed}} = 0.87, \alpha_{\text{malleable}} = 0.85; \alpha_{\text{threat}} = 0.83; \alpha_{\text{opportunity}} = 0.91; \alpha_{\text{UM}} = 0.92$). Overall, the results

of Study 1 provided initial evidence that UM is a multi-faceted construct, showing good internal consistency in each the four subscales, as well as a higher-level construct.

4. Study 2

We conducted Study 2 to confirm the factor structure with a confirmatory factor analyses (CFA), and to test the convergent, divergent, and predictive validity of UM.

4.1. Methods

4.1.1. Participants and procedure

We recruited 679 US-based adult workers (62% female, 37% male, 1% other; $M_{\text{age}} = 38.33, SD_{\text{age}} = 11.42$)³ for a two-wave study on Prolific. In the first wave, participants were requested to report their UM—following the same procedure as in Study 1—and other mindsets and uncertainty-related constructs. To ensure response quality with panel data, we included attention checks, and used response time (less than 2 s per item on average) and longstrings (i.e., highest number of same consecutive answers to Likert scale questions) higher than half the total items as filters to exclude low quality responses (Curran, 2016).⁴ This resulted in a sample of 645 participants, whose answers were used to test convergent and divergent validity. After two weeks, the same participants were invited to complete a second survey with outcomes relevant to test predictive validity. Six-hundred and four (63% female, 37% male; $M_{\text{age}} = 38.76, SD_{\text{age}} = 11.41$) completed the second survey, resulting in a response rate of 88.95%. Participants were paid £1.36 for completing each survey.

4.1.2. Measures

Participants answered the items on seven-point agreement Likert scales, unless noted. The full list of items is reported in Supplementary Materials 3.

4.1.2.1. UM. Were measured UM in both waves with the retained 22 items (five items each for fixed and malleable, and six items each for threat and opportunity) from Study 1.

4.1.2.2. Mindset measures. As our theoretical development is rooted in the growth and stress mindset literatures, we measured both constructs using an eight-item stress mindset scale (Crum et al., 2013) and a three-item intelligence growth mindset scale (Chiu, Hong, & Dweck, 1997).⁵

4.1.2.3. Uncertainty measures. We used the seven-item scale of trait uncertainty avoidance (Jung & Kellaris, 2004), and a five-item shortened scale of the need for cognitive closure (Magni, 2021; original scale from Roets & Van Hiel, 2011), as measures of uncertainty-related constructs.

4.1.2.4. Individual differences. We measured participants' core self-evaluations with a 12-item scale (Judge et al., 2003), and the big five personality dimensions with the 10-item TIPI scale, using two items per dimension (Gosling et al., 2003).

4.1.2.5. Outcomes. In the second wave of Study 2, we measured learning goal orientation (five-items; Gong et al., 2013), general stress

³ We estimated sample size based on recommendations for CFA (five to ten participants per item; Bentler & Chou, 1987) and the amount of items included in our convergent and divergent CFA analyses.

⁴ We conducted analyses including all participants and did not find any changes in the significance patterns.

⁵ The items in this scale are reverse-coded, such that higher values reflect a lower growth mindset.

(four-items; Pejtersen et al., 2010), positive and negative affect (12-item PANAS short version; Thompson, 2007), life satisfaction (single-item measure; Cheung & Lucas, 2014). We further validated and used two new scales measuring exploration (six items) and exploitation (four items) on a five-point frequency Likert scale (see Supplementary Materials 5).

4.2. Results

Means, standard deviations, Cronbach's alphas, and correlations are shown in Table S4.

4.2.1. CFA

We conducted CFAs using maximum-likelihood estimation to identify the optimal factor structure, and assessed the model fit with confirmatory fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean residual (SRMR). Given sample size and model's degrees of freedom, we set a good model fit indicatively as CFI >0.90, RMSEA <0.10, and SRMR <0.10 (Browne & Cudeck, 1992; Lai & Green, 2016).

The results, reported in Table 2, indicate that a four-factor model with the fixed, malleable, threat, and opportunity facets (Model A) fit the data well, and significantly better than a two-factor model with fixed-malleable and threat-opportunity (Model B), and a one-factor model with all subscales combined (Model C). The four facets exhibited very good internal consistency ($\alpha_{\text{threat}} = 0.81$; $\alpha_{\text{opportunity}} = 0.88$; $\alpha_{\text{fixed}} = 0.84$; $\alpha_{\text{malleable}} = 0.83$). Building on our theorization of UM as a latent construct with formative indicators, we tested two multilevel factor structures, both with four factors (threat, opportunity, fixed, malleable) at the first level, and one with one factor (overall UM; Model D) and the other with two factors (growth UM, challenge UM; Model E) at the second level, which showed acceptable-to-good fit indices. Taken together, due to the high internal consistency of overall UM both here ($\alpha = 0.89$) and in Study 1 we opted for the overall UM scale to conduct further tests.

Moreover, we assessed test-retest reliability of UM using a two-way mixed-effects intraclass correlation coefficient for absolute agreement. We found moderate-to-good reliability, $\text{ICC}(A,1) = 0.66$, 95% CI [0.61, 0.70], $F(574, 574) = 4.88$, $p < .001$.

4.2.2. Convergent, divergent, and predictive validity

As a next step, we examined the convergent, divergent, and predictive validity of UM. Results showed that UM (with higher values indicating a stronger uncertainty-as-enabling mindset) correlated negatively with uncertainty avoidance ($r = -0.45$; $p < .001$) and need for closure ($r = -0.40$; $p < .001$), supporting convergent validity. Divergent validity was substantiated by the medium-to-low correlations of the UM scale with the big five personality dimensions—extraversion ($r = 0.21$; $p < .01$), agreeableness ($r = 0.15$; $p < .001$), conscientiousness ($r = 0.18$; $p < .001$), openness ($r = 0.31$; $p < .001$) and neuroticism ($r = -0.39$; $p < .001$)—and with other mindsets—growth mindset ($r = -0.22$; $p < .001$), stress mindset ($r = 0.02$, $p = .618$). We found UM to correlate more strongly with core self-evaluations ($r = 0.49$, $p < .001$) than we initially expected. This could be explained by the fact that core self-evaluations tap into notions such as locus of control, which could align with the fixed-malleable facets of UM, and self-efficacy, which could align with the threat-opportunity facets of UM. We further substantiated the distinctiveness of UM from orbiting constructs with a series of CFAs (see Supplementary Materials 2).

Table 2
Confirmatory factor analyses results for Study 2.

Model	χ^2	df	RMSEA	CFI	SRMR	$\Delta \chi^2$ (df)
A (four-factor)	774.00***	203	0.07	0.91	0.05	
B (two-factor)	1603.32***	208	0.10	0.79	0.08	829.32 (5)***
C (one-factor)	3337.44***	209	0.15	0.52	0.15	2563.44 (6)***
D (4-1 two-level)	898.90***	205	0.07	0.89	0.09	
E (4-2 two-level)	796.22***	204	0.07	0.91	0.06	

Note: $\Delta \chi^2$ takes Model A as a comparison.
*** $p < .001$.

Regarding predictive validity, UM correlated positively with learning goal orientation ($r = 0.35$, $p < .001$), positive affect ($r = 0.36$, $p < .001$), life satisfaction ($r = 0.25$, $p < .001$), and exploration ($r = 0.36$, $p < .001$), and negatively with stress ($r = -0.31$, $p < .001$) and negative affect ($r = -0.33$, $p < .001$), as expected; however, UM did not correlate significantly with exploitation ($r = 0.01$, $p = .887$). To further substantiate the validity of UM, we ran regression models (Table 3): one including UM, stress and growth mindset, uncertainty avoidance, and need for closure as covariates, and another further adding personality dimensions. We found that UM was a significant predictor of relevant outcomes above and beyond the other mindsets and uncertainty-related individual differences—and further above and beyond personality in most cases—both as a single construct and in its four facets (see Table S5). In sum, the results of Study 2 further supported a four-factor structure of UM, once again indicating that an overall, higher-level construct was however viable. We also gathered evidence in support of the convergent, divergent, and predictive validity of UM.

5. Study 3

5.1. Cross-national testing

Given that previous research found evidence of cross-national individual differences (e.g., Hofstede & McCrae, 2004), we aimed to examine generalizability and verify whether such differences would emerge in UM. As the construct validation of UM in Study 2 was based on an English-speaking USA-based sample, we translated the UM in Study 3 into three languages. We chose Germany, Italy, and China as countries that differed culturally from the USA and from each other (Jung & Kellaris, 2004), and collected data with a one-time survey for each sample and again explored validity of UM.

5.2. Methods

5.2.1. Procedure

We recruited working adults as participants via Prolific (German, Italian samples) and Cloud Research (Chinese sample).⁶ Participants were eligible to participate if employed at least part-time, above 18 years of age, residing in the target country (Germany, Italy, or China), and native speakers of the respective language. Recognizing the benefit of samples over 500 participants for complex factor analyses (Brown et al., 2017), we aimed for a cumulative sample of 600 participants. The same criteria as in Study 2 were applied to assess response quality and exclude participants from the final sample—we conducted analyses including all participants and did not find significant changes in the results.

5.2.2. Participants

5.2.2.1. German sample. We recruited 200 working adults (31% female, 68% male, 1% other; $M_{\text{age}} = 34.91$, $SD_{\text{age}} = 9.54$). Three participants were excluded because they failed to meet our criteria, leaving a final

⁶ Prolific participants were paid £1.50. As Chinese residents and native speaker were a special sample under Cloud Research's policy, we only know the total cost per participant (US\$ 3.60), but not their actual payment.

Table 3
Linear regression results –UM & mindsets, uncertainty-related differences, and Big Five Personality (Study 2).

	Learning goal orientation		Stress		Positive affect		Negative affect		Life satisfaction		Exploration (life)		Exploitation (life)	
	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	B	SE
Model 1														
Stress Mindset	0.14	0.09	0.06	0.06	0.06	0.05	0.06	0.05	-0.04	0.14	0.06	0.05	0.05	0.05
Growth Mindset (Intel.)	-0.03	0.02	-0.02	0.02	-0.04**	0.01	-0.01	0.01	-0.02	0.04	-0.04*	0.02	-0.00	0.01
Uncertainty Avoidance	-0.18**	0.06	0.01	0.05	-0.01	0.04	-0.01	0.04	0.25*	0.11	-0.15***	0.04	0.10**	0.03
Need for Closure	0.11*	0.06	0.08	0.04	0.04	0.03	0.07*	0.03	-0.09	0.09	0.08*	0.04	0.05	0.03
Extraversion	0.03	0.03	0.03	0.02	0.07***	0.02	-0.01	0.02	0.12**	0.04	0.00	0.02	0.03*	0.01
Agreeableness	-0.03	0.03	-0.04	0.02	0.03	0.02	0.00	0.02	0.04	0.06	-0.01	0.02	0.04*	0.02
Conscientiousness	0.11**	0.03	-0.04	0.02	0.12***	0.02	-0.07***	0.02	0.11*	0.06	0.01	0.02	0.03	0.02
Neuroticism	-0.04	0.03	0.29***	0.02	-0.08***	0.02	0.28***	0.02	-0.34***	0.05	0.01	0.02	-0.02	0.02
Openness	0.26***	0.03	0.00	0.02	0.07**	0.02	-0.01	0.02	0.03	0.06	0.13***	0.02	0.02	0.02
UM	0.22***	0.06	-0.06	0.04	0.13***	0.04	-0.03	0.03	0.23*	0.10	0.17***	0.04	0.10**	0.03
R ²	0.29		0.42		0.33		0.51		0.19		0.25		0.11	
ΔR ²	0.02		0.00		0.02		0.00		0.01		0.03		0.02	
Model 2														
Stress Mindset	0.17	0.09	0.05	0.07	0.07	0.06	0.04	0.06	-0.01	0.15	0.08	0.06	0.05	0.05
Growth Mindset (Intel.)	-0.04	0.02	-0.03	0.02	-0.05**	0.02	-0.02	0.02	-0.02	0.04	-0.04**	0.02	-0.01	0.01
Uncertainty Avoidance	-0.33***	0.06	0.14**	0.05	-0.09*	0.04	0.14**	0.04	0.03	0.11	-0.21***	0.04	0.08*	0.03
Need for Closure	0.11	0.06	0.09	0.05	0.04	0.04	0.08	0.04	-0.12	0.10	0.07*	0.04	0.04	0.03
UM	0.33***	0.06	-0.22***	0.05	0.25***	0.04	-0.20***	0.04	0.48***	0.10	0.20***	0.04	0.14***	0.03
R ²	0.19		0.17		0.15		0.18		0.07		0.20		0.07	
ΔR ²	0.05		0.03		0.06		0.03		0.04		0.04		0.04	

Note. *n* = 604. Unstandardized coefficients are reported. UM = Uncertainty Mindset. Intel. = Intelligence. ΔR² is compared to the same regression model excluding UM.

* *p* < .05.
** *p* < .01.
*** *p* < .001.

sample of *N* = 197.

5.2.2.2. Italian sample. We requested 200 and obtained 198 employed individuals (44% female, 54% male, 2% other; *M*_{age} = 33.16, *SD*_{age} = 9.36). One participant was excluded because they failed to meet our criteria, leaving a final sample of *N* = 197.

5.2.2.3. Chinese sample. We requested 200 and obtained 228 employed individuals (57% female, 43% male; *M*_{age} = 36.63, *SD*_{age} = 10.48). Twenty-three participants were excluded because they failed to meet our criteria, leaving a final sample of *N* = 205.

5.2.2.4. USA sample. To compare the generalizability and factor structure of the original items, we further used the USA-based sample of Study 2 for the cross-national analysis.

5.2.3. Measures

We followed standard translation-back-translation practices to translate the UM scale into German, Italian, and Chinese (see Table S7), and to translate other scales used in our research when we could not locate existing translations (Brislin, 1980; Klotz et al., 2023). Unless differently stated, participants answered on a seven-point agreement Likert scale.

5.2.3.1. UM. UM was measured as in previous studies. The four facets and the overall scale of UM exhibited excellent internal consistency across all national samples (see Table S8).

5.2.3.2. Mindset measures. We measured stress mindset and growth mindset as in Study 2. Additionally, we were interested in how UM would relate to the paradox mindset (i.e., a both-and-mindset) and measured it with the nine-item scale by Miron-Spektor et al. (2018).

5.2.3.3. Uncertainty measures. We measured uncertainty avoidance and need for closure as in Study 2. Additionally, we included a measure of curiosity (five-item scale; Litman, 2008) as a positive-valence

uncertainty-related measure to expand the conceptual breadth of our validity tests.

5.2.3.4. Individual differences. We measured participants' core-self evaluations and big five personality dimensions with the same items as in Study 2.

5.2.3.5. Outcomes. We assessed life satisfaction, stress, exploration, and exploitation in life with the same scales as in Study 2.

5.3. Results

We provide descriptive statistics and correlations of the cumulative Study 3 sample as well as by national sample in Tables S8–S11.

5.3.1. Convergent, divergent, and predictive validity

To replicate the factor structure previously found, we ran CFAs for each sample separately, and convergent, divergent, and predictive validity tests on the cumulative sample using the same analytical tools and procedures as in Study 2. Results generally aligned with those of Study 2 (see Supplementary Materials 4 for detailed reports).

In the cumulative sample, UM negatively correlated with uncertainty avoidance (*r* = -0.34; *p* < .001), need for closure (*r* = -0.30; *p* < .001), and positively with curiosity (*r* = 0.31; *p* < .001), supporting convergent validity. Regarding divergent validity, we found that UM correlated moderately with big five personality dimensions—extraversion (*r* = 0.27; *p* < .001), agreeableness (*r* = 0.25; *p* < .001), conscientiousness (*r* = 0.22; *p* < .001), openness (*r* = 0.34; *p* < .001) and neuroticism (*r* = -0.49; *p* < .001)—the latter correlation comparatively larger than the others, as in Study 2. The correlation with core self-evaluations (*r* = 0.58, *p* < .001) was also moderately strong as in Study 2. Further, UM correlated moderately with growth mindset (*r* = -0.26, *p* < .001), stress mindset (*r* = 0.36, *p* < .001), and paradox mindset (*r* = 0.38, *p* < .001), further substantiating support for divergent validity.

Regarding predictive validity, UM correlated positively with life satisfaction (*r* = 0.43, *p* < .001), exploration (*r* = 0.32, *p* < .001), and

negatively with stress ($r = -0.44, p < .001$). Again, UM did not correlate significantly with exploitation ($r = 0.02, p = .578$). We performed regression analyses on the measured outcomes (see Table S6): The results, mostly aligned with Study 2, showed that UM predicted all outcomes above and beyond extant predictors.

5.3.2. Cross-national test of measurement invariance

To assess the cross-national construct validity of UM, we adopted a multi-group approach to test for measurement invariance across samples—a critical test when scales are translated into foreign languages (Vandenberg & Lance, 2000). We conducted a multigroup CFA with German, Italian, Chinese, and USA (Study 2) samples, testing configural, metric, and scalar invariance stepwise (Klotz et al., 2023). Invariance was supported when successive constraints did not reduce CFI by more than 0.01 (Cheung & Rensvold, 2002).

The results support configural and metric invariance of UM among the German, Italian, Chinese, and American samples. Configural invariance analysis showed acceptable fit ($\chi^2(812) = 2293, p < .001, CFI = 0.89, RMSEA = 0.08, SRMR = 0.06$), indicating that the measurement model fitted well across samples and translated scale versions. Metric invariance analysis exhibited acceptable fit ($\chi^2(866) = 2384, p < .001, CFI = 0.89, RMSEA = 0.07, SRMR = 0.06; \Delta_{CFI} = 0.00$), and the CFI difference from the metric to the configural model was below the threshold of 0.01. Scalar invariance analysis showed partial model fit ($\chi^2(920) = 2777, p < .001, CFI = 0.87, RMSEA = 0.08, SRMR = 0.07; \Delta_{CFI} = 0.02$). The CFI difference between the scalar and metric models was larger than 0.01, not supporting scalar invariance. Overall, these findings indicate that the UM scale can be replicated in different languages with factor loadings equivalently loading on the desired factors (configural, metric invariance), while presenting slight mean differences across samples.

Mean values across countries are shown in Table 4. To examine mean level differences, we conducted an analysis of variance (ANOVA) for the full UM scale and a multivariate analysis of variance (MANOVA) for the four facets. The ANOVA indicated a small significant effect ($F(3, 1274) = 7.73, p < .001, \eta^2 = 0.02$), suggesting group mean differences between the countries in overall UM. Post-hoc pairwise comparisons using Tukey's HSD showed mean differences between participants from USA and Germany ($\Delta_M = -0.18, 95\% \text{ CI: } [-0.34, -0.03], p = .014$), as well as between USA and China ($\Delta_M = -0.26, 95\% \text{ CI: } [-0.41, -0.10], p < .001$), whereas the Italian sample did not differ from the others countries, nor did the Chinese and German samples differ from each other.

The MANOVA showed a small significant effect ($F(12, 3819) = 22.64, p < .001, \eta^2 = 0.07$), indicating significant differences on the four facets across groups. We report significant differences here and provide a full overview in Supplementary Materials 3. For the threat facet, U.S. participants reported higher levels than participants from China ($p = .002$). For the opportunity facet, participants from China reported higher levels than participants from Germany ($p < .001$), USA ($p < .001$), and Italy ($p < .001$). In addition, participants from U.S. reported higher scores than participants from Italy ($p < .001$). For the fixed facet, participants from China reported higher levels than their counterparts from Germany ($p < .001$), Italy ($p < .001$), and USA ($p < .001$). American participants also showed higher levels than the ones from Germany ($p < .001$). For the malleable facet, American participants reported lower levels than participants from China ($p < .001$) and Germany ($p =$

.001).

The overall results suggest that the validity and factor structure of UM adequately translate into different languages cross-nationally. Although cross-national mean level differences in UM were smaller in effect size, they suggest that an uncertainty-as-enabling mindset is more prevalent in Germany and China, compared to USA and Italy.

6. General discussion

Past research suggests that individuals respond to uncertainty differently based on how they assess uncertainty in their daily lives. To elucidate possible sources of specific uncertainty preferences in any given situation—a key component of uncertainty regulation—(Griffin & Grote, 2020), we introduce the concept of UM, which captures individuals' beliefs about uncertainty as disabling or enabling successful goal pursuit. With three empirical studies, we show that UM is a distinct, higher-level construct composed of four formative facets. Our results indicate convergent and divergent validity with respect to a range of other constructs (personality traits, core self-evaluations, uncertainty-related individual differences, mindsets) and predictive validity for relevant attitudinal, affective, and behavioral outcomes (Gosling et al., 2003; Judge et al., 2003; Jung & Kellaris, 2004).

6.1. Contributions to the mindset literature

Following research on other mindsets, we conceptualized four facets—fixed, malleable, threat, and opportunity—of UM. Empirical evidence showed these four facets do not cleanly map into two dimensions (fixed-malleable and threat-opportunity) as we initially envisioned, but rather each of the four facets exists as a meaningful separate entity. However, the four facets can be integrated (taking malleable and opportunity, and the inverse of fixed and threat) to form a higher-level UM construct with acceptable empirical validity. We termed this construct as uncertainty-as-enabling mindset (the opposite being uncertainty-as-disabling mindset). With these findings, we expand mindset research by not only conceptualizing a mindset about a new belief target—uncertainty—but, most importantly, by acknowledging (the possibility) that mindsets are multi-faceted constructs comprising distinct facets that can be formatively taken together into a higher-level construct. In this regard, UM as a composite construct that includes multiple facets breaks new ground, in line with recent research on synergistic mindsets (Yeager et al., 2022) and on mindsets capturing various facets such as attributes and experiences (Burnette et al., 2025). The results raise interesting questions regarding the nature of such a composite construct. To date, fixed-malleable and, to a lesser extent, threat-opportunity have been treated as representing the ends of two continua (Crum et al., 2013; Dweck, 2016). Our finding of a first order four-factor structure, however, indicate that UM is instead a formative construct (MacKenzie et al., 2005), where each facet represents a distinct part of the overall construct. Although this finding may be specific to uncertainty, because the elusive, encompassing, and ambivalent nature of uncertainty may trigger all four facets simultaneously, it may be worth considering the possibility that other mindsets can be more complex and multi-faceted than previously assumed (Burnette et al., 2023; Macnamara & Burgoyne, 2023; Oyserman, 2023).

Table 4
Overview of means for UM and facets across countries.

Country	Overall UM	Threat	Opportunity	Fixed	Malleable
United States	4.40 (0.84)	4.20 (1.02)	4.62 (1.07)	3.49 (1.13)	4.75 (1.01)
Germany	4.59 (0.84)	4.05 (1.15)	4.46 (1.15)	3.07 (1.03)	5.01 (0.96)
Italy	4.45 (0.95)	4.03 (1.22)	4.28 (1.26)	3.33 (1.13)	4.89 (1.07)
China	4.66 (0.88)	3.89 (1.41)	5.32 (0.94)	3.89 (1.41)	5.09 (0.94)

Note. $n = 645$ (USA); $n = 197$ (Germany); $n = 197$ (Italy); $n = 205$ (China). Standard Deviation values are reported in parenthesis.

6.2. Contributions to the uncertainty literature

We also make contributions to uncertainty theory and research. First, we extend URT (Griffin & Grote, 2020) by conceptualizing UM as a critical antecedent of uncertainty appraisals. By proposing UM as a construct that captures the full range of beliefs about uncertainty from disabling to enabling, the UM scale is suitable for testing the theory's propositions. Moreover, the ARTU model (Kruglanski et al., 2025) could be expanded to include UM as a possible consequence of past experiences with uncertainty, which, at the same time, would add to URT by elucidating the origins of individual uncertainty preferences. Second, we evidenced the predictive power of UM above and beyond not only growth and stress mindsets, but also uncertainty avoidance and need for closure—as well as personality dimensions. We found that, for a range of outcomes, adding UM as a covariate to linear regression models increased the explained variance substantially—by up to 10%. This reflects the pervasiveness of uncertainty and, consequently, the relevance of studying UM as a critical antecedent of individual differences. Specifically, a higher uncertainty-as-enabling mindset was predictive of higher levels of positive affect and life satisfaction above and beyond personality traits and other relevant individual differences, whereas it predicted lower levels of negative affect and stress above and beyond other mindsets and uncertainty-relevant constructs, but not personality traits such as neuroticism and conscientiousness. Learning goal orientation and a preference for exploration were more strongly predicted by UM than the other mindsets and uncertainty-related individual differences as well. These findings provide a solid justification for studying UM not only as an antecedent of uncertainty regulation processes (Griffin & Grote, 2020), but also of more general attitudes and behaviors.

Third, acknowledging that uncertainty is ubiquitous while at the same time beliefs about it may be influenced by individual and cultural factors, we find discrete cross-national generalizability of UM across four countries—USA, Germany, Italy, and China. The results of configural and metric invariance, as well as similar results concerning validity across samples, support the generalizability of the UM. Furthermore, observing cross-national mean differences—albeit small—in UM suggests that there exist cross-country differences in beliefs about the nature of uncertainty. Comparing our findings with Hofstede's uncertainty avoidance dimension (Hofstede, 1991; Hofstede & McCrae, 2004), we substantiated China as the least avoidant and highest uncertainty-as-enabling among the four countries. On uncertainty avoidance, the USA ranked second after China, whereas our American sample reported lower UM than other countries. While UM in German and Italian samples largely aligned with Hofstede's classification, the differences overall indicate that UM and uncertainty avoidance, through related, merit distinct treatment.

6.3. Limitations and directions for future research

Our research remains affected by some limitations. First, comparing the four facets and their higher-order composite requires further scrutiny, as different combinations of the four facets may be conducive to different outcomes. Moreover, specific facets may drive predictive validity. For instance, the positive correlation between UM and life satisfaction was driven by the malleable facet (Table S5). Aiming for simplicity and parsimony, and in line with Yeager et al. (2022), we focused on the combination of malleability, opportunity, inverse threat, and inverse fixedness to conceptualize an uncertainty-as-enabling mindset. However, other combinations of the UM facets are possible in principle. An important step in future research therefore would be to further investigate the individual facets and their interplay. Drawing on the ARTU model (Kruglanski et al., 2025), investigations on how past experiences with uncertainty might influence the UM facets in different ways would also expand the literature—e.g., examining different aspects of past experiences related to threats/opportunities and the degree of

personal agency involved. Furthermore, by including also cognitive and behavioral responses as in our current study, the validity of the ARTU model might be extended beyond affective responses. More broadly, we question the implicit credence in past mindset research that mindsets are reflective constructs, showing that looking at them as formative constructs may help shed more light on their nature and effects.

A second limitation pertains to the use of self-reported data. Although we have striven to reduce common source bias by using time lags in Study 2 and self-reports may be most accurate for variables such as affect (Möttus et al., 2024), future research could generalize our findings using different assessment methods. For instance, though we expected UM to correlate negatively with exploitation—i.e., behaviors that rely on existing knowledge and routines (Schulz & Gershman, 2019)—we found positive or non-significant correlations. Though it is possible that an uncertainty-as-enabling mindset can lead to both more exploration and exploitation behaviors—i.e., ambidexterity (March, 1991; Gibson & Birkinshaw, 2004), rigorous behavioral measures for exploitation and exploration (e.g., Gershman, 2019) would help generalize and expand our results.

A third limitation is the generic definition of uncertainty that we used. Future research may extend this by focusing on uncertainty in different domains, such as work (see Supplementary Materials 7 for initial results in this direction), family, or leisure (Judge & Kammeyer-Mueller, 2012), and on different aspects of uncertainty, such as comparing UM—a cognition—to more affect-based constructs (e.g., intolerance of uncertainty; Carleton, 2016; Freeston et al., 1994), or examining the valence of its outcomes (Kruglanski et al., 2025; Milliken, 1987).

Finally, we point to the potential of UM as a target for tailored interventions. There is ample evidence that mindsets can be altered to the benefit of the concerned individuals (Walton & Crum, 2020; Walton & Wilson, 2018). As people are challenged by the ubiquity of uncertainty resulting from technological, political, economic and societal changes, interventions targeted at promoting an uncertainty-as-enabling mindset may facilitate adaptive responses to uncertainty and thereby foster individuals' effective self-regulation and well-being. Such interventions would be an answer to the call to “augment (people's) ability to embrace rather than escape uncertainty” (Kruglanski et al., 2025, p. 1).

7. Conclusion

Building on URT and mindset research, we introduced UM as a multi-faceted construct assessing beliefs about the nature of uncertainty as malleable, fixed, threat, and opportunity. The four facets exist as distinct entities but can be integrated into a higher-level construct: uncertainty-as-enabling mindset. We found consistent evidence supporting the distinctiveness and predictive validity of UM on relevant attitudes and behaviors. By introducing the UM as an antecedent of uncertainty-related preferences and attitudes, we hope to foster research on uncertainty regulation that can have deep practical implications on how to successfully navigate uncertainty in turbulent times.

CRediT authorship contribution statement

F. Magni: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **A. Gerlach:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **J. Pfrombeck:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **L.E. Strittmatter:** Writing – review & editing, Conceptualization. **S. Zaniboni:** Writing – review & editing, Supervision, Methodology, Conceptualization. **G. Grote:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization.

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Declaration of competing interest

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Research materials are available on OSF at: <https://osf.io/8rmsk/>.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.paid.2026.113777>.

Data availability

Data and code are available at the OSF link indicated in the manuscript.

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