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**Validation of the Comprehensive Inventory of Mindfulness Experiences Using
Rasch Methodology**

A thesis

submitted in fulfilment

of the requirements for the degree

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Abstract

Although mindfulness has now been studied for multiple decades, the field of psychometric research has yet to agree upon the optimal way to measure the mindfulness construct. Prior research has identified eight distinct aspects of mindfulness, which were not adequately captured by any available measures until the development of the Comprehensive Inventory of Mindfulness Experiences (CHIME). The CHIME contains 37 items and has demonstrated excellent psychometric properties in both the German and Dutch languages, but an English version for adults has not been validated to date. The purpose of the present study was to investigate the psychometric characteristics of the translated English CHIME scale using Rasch methodology. The current study utilized the unrestricted Partial Credit Rasch model to evaluate the psychometric characteristics of the English CHIME. The sample included 620 participants from the general population. The validity of the English CHIME was examined by correlating its scores with various measures of mindfulness and psychological functioning. Initial Rasch analysis of the English CHIME showed poor model fit, local dependency, and evidence against the assumption of unidimensionality. Several minor modifications, which involved creating Super-Items, were required to achieve good fit to the Rasch model ($\chi^2(45)=31.99, p=0.93$). The modified scale displayed evidence of unidimensionality, invariance across personal factors, and a high reliability (PSI=0.92). The developed Rasch algorithm permitted the transformation of ordinal responses into interval scale scores, increasing the English CHIME's precision of measurement. The English CHIME's external validity was established by moderate–high correlations with other measures of mindfulness and various measures of psychological functioning. The results of this study provide evidence for the validity of the English CHIME scale, which can be used to assess the overarching construct of mindfulness.

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Co-Authored Works

The study presented in this thesis is predominantly my own work (80%), which is also co-authored with other researchers who collected the data and acted as external and internal advisors, including Leticia Ribeiro, Chris Krägeloh, Claudia Bergomi, Marie Parsons, Alex Siegling, Wolfgang Tschacher, Zeno Kupper, and my supervisor Oleg N. Medvedev. The journal article reporting this study is currently under review in the journal *Mindfulness* (impact factor = 4.6).

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Introduction

Definitions and Origin of Mindfulness

Mindfulness is an optimal state of psychological functioning where the mind is both fully engaged and relaxed at the same time (Krägeloh et al. 2019). It emerges when attention is directed entirely towards the experiences of the present moment, without clinging to or pushing away from any sensations that arise within the space of awareness. Mindfulness has previously been defined as “the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment” (Kabat-Zinn 2003, p.10). Another frequently cited definition describes mindfulness as “a process of regulating attention in order to bring a quality of non-elaborative awareness to current experience and a quality of relating to one’s experience within an orientation of curiosity, experiential openness, and acceptance. We further see mindfulness as a process of gaining insight into the nature of one’s mind and the adoption of a de-centered perspective... on thoughts and feelings so that they can be experienced in terms of their subjectivity (versus their necessary validity) and transient nature (versus their permanence)” (Bishop et al. 2004, p. 234). In these definitions, ‘awareness’ refers to the contents of consciousness, i.e., the sensations of touch, smell, vision, taste, hearing, and thoughts (in Buddhist psychology, thinking is considered the sixth sense) (Kang & Whittingham 2010). ‘Attention’ is the spotlight or focus of awareness, whereby certain sensations are magnified and brought into focus. The ‘nonjudgmental’ component refers to an accepting disposition towards all sensory input, pleasant and unpleasant, that appear within the field of consciousness.

From a traditional Buddhist perspective, the practice of mindfulness is a fundamental component on the path to attain freedom from suffering (Harvey 2013). This path is nested within the four noble truths of Buddhism, which were the first teachings of the Buddha after he became enlightened. The first noble truth of Buddhism is the truth of ‘Dukkha’, which states that life contains inevitable suffering (Van Gordon et al. 2015). This suffering is an innate quality of ‘Samsara’ (world), which is impermanent and constantly in a cycle of death and rebirth. The second noble truth is that of ‘Samudaya’, which states that there is a cause or origin to this suffering. In this view, the suffering is caused by ‘tahnā’ which translates to desire, craving or attachment. The third noble truth is that of ‘Nirodha’, which explains that the alleviation and end of suffering can be attained by letting go of ‘tahnā’. The fourth noble truth is that of ‘magga’, which states that the alleviation of suffering, the way to let go of ‘tahnā’, is contained within the eight-fold path.

The eight-fold path includes eight interrelated steps, or aspects of consciousness, that must be in place to achieve enlightenment and permanently alleviate suffering (Huxter 2015). This path includes: (1) Right View, (2) Right Intention, (3) Right Speech, (4) Right Action, (5) Right Livelihood, (6) Right Effort, (7) Right Concentration, and (8) Right Mindfulness. Hence, meditation practice develops the capacity to pay attention and be grounded in the present moment, so that one can act skillfully and live a life that promotes well-being. Although it has perhaps been most thoroughly elaborated by Eastern spiritual traditions, mindfulness is an innate quality of human consciousness and not exclusive to any theological framework.

Mindfulness Interventions

After being inspired by his extensive practice in meditation in the East, in the late 1970s, John Kabat-Zinn created secular mindfulness interventions that could be readily exported to the

academically orientated West (Huxter 2015). These Mindfulness Based Stress Reduction (MBSR) programs used the cultivation of mindfulness to reduce stress and alleviate psychological, and to some extent physical (e.g., pain), suffering (Kabat-Zinn 1982, 1990). A typical MBSR program runs for eight weeks, where participants engage in a two-hour weekly session and attend one full-day meditation retreat after the fifth week of the program. In the MBSR program, participants are taught how to meditate and are instructed to engage in formal meditation practice (traditional sitting meditation) for 45 minutes a day, six days per week. In addition to the formal practice, participants are encouraged to incorporate mindfulness into their daily lives during regular activities, such as walking, eating, sitting, and standing. In the MBSR program, participants are taught three core meditation techniques: mindfulness meditation, mindful body scanning, and mindful yoga movements.

Since the emergence of MBSR, many other therapies have been developed that incorporate mindfulness training into their therapeutic systems. Mindfulness-Based Cognitive Therapy (MBCT; Segal et al. 2002) integrates mindfulness training with traditional cognitive therapy. The typical format for an MBCT program is similar to the format used in MBSR, with an MBCT program lasting eight weeks, comprised of one two-hour weekly session, and a full-day retreat held after the fifth week. However, in MBCT, the mindfulness training is centered around a breathing-space 3-minute meditation, which emphasizes three different mindfulness techniques. Firstly, a focus is placed on “awareness”, where participants direct their attention to the contents of consciousness, identifying what sensations, feelings, and cognitions are in the present. Next, the participants focus on “gathering”, where attention is directed towards the sensations of breathing (usually either the sensations of air flow at the tip of the nose or sensations associated with the rising and falling of the abdomen). Finally, the participants focus

on “expanding”, where the concentration gathered by paying attention to breath is expanded to the entirety of the body, attending to awareness as if the whole body was breathing. After an MBCT program, participants should feel less self-focused and carried away by their cognitions and be better able to view their thoughts as objects that pass through the space of awareness.

Dialectical Behaviour Therapy (DBT; Linnehan 1993) is an intervention which fuses the techniques of Cognitive Behavioral Therapy with mindfulness practice. DBT was originally developed to treat patients with borderline personality disorder, but it can also be used successfully to treat people who suffer from emotional dysregulation and people who engage in repetitive self-destructive behaviours (such as substance abuse). Mindfulness is central in DBT, because a mindfulness meditation precedes the teaching of each DBT skill. In DBT, mindfulness is conceptualized as having six key elements: three in relation to what a person is doing when being mindful (participating, observing, and describing) and three in relation to how one does it (one-mindfully, non-judgmentally, and effectively) (Baer et al. 2006).

Like MBCT and DBT, Acceptance and Commitment Therapy (ACT; Hayes et al. 1999) is an intervention which incorporates aspects of Western psychology with mindfulness training. ACT is based upon relational frame theory and helps people connect with their transcendent self-nature, which can be understood as self-as-context—the space where the contents of consciousness are appearing from moment to moment. The central premises of ACT are that psychological suffering is caused by cognitive entanglement (becoming overly identified with thoughts), experiential avoidance (aversion), and the resultant cognitive and behavioral rigidity which cause a person to fail to act in a way that is in line with their values. Therefore, the process of ACT requires participants to clarify their values so that they understand how they need to behave to actualize their well-being. Once values have been clarified, ACT teaches participants

mindfulness skills so that they can become in touch with their experience of the present moment, accept the contents of their experience, commit to acting in a way in line with their values, and act in the chosen direction.

In addition to MBSR, MBCT, DBT, and ACT, several other interventions have emerged which incorporate mindfulness training into their programs, such as Mindfulness-integrated Cognitive Therapy (MiCBT Institute 2011) and Behavioral Activation (Dimidjan et al. 2006). Due to the surge in mindfulness-based therapies, scientific research has been conducted to establish the efficacy of these interventions. The resulting literature has demonstrated that interventions based in mindfulness are effective in reducing both the physical and psychological symptoms of various psychopathologies, such as depression, anxiety, stress, borderline personality disorder, substance abuse, suicidal/self-harm behaviour, and post-traumatic stress disorder (Krägeloh et al. 2019). Additionally, Mindfulness-Based Interventions (MBIs) have been shown to increase the well-being of participants (Bennett & Dorjee 2016), as well as improve their emotional regulation (de Vibe et al. 2018).

Mechanisms of Mindfulness

As the benefits of mindfulness practice are well established, research has subsequently been conducted to investigate the mechanisms by which mindfulness works (Krägeloh et al. 2019). This research has identified that the positive effects of mindfulness meditation are mediated by improvements in attention regulation, body awareness, emotional regulation, and by changing perspective on the self (Hölzel et al. 2019). Additionally, neuroscientific research has identified different regions of the brain that are associated with mindfulness practice. Although a wide variety of brain regions have been shown to correlate with mindfulness, frequently identified areas of the brain include the amygdala, striatum, insula, cingulate cortex, medial

prefrontal cortex (mPFC), and multiple prefrontal regions (Tang et al. 2015). A common model of connectivity associated with meditation practice is that of the Default Mode Network (DMN) (Brewer et al. 2011). The DMN is a large-scale brain activity network that includes many regions of the brain, notably the posterior cingulate cortex (PCC) and the medial prefrontal cortex. The DMN has been implicated in self-referential processing and shows increased activation during mind-wandering and daydreaming. As such, experienced meditators show decreased activation in the DMN when compared with controls, suggesting that the positive effects of mindfulness training are mediated by improvements in connectivity and activation of the DMN regions (Hölzel et al. 2019).

Assessment of Mindfulness

Since mindfulness training has a significant positive effect on mental and physical health (Krägeloh et al. 2019), it is crucial for researchers and clinicians to be able to accurately measure the overarching mindfulness construct and discriminate precisely between individual mindfulness levels. However, due to the wide variety of meditation traditions and all-encompassing nature of mindfulness, the operationalization and subsequent measurement of mindfulness remains a challenge. In the scientific literature, mindfulness is often understood as being comprised of two integral components: (1) the regulation of attention, and (2) the adoption of an accepting and curious disposition towards experience (Bishop et al. 2004). The intention behind mindfulness practice has also been frequently cited as an important component of the mindfulness construct (Shapiro et al. 2006). Despite there being considerable definitional overlap, the question remains whether mindfulness is best understood as a unidimensional or multi-faceted construct. Is it one thing? Or many different, related things combined?

The Freiburg Mindfulness Inventory (FMI)

One of the first attempts to psychometrically assess the mindfulness construct was the development of the Freiburg Mindfulness Inventory (FMI; Buchheld et al. 2001; Walach et al. 2006). The construction of the FMI was heavily influenced by mindfulness as it is conceptualized in traditional Buddhist psychology. The development of the FMI included participants who were experienced in meditation (e.g., participants who were sitting meditation retreats). Hence, the FMI is particularly suited towards participants who have previous meditation experience and the authors warn that the measure may not be suitable for participants unfamiliar with mindfulness practice. The full FMI contains 30 items which measure four interrelated aspects of mindfulness: mindful presence, non-judgmental acceptance, openness to experiences, and insight. The items were constructed after an extensive review of the existing literature and were presented to experts in meditation who rated how well they reflected the mindfulness construct. Principal Component Analysis (PCA) was used to scrutinize the psychometrics of the scale. Due to the high correlations between items of the different proposed dimensions, the authors recommend using the short version of the scale, the FMI-14 (containing 14 items), which conceptualizes mindfulness as a unidimensional construct with highly interrelated components.

The Mindful Attention Awareness Scale (MAAS)

Currently, the most cited measure of mindfulness is the Mindful Attention and Awareness Scale (MAAS; Brown & Ryan 2003), which is a testament to the thoroughness of its development. The MAAS was shown to have high internal consistency, the ability to discriminate across levels of meditation experience, and was correlated with various measures of well-being. The MAAS is a unidimensional measure of mindfulness defined by a single presence

factor and includes 15 negatively-worded items that require reverse coding before the total score can be calculated.

During the development of the MAAS, different factor structures were tested, including a model containing both a presence and acceptance factor. However, when examining the convergent validity of the MAAS with various measures of well-being, analysis indicated that the inclusion of the acceptance factor did not add any explanatory power over the unitary presence factor (Brown & Ryan 2004). The authors concluded that although acceptance is conceptually an important component of mindfulness, it is redundant when assessed as an additional factor. They justify this conclusion by explaining that acceptance of experience is imbedded within the regulation of attention, i.e., it is impossible to fully accept the contents of one's experience without first directing attention to the present moment. However, this conclusion has been challenged by the development of mindfulness measures which measure mindfulness as a multi-dimensional construct.

One of the main limitations of the MAAS is that items describing both the attitudinal and intent components of mindfulness were intentionally excluded during the development of the scale, as the authors wanted to investigate the relationship between mindfulness and well-being. They believed that if items including attitude and intent were included, those items would confound the relationship between the MAAS and other well-being measures. In addition, previous authors (Van Dam et al. 2010; Grossman 2011) have questioned whether the MAAS actually measures the construct of mindfulness. Specifically, it has been noted that the MAAS does not measure the accepting attitudinal component of mindfulness, or content related to non-judgmental awareness. The scale is limited because all items are negatively-worded, and it includes items that describe the absence of attention, meaning that the scale may measure

perceived inattention rather than mindfulness (Van Dam, et al. 2010). Similarly, the MAAS has also been condemned as assessing mindlessness rather than the construct of mindfulness (Sauer et al. 2011). In summary, although there is evidence for the internal and external validity of the MAAS, the content validity of the scale is questionable.

The Kentucky Inventory of Mindfulness Skills (KIMS)

The first assessment to measure mindfulness as a multi-faceted construct was the Kentucky Inventory of Mindfulness Skills (KIMS; Baer et al. 2004). The KIMS was primarily developed based on the conceptualization of mindfulness as it is taught in Dialectical Behaviour Therapy (Linehan 1993). However, the development of the KIMS was also influenced by understandings of mindfulness as it is taught in interventions such as MBSR and MCBT. The KIMS contains 39 items that measure four different facets: observing, describing, acting with awareness, and accepting without judgement. Although the KIMS includes the attitudinal components of mindfulness that the MAAS is said to be lacking, the KIMS has also been criticized because it was operationalized based on programs which utilize mindfulness as a psychological intervention. Although this does not necessarily limit its validity, by deriving its content from objectives of mindfulness-based interventions, the measure fails to capture some of the broader aspects of mindfulness, such as mindfulness as a path to understanding reality more clearly.

The Cognitive and Affective Mindfulness Scale-Revised (CAMS-R)

The Cognitive and Affective Mindfulness Scale-Revised (CAMS-R; Feldman et al. 2007) is a 12-item self-report measure of mindfulness in general life. The CAMS-R is the revised version of the Cognitive and Affective Mindfulness Scale (CAMS; Kumar et al. 2005), an 18-item scale which was developed as a broad measure of mindfulness, utilizing language that could

be readily understood by individuals who did not have significant meditation experience. The CAMS was also used to measure mindfulness in a way that could be used in the treatment of depression (Hayes & Feldman 2004). Although the CAMS showed some promising psychometric properties, the scale suffered from several measurement issues, such as low internal consistency. Hence, the CAMS-R was developed to address these issues. The CAMS-R is a unidimensional measure of mindfulness that captures the mindful aspects of attention regulation, present state focus, awareness of experiences, and an accepting non-judgmental attitude towards experiences.

The Southampton Mindfulness Questionnaire (SMQ)

Most of the currently existing mindfulness measures assess variations of the awareness, attention, and attitude components, which are believed to be central to the construct of mindfulness. Although these aspects of mindfulness are essential, Buddhist psychology teaches that mindfulness itself is the path to reduce craving and aversion to experience, and subsequently eliminate suffering. The Southampton Mindfulness Questionnaire (SMQ; Chadwick et al. 2008) was initially introduced as *Mindfulness Questionnaire* (MQ; Chadwick et al. 2005) in an unpublished manuscript. Cited by Baer et al. (2006), it was the first scale to measure mindfulness specifically as it relates to craving and aversion. The SMQ contains 16 items, which all responded to the prompt “Usually when I experience distressing thoughts and images...”. The SMQ was conceptualized to assess the four interrelated bipolar dimensions: (1) decentered awareness versus being lost or reacting to cognitions, (2) remaining with difficult cognitions versus experiential avoidance, (3) accepting cognitions and oneself versus judging cognitions and self, and (4) letting difficult cognitions pass versus rumination/worry. Although it was

initially conceptualized as above, factor analysis revealed that the SMQ is best understood in terms of a unidimensional construct.

The Five Facet Mindfulness Questionnaire (FFMQ)

At present, the most commonly used multi-faceted measure of mindfulness is the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al. 2006). The FFMQ was constructed by applying exploratory factor analysis to 112 items from the FMI, MAAS, KIMS, CAMS, and SMQ. This measure includes five subscales: describing, observing, non-judging, non-reacting to inner experience, and acting with awareness. The five facets of the FMMQ show robust psychometric properties; however, the dimensionality of the construct appears to be conceptually dynamic. Results from a confirmatory factor analysis indicated that the best fitting model was found for a hierarchal four factor model of mindfulness, with the describing, non-judging, non-reacting to inner experience, and acting with awareness facets loaded onto an overall mindfulness factor (Baer et al. 2006). In this model, the observe facet of the FFMQ did not load significantly onto the overall mindfulness factor, a result which challenges the dimensionality of the FFMQ. Additionally, all FFMQ facets, apart from observe, showed negative correlations with various psychological symptoms. In contrast, the observe facet showed positive correlations with these symptoms. However, when tested with a sample of participants who had meditation experience, the findings for the observe facet reversed, significantly loading onto the overall mindfulness factor and displaying negative correlations with negative psychological symptoms, suggesting that the functioning of this facet varies along different levels of meditation experience.

The findings from the FFMQ's construction, and the differential functioning of the observe facet, support the idea that mindfulness is both an innate quality of consciousness and a

learnable skill. However, because the scale was constructed by applying the factor analysis to the FMI, MAAS, KIMS, CAMS, and SMQ, the limitational and methodological flaws associated with these scales spill over to the FFMQ. As 24 of the 39 FFMQ items are derived from the KIMS (Baer et al. 2006), the limitations associated with this measure are of particular note. The operationalization of mindfulness in the KIMS was based on mindfulness as it is conceptualized in DBT (Baer et al. 2004). DBT combines mindfulness skills training with Western psychology and was developed as a treatment for borderline personality disorder (Linnehan 1993). Hence, mindfulness in DBT was largely stripped from its Eastern spiritual roots so that it could be understood within a secular Western context. The second largest contributor to the FFMQ is the MAAS, with 5 out of 39 FFMQ items originating from the MAAS and the remaining 10 items coming from the FMI, SMQ and the CAMS. With the KIMS being derived from DBT, the MAAS being solely a measure of attention, and the FMI being the only included scale that was derived specifically in relation to Buddhist psychology, the FFMQ can be largely understood as measuring mindfulness when it is stripped from its spiritual roots. The scale thus fails to capture any content related to mindfulness as a practice to develop insight and wisdom into the nature of reality, aspects which are fundamental in the original Buddhist teachings (Kang & Whittingham 2010; Huxter 2015; Van Gordon et al. 2015).

The Toronto Mindfulness Scale (TMS)

Although most existing mindfulness scales vary in how they operationalize the construct of mindfulness, they all conceptualize and measure mindfulness as a trait-like quality that can be modified through meditation practice. The Toronto Mindfulness Scale (TMS; Lau et al. 2006) was the first assessment developed that measures the mindful state. The TMS contains 15 items and is administered immediately after participants sit a brief meditation session. The TMS is

comprised of two factors: curiosity and decentering. The curiosity items reflect an inquisitive disposition towards the contents of one's experience, whereas decentering refers to the state of mind where one pays attention to the field of awareness as a whole (rather than identifying with any particular cognition). The development of the TMS was heavily influenced by Bishop et al.'s (2004) two-part conceptualization of mindfulness. However, their results did not support the first component (self-regulation of attention), as the aspects of curiosity and decentering seem to primarily assess the second component (an accepting disposition towards experience). The authors suggest that the attentional and attitudinal components of mindfulness may not easily be differentiated by self-report measures, as it may be impossible for a person to become present to the moment without adopt an accepting, curious, or open disposition towards experience. It is interesting to note that the conclusions the authors reached from the construction of the TMS (which measures the mindful state), are the inverse of those made by the authors of the MAAS (which measures mindfulness as a trait). After the MAAS's construction, and after finding support for a unitary presence factor, the authors concluded that an accepting attitude may be a byproduct of bringing attention fully to the experiences of the present moment. This suggests that what one experiences in a mindful state is an overarching feeling or tone characterized by a decentered, curious, open view of experience, and that the stability of this state over time is maintained by constantly bringing attention back to the experiences of the present. Hence, it is likely that by practicing mindfulness over time, it will eventually become a trait, which is the implicit goal of mindfulness practices.

The Philadelphia Mindfulness Scale (PHLMS)

As is evident from the reviewed literature, both awareness and acceptance seem to be integral components of the mindfulness construct. However, the degree to which these aspects of

mindfulness are entangled remains unclear. After the development of the MAAS, Brown and Ryan (2003) suggested that the acceptance component of mindfulness is redundant, and that the mindfulness construct can be sufficiently captured by a unitary presence factor. Conversely, Lau et al. (2006) found better support for the attitudinal components than the attention regulation components. The authors of both studies concluded that the attentional and attitudinal components of mindfulness may not be separable, as it may be impossible to become fully present to the moment without adopting an accepting disposition (or vice versa). However, it could be possible that changes in attention regulation may not necessitate changes in attitude, as would be the case in a panic attack, where attention to the present moment is upregulated without an acceptance of experience. In order to investigate this hypothesis and create a measure that assesses both the attention and attitude components of mindfulness, the Philadelphia Mindfulness Scale (PHLMS; Cardaciotto et al. 2008) was developed. The PHLMS is a 20-item measure conceptualized by both an awareness factor and an acceptance factor. Overall, the scale has robust psychometric characteristics and support was found for the two-factor model. A validation study conducted with patients diagnosed with an eating disorder confirmed the separability of the two factors, as this clinical sample was found to have overall lower levels of acceptance, but not awareness, when compared with controls (Cardaciotto et al. 2008).

The Comprehensive Inventory of Mindfulness Experiences (CHIME)

Although there is agreement regarding the components that are integral to the mindfulness construct, and despite the efficacy of some of the well-established measures (such as the MAAS and FFMQ), an analysis of the reviewed mindfulness measures conducted by Bergomi et al. (2013) revealed that there were aspects of mindfulness that were not adequately captured by any of the available mindfulness assessment tools. It should be noted that this

analysis did not include the Child and Adolescent Mindfulness Questionnaire (CAMM; Greco et al. 2011) and the Mindfulness/Mindless Scale (MMS; Haig et al. 2011), as these scales were not widely used at the time of this review. These aspects related mostly to the wisdom components of mindfulness, which are fundamental in the original Buddhist doctrines (Kang & Whittingham 2010). From the Buddhist perspective, the purpose of mindfulness meditation is to become attuned to, and gain insight into, the nature of reality, so that one is able to live a better life. Hence, in order to address this issue and create a complete measure of mindfulness, the Comprehensive Inventory of Mindfulness Experiences (CHIME) was developed (Bergomi et al. 2014). The CHIME includes all the components of mindfulness highlighted by Bergomi et al. (2013) and is rooted within the relevant theoretical frameworks (Krägeloh et al. 2019). The CHIME is comprised of eight subscales that measure: awareness of internal experiences, awareness of external experiences, acting with awareness, accepting non-judgmental attitude, non-reactive decentering, openness to experience, awareness of thoughts' relativity, and insightful understanding.

Since its development, the CHIME has demonstrated excellent psychometric properties. The CHIME has been validated using participants from a Mindfulness-Based Stress Reduction (MBSR) intervention, in addition to participants from a community sample (Bergomi et al. 2014). In both samples, the CHIME demonstrated high internal consistency (α ranging from 0.70–0.90) in addition to high reliability (test–re-test reliability, with r ranging from 0.70–0.90). Confirmatory factor analysis has been performed on a different sample, which verified that the eight-factor structure was appropriate. Additionally, each CHIME item demonstrated invariance of measurement across the personal factors included in the study, indicating that there was no reliable difference in the participant's ability to understand the CHIME items. The external

validity of the scale was highlighted by a high correlation with the FFMQ ($r=0.85$), as well as moderate correlations with depression (-0.46), anxiety (-0.39), and stress (-0.40) (Bergomi et al. 2014).

The CHIME scale has two main advantages over other existing mindfulness measures. Firstly, it was developed with a strong theoretical grounding in traditional conceptualizations of mindfulness (Bergomi et al. 2014; Krägeloh et al. 2019). Secondly, it incorporates a wide range of characteristics that define and operationalize mindfulness (Bergomi et al. 2014). The scale was originally developed in the German language and has been validated using Rasch analysis (Medvedev et al. 2019). This analysis confirmed that the CHIME has excellent overall psychometric properties. Additionally, a Dutch translation of the CHIME, as well as a short version, have been developed and validated using classical test theory methods (Cladder-Micus et al. 2019). However, at present, the only English CHIME version is one that has been adapted for children and adolescents (Johnson et al., 2016); no English version for adults has been developed or validated to date. Hence, further investigation is needed to evaluate the psychometric characteristics of the CHIME after it has been translated into English. Rasch analysis is especially suitable for this investigation, as it utilizes a probabilistic model and interval-level scaling (Rasch 1961; Tennant & Conaghan 2007).

Rasch Analysis

There are several key advantages to using Rasch analysis over classical test theory methods. Firstly, the Rasch model accounts for both the underlying ability of the person and the difficulty of each item (Bond & Fox 2007), allowing interval scores to be derived from ordinal questionnaires. This ordinal–interval conversion increases the precision of measurement and allows for parametric statistics to be conducted (Brogden 1977; Rasch 1961). The increased

precision of measurement can be demonstrated by comparing the accuracy of the original ordinal-level scores with their Rasch-converted interval equivalents (Norquist et al. 2004). Secondly, the Rasch model adheres to the fundamental principles of measurement formulated by Thurstone (1931). These principles include equal measurement units across the scale continuum, invariance by personal factors, and unidimensionality in assessing the overarching latent construct operationalized by multiple items and facets. Another benefit of Rasch modelling is reduced measurement error, where participant parameter estimations usually have a lower standard deviation. The lower standard deviation also allows for more precise assessment of change in individual scores, making the measurement more accurate and reliable.

Rasch Methodology and Mindfulness Measures

There is a dearth of studies that have applied Rasch analysis to explore the psychometric characteristics of mindfulness measures (Goh et al. 2015; Medvedev et al. 2016a, 2016b; Sauer et al. 2013). In 2013, Sauer et al. utilized Rasch analysis to assess the properties of the Freiburg Mindfulness Inventory (Walach et al. 2006). After discarding one item, they achieved a Rasch model fit. However, a better fit was obtained after the two dimensions of ‘presence’ and ‘acceptance’ had the Rasch model applied to them individually. On a similar note, both Medvedev et al. (2016a) and Goh et al. (2017) applied Rasch analysis to assess the characteristics of the MAAS (Brown & Ryan 2003). Interestingly, the approaches they used to fit the Rasch model were quite different. Goh et al. (2017) removed five items that were misfitting, whereas Medvedev et al. (2016a) only discarded two. Medvedev et al. (2016a) were able to reduce the number of items they discarded by using Super-Items to resolve issues of local dependency. In contrast, Medvedev et al. (2016b) conducted Rasch analysis on the KIMS (Baer et al. 2004), but were unable to find a fit for the overall scale, even after they discarded five

items that were misfitting. Medvedev et al. (2016) ended up resolving this issue and achieved an adequate fit by applying the Rasch model to each of the KIMS subscales individually. Rasch analysis was also used to evaluate the psychometrics of the FFMQ (Medvedev et al. 2017). To fit the Rasch model, two misfitting items of the FFMQ were discarded. Additionally, each of the individual FFMQ subscales were summed to form Super-Items. After these modifications, the best model fit was obtained. Finally, although it is not solely a measure of mindfulness, the Self-Compassion Scale (SCS; Neff 2003) was also scrutinized using Rasch methodology (Finaulahi et al. 2021). Although no SCS items significantly misfit the Rasch model, the individual items were found to be locally dependent, which affected the overall model fit. Once again, this problem was solved by summing the SCS items to form four higher order Super-Items.

Present Research

As evidenced by the above literature, Rasch analysis is starting to become the new gold standard in the evaluation of psychometric properties of mindfulness measures. Thus, by utilizing modern Rasch methodology, the present study aimed to evaluate the psychometric characteristics of the CHIME following its translation into English. A product of this analysis is the development of ordinal–interval conversion algorithms, increasing the CHIME’s accuracy of measurement, which will aid in future mindfulness research. Informed by previous studies utilizing Rasch analysis, the hypothesis of the present research is that if the individual items and subscales of the English CHIME adequately represent the underlying mindfulness construct, then a Rasch model fit will be obtained if the subscales are treated as Super-Items.

Method

Participants

Out of the 760 participants who responded to the survey, 140 did not complete all the study measures and were therefore excluded from the analyses. Hence, the analysis sample was comprised of 620 English-speaking participants from the general population. The sample was comprised of 301 (48.5%) males, and 238 (38.4%) participants indicated that they meditated or engaged in some form of contemplative practice (such as yoga or tai-chi). In this sample, 503 participants (81.1%) were White American, 69 (11.1%) were African American, 26 (4.2%) were Asian, and 22 (3.6%) identified as other. All participants were proficient in English and were living in the United States (US) at the time of data collection. The ages of the participants spanned between 18 and 70 years old ($M=41.65$, $SD=13.07$). To determine whether any differential item functioning (DIF) was present, participant data was sorted into different age categories. The categories utilized were as follows: 18–34 years, 35–49 years, and 50–70 years.

Procedure

The translation of the original German CHIME scale into English was completed in multiple stages, adhering to the recommendations outlined by Hambleton et al. (2005) and the guidelines of the International Test Commission (2017). The original CHIME authors (German native speakers who also spoke English fluently) translated the CHIME items into English, and the translated items were then reviewed by two English speakers who were familiar with meditation. The translated items were then given to a professional book translator, who translated the items back into German. The back-translated items were compared with the original CHIME items to assess whether the translation was successful. Considering the validity of cultural and language differences between the two populations, the CHIME items were further

adapted before running the validation study. Twenty graduate psychology students originally from the US (8 males, 12 females) rated the CHIME items according to their readability and understandability. Participants were also asked to rewrite the items according to their understanding. This small sample survey was then subjected to a qualitative analysis, in which a group of six mindfulness researchers and practitioners analyzed each item, adapting them as needed according to the participants' feedback.

Data were collected using Qualtrics Research Services in March 2018 and targeted participants of both sexes (male/female split of 50/50). The average survey completion time was estimated by the work of five volunteers who filled out the survey and reported how long it took them. The average completion time of 15 minutes was used as a parameter for data collection. Online data collection lasted up to ten days, and each participant was compensated with \$20 USD after completing the survey. Each participant had their IP address recorded, preventing the same participant from filling out the survey multiple times. Analysis of the IP addresses collected confirmed that the survey was distributed throughout the country, guaranteeing good sample representation. This research was approved by the author's institutional ethics review board. All participants who were involved in the study provided informed consent to participate in the research.

Measures

The CHIME is a self-report questionnaire containing 37 items. It includes eight subscales that measure different aspects of mindfulness: awareness of internal experiences, awareness of external experiences, acting with awareness, accepting non-judgmental attitude, non-reactive decentering, openness to experience, awareness of thought's relativity, and insightful understanding (Bergomi et al. 2014). The measure utilizes a six-point Likert scale format,

ranging from ‘almost never’=1 to ‘almost always’=6, and negatively worded items (7, 10, 17, 19, 22, 26, 30, 33, and 36) require reverse coding before subscale scores can be calculated. The total score is computed by summing the answers from each individual CHIME item. Higher scores on the CHIME correspond to higher levels of the underlying mindfulness construct. A routine check of reliability was conducted before the Rasch analysis. The overall scale had a strong internal consistency, reflected by both a Cronbach alpha and McDonalds Omega of 0.95, suggesting that it is a good candidate for a unidimensional Rasch model.

The FFMQ (Baer et al. 2006) contains 39 items measuring five separate facets: describing, observing, non-judging, non-reacting to inner experience, and acting with awareness. Answers are scored on a five-point Likert scale, from ‘never’=1 to ‘always true’=5. The measure contains 19 items that are negatively worded (3, 5, 8, 10, 12, 13, 14, 16, 17, 18, 22, 23, 25, 28, 30, 34, 35, 38, and 39), which require reverse coding before the total and subscale scores can be calculated.

The Self-Compassion Scale (SCS) contains 26 items and assesses a person’s underlying amount of self-compassion (Neff 2003). The measure includes six subscales: self-kindness, self-judgement, common humanity, isolation, mindfulness, and over-identification. Questions are answered on a five-point Likert scale, from ‘almost never’=1 to ‘almost always’=5. Half of the items are negatively worded (1, 2, 4, 6, 8, 11, 13, 16, 18, 20, 21, 24, and 25) and require reverse coding before total and subscale scores can be calculated. There are multiple versions of the SCS and the abbreviated version containing 12 items, the Self-Compassion Scale Short Form (SCS-SF), was used in this study.

The Satisfaction with Life Scale (SWLS) is a brief inventory of five items that measures a person’s self-reported life satisfaction (Diener et al. 1985). Items are scored on a seven-point

Likert scale, from ‘strongly disagree’=1 to ‘strongly agree’=7. The scale takes approximately one minute to complete and higher scores on the scale are associated with higher levels of overall life satisfaction.

The Depression Anxiety Stress Scales (DASS) is a self-report measure which assesses the negative emotion facets of depression, anxiety, and stress (Lovibond & Lovibond 1995). The measure includes 42 items (14 for each subscale). Scoring of the items takes place on a four-point Likert scale, ranging from ‘Did not apply to me at all’=0 to ‘Applied to me very much or most of the time’=3. In addition to the 42-item questionnaire, a shorter version of the scale (the DASS-21) containing 21 items is also available (Antony et al. 1998). Both versions of the scale have been shown to have high internal consistencies and robust psychometric properties. The DASS-21 was utilized in the present study.

The Positive and Negative Affect Schedule (PANAS; Watson et al. 1988) is a short list of adjectives that describe different emotions and feelings. Participants are instructed to indicate the degree to which they have felt the emotions/feelings over the past week and answers are recorded on a five-point Likert scale. Scores range from ‘Very slightly or not at all’=1 to ‘Extremely’=5. Once the survey is complete, answers from all positive emotion adjectives are added to create the Positive Affect Scale, and answers from all negative emotion adjectives are added to create the Negative Affect Scale.

Data Analyses

Rasch analysis was conducted using RUMM2030 software (Andrich et al. 2009). The Rasch analysis methodology has been published previously (Medvedev et al. 2019). A likelihood-ratio test was computed on the initial analysis output for the CHIME scale prior to the main analysis. The likelihood-ratio test supported the suitability of the unrestricted partial credit

version of the Rasch model ($p < 0.001$) (Masters 1982). Rasch analysis was conducted for the full scale, where all the subscales were treated as Super-Items, following the methodology of Lundgren-Nilsson et al. (2013).

The ideal Rasch model will have a mean close to 0.00 and a standard deviation close to 1.00 for the overall and person fit residuals (see Balalla et al. 2019 for an overview of these criteria). Individual item fit residuals are expected to range from -2.50 to +2.50. Trait–item interaction, reflected by an overall and individual Chi-square fit statistic, should be non-significant ($p < 0.05$, Bonferroni adjusted). The residuals correlation matrix should display no evidence of local dependency between individual items. A correlation magnitude of 0.20 relative to the mean residual correlation indicates local dependency (Christensen et al. 2016), an issue which can be resolved by combining the dependent items into Super-Items (Lundgren-Nilsson et al. 2013; Wainer and Kiely 1987). In the Rasch model, personal factors should not produce any significant DIF. The person separation index (PSI) reflects how precisely subjects have been spread out along the measurement construct defined by the items, and is used to test the reliability of subscales in the Rasch analysis. PSI is interpreted in a similar way to Cronbach’s alpha (Tennant & Conaghan 2007).

In Rasch analysis, dimensionality is typically investigated by using independent sample *t*-tests to compare person estimates for two-item groups. In this method, the highest positive and negative factor loadings are on the first principal component of the residuals, after the latent factor has been removed (Smith 2002). If the percentage of significant *t*-test comparisons remains below 5%, or if the 5% cut-off point is overlapped by the lower bound of a binomial confidence interval (computed for the number of significant *t*-tests), then the scale is considered unidimensional (Tennant & Pallant 2006).

Results

Table 1 shows the fit statistics of the Rasch model from the main analysis. The English CHIME scale displayed poor model fit in the initial analysis, with a significant Chi-square value, indicating that there was a deviation from the expectations of the Rasch model ($\chi^2(185)=1111.39, p<0.001$). Although the reliability of the scale was strong (PSI=0.95), there was evidence against the assumption of unidimensionality (Table 1). Table 2 presents the fit statistics for each individual item. Notably, several items were misfitting, with fit residuals outside the acceptable range of -2.50 to +2.50. The misfitting items included item 1 ('When my mood changes, I notice it right away'), 10 ('I break or spill things because I am not paying attention or am thinking of something else'), 11 ('I see my mistakes and difficulties without judging myself'), 17 ('In everyday life, I get distracted by many memories, images, or daydreams'), 19 ('I try to stay busy to avoid specific thoughts or feelings from coming to mind'), 26 ('When I read, I have to reread paragraphs because I was thinking of something else'), and 36 ('I resent my own mistakes and weaknesses').

Table 1. *The overall Rasch model fit statistics for the English CHIME version, including initial and final analyses (n=620).*

Analyses	Item fit residual		Person fit residual		Goodness of fit		PSI	Unidimensionality Independent <i>t</i> -test	
	Value	SD	Value	SD	χ^2 (df)	<i>P</i>		%	Lower bound
Initial	0.93	3.41	-1.23	3.78	1111.39 (185)	<0.001	0.95	25.97	24.25 (NO)
8 Super-Items	0.02	3.00	-0.68	1.57	170.25 (72)	<0.001	0.90	0.81	-0.91 (YES)
Final	0.03	1.76	-0.61	1.30	31.99 (45)	0.928	0.92	6.61	4.90 (YES)

Table 2. Initial Rasch model fit statistics for individual items, including item location, fit residual, and Chi-square (n=620).

No	Item Content	Location	Fit Resid	Chi Sq
1	When my mood changes, I notice it right away.	-0.37	3.37*	14.28
2	During both ups and downs of life, I am kind to myself.	0.02	8.17*	10.98
3	In everyday life I notice when my negative attitudes toward a situation make things worse.	-0.22	0.11	8.87
4	It is clear to me that my evaluation of situations and people can easily change.	-0.32	-0.21	10.39
5	When I am sitting or lying down, I notice the sensations in my body.	0.18	1.69	2.38
6	I am able to smile when I notice myself seeing things as more complicated than they actually are.	0.20	-0.85	12.48
7	I am hard on myself when I make a mistake. ^R	0.04	7.60*	121.91
8	When I have distressing thoughts or images, I am able to feel calm soon afterward.	0.24	-1.11	14.93
9	I notice the details in nature, such as colours, shapes, and textures.	-0.39	-0.91	15.16
10	I break or spill things because I am not paying attention or I am thinking of something else. ^R	0.65	7.85*	133.50
11	I see my mistakes and difficulties without judging myself.	0.24	4.09*	7.03
12	It is easy for me to stay focused on what I am doing.	0.02	2.07	13.47
13	When I have distressing thoughts or images, I am able to notice them without having to react.	0.11	-1.23	13.34
14	When I talk to other people, I notice what feelings I am experiencing.	-0.28	-1.43	32.81
15	When I have been needlessly hard on myself, I can see it with some humour.	0.22	-1.28	11.17
16	In difficult or triggering situations, I can pause for a moment without reacting immediately.	0.12	-1.30	17.60
17	In everyday life, I get distracted by many memories, images, or daydreams. ^R	0.19	5.18*	63.65
18	When I ride in a car, bus, or train, I am aware of the surroundings, such as the landscape.	-0.35	-0.70	10.21
19	I try to stay busy to avoid specific thoughts or feelings from coming to mind. ^R	0.18	4.33*	41.16
20	When caught in thoughts and emotions, I am able to “step back” and quickly notice the thought or image without being taken over by it.	0.16	-2.04	24.97
21	I pay attention to sensations, such as the wind in my hair or sunshine on my face.	-0.30	-2.26	35.01
22	I try to distract myself when I feel unpleasant emotions. ^R	0.09	1.95	10.82
23	In everyday life, I realize my thoughts are not always facts.	-0.12	-1.33	10.68
24	I am able to smile to myself when I notice I have made a big deal out of a small problem.	0.13	-1.85	15.59
25	I am able to notice my thoughts and feelings without getting tangled up in them.	0.06	-2.50	24.62
26	When I read, I have to reread paragraphs because I was thinking of something else. ^R	0.20	5.24*	75.77
27	I notice sounds in my environment, such as birds chirping or cars passing.	-0.55	-1.85	28.16
28	I notice my thoughts and feelings and can also “step back” and observe them from a distance.	0.16	-1.35	20.07
29	I clearly notice changes in my body, such as quicker or slower breathing.	0.05	-1.63	20.83
30	I do not like it when I am angry or fearful, and try to get rid of these feelings. ^R	-0.06	2.52	10.73
31	In everyday life, I am aware that my view on things is not always based on facts.	0.02	-0.35	3.12
32	Even when I make a big mistake, I treat myself with kindness and understanding.	0.19	-0.79	10.39
33	When I am in pain, I try to avoid the sensations as much as possible. ^R	-0.03	0.23	2.08
34	I am aware of how I am feeling at any given time.	-0.29	-1.06	9.56
35	I am aware that even my strongly held opinions may change over time.	-0.32	-2.11	20.26
36	I resent my own mistakes and weaknesses. ^R	0.19	9.90*	209.39
37	I am able to notice when I needlessly make life more difficult for myself.	-0.05	-1.89	24.04

Note: ^R reverse-scored item. * Significant misfit ($p < 0.05$).

The residual correlation matrix indicated that there were high residual correlations (above 0.20) between items representing the eight mindfulness facets. Hence, the individual English CHIME items were combined to form eight Super-Items, which were then treated as individual items in the Rasch analysis, a method which is now common practice (Lungren-Nilsson et al. 2013; Medvedev et al. 2018). After the creation of the eight Super-Items, the fit improved considerably, the reliability remained high (PSI=0.90), and strict unidimensionality was confirmed (Table 1, 8 Super-Items). However, the Chi-square remained significant ($\chi^2(72)=170.25, p<0.001$), indicating deviation from the Rasch model.

Examination of the correlation matrix between the eight Super-Items revealed local dependency between six out of the eight Super-Items (above 0.20). To address this issue, the locally dependent Super-Items were reconfigured to form three new Super-Items as follows: 2 ('awareness of external experiences') was combined with 4 ('accepting non-judgmental attitude'), 3 ('acting with awareness') was combined with 8 ('insightful understanding'), and 5 ('non-reactive decentering') was combined with 6 ('openness to experience'). After creating these higher order Super-Items, the best fit was obtained ($\chi^2(45)=31.99, p=0.928$). This model displayed high reliability (PSI=0.92) and unidimensionality was confirmed (Table 1, Final). Additionally, there was no DIF by the personal factors (meditation practice, gender, and age), and all individual Super-Items displayed excellent fit to the overall Rasch model (Table 3).

Table 3. Individual Super-Items Rasch fit statistics for the final analysis (n=620).

Final Super-Items	Item Location	Fit Residual	Chi-Square
Super-Item 7 ('awareness of thoughts' relativity')	-0.06	1.22	1.69
Super-Item 2 ('awareness of external experiences') + 4 ('accepting non-judgmental attitude')	-0.04	-1.77	2.75
Super-Item 3 ('acting with awareness') + 8 ('insightful understanding')	0.12	-0.11	3.72
Super-Item 5 ('non-reactive decentering ') + 6 ('openness to experience')	0.15	-1.70	1.02
Super-Item 1 ('awareness of internal experiences')	-0.16	2.20	4.70

The distribution of person-item thresholds of the English CHIME are illustrated in Figure 1. The plot demonstrates excellent targeting of the sample by item thresholds ($M=0.31$, $SD=0.50$), with person mean slightly above item mean. There were no detectable ceiling or floor effects, with person abilities perfectly covered by the scale items. Overall, Figure 1 indicates that there is a good combination of both easy and difficult items in the English CHIME scale.

Figure 1. Person-item threshold distribution of the English CHIME version (final analysis).

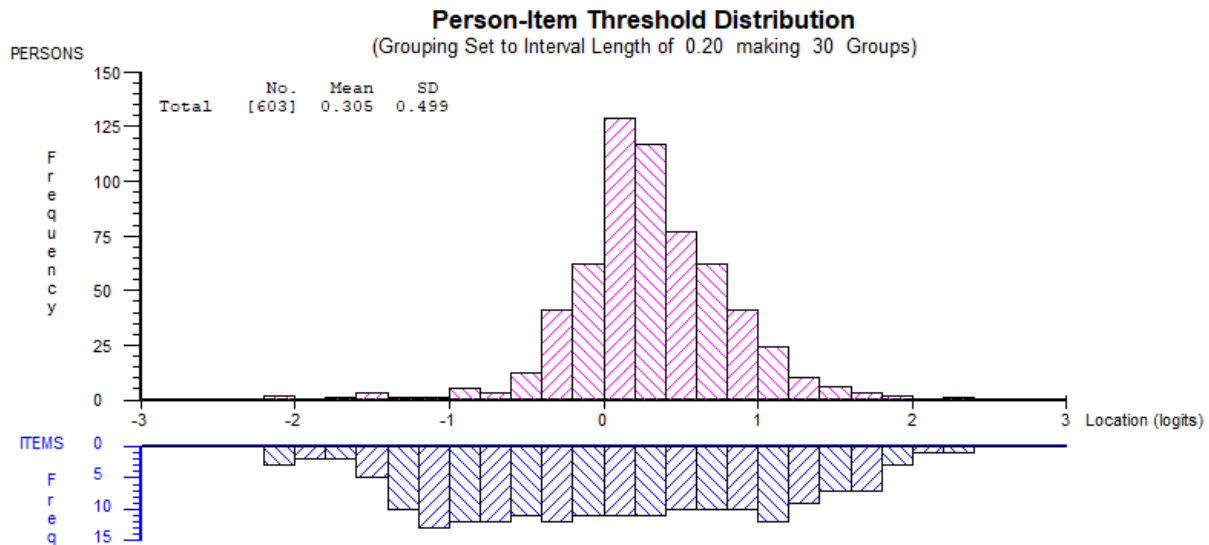


Table 4 presents the conversion algorithms that were used to convert ordinal scores into interval scores for the English CHIME scale. The conversion algorithms are based on the final

analysis using five Super-Items. In the conversion table, the ordinal scores are shown in the first column, logit unit interval scores are shown in the second column, and in the third column, the interval scores are shown in the original scale metric. To use the conversion table: (1) negatively worded items are reversed, (2) the total score is computed by summing the individual scores of items, and (3) the equivalent interval level scores in logits in the second column and the original scale metric in the third column can be found. Note that these conversions are not able to be performed for participants who have responses that are missing.

Table 4. Ordinal-to-interval conversion table for the English CHIME scale.

Ordinal Scores	Interval		Ordinal Scores	Interval		Ordinal Scores	Interval		Ordinal Scores	Interval		Ordinal Scores	Interval		Ordinal Scores	Interval	
	Logits	Scale		Logits	Scale		Logits	Scale		Logits	Scale		Logits	Scale		Logits	Scale
37	-3.62	37.00	68	-1.08	101.09	99	-0.55	114.50	130	-0.01	128.16	161	0.58	142.96	192	1.23	159.32
38	-3.01	52.43	69	-1.06	101.60	100	-0.53	114.93	131	0.01	128.62	162	0.60	143.46	193	1.25	159.92
39	-2.64	61.83	70	-1.04	102.08	101	-0.51	115.36	132	0.03	129.07	163	0.62	143.97	194	1.28	160.50
40	-2.41	67.57	71	-1.02	102.56	102	-0.50	115.79	133	0.05	129.53	164	0.64	144.47	195	1.30	161.11
41	-2.25	71.63	72	-1.00	103.04	103	-0.48	116.22	134	0.07	130.00	165	0.66	144.98	196	1.33	161.71
42	-2.13	74.76	73	-0.99	103.49	104	-0.46	116.65	135	0.09	130.46	166	0.68	145.48	197	1.35	162.34
43	-2.02	77.33	74	-0.97	103.97	105	-0.45	117.07	136	0.10	130.91	167	0.70	145.98	198	1.38	162.97
44	-1.94	79.49	75	-0.95	104.42	106	-0.43	117.50	137	0.12	131.39	168	0.72	146.49	199	1.40	163.60
45	-1.86	81.38	76	-0.93	104.85	107	-0.41	117.96	138	0.14	131.84	169	0.74	146.99	200	1.43	164.28
46	-1.80	83.05	77	-0.91	105.30	108	-0.39	118.38	139	0.16	132.32	170	0.76	147.50	201	1.45	164.94
47	-1.74	84.54	78	-0.90	105.73	109	-0.38	118.81	140	0.18	132.80	171	0.78	148.00	202	1.48	165.64
48	-1.68	85.87	79	-0.88	106.16	110	-0.36	119.24	141	0.20	133.26	172	0.80	148.53	203	1.51	166.37
49	-1.63	87.13	80	-0.86	106.59	111	-0.34	119.70	142	0.22	133.73	173	0.82	149.03	204	1.54	167.13
50	-1.59	88.27	81	-0.85	106.99	112	-0.33	120.12	143	0.23	134.21	174	0.84	149.56	205	1.57	167.91
51	-1.55	89.32	82	-0.83	107.42	113	-0.31	120.55	144	0.25	134.69	175	0.86	150.07	206	1.60	168.74
52	-1.51	90.31	83	-0.81	107.85	114	-0.29	121.01	145	0.27	135.17	176	0.88	150.60	207	1.64	169.60
53	-1.47	91.24	84	-0.80	108.25	115	-0.27	121.43	146	0.29	135.65	177	0.90	151.10	208	1.67	170.51
54	-1.44	92.12	85	-0.78	108.68	116	-0.26	121.89	147	0.31	136.13	178	0.93	151.63	209	1.71	171.49
55	-1.40	92.93	86	-0.76	109.08	117	-0.24	122.32	148	0.33	136.61	179	0.95	152.16	210	1.76	172.55
56	-1.37	93.71	87	-0.75	109.49	118	-0.22	122.77	149	0.35	137.09	180	0.97	152.69	211	1.80	173.71
57	-1.34	94.47	88	-0.73	109.92	119	-0.20	123.20	150	0.37	137.57	181	0.99	153.22	212	1.85	174.97
58	-1.31	95.20	89	-0.71	110.32	120	-0.19	123.65	151	0.39	138.04	182	1.01	153.77	213	1.91	176.35
59	-1.29	95.88	90	-0.70	110.75	121	-0.17	124.11	152	0.41	138.55	183	1.03	154.30	214	1.97	177.92
60	-1.26	96.53	91	-0.68	111.15	122	-0.15	124.53	153	0.43	139.03	184	1.05	154.83	215	2.04	179.73
61	-1.24	97.16	92	-0.66	111.58	123	-0.13	124.99	154	0.44	139.51	185	1.07	155.38	216	2.12	181.82
62	-1.21	97.77	93	-0.65	111.98	124	-0.11	125.44	155	0.46	140.01	186	1.10	155.94	217	2.22	184.32
63	-1.19	98.37	94	-0.63	112.41	125	-0.10	125.90	156	0.48	140.49	187	1.12	156.49	218	2.34	187.39
64	-1.17	98.95	95	-0.62	112.81	126	-0.08	126.35	157	0.50	140.99	188	1.14	157.05	219	2.50	191.43
65	-1.14	99.51	96	-0.60	113.24	127	-0.06	126.80	158	0.52	141.47	189	1.16	157.60	220	2.73	197.15
66	-1.12	100.04	97	-0.58	113.67	128	-0.04	127.26	159	0.54	141.98	190	1.19	158.18	221	3.10	206.55
67	-1.10	100.57	98	-0.56	114.10	129	-0.02	127.71	160	0.56	142.48	191	1.21	158.76	222	3.72	222.00

To compare the original ordinal English CHIME scores with the Rasch-transformed interval scores, a paired samples *t*-test was run. The *t*-test revealed that the difference between ordinal scores ($M=145.95$, $SD=29.16$) and the interval scores ($M=136.26$, $SD=19.59$) was significant, $t(619)=-18.93$, $p<0.001$, $d=-0.76$. Note that the standard deviation of the interval scores was noticeably smaller than the ordinal scores, providing additional evidence that the measurement error was significantly reduced by using Super-Items. Independent samples *t*-tests were then conducted, comparing meditators and non-meditators scores using the original ordinal scores and scores that had undergone the Rasch interval transformation. Meditators' ordinal scores ($M=153.66$, $SD=29.62$) were found to be significantly higher compared to non-meditators' ordinal scores ($M=146.18$, $SD=29.62$), $t(314)=2.00$, $p=0.047$, $d=0.26$. Similarly, meditators' interval scores ($M=141.01$, $SD=19.23$) were significantly higher compared to non-meditators' interval scores ($M=136.08$, $SD=18.04$), $t(314)=2.00$, $p=0.047$, $d=0.26$. These results provided evidence that the English CHIME accurately differentiates between mindfulness levels, as people who practice meditation tend to score higher on the scale than those who do not practice meditation.

Table 5 shows the correlations between the English CHIME total interval scores and other relevant psychometric measures. All additional measures included in Table 5, excluding the SWLS, were converted into interval scores using the available Rasch transformation algorithms. All correlations were in the expected directions, except for the relationship between the English CHIME total score and DASS-Anxiety, which remained non-significant. The external validity of the English CHIME was demonstrated by high positive correlations with both the FFMQ and SCS, and a moderate positive correlation with Positive Affect. As expected, the English CHIME correlated negatively with stress, depression, and Negative Affect.

Table 5. *Correlations between Rasch-transformed CHIME total scores and other psychological measures (n=208).*

Scales	CHIME-R	FFMQ-R	SCS-R	SWLS	PA-R	NA-R	Depression-R	Anxiety-R
FFMQ-R	.66**							
SCS-R	.61**	.70**						
SWLS	.37**	.33**	.45**					
PA-R	.56**	.42**	.45**	.47**				
NA-R	-.20**	-.46**	-.42**	-.25**	-0.07			
Depression-R	-.23**	-.48**	-.49**	-.39**	-.18**	.72**		
Anxiety-R	-0.01	-.33**	-.29**	-.14**	0.05	.68**	.77**	
Stress-R	-.148**	-.41**	-.42**	-.25**	-0.05	.72**	.82**	.82**

Note:** $p < 0.01$; * $p < 0.05$; -R denotes scales that have undergone Rasch transformation; CHIME = Comprehensive Inventory of Mindfulness Experiences, FFMQ = Five Facet Mindfulness Questionnaire, SCS = Self Compassion Scale, SWLS = Satisfaction with Life Scale, PA = PANAS Positive Affect, NA = PANAS Negative Affect, Depression = DASS-Depression, Anxiety = DASS-Anxiety, Stress = DASS-Stress.

Discussion

Using modern Rasch methodology, the present research validated the English CHIME measure and developed ordinal-to-interval transformation tables to be used in future mindfulness research. The English CHIME instrument displayed evidence of internal structural validity, unidimensionality, high reliability, and external validity. Several items in the initial analysis misfit the Rasch model. This issue was addressed by summing the individual items to form Super-Items. The utilization of Super-Items effectively reduced the measurement error due to spurious correlations between items and possible method effects (Finaulahi et al. 2021), resulting in the best fit. After the best fitting model was achieved, ordinal–interval transformation algorithms were developed, which may be used to measure mindfulness and the effects of MBIs more precisely in future research.

Rasch transformation is highly desirable in the case of multifaceted measures because it reduces the error of measurement whilst also accounting for the different contributions of items and subscales to the overarching construct (i.e., mindfulness as measured by the English CHIME). A major limitation of ordinal measures is that they do not consider the difficulty

(location) of items when calculating the total scores. Not considering item difficulty decreases the accuracy of the assessment and increases the amount of measurement error (Bond & Fox 2007; Norquest et al. 2004). As a result of the Rasch transformation, ordinal English CHIME scores may be converted into interval scores by using the transformation algorithms shown in Table 4, allowing for parametric statistics to be calculated. This ordinal to interval transformation is achieved by accounting for unwanted measurement error unrelated to the overarching mindfulness construct, increasing the accuracy of the English CHIME without modification to the original scale format. This conversion can be conducted for the full scale if there is no missing data.

The Rasch transformation algorithm allows for the measurement of mindfulness to the extent by which it is reflected by each individual item or Super-Item, whilst also filtering out the irrelevant influences associated with other constructs (e.g., personality) along with methodological errors. Sandham et al. (2019) compared the application of Rasch analysis with Super-Items to the process of squeezing vitamin C (which would represent the construct of mindfulness in the present study) from different fruits (representing the scale items) that contain differing levels of vitamin C as well as other unwanted vitamins and ingredients (representing error variances). For example, item 10 ('I break or spill things because I am not paying attention or I am thinking of something else') contains more mindfulness, as reflected by a positive location of 0.65, than item 27 ('I notice sounds in my environment, such as birds chirping or cars passing'), which has a negative location of -0.55. The same is true at the Super-Item level, where a Super-Item could be compared to a smoothie made up of fruits which have differing levels of vitamin C. The Super-Item (smoothie) thresholds are estimated by using the combined responses of all the included items (fruits). This example is useful to illustrate that the Super-Items and

their combinations used in the current study refine the measurement of the overarching mindfulness construct (as captured by the English CHIME items) and have no implications for either the factor structure of the English CHIME or the use of its individual subscales. It is important to note that by using individual subscales, only a specific facet that is relevant to mindfulness can be measured.

The initial exploration of the English CHIME scale revealed that the baseline model showed promising psychometric properties. However, the significant Chi-square value showed a Rasch model misfit, with several items exhibiting issues of local dependency. Hence, the individual English CHIME items were summed to form eight Super-Items, following the methodology previously utilized by Lundgren-Nilsson et al. (2013). A key advantage of this approach is that the issue of local dependency can be dealt with without the deletion of any items. Deleting items can affect the construct validity of a scale, and should be avoided whenever possible. Even though the English CHIME retained its excellent psychometric properties after these modifications, the Chi-square remained significant. After some investigation, it was determined that six out of the eight Super-Items showed issues of local dependency. Hence, the model was adjusted, and instead the English CHIME items were summed to form five Super-Items. After this adjustment, the Chi-square became non-significant, and the best Rasch model fit was obtained.

Compared with other mindfulness measures, the English CHIME required only marginal modification to fit the Rasch model. This is in contrast with the Rasch exploration of the KIMS (Medvedev et al., 2016b), where the fit was only achieved at the subscale level after the deletion of five items. On a similar note, the FFMQ required the deletion of two items to fit the Rasch model, with the five facets summed to form Super-Items (Medvedev et al., 2017). The English

CHIME, on the other hand, did not require the deletion of any items to obtain the best fit. This result is consistent with the Rasch analysis conducted on the original CHIME scale in German, which also did not require the deletion of any items (Medvedev et al. 2019). However, in the German scale, the best fit was obtained by forming eight Super-Items, whereas in the present study, the best fit was achieved after forming five Super-Items. This discrepancy is likely an artifact of translating the scale from German to English. Although both the German and English scales displayed exceptional psychometric properties, the results of the present research indicate that the CHIME items may present with a different pattern of local dependency when translated into different languages. However, in terms of overall structure and scoring as a unidimensional profile, there is no difference between the German and English CHIME versions.

As was the case in the original validation study (Medvedev et al. 2019), the English CHIME showed correlations in the expected directions with the other psychometric measures, apart from the correlation with DASS-Anxiety, which remained non-significant. Unsurprisingly, the English CHIME showed convergent validity with the FFMQ. Although the magnitude of the correlation was high ($r=0.66$), indicating that the scales reflect the overlapping construct, the English CHIME explains a unique amount of variance not covered by the FFMQ. The English CHIME was found to be positively correlated with negative affect, stress, and depression. These results are consistent with the substantial literature findings that demonstrate higher mindfulness levels are linked with better psychological functioning (Morton et al. 2020; Fumero et al. 2020; Thomas et al. 2020). The non-significant correlation between the English CHIME total score and DASS-Anxiety is unexpected and may be explained by the relatively low anxiety levels in the current sample. However, this will require further investigation to verify whether the effect is consistent across different samples.

A significant difference was found between the English CHIME total scores of meditators and non-meditators. This effect was consistent when examining the original ordinal data and the Rasch transformed interval data. Although the overall effect sizes were similar, the result does not undermine the benefits of conducting the ordinal-to-interval conversion, because the transformation increases the precision of measurement. Furthermore, this result demonstrates that the English CHIME maintains its excellent psychometric properties, even without the ordinal–interval conversion.

No differences were found in the functioning of the English CHIME items across the personal factors of meditation practice, gender, or age. Additionally, the person-item plots show that the English CHIME items discriminate almost perfectly between different levels of meditation experience, meaning that the scale functions just as well for meditators and non-meditators. These results are identical to those found in the original validation of the CHIME scale, and taken together, provides strong evidence that the CHIME maintains its reliability and validity across different populations.

Implications

The results from the present study have expanded the evidence that the overarching mindfulness trait can be conceptualized and measured as a multi-faceted construct. This builds on the evidence from both KIMS and FFMQ, which are the only two other measures that operationalize mindfulness using more than two facets. Whereas the KIMS and the FFMQ are comprised of 4 and 5 facets, respectively, the CHIME is composed of eight conceptually informed facets. The additional facets included in the CHIME provide more comprehensive conceptual content not covered within the FFMQ. While some of the FFMQ facets likely overlap conceptually with the CHIME facets (i.e., the FFMQ’s observe facet may potentially overlap with the CHIME’s

awareness of internal experiences and awareness of external experiences facets, the FFMQ's non-react to inner experience likely maps to the CHIME's non-reactive decentering facet, and both scales contain an acting with awareness and an accepting non-judgmental attitude facet) others do not. For example, there was no describe facet found in the CHIME, and the CHIME contains the openness to experience, awareness of thoughts' relativity, and insightful understanding facets, which are not found in the FFMQ. The lack of a describe facet is unsurprising, as it is not found in any existing definition of mindfulness (traditional or modern) and was an invention of DBT developed for a clinical population to facilitate transition from a disorder to more normal functioning (Linnehan 1993). Hence, unlike the FFMQ and other mindfulness measures, the CHIME comprehensively covers facets that are consistent with both the traditional and modern definitions of mindfulness, while excluding extraneous facets that lack conceptual support.

The results of the CHIME's validation also run contrary to the results from the PHLMS development, where mindfulness was operationalized as being composed of the two acceptance and awareness facets. While some of the CHIME's facets could potentially be collapsed to form both awareness and acceptance factors, the presence of the awareness of thought's relativity and insightful understanding facets of the CHIME suggest that these additional facets are required to sufficiently operationalize mindfulness. Most of the available scales are based on either Kabat-Zinn's (2003) or Bishop et al.'s (2004) definitions of mindfulness, which emphasize non-judgmental awareness and acceptance. However, the results from the present study support the notion that in addition to these factors, mindfulness can be better operationalized by considering the context from which it has been developed (i.e., Buddhist psychology), where mindfulness is used to reduce perceptual bias of reality, contributing to a better life.

In practical terms, the development of the English CHIME will allow for a more detailed investigation into the effects of mindfulness training. As MBIs are becoming increasingly popular, it is important for research to elaborate on how these interventions exert their effects. If the improvements in psychological functioning and well-being as a result of attending MBIs are mediated by improvements in mindfulness, then this should be reflected by increases in scores for measures that comprehensively assess levels of mindfulness. The results of the present research suggest that there may be unique advantages of using the CHIME for such an assessment. The CHIME not only contains the awareness and attitude components that are assessed by other scales, but it also contains the wisdom/insight components that are so highly emphasized in the original Buddhist teachings (Van Gordon et al. 2015; Huxter et al. 2015). Using robust Rasch methodology, this study has demonstrated that facets used to operationalize the English CHIME are integrative parts of one overarching mindfulness construct, which opens new research avenues and permits investigators to answer various research questions. What proportion of the improvements in well-being after attending an MBSR are the result of developing an insightful understanding into the nature of reality? What degree of the benefits that borderline personality patients experience through DBT are due to an improved awareness of thought's relativity? These kinds of questions can only be answered by using the CHIME to measure changes in mindfulness. By having a more detailed understanding of how mindfulness levels are related to psychological symptoms and well-being, clinicians will be better able to individualize the prescription of MBIs as a psychological intervention.

Limitations and Future Directions

The primary limitation of the present research stems from the use of online survey data. Although the use of online data collection is becoming more prevalent, it can present unique

research challenges. In this research, participants voluntarily signed up to participate in the study. As mindfulness practice is still considered to be relatively esoteric and known to only a small percentage of the general population, the sample would have self-selected for, and therefore been skewed towards, individuals who were familiar with the concept of mindfulness. This effect is evidenced by the relatively high number of participants who indicated they practiced mindfulness or engaged in some form of contemplative practice (38.4%). The higher average level of mindfulness in this sample could distort the correlations between other psychometric measures, an effect which may explain the non-significant relationship between the English CHIME total score and DASS-Anxiety. Future research could address this issue by selecting participants based on different sampling characteristics.

The present study included participants from the general population. Future research should seek to replicate this research in different population types, such as people diagnosed with affective conditions or other psychological disorders. Both samples in this study consisted largely of participants who identified themselves as White American. Future research should use more diverse sample populations to generalize this study's findings to other cultural and ethnic groups. Nonetheless, Rasch analysis is less dependent on sample characteristics compared with other traditional methods (e.g., factor analysis) (Tennant & Conaghan 2007). Additionally, the sample utilized in this study was large enough to ensure the robustness and generalizability of these results. The German language version of the CHIME has been shown to be stable over time, with little evidence that items are interpreted differently before and after a mindfulness intervention (Krägeloh et al. 2018). Such evidence is important as it demonstrates that the questionnaire is evaluated using the same standard at both measurement times. Future work will need to confirm the absence of such a response shift in the English CHIME version.

Perhaps the most interesting distinction between the validation of the original German scale and the translated English scale is the different Super-Item structure required to obtain the best Rasch model fit. In the original German validation (Medvedev et al. 2019), the best fit was confirmed when the individual CHIME items were summed to form eight Super-Items, which is in line with the subscales of the original measure. However, in the present study, the best fit was achieved after summing the items to form five Super-Items. Taken alone, this result suggests that the CHIME may be affected by spurious residual correlations that are different in English compared to German. This raises the question of whether linguistic conceptualization and understanding of mindfulness differ significantly across different languages and cultures. Further research is required to elucidate whether the Super-Item structure of the CHIME differs significantly across other these domains.

The comprehensive nature of the CHIME will allow for more precise exploration of the CHIME with other related constructs. So far, the validity of mindfulness scales have always been assessed by comparing the developed scales with various measures of well-being. As the CHIME is proposed as the most comprehensive assessment of mindfulness developed to date, it will allow for more detailed investigation into the relationship between these constructs. As noted from the development of other scales (Brown & Ryan 2003; Baer et al. 2006), the construct of mindfulness appears to be significantly related to the construct of personality, notably the openness to experience facet of the Five Factor Model of Personality (Costa & McCrae 2008). It is interesting to note the similarity between the CHIME's openness to experience subscale and the openness to experience facet of personality. Additionally, the insightful understanding facet of the CHIME bears some resemblance to the insight facet of openness to experience often used in hierarchical models of personality. Although they may share similar names, they do not

necessarily measure the same constructs. Hence, future research using the CHIME will be required to clarify the relationship between these constructs.

Another area of research that requires further clarification is the directionality of the relationship between mindfulness and well-being. As the purpose of mindfulness training is to alleviate suffering and promote well-being (Van Gordon et al. 2015; Huxter 2015), it is unsurprising that these constructs are highly related. The assumption that having higher levels of mindfulness causes people to have higher levels of well-being underlies the development of most mindfulness scales. While it is almost certain that mindfulness training promotes well-being, it is likely that the directionality of the relationship runs both ways. For example, if one has higher levels of well-being, one naturally has less craving and aversion towards experience because one is content with the contents of consciousness and therefore does not feel an urge to change anything. The exact nature of this relationship could be examined by developing interventions to improve well-being (purposefully excluding mindfulness training) and determining whether subsequent improvements are associated with higher levels of mindfulness without explicitly teaching mindfulness. If improvements in well-being are associated with higher levels of mindfulness (as assessed with a scale such as the CHIME) in the absence of direct mindfulness training, then this would provide strong evidence for a bi-directional relationship between the two constructs.

Conclusions

As our understanding of the benefits of mindfulness continues to grow, it is becoming increasingly valuable for researchers and clinicians to be able to measure the mindfulness construct accurately. The present study utilized Rasch analysis methods to explore the psychometric characteristics of the English CHIME scale. The results demonstrate that the

CHIME maintains its structural validity and reliability after being translated from German into English. However, a different Super-Item structure was used for the English CHIME compared with the German CHIME, which may be related to error variances associated with linguistic differences or other unknown method effects and requires further investigation.

As for the questions of whether mindfulness is one thing or many interrelated things, and whether it is best measured in terms of the unidimensional or multifaceted construct, the answer is likely both. As mindfulness pertains to the flow of consciousness, the mystery underlying our collective experience, it is likely that the constraints one uses to operationalize it will determine the pattern of results. When one zooms in on an atom, one must eventually understand matter as an ever-changing field rather than a solid object. The same is true for mindfulness. When one zooms in on one's experience, there is just one thing: an ever-changing field, but there are so many ways to explain it.

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Appendix A (Ethics Approval)

Te Wānanga o Ngā Kete | **Division of Arts,
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THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Samuel Wilkinson

Dr Oleg Medvedev

School of Psychology

2 December 2021

Dear Samuel

Re: FS2021-70: Validation of the Comprehensive Inventory of Mindfulness Experiences (CHIME) in English Using Rasch Methodology

Thank you for submitting your application to the ALPSS Human Research Ethics Committee. We have reviewed the final electronic version of your application and the Committee is now pleased to offer formal approval for your research activities, including secondary analysis of data collected as a part of your co-investigators' research with Miami University of Ohio, USA.

We encourage you to contact the committee should issues arise during your data analysis, or should you wish to add further research activities or make changes to your project as it unfolds. We wish you all the best with your research. Thank-you for engaging with the process of Ethical Review.

Kind regards,

A handwritten signature in blue ink, appearing to read 'C Barber'.

Dr Carrie Barber, Deputy Convenor
Division of Arts, Law, Psychology & Social Sciences Human Research Ethics

Appendix B (Study Measures)

Qualtrics Survey Software

<https://pacificu.co1.qualtrics.com/ControlPanel/Ajax.php?action=GetSu...>

INFORMED CONSENT

**Pacific University
School of Graduate Psychology**

INFORMED CONSENT

Thank you for your interest in participating in this research study. The purpose of the project is the validation of the Comprehensive Inventory of Mindfulness Experiences (CHIME) in the United States. The CHIME is a psychological instrument that helps to access how people feel toward some experiences in their life, for example, how attentive they are to the present moment. You have been invited to complete this survey because you are over 18 years old and a fluent English speaker. We are hoping to recruit 540 participants; therefore your participation is very welcome!

The survey will take about 15-20 minutes to complete and consists of questions about your demographics, and your current experiences regarding emotional arousal, psychological symptoms of anxiety and depression, mindfulness, quality of life and your capacity to manage adverse events. Please read this material carefully to be sure you understand the nature of the project before agreeing to participate. **If questions remain, or you later have concerns about any aspect of the project or your participation, you may contact any of the investigators or the Pacific University Research Office, as listed below.** Please be aware that if you do make contact, then some of your information will be known to the Review Board, but this information will be strictly protected by confidentiality practices. Please print this page as a copy for your records.

Do you meet the eligibility requirements? To be eligible, you must meet **ALL** of the following criteria. Even if just one item does not apply to you, we ask that you not take the survey.

- **You are at least 18 years of age or older**
- **You are a native English-speaker or a fluent speaker of English**
- **You are currently living in the United States**
- **You have completed High School Education**

How will your responses be kept private? An anonymous methodology is being used. This means we are collecting no information about your identity; we will not know who responded and there is no way to link answers to identities. However, we cannot guarantee the privacy of data transmitted via the internet. The survey has been built using Qualtrics Survey Software. Only the investigator(s) are the formal owners of the survey account, but all gathered information is available to any person who gains account access. Once the survey period is closed no later than the end of December 2017, all data will be transferred to a secure storage device and the account will be deactivated.

Are there risks to taking the survey? The study has been reviewed and approved by the Pacific University human subject research ethics committee. Any potential risks (e.g., emotional, financial, social, legal) due to participating are minimal, no greater than what one faces in normal daily life. One way to avoid potential risk is for you to not answer the question(s), and you may completely withdraw at any time simply by closing your browser or navigating away from the survey. If you do skip questions, we may use the responses you did provide. However, once you submit your survey, withdrawing is impossible due to the anonymous methodology. If at any point while taking this survey you experience more than just minimal distress, please contact the investigators through the information below. We will contact our institutional review board immediately and provide you with resources and referrals for psychological care. Also, feel free to contact the American Psychological Association (APA) to get more information about where you can seek for psychological help.

Are there benefits to taking the survey? Your participation is voluntary, but you will be rewarded with an amount of US\$ ____ (amount to be defined by Qualtrics) for your time. Your engagement is of crucial matter for the development of science and therefore, is extremely valuable. Except for your time, there are no additional costs. It is important to understand you are receiving no services of any sort from Pacific University, as a result of your participation in this study. Any past, current or future relationships you may have with Pacific University will not be affected in any way as a consequence of your choosing whether or not to participate.

CONSENT

Submitting your survey indicates that you understand the nature of your participation and that you freely and voluntarily grant your consent.

I declare that I have read and understood the above information and I meet this study's eligibility criteria. Therefore, I agree to participate in this study.

If you agree to participate, please type "yes" in the space below.

Principal Investigator: Leticia Ribeiro, M.S., Doctoral Student
Advisor: Michael Christopher, Ph.D., Advisor Pacific University
Pacific University Institutional Revision Board
503-352-1478
American Psychological Association (APA)
374-2721

Email: Ribe6180@pacificu.edu
Email: mchristopher@pacificu.edu
Email: IRB@pacificu.edu **Phone:** 503-352-2498 **Phone:**
Address: 750 First St. NE, Washington, DC 20002-4242 | Phone: (800)

Demographics

Please mark your gender identity

- Male
- Female
- Transgender male
- Transgender female
- other

What ethnicity do you most identify with? (please select all that apply)

- White/ Not Hispanic
- Hispanic, Latino, or Spanish origin
- Mexican, Mexican American, Chicano
- Puerto Rican
- Asian American
- Black or African American
- Native American
- Other

What is your age?

What is the highest level of education you have completed?

- High School / GED
- Some College
- 2-year College Degree
- 4-year College Degree
- Masters Degree
- Doctoral Degree
- Professional Degree (JD, MD)

Are you familiar with contemplative practices (including yoga, meditation, mindfulness, and Tai Chi)?

- Yes, I am familiar and practice or have practiced some of these modalities.
- Read or heard about it, never practiced and do not intent to.
- Read or heard about it, never practiced and intend to practice some day.
- Never heard about it.

Do you currently meditate or practice any other contemplative practice (including yoga, meditation, mindfulness, and Tai Chi)?

- Yes
- No

What kinds of meditation do practice or have practiced in the past (name or describe)?

How long have you been meditating (consider the moment you started to meditate, regardless of how faithful to it you have been since then)?

- Less than 6 months
- Between 6 months and 1 year
- Between 1 and 2 years
- Between 2 and 3 years
- Between 3 and 4 years
- Between 4 and 5 years
- More than 5 years

How often do you currently meditate?

- One or more times a day
- One or more times a week
- Less than weekly
- About one or twice a month
- Very occasionally, only when I need to relax or center myself due to a specific situation

For how long do you meditate on average (consider the total time of each time you practice)?

- 10 minutes
- 10-20 minutes
- 20-30 minutes
- 30-40 minutes
- 40-60 minutes
- More than 60 minutes

Considering that you are not currently meditating or practicing other contemplative practices, please indicate for how long did you do it in the past.

- Less than 6 months
- Between 6 months and 1 year
- Between 1 and 2 years
- Between 2 and 3 years
- Between 3 and 4 years
- Between 4 and 5 years
- More than 5 years

Please indicate the main reasons why you are not currently engaged in this practice?

FFMQ

Please rate each of the following statements using the scale provided. Mark the answer that best describes your own opinion of what is generally true for you.

	Never or very rarely true	Rarely true	Sometimes true	Often true	Very often or always true
1. I am good at describing my feelings.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I can easily put my beliefs, opinions, and expectations into words.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I watch my feelings without getting carried away by them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I tell myself I should not be feeling the way I am feeling.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. It is hard for me to find the words to describe what I am thinking.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I pay attention to physical experiences such as the wind in my hair or sun or my face.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I make judgments about whether my thoughts are good or bad.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I find it difficult to stay focused on what is happening in the present moment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. When I have distressing thoughts or images, I don't let myself be carried away by them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Generally, I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. When I feel something in my body, it is hard for me to find the right words to describe it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. It seems I am 'running on automatic' without much awareness of what I am doing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. When I have distressing thoughts or images, I feel calm soon after.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. I tell myself I shouldn't be thinking the way I'm thinking.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. I notice the smells and aromas of things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. Even when I'm feeling terribly upset, I can find a way to put it into words.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. I rush through activities without being really attentive to them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. Usually, when I have distressing thoughts or images I can just notice them without reacting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. I think some of my emotions are bad or inappropriate and I shouldn't feel them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. When I have distressing thoughts or images, I just notice them and let them go.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. I do jobs or tasks automatically without being aware of what I'm doing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. I find myself doing things without paying attention.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. I disapprove of myself when I have illogical ideas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

SCS- SF

Please read each statement carefully before answering. Indicate how often you behave in the stated manner.

	1. Almost never	2	3	4	5. Almost always
1. When I fail at something important to me I become consumed by feelings of inadequacy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I try to be understanding and patient toward those aspects of my personality I don't like.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. When something painful happens, I try to take a balanced view of the situation.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. When I am feeling down, I tend to feel like most other people are probably happier than I am.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I try to see my failings as part of the human condition.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. When I am going through a very hard time, I give myself the caring and tenderness I need.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. When something upsets me I try to keep my emotions in balance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. When I fail at something that's important to me, I tend to feel alone in my failure.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. When I am feeling down I tend to obsess and fixate on everything that is wrong.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. I am disapproving and judgmental about my flaws and inadequacies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. I am intolerant and impatient toward those aspects of my personality I don't like.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

WBSI

This survey is about thoughts. There are no right or wrong answers, so please respond honestly to each of the items below.

	Strongly disagree	Disagree	Neutral or don't know	Agree	Strongly agree
1. There are things I prefer not to think about.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Sometimes I wonder why I have the thoughts I do.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I have thoughts I cannot stop.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. There are images that come to mind that I cannot erase.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. My thoughts frequently return to one idea.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I wish I could stop thinking of certain things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Sometimes my mind races so fast I wish I could stop it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I always try to put problems out of mind.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. There are thoughts that keep jumping into my head.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Sometimes I stay busy just to keep thoughts from intruding on my mind.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. There are things that I try not to think about.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Sometimes I really wish I could stop thinking.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. I often do things to distract myself from my thoughts.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. I often have thoughts that I try to avoid.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. There are many thoughts that I have that I don't tell anyone.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

AAQ-II

Below you will find a list of statements. Please rate how true each statement is for you by circling a number next to it. Use the scale below to make your choice.

	never true	very seldom true	seldom true	sometimes true	frequently true	almost always true	always true
1. My painful experiences and memories make it difficult for me to live a life that I would value.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I'm afraid of my feelings.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I worry about not being able to control my worries and feelings.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. My painful memories prevent me from having a fulfilling life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Emotions cause problems in my life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. It seems like most people are handling their lives better than I am.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Worries get in the way of my success.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

PANAS

This scale consists of a number or words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. Indicate the extent you have felt this way over the past week.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Interested	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Distressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Excited	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Strong	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Guilty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scared	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hostile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enthusiastic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Proud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alert	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ashamed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inspired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nervous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Determined	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attentive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jittery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Active	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Afraid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

SMS-R

The statements below concern your personal reactions to a number of situations. No two statements are exactly alike, so consider each statement carefully before answering. If a statement is true or mostly true as applied to you, mark T as your answer. If a statement is false or not usually true as applied to you, mark F as your answer. It is important that you answer as frankly and as honestly as you can.

	T	F
1. In social situations, I have the ability to alter my behavior if I feel that something else is called for.	<input type="radio"/>	<input type="radio"/>
2. I have the ability to control the way I come across to people, depending on the impression I wish to give them.	<input type="radio"/>	<input type="radio"/>
3. When I feel that the image I am portraying isn't working, I can readily change it to something that does.	<input type="radio"/>	<input type="radio"/>
4. I have trouble changing my behavior to suit different people and different situations.	<input type="radio"/>	<input type="radio"/>
5. I have found that I can adjust my behavior to meet the requirements of any situation I find myself in.	<input type="radio"/>	<input type="radio"/>
6. Even when it might be to my advantage, I have difficulty putting up a good front.	<input type="radio"/>	<input type="radio"/>
7. Once I know what the situation calls for, it's easy for me to regulate my actions accordingly.	<input type="radio"/>	<input type="radio"/>
8. I am often able to read people's true emotions correctly through their eyes.	<input type="radio"/>	<input type="radio"/>
9. In conversations, I am sensitive to even the slightest change in the facial expression of the person I'm conversing with.	<input type="radio"/>	<input type="radio"/>
10. My powers of intuition are quite good when it comes to understanding others' emotions and motives.	<input type="radio"/>	<input type="radio"/>
11. I can usually tell when others consider a joke to be in bad taste, even though they may laugh convincingly.	<input type="radio"/>	<input type="radio"/>
12. I can usually tell when I've said something inappropriate by reading it in the listener's eyes.	<input type="radio"/>	<input type="radio"/>
13. If someone is lying to me, I usually know it at once from that person's manner of expression.	<input type="radio"/>	<input type="radio"/>

BRS

Please respond to each item by marking one box per row :

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. I tend to bounce back quickly after hard times.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I have a hard time making it through stressful events.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. It does not take me long to recover from a stressful event.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. It is hard for me to snap back when something bad happens.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I usually come through difficult times with little trouble.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I tend to take a long time to get over set-backs in my life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

MAAS

Below is a collection of statements about your everyday experience. Using the 1–6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be.

	Almost always	Very frequently	Somewhat Frequently	Somewhat infrequently	Very Infrequently	Almost never
1. I could be experiencing some emotion and not be conscious of it until some time later.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I break or spill things because of carelessness, not paying attention, or thinking of something else.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I find it difficult to stay focused on what's happening in the present.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I forget a person's name almost as soon as I've been told it for the first time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. It seems I am "running on automatic" without much awareness of what I'm doing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I rush through activities without being really attentive to them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I get so focused on the goal I want to achieve that I lose touch with what I am doing right now to get there.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. I do jobs or tasks automatically, without being aware of what I'm doing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. I find myself listening to someone with one ear, doing something else at the same time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. I drive places on "automatic pilot" and then wonder why I went there.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. I find myself preoccupied with the future or the past.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. I find myself doing things without paying attention.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. I snack without being aware that I'm eating.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

DASS-21

Please read each statement and select a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement. The rating scale is as follows:

0	1	2	3
Did not apply to me at all - NEVER	Applied to me to some degree, or some of the time - SOMETIMES	Applied to me to a considerable degree, or a good part of time - OFTEN	Applied to me very much, or most of the time - ALMOST ALWAYS

	0	1	2	3
1. I found it hard to wind down.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I was aware of dryness of my mouth.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I couldn't seem to experience any positive feeling at all.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I found it difficult to work up the initiative to do things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I tended to overreact to situations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I experienced trembling (e.g., in the hands).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I felt that I was using a lot of nervous energy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I was worried about situations in which I might panic and make a fool of myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. I felt that I had nothing to look forward to.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. I found myself getting agitated.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. I found it difficult to relax.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. I felt downhearted and blue.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. I was intolerant of anything that kept me from getting on with what I was doing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. I felt I was close to panic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. I was unable to become enthusiastic about anything.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. I felt I wasn't worth much as a person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. I felt that I was rather touchy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I felt scared without any good reason.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. I felt that life was meaningless.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

CHIME

Please indicate how often, in the past two weeks, you have had each of the following experiences.

	Never or Almost Never	Rarely	Not Often	Fairly Often	Often	Always or Almost Always
1. When my mood changes, I notice it right away.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. In the ups and downs of life, I am kind to myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. In everyday life, I notice when my negative attitudes toward a situation make things worse.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. It is clear to me that my evaluations of situations and people can change easily.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. When I am sitting or lying down, I notice the sensations in my body.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I am able to smile when I notice myself seeing things as more complicated than they actually are.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I am hard on myself when I make a mistake.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. When I experience distressing thoughts or images, I am able to feel calm soon afterward.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I notice details in nature, such as colors, shapes, and textures.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. I break or spill things because I am not paying attention or I am thinking of something else.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. I experience my mistakes and difficulties without judging myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. It is easy for me to stay focused on what I am doing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. When I experience distressing thoughts or images, I am able to notice them without having to react.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. When I talk to other people, I notice the feelings I am experiencing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. When I have needlessly given myself a hard time, I can see it with humor.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. In difficult situations, I can pause for a moment without reacting immediately.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. In everyday life, I get distracted by many memories, images, or daydreams.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. When I ride in a car or train, I am aware of the surroundings, such as the landscape.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. I try to stay busy to avoid specific thoughts or feelings from coming to mind.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. When caught in thoughts and emotions, I am able to step back and quickly notice the thought or emotion without becoming overwhelmed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. I pay attention to sensations, such as the wind in my hair or sunshine on my face.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. I try to distract myself when I feel unpleasant emotions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. In everyday life, I realize my thoughts are not always facts.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. I am able to smile to myself when I notice I have made a big deal out of a small problem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25. I am able to notice my thoughts and feelings without getting tangled up in them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26. When I read, I have to reread paragraphs because I was thinking of something else.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27. I notice sounds in my environment, such as birds chirping or cars passing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28. I notice my thoughts and feelings and can also step back and observe them from a distance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29. I clearly notice changes in my body, such as quicker or slower breathing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30. I do not like it when I am angry or fearful and I try to get rid of these feelings.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31. In everyday life, I am aware that my view on things is not always based on facts.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
32. Even when I make a big mistake, I treat myself with kindness and understanding.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
33. When I experience discomfort, I try to avoid this sensation as much as possible.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
34. I am usually aware of how I am feeling at any given time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
35. I am aware that even my strongly held opinions may change over time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
36. I resent my own mistakes and weaknesses.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
37. I am able to notice when I unnecessarily make life more difficult for myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

(WHOQOL)-BREF

1. How would you rate your quality of life?

- Very poor
- Poor
- Neither poor nor good
- Good
- Very good

2. How satisfied are you with your health?

- Very dissatisfied
- Dissatisfied
- Neither satisfied nor dissatisfied
- Satisfied
- Very satisfied

The following questions ask about how much you have experienced certain things in the last four weeks.

	Not at all	A little	A moderate amount	Very much	An extreme amount
3. To what extent do you feel that physical pain prevents you from doing what you need to do?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. How much do you need any medical treatment to function in your daily life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. How much do you enjoy life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. To what extent do you feel your life to be meaningful?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. How well are you able to concentrate?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. How safe do you feel in your daily life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. How healthy is your physical environment?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions ask about how completely you experience or were able to do certain things in the last four weeks.

	Not at all	A little	Moderately	Mostly	Completely
10. Do you have enough energy for everyday life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. Are you able to accept your bodily appearance?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Have you enough money to meet your needs?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. How available to you is the information that you need in your day-to-day life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. To what extent do you have the opportunity for leisure activities?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Very poor	Poor	Neither poor nor good	Good	Very good
15. How well are you able to get around?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
16. How satisfied are you with your sleep?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. How satisfied are you with your ability to perform your daily living activities?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. How satisfied are you with your capacity for work?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. How satisfied are you with yourself?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. How satisfied are you with your personal relationships?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. How satisfied are you with your sex life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. How satisfied are you with the support you get from your friends?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. How satisfied are you with the conditions of your living place?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. How satisfied are you with your access to health services?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25. How satisfied are you with your transport?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following question refers to how often you have felt or experienced certain things in the last four weeks.

	Never	Seldom	Quite often	Very often	Always
26. How often do you have negative feelings such as blue mood, despair, anxiety, depression?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix D (Submitted Manuscript)

Validation of the Comprehensive Inventory of Mindfulness Experiences (CHIME) in English Using Rasch Methodology

Abstract

Objectives: Although mindfulness has now been studied for multiple decades, psychometric research has yet to agree upon the optimal way to measure the mindfulness construct. Prior research has identified eight distinct aspects of mindfulness which, until recently, were not adequately captured by any of the available measures. Hence, the Comprehensive Inventory of Mindfulness Experiences (CHIME) was developed. The CHIME contains 37 items and was originally developed in the German language. So far, the CHIME has demonstrated excellent psychometric properties in both the German and Dutch Languages, but no English version has yet been validated. The purpose of the present study was to investigate the psychometric characteristics of the translated English CHIME scale using Rasch Methodology.

Method: The current study utilized Partial Credit Rasch analysis to evaluate the psychometric characteristics of the English CHIME. The sample include responses from 620 participants from the general population. The validity of the English CHIME was examined by correlating its scores with various measures of mindfulness and psychological functioning.

Results: Initial Rasch analysis of the English CHIME showed poor model fit, local dependency, and evidence against the assumption of unidimensionality. Several minor modifications, that involved creating Super-Items, were required to fit the Rasch model ($\chi^2(45)=31.99, p=0.93$). This model displayed evidence of unidimensionality, invariance across personal factors, and a high reliability (PSI=0.92). Ordinal-interval transformation tables were produced, which increase the English CHIME's precision of measurement. The

English CHIME's external validity was established by moderate-high correlations with other measures of mindfulness and various measures of psychological functioning.

Conclusions: The results of this study provide evidence for the validity of the English CHIME scale, which can be used to assess the overarching construct of Mindfulness.

Keywords: Mindfulness, Rasch analysis, Comprehensive Inventory of Mindfulness Experiences, Validation, Assessment, Psychometrics.

Mindfulness can be defined as “the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment” (Kabat-Zinn 2003, p.10). Interventions based in mindfulness have been shown to reduce both the physical and psychological symptoms of various psychopathologies, such as depression, anxiety, stress, borderline personality disorder, substance abuse, suicidal/self-harm behaviour, and post-traumatic stress disorder (Krägeloh et al. 2019). Additionally, Mindfulness-Based Interventions (MBIs) have been shown to increase the well-being of participants (Bennett & Dorjee 2016) as well as improve their emotional regulation (de Vibe et al. 2018). As mindfulness training has many positive effects, it is crucial for researchers and clinicians to be able to accurately measure the overarching mindfulness construct and discriminate precisely between individual mindfulness levels.

At present, the most commonly used multi-faceted measure of mindfulness is the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al. 2006). The FFMQ was constructed by applying factor analysis to the Kentucky Inventory of Mindfulness Skills (KIMS; Baer et al. 2004), the Mindful Attention and Awareness Scale (MAAS; Brown and Ryan 2003), and other available mindfulness measures. The FFMQ includes five subscales: describing, observing, non-judging, non-reacting to inner experience, and acting with awareness. However, despite the well-established efficacy of the FFMQ, an analysis of mindfulness measures conducted by Bergomi et al. (2013) revealed that there were aspects of mindfulness which were not adequately captured by the FFMQ or any other available mindfulness assessment. Hence, to address this issue, and create a complete measure of mindfulness, the Comprehensive Inventory of Mindfulness Experiences (CHIME) was developed (Bergomi et al. 2014). The CHIME includes all the components of mindfulness highlighted by Bergomi et al. (2013) and is rooted within the relevant theoretical frameworks (Krägeloh et al. 2019). The CHIME is comprised of eight subscales, which measure: awareness of internal

experiences, awareness of external experiences, acting with awareness, accepting non-judgemental attitude, nonreactive decentering, openness to experience, awareness of thoughts' relativity, and insightful understanding.

Since its development, the CHIME has been shown to have excellent psychometric properties. Specifically, the CHIME has been validated using participants from a Mindfulness Based Stress Reduction (MBSR) intervention, in addition to participants from a community sample (Bergomi et al. 2014). The CHIME demonstrated high internal consistency (α ranging from .70-.90) in addition to high reliability (test re-test reliability, with r ranging from .70-.90). Confirmatory factor analysis was run on a different sample, which confirmed that the eight-factor structure was appropriate. Additionally, each CHIME item demonstrated invariance of measurement across the personal factors included in the study, indicating that there was no reliable difference in the participant's ability to understand of the CHIME items. The external validity of the scale was highlighted by a high correlation with the FFMQ ($r=.85$), as well as moderate correlations with depression (-.46), anxiety (-.39), and stress (-.40) (Bergomi et al. 2014).

The CHIME scale has two main advantages over other existing mindfulness measures. Firstly, it was developed with a strong theoretical grounding in traditional conceptualisations of mindfulness (Bergomi et al. 2014; Krägeloh et al. 2019). Secondly, it incorporates a wide range of characteristics that define and operationalize mindfulness (Bergomi et al. 2014). The scale was originally developed in the German language and has been validated using Rasch analysis (Medvedev et al. 2019). This analysis confirmed that the scale has excellent overall psychometric properties. Additionally, a Dutch translation of the CHIME, as well as a short version, have been developed and validated using classical test theory methods (Cladder-Micus et al. 2019). However, at present, there is only an English CHIME version adopted for children and adolescents (Johnson et al., 2016), whereas no

English version for adults has been developed and validated to date. Hence, further investigation is needed to evaluate the psychometric characteristics of the CHIME after it has been translated into the English Language. Rasch analysis is especially suitable for this investigation, as it utilizes a probabilistic model and interval-level scaling (Rasch 1961; Tennant & Conaghan 2007).

There are several key advantages to using Rasch analysis over classical test theory methods. Firstly, the Rasch model accounts for both the underlying ability of the person and the difficulty of each item (Bond & Fox 2007), allowing interval scores to be derived from ordinal questionnaires. This ordinal-interval conversion increases the precision of measurement and allows for parametric statistics to be conducted (Brogden 1977; Rasch 1961). The increased precision of measurement is demonstrable by comparing the accuracy of the original ordinal-level scores with their Rasch-converted interval equivalents (Norquist et al. 2004). Secondly, the Rasch model adheres to the fundamental principles of measurement which were formulated by Thurstone (1931). These principles include equal measurement units across scale continuum, invariance by personal factors, and unidimensionality in assessing the overarching latent construct operationalised by multiple items and facets. Another benefit of Rasch modelling is reduced measurement error, where participant parameter estimations usually have a lower standard deviation. The lower standard deviation also allows for more precise assessment of change in individual scores, making the measurement more accurate and reliable.

Currently, only a dearth of studies has applied Rasch analysis to explore the psychometric characteristics of mindfulness measures (Goh et al. 2015; Medvedev et al. 2016a, 2016b; Sauer et al. 2013). In 2013, Sauer et al. utilised Rasch analysis, analysing the properties of the Freiburg Mindfulness Inventory (FMI-14, Wlach et al. 2006). After discarding one item, they achieved a Rasch model fit. However, a better fit was obtained after

the two dimensions of ‘presence’ and ‘acceptance’ had the Rasch model applied to them individually. On a similar note, both Medvedev et al. (2016a) and Goh et al. (2017) applied Rasch analysis to assess the characteristics of the MAAS (Brown & Ryan 2003). Interestingly, the approaches they used to fit the Rasch model were quite different. Goh et al. (2017) removed five items that were misfitting, whereas Medvedev et al. (2016a) only discarded two. Medvedev et al. (2016a) were able to reduce the number of items they discarded by using Super-Items to resolve issues of local dependency. In contrast, Medvedev et al. (2016b) conducted Rasch analysis on the KIMS (Baer et al. 2004) but were unable to find a fit for the overall scale, even after they discarded five items that were misfitting. Medvedev et al. (2016) ended up resolving this issue and achieve an adequate fit by applying the Rasch model to each of the KIMS subscales individually. Rasch analysis was also used to evaluate the psychometrics of the FFMQ (Medvedev et al. 2017). To fit the Rasch model, two misfitting items of the FFMQ were discarded. Additionally, each of the individual FFMQ subscales were summed to form Super-Items. After these modifications, the best model fit was obtained. Finally, although it is not solely a measure of mindfulness, the Self-Compassion scale (SCS; Neff 2003) was also scrutinized using Rasch methodology (Finaulahi et al. 2021). Although no SCS items were significantly misfitting the Rasch model, the individual items were found to be locally dependant, which affected the overall model fit. Once again, this problem was solved by summing the SCS items to form four higher order Super-Items.

Judging from the outline of the above literature, it appears that Rasch analysis is starting to become the new gold standard in the evaluation of psychometric properties of mindfulness measures. Hence, by utilising modern Rasch methodology, the present study aimed to evaluate the psychometric characteristics of the CHIME, after it was translated into the English Language. A product of this analysis is to develop ordinal-interval conversion

algorithms, increasing the CHIME's accuracy of measurement, which will aid in future mindfulness research. Informed by previous studies utilising Rasch analysis, we hypothesised that, if the individual items and subscales of the English CHIME adequately represent the underlying mindfulness construct, then a Rasch model fit will be obtained if the subscales are treated as Super-Items.

Method

Participants

Out of the 760 participants who responded to the survey, 140 did not complete all the study measures and were therefore not included in the subsequent analyses. Hence, the sample contained 620 English-speaking participants from the general population. The sample was comprised of 301 (48.5%) males, and 238 (38.4%) participants indicated that they meditated or engaged in some form of contemplative practice (such as Yoga or Tai-Chi. In this sample, 503 participants (81.1%) were White American, 69 (11.1%) were African American, 26 (4.2%) were Asian, and 22 (3.6%) identified as other. All participants were proficient in English and were living in the US at the time of data collection. The ages of the participants spanned between 18 and 70 years old ($M=41.65$, $SD=13.07$). To determine whether there was any differential item functioning (DIF), participant data was sorted into different age categories. The categories utilised were as follows 18-34, 35-49, and 50-70.

Procedure

Data were collected using Qualtrics Research Services in March 2018 and targeted participants of both sexes (male/female split of 50/50). The average survey completion time was estimated by the work of five volunteers who filled out the survey and reported the length of their work. An average completion time of 15 minutes was used as a parameter for data collection. The online data collection lasted up to ten days, and each participant was

compensated with \$20 after completing the survey. Each participant had their IP address recorded, preventing the same participant from filling out the survey multiple times. The IP address collection confirmed that the survey was distributed throughout the country, guaranteeing good sample representation. This research was approved by the author's institutional ethics review board. All participants who were involved in the study provided informed consent to participate in the research.

Measures

The Comprehensive Inventory of Mindfulness Experiences (CHIME) is a self-report questionnaire containing 37 items. It includes eight subscales that measure different aspects of mindfulness: awareness of internal experiences, awareness of external experiences, acting with awareness, accepting non-judgemental attitude, nonreactive decentring, openness to experience, awareness of thought's relativity, and insightful understanding (Bergomi et al. 2014). The measure utilizes a six-point Likert scale format, ranging from 'almost never'=1 to 'almost always'=6, and negatively-worded items (7, 10, 17, 19, 22, 26, 30, 33, and 36) require reverse coding before subscale scores can be calculated. The total score is computed by summing the answers from each individual CHIME item. Higher scores on the CHIME correspond to higher levels of the underlying mindfulness construct. A routine check of reliability was conducted before the Rasch analysis. The overall scale had a strong internal consistency reflected by both Cronbach alpha and McDonalds Omega of .95, suggesting that it is a good candidate for a unidimensional Rasch model.

The translation of the original German CHIME scale into English was completed in multiple stages, adhering to the recommendations outline by Hambleton et al. (2005) and the guidelines laid out by the International Test Commission (2017). The original CHIME authors (German native speakers who also spoke English fluently) translated the CHIME

items into English and then the translated items were reviewed by two English speakers who were familiar with meditation. The translated items were then given to a professional book translator, who translated the items back into German. The back-translated items were compared with the original CHIME items to assess whether the translation was successful. Considering the validity of cultural and language differences between the two populations, the CHIME items were further adapted before running the validation study. Twenty graduate psychology students originally from the US (8 males, 12 females) rated the CHIME items according to their readability and understandability. Participants were also asked to rewrite the items according to their understanding. This small sample survey was then subjected to a qualitative analysis in which a group of six mindfulness researchers and practitioners analysed item by item, adapting them as needed, according to the participants' feedback.

The FFMQ (Baer et al. 2006) contains 39 items, measuring five separate facets: describing, observing, non-judging, non-reacting to inner experience, and acting with awareness. Answers are scored on a five-point Likert scale, from 'never'=1 to 'always true'=5. The measure contains 19 items that are negatively worded (3, 5, 8, 10, 12, 13, 14, 16, 17, 18, 22, 23, 25, 28, 30, 34, 35, 38, and 39), which require reverse coding before the total and subscale scores can be calculated.

The Self-Compassion Scale (SCS) is a measure which contains 26-items and assesses a person's underlying amount of self-compassion (Neff 2003). The measure includes six subscales: Self-Kindness, Self-Judgement, Common Humanity, Isolation, Mindfulness, and Over-Identification. Questions are answered on a five-point Likert scale, from 'almost never'=1 to 'almost always'=5. Half of the items are negatively worded (1, 2, 4, 6, 8, 11, 13, 16, 18, 20, 21, 24, and 25) and require reverse coding before total and subscale scores can be calculated. There are multiple versions of the SCS and the abbreviated version containing 12 items, the Self-Compassion Scale Short Form (SCS-SF) was used in this study.

The Satisfaction with Life Scale (SWLS) is a brief inventory including five-items and measures a person's self-reported life satisfaction (Diener et al. 1985). Items are scored on a seven-point Likert scale, from 'strongly disagree'=1 to 'strongly agree'=7. The scale takes approximately one minute to complete and higher scores on the scale are associated with higher levels of overall life satisfaction.

The Depression Anxiety Stress Scales (DASS) is a self-report measure which assesses the negative emotion facets of depression, anxiety, and stress (Lovibond & Lovibond 1995). The measure includes 42 items, 14 for each subscale. Scoring of the items takes place on a four-point Likert scale, ranging from 'Did not apply to me at all'=0 to 'Applied to me very much or most of the time'=3. In addition to the 42-item questionnaire, a shorter version of the scale (the DASS-21) containing 21 items is also available (Antony et al. 1998). Both versions of the scale have been shown to have high internal consistencies and robust psychometric properties. The DASS-21 was utilized in the present study.

The Positive and Negative Affect Schedule (PANAS; Watson et al. 1988) is a short list of adjectives that describing different emotions and feelings. Participants are instructed to indicate the degree to which they have felt the emotions/feelings over the past week and answers are recorded on a five-point Likert scale. Scores range from 'Very slightly or not at all'=1 to 'Extremely'=5. Once the survey is complete, answers from all the positive emotion adjectives are added to create the Positive Affect scale and answers from all the negative emotion adjectives are added to create the Negative Affect Scale.

Data Analyses

Rasch analysis was conducted using RUMM2030 software (Andrich et al. 2009). The Rasch analysis was performed following procedure outlined elsewhere (Medvedev et al. 2019). A likelihood-ratio test was computed on the initial analysis output for the CHIME

scale prior to the main analysis. The likelihood-ratio test supported the suitability of the unrestricted partial credit version of the Rasch model ($p < .001$) (Masters 1982). Rasch analysis was conducted for the full scale, where all the subscales were treated as Super-Items, following the methodology of Lundgren-Nilsson et al. (2013).

The ideal Rasch model will have a mean close to 0.00 and a standard deviation close to 1.00 for the overall and person fit residuals (see Balalla et al. 2019, for an overview of these criteria). Individual item fit residuals are expected to range from -2.50 to +2.50. Trait-item interaction, reflected by an overall and individual Chi-Square fit statistic, should be non-significant ($p < .05$, Bonferroni adjusted). The residuals correlation matrix should display no evidence of local dependency between individual items. A correlation magnitude of 0.20 relative to the mean residual correlation indicates local dependency (Christensen et al. 2016), an issue which can be resolved by combining the dependant items into Super-Items (Lundgren-Nilsson et al. 2013; Wainer and Kiely 1987). In the Rasch model, personal factors should not produce any significant differential item functioning (DIF). The person separation index (PSI) reflects how precisely subjects have been spread out along the measurement construct defined by the items and is used to test the reliability of subscales in Rasch analysis. PSI is interpreted in a similar way to Cronbach's alpha (Tennant & Conaghan 2007).

In Rasch analysis, dimensionality is typically investigated by using independent-samples *t*-tests to compare person estimates for two item groups. In this method, the highest positive and negative factor loadings are on the first principal component of the residuals, after the latent factor has been removed (Smith 2002). If the percentage of significant *t*-test comparisons doesn't exceed 5%, or if the 5% cut-off point is overlapped by the lower bound of a binomial confidence interval (computed for the number of significant *t*-tests), then the scale is considered unidimensional (Tennant & Pallant 2006).

Results

Included in Table 1 are the fit statistics of the Rasch model from the main analysis. The English CHIME scale displayed poor model fit in the initial analysis, with a significant Chi-Square indicating that there was a deviation from the expectations of the Rasch model ($\chi^2(185)=1111.39, p<.001$). Although the reliability of the scale was strong (PSI=.95), there was evidence against the assumption of unidimensionality (Table 1). Table 2 includes the fit statistics for each individual item. Notably, several items were misfitting, with fit residuals outside the acceptable range of -2.50 to +2.50. The misfitting items included item 1 ('When my mood changes, I notice it right away'), 10 ('I break or spill things because I am not paying attention or am thinking of something else'), 11 ('I see my mistakes and difficulties without judging myself'), 17 ('In everyday life, I get distracted by many memories, images, or daydreams'), 19 ('I try to stay busy to avoid specific thoughts or feelings from coming to mind'), 26 ('When I read, I have to reread paragraphs because I was thinking of something else'), and 36 ('I resent my own mistakes and weaknesses').

<Insert Tables 1 and 2 here>

The residual correlation matrix indicated that there were high residual correlations (above .20) between items representing the eight mindfulness facets. Hence, the individual English CHIME items were combined to form eight Super-Items, which were then treated as individual items in the Rasch analysis, a method which is now becoming common practice (Lungren-Nilsson et al. 2013; Medvedev et al. 2018). After creation of the eight Super-Items, the fit improved considerably, the reliability remained high (PSI=.90), and strict unidimensionality was confirmed (Table 1, 8 Super-Items). However, the Chi-Square remained significant ($\chi^2(72)=170.25, p<.001$), indicating deviation from the Rasch model.

Examination of the correlation matrix between the eight Super-Items revealed local dependency between six out of the eight Super-Items (above .20). To address this issue, the locally dependent Super-Items were reconfigured to form three new Super-Items as follows: 2 ('awareness of external experiences') was combined with 4 ('accepting non-judgmental attitude'), 3 ('acting with awareness') was combined with 8 ('insightful understanding'), and 5 ('nonreactive decentring') was combined with 6 ('openness to experience'). After creating these higher order Super-Items, the best fit was obtained ($\chi^2(45)=31.99, p=.928$). This model displayed high reliability (PSI=.92) and unidimensionality was confirmed (Table 1, Final). Additionally, there was no DIF by the personal factors (meditation practice, gender, and age), and all the individual Super-Items displayed excellent fit to the overall Rasch model (Table 3).

<Insert Table 3 here>

The distribution of person-item thresholds of the English CHIME are illustrated in Figure 1. The plot demonstrates excellent targeting of the sample by item thresholds ($M=0.31, SD=0.50$) with person mean slightly above item mean. There were no detectable ceiling or floor effects, with person abilities perfectly covered by the scale items. Overall, Figure 1 indicates that there is a good combination of both easy and difficult items in the English CHIME scale.

<Insert Figure 1 here>

Included in Table 4 are conversion algorithms which allow for ordinal scores to be converted into interval scores for English CHIME scale. The conversion algorithms are based on the final analysis using five Super-Items. In the conversion table, the ordinal scores are presented in the first column, logit unit interval scores are presented in the second column, and in the third column, the interval scores are presented in the original scale metric. To use

the conversion table (1) reverse code the negatively worded items (2) compute the total score by summing the individual scores of items (3) find the equivalent interval level scores in logits in the second column and the original scale metric in the third column. Note that these conversions are not able to be performed for participants who have responses that are missing.

<Insert Table 4 here>

To compare the original ordinal English CHIME scores with the Rasch-transformed interval scores, a paired samples *t*-test was run. The *t*-test revealed that the difference between ordinal scores ($M=145.95$, $SD=29.16$) and the interval scores ($M=136.26$, $SD=19.59$) was significant, $t(619)=-18.93$, $p<.001$, $d=-0.76$. Note that the standard deviation of the interval scores was noticeably smaller than the ordinal scores, providing additional evidence that the measurement error was significantly reduced by using Super-Items. Independent samples *t*-tests were then conducted comparing meditators and non-meditators scores, using the original ordinal scores and scores that had undergone the Rasch interval transformation. Meditators' ordinal scores ($M=153.66$, $SD=29.62$) were found to be significantly higher compared to non-meditators' ordinal scores ($M=146.18$, $SD=29.62$), $t(314)=2.00$, $p=.047$, $d=0.26$. Similarly, meditators' interval scores ($M=141.01$, $SD=19.23$) were significantly higher compared to non-meditators' interval scores ($M=136.08$, $SD=18.04$), $t(314)=2.00$, $p=.047$, $d=0.26$. These results provided evidence that the English CHIME accurately differentiates between mindfulness levels, as people who practice meditation tend to score higher on the scale than those who do not practice meditation.

Table 5 shows the correlations between the English CHIME total interval scores and other relevant psychometric measures. All the additional measures included in Table 5, excluding the SWLS, were converted into interval scores using the available Rasch

transformation algorithms. All correlations were in the expected directions, except for the relationship between the English CHIME total score and DASS-Anxiety, which remained non-significant. The external validity of the English CHIME was demonstrated by high positive correlations with both the FFMQ and SCS, and a moderate positive correlation with positive affect. As expected, the English CHIME correlated negatively with stress, depression, and negative affect.

<Insert Table 5 here>

Discussion

Using modern Rasch methodology, the present research validated the English CHIME measure and developed ordinal-to-interval transformation tables to be used in future mindfulness research. The English CHIME instrument displayed evidence of internal structural validity, unidimensionality, high reliability, and external validity. Several items in the initial were misfitting the Rasch model. This issue was addressed by summing the individual items to form Super-Items. The utilization of Super-Items effectively reduced the measurement error due to spurious correlations between items and possible method effects (Finaulahi et al. 2021), resulting in the best fit. After the best fitting model was achieved, Ordinal-interval transformation algorithms were developed, which may be used to measure mindfulness and the effects of MBIs more precisely in future research.

Rasch transformation is highly desirable in the case of multifaceted measures because it reduces the error of measurement, whilst also accounting for the different contributions of items and subscales to the overarching construct (i.e., mindfulness as measured by the English CHIME). A major limitation of ordinal measures is that they do not consider the difficulty (location) of items when calculating the total scores. Not considering item difficulty decreases the accuracy of assessment and increases the amount of measurement error (Bond

& Fox 2007; Norquest et al. 2004). As a result of the Rasch transformation, ordinal English CHIME scores may be converted into interval scores by using the transformation algorithms displayed in Table 4, allowing for parametric statistics to be conducted. This ordinal to interval transformation is achieved by accounting for unwanted measurement error unrelated to the overarching mindfulness construct, increasing the accuracy of the English CHIME, without modification to the original scale format. This conversion can be conducted for the full scale if there is no missing data.

The Rasch transformation algorithm allows for the measurement of mindfulness to the extent by which it is reflected by each individual item or Super-Item, whilst also filtering out the irrelevant influences associated with other constructs (e.g., personality) along with methodological errors. Sandham et al. (2019) compared the application of Rasch analysis with Super-Items to the process of squeezing vitamin C (which would represent the construct of mindfulness in the present study) from different fruits (representing the scale items) that contain differing levels of vitamin C as well as other unwanted vitamins and ingredients (representing error variances). For example, item 10 ('I break or spill things because I am not paying attention or I am thinking of something else') contains more mindfulness, as reflected by a positive location of 0.65, than item 27 ('I notice sounds in my environment, such as birds chirping or cars passing'), which has a negative location of -0.55. The same is true at Super-Item level, where a Super-Item could be compared to a smoothy made up of fruits which have differing levels of vitamin C. The Super-Item (smoothy) thresholds are estimated by using the combined responses of all the included items (fruits). This example is useful to illustrate that the Super-Items and their combinations used in the current study, refine the measurement of the overarching mindfulness construct (as captured by the English CHIME items) and have no implications for either the factor structure of the English CHIME or the

use of its individual subscales. A reader should be mindful that by using individual subscales they are only able to measure a specific facet that is relevant to mindfulness.

The initial exploration of the English CHIME scale revealed that the baseline model showed promising psychometric properties. However, the significant Chi-Square showed a Rasch model misfit, with several items exhibiting issues of local dependency. Hence, the individual English CHIME items were summed to form eight Super-Items, following the methodology previously utilized by Lundgren-Nilsson et al. (2013). A significant advantage of this approach is that the issue of local dependency can be dealt with without the deletion of an items. Deleting items can affect the construct validity of a scale, and therefore should be avoided whenever possible. Even though the English CHIME retained its excellent properties after these modifications, the Chi-Square remained significant. After some investigation, it was determined that six out of the eight Super-Items showed issues of local dependency. Hence, the model was adjusted, and instead the English CHIME items were summed to form five Super-Items. After this adjustment, the Chi-Square became non-significant, and the best Rasch model fit was obtained.

Compared with other mindfulness measures, the English CHIME required only marginal modification to fit the Rasch model. This is in contrast with the Rasch exploration of the KIMS (Medvedev et al., 2016b), where the fit was only achieved at subscale level after the deletion of five items. On a similar note, the FFMQ required the deletion of two items to fit the Rasch model, with the five facets summed to form Super-Items (Medvedev et al., 2017). The English CHIME, on the other hand, did not require the deletion of any items to obtain the best fit. This result is consistent with the Rasch analysis conducted on the original CHIME scale in German, which also did not require the deletion of any items (Medvedev et al. 2019). However, in the German scale, the best fit was obtained by forming eight Super-Items, whereas in the present study, the best fit was achieved after forming five Super-Items.

This discrepancy is likely an artifact of translating the scale from German to English. Although both the German and English scales displayed exceptional psychometric properties, the results of the present research indicate that the CHIME items may present with a different pattern of local dependency when translated into different languages. However, in terms of its overall structure and scoring as a unidimensional profile, there is no difference between the German and English CHIME versions.

As was the case in the original validation study (Medvedev et al. 2019), the English CHIME showed correlations in the expected directions with the other psychometric measures, apart from the correlation with DASS anxiety which remained non-significant. Unsurprisingly, the English CHIME showed convergent validity with the FFMQ. Although the magnitude of the correlation was high (.66) indicating that the scales reflect the overlapping construct, the English CHIME explains a unique amount of variance not covered by the FFMQ. The English CHIME was found to be positively correlated with negative affect, stress, and depression. These results are consistent with the substantial literature findings which demonstrate higher mindfulness levels are linked with better psychological functioning (Morton et al. 2020; Fumero et al. 2020; Thomas et al. 2020). The non-significant correlation between the English CHIME total score and DASS-Anxiety is unexpected and may be explained by the relatively low anxiety levels in the current sample. However, this will require further investigation to verify whether the effect is consistent across different samples.

A significant difference was found between the English CHIME total scores of meditators and non-meditators. This effect was consistent when examining the original ordinal data and the Rasch transformed interval data. Although the overall effect sizes were similar, the result does not undermine the benefits of conducting the ordinal-to-interval conversion, because the transformation increases the precision of measurement. Furthermore,

this result demonstrates that the English CHIME maintains its excellent psychometric properties, even without the ordinal-interval conversion.

No differences were found in the functioning of the English CHIME items across the personal factors of meditation practice, gender, and age. Additionally, the person-item plots show that the English CHIME items discriminate near perfectly between different levels of meditation experience, meaning that the scale functions just as well for meditators and non-meditators. These results are identical to those found in the original validation of the CHIME scale, and taken together, provides strong evidence that the CHIME maintains its reliability and validity across different populations.

Limitations and Future Directions

The primary limitation of the present research stems from the use of online survey data collection. Although the use of online data collection is becoming more prevalent, it can present research with unique challenges. In the present research, participants voluntarily signed up to participate in the study. As mindfulness practice is still considered to be relatively esoteric and known to only a small percentage of the general population, the sample would have self-selected for, and therefore been skewed towards, individuals who were familiar with the concept of mindfulness. This effect is evidenced by the relatively high number of participants who indicated that practiced mindfulness or engaged in some form of contemplative practice (38.4%). The higher average level of mindfulness in this sample could distort the correlations between other psychometric measures, an effect which may explain the non-significant relationship between the English CHIME total score and DASS-Anxiety. Future research could address this issue by selecting participants based on different sampling characteristics.

The present study included participants from the general population and therefore future research should seek to replicate this research in different population types, such as people diagnosed with affective conditions or other psychological disorders. Both samples in this study consisted largely of participants who identified themselves as White American. Future research could use more diverse samples to generalize this study's findings to other cultural and ethnic groups. Nonetheless, Rasch analysis is less dependent on sample characteristics compared with other traditional methods (e.g., factor analysis) (Tennant & Conaghan 2007). Additionally, the sample utilized in the present study was large enough to ensure the robustness and generalizability of these results. For its German-Language version, the CHIME has been shown to be stable over time, with little evidence that items are interpreted differently before and after a mindfulness intervention (Krägeloh et al. 2018). Such evidence is important as it demonstrates that the questionnaire is evaluated using the same standard at both measurement times. Future work will need to confirm the absence of such a response shift in the English CHIME version.

Perhaps the most interesting distinction between the validation of the original German scale and the translated English scale, is the different Super-Item structure required to obtain the best Rasch model fit. In the original German validation (Medvedev et al. 2019), the best fit was confirmed when the individual CHIME items were summed to form eight Super-Items, which is in line with the subscales of the original measure. However, in the present study, the best fit was achieved after summing the items to form five Super-Items. Taken alone, this result suggests that the CHIME may be affected by spurious residual correlations that are different in English compared to German. The question then is, does the linguistic conceptualization and understanding of mindfulness itself differ significantly across different languages and cultures? Further research is required to elucidate whether the Super-Item structure of the CHIME differs significantly across other languages and cultures.

As our understanding of the benefits of mindfulness continues to grow, it is becoming increasingly valuable for researchers and clinicians to be able to measure the mindfulness construct accurately. The present study utilized Rasch analysis methods to explore the psychometric characteristics of the English CHIME scale. The results demonstrate that the CHIME maintains its structural validity and reliability after being translated from German to English. However, a slightly different Super-Item structure was used for the English CHIME compared to the German CHIME, which may be related to error variances associated with linguistic differences or other unknown method effects and requires further investigation.

Compliance with Ethical Standards

We declare no conflicts of interest in connection with this paper. The study was conducted in compliance with the guidelines of the author's university ethics committee. All participants provided informed consent prior to their participation in the study.

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