Effects of meditation training on psychological well-being in older adults

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EFFECTS OF MEDITATION TRAINING ON PSYCHOLOGICAL WELL-BEING IN OLDER ADULTS

THESE

Présentée à la
Faculté de psychologie et des sciences de l'éducation
de l'Université de Genève
pour obtenir le grade de **Docteur en Psychologie**

par

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Allemagne

Thèse No 856

GENEVE

November 2023

Numéro d'étudiant: 20-301-248

Abstract

We live in a complex world confronted with unprecedented existential risks, global pandemics, and a growing mental health crisis. Older adults present a particularly vulnerable group during these times – the physical, social, and psychological challenges associated with ageing are, today, compounded by the difficulties of navigating a fast and uncertain world. Understanding how older adults can maintain and deepen their psychological well-being amidst the challenges of ageing in today's complex world presents a pertinent scientific question.

In this thesis, consisting of four empirical projects including two randomised controlled trials, we investigated if meditation training can positively impact diverse dimensions of psychological well-being in older adults.

First, we developed three theory-based composite scores of well-being in line with a recent model of meditation-based dimensions of human flourishing. Findings offer empirical support for the psychometric delineation of awareness, connection, and insight as meaningful domains of well-being.

Second, we tested the effects of an 8-week mindfulness-based intervention (MBI), compared to a health self-management programme, on well-being in older adults with subjective cognitive decline (SCD, n = 147), who regularly experience reduced well-being related to concerns about worsening memory and risk of dementia. To measure well-being, we utilised the previously developed composite scores alongside two established measures of well-being introduced by Carol Ryff and the World Health Organisation, respectively. Findings suggest that the MBI was associated with only limited effects on psychological well-being.

Third, we tested the effects of an 18-month meditation training on well-being in healthy older adults (n = 137) using the same set of well-being outcomes utilised during the

8-week MBI. Findings indicate that meditation training, compared to English language training and no-intervention, improved a global composite score reflecting the well-being dimensions of awareness, connection, and insight.

Fourth, we developed and validated the 7-item Compassion for Others Scale (COS-7) in both English and German. The COS-7 is the first German measure of compassion for others published to date. The COS-7 was developed in response to prior work that questioned the validity of the Compassionate Love Scale, which was included in the meditation-based composite score used to measure connection in both trials presented in this thesis.

Taken together, this work suggests that longer-term meditation training can enhance important dimensions of psychological well-being in healthy older adults and could thus present a promising non-pharmacological approach for the cultivation of human flourishing. In contrast, shorter-term MBIs for older adults with SCD might be more limited in their utility for enhancing psychological well-being. I conclude by proposing conceptual and empirical avenues of inquiry that could help future meditation research transcend the limitations of the present work and refine the development and impact of tailored meditation training.

Résumé

Nous vivons dans un monde complexe confronté à des risques existentiels sans précédent, des pandémies mondiales et une crise croissante de la santé mentale. Les personnes âgées représentent un groupe particulièrement vulnérable en ces temps – les défis physiques, sociaux et psychologiques associés au vieillissement sont aujourd'hui exacerbés par les difficultés à naviguer dans un monde rapide et incertain. Comprendre comment les personnes âgées peuvent maintenir et approfondir leur bien-être psychologique au milieu des défis du vieillissement dans le monde complexe d'aujourd'hui présente une question scientifique pertinente.

Dans cette thèse, composée de quatre projets empiriques, dont deux essais contrôlés randomisés, nous avons enquêté pour savoir si la formation à la méditation peut avoir un impact positif sur diverses dimensions du bien-être psychologique chez les personnes âgées.

Premièrement, nous avons développé trois scores composites basés sur la théorie du bien-être, conformément à un modèle récent des dimensions de l'épanouissement humain basé sur la méditation. Les résultats apportent un soutien empirique à la délimitation psychométrique de la conscience, de la connexion et de l'aperçu comme domaines significatifs du bien-être.

Deuxièmement, nous avons testé les effets d'une intervention basée sur la pleine conscience (MBI) de 8 semaines sur le bien-être chez les personnes âgées avec un déclin cognitif subjectif (SCD), qui ressentent régulièrement une réduction du bien-être liée à des préoccupations concernant la détérioration de la mémoire et le risque de démence. Pour mesurer le bien-être, nous avons utilisé les scores composites précédemment développés ainsi que deux mesures établies du bien-être introduites par Carol Ryff et l'Organisation Mondiale de la Santé, respectivement. Les résultats suggèrent que le MBI était associé à des effets limités sur le bien-être psychologique.

Troisièmement, nous avons testé les effets d'une formation à la méditation de 18 mois sur le bien-être chez les personnes âgées en bonne santé en utilisant le même ensemble de résultats de bien-être utilisés lors du MBI de 8 semaines. Les résultats indiquent que la formation à la méditation a amélioré un score composite global reflétant les dimensions de bien-être de la conscience, de la connexion et de l'aperçu.

Quatrièmement, nous avons développé et validé l'échelle de Compassion pour Autrui à 7 items (COS-7) en anglais et en allemand. Le COS-7 est la première mesure allemande de la compassion pour autrui publiée à ce jour. Le COS-7 a été développé en réponse aux travaux antérieurs qui remettaient en question la validité de l'Échelle d'Amour Compassionnel, qui faisait partie du score composite basé sur la méditation utilisé pour mesurer la connexion dans les deux essais présentés dans cette thèse.

Dans l'ensemble, ce travail suggère que la formation à la méditation à long terme peut améliorer des dimensions importantes du bien-être psychologique chez les personnes âgées en bonne santé et pourrait donc représenter une approche non pharmacologique prometteuse pour la culture de l'épanouissement humain. En revanche, les MBI à court terme pour les personnes âgées atteintes de SCD pourraient être plus limités dans leur utilité pour améliorer le bien-être psychologique. Je conclus en proposant des avenues d'enquête conceptuelles et empiriques qui pourraient aider la recherche future sur la méditation à transcender les limites du présent travail et à affiner le développement et l'impact de la formation à la méditation sur mesure.

Acknowledgments

I feel grateful for the generous support and encouragement that I have received from my supervisors Matthias Kliegel, Olga Klimecki, and Natalie Marchant. Although Covid restricted much of our personal interactions to Zoom calls and emails for a significant period of my work, I did not feel isolated or impeded in my progress, which I see as a reflection of my supervisors' flexibility and resourcefulness during this challenging period. All along the way, I was given the opportunity to explore avenues of inquiry even if they occasionally meandered through areas that lay outside the ambit of my research questions. I greatly cherished the independence that my supervisors afforded me to explore my research interests from a variety of conceptual and experiential angles.

Matthias' rich expertise in the psychology of ageing and its research literature helped me to adequately contextualise my work within this research field. His penetrative feedback on my work as well as his guidance in administrative and academic-political aspects have taught me much about the process of conducting high-quality science.

Olga's in-depth knowledge of the contemplative and affective sciences literature has given me a secure theoretical grounding for the empirical results of this work. I am very grateful for her proactive efforts to connect me with her colleagues in the European research community and to provide me with valuable opportunities to present and develop my work at various research labs and conferences.

Even before this PhD thesis, Natalie had played an invaluable role in my academic and personal development. I first met her in 2016, when she took me under her wing as a Master student in University College London's Division of Psychiatry. It is not possible to summarise the tremendous amount she has taught me over the past seven years. I always felt wholeheartedly supported.

The mentorship of Antoine Lutz has been crucial to me. Although not formally a part of my supervisory group, Antoine's expertise has significantly shaped this work. His astute research skills as well as his warmth have greatly enriched not only my scientific understanding of meditation practice but contributed to my sense of being a valued member of the meditation research community.

I gratefully acknowledge the funding that was provided by the European Union's Horizon 2020 research programme to support this work as part of the Medit-Ageing Project, which embedded me within a European network of researchers, from which I drew much intellectual stimulation and inspiration over the years. I feel particularly indebted to my UCL colleagues Harriet Demnitz-King and Tim Whitfield for their friendship and countless discussions.

I thank several friends for their inspiring questions and our shared passion for contemplative practice: Florian Hammer, Esmee Jiskoot, Lucas den Engelsman, Leon Muser, Henrik Röhr, Boaz Feldman, and Sebastjan Vörös. I owe gratitude to my meditation teachers, the late Rob Burbea and Yahel Avigur.

I am deeply grateful to my partner, Katharina, my parents, Jorg and Evelyn, my sister, Patricia, and my grandparents, Manfred and Waltraud, for their inexhaustible patience and their loving support throughout this academic endeavour and the long periods on meditation retreat that interspersed it.

Contents

1. Introduction

We live in a complex and fragile world confronted with unprecedented existential risks, tremendous economic uncertainties, increasing political polarisation, and a growing mental health crisis (Ehrlich & Ehrlich, 2013; Storm, 2021; Vahia et al., 2020; Wu et al., 2021). These complex challenges can disrupt established lifestyles and narratives and expose limitations in both personal and collective capacities for meaning-making (Koltko-Rivera, 2004; Park, 2010; Stein, 2019). Older adults present a particularly vulnerable group during these challenging times (Zaninotto et al., 2022). The physical, social, and psychological difficulties associated with ageing are, today, compounded by the challenges of navigating a fast and uncertain world. Research conducted over the past decades suggested that older adults, despite the physical and cognitive changes associated with ageing, maintain comparably high levels of well-being (Lee et al., 2019; Ryff, 1989b; Springer et al., 2011). However, changes over recent years (e.g., widespread use of smart phones/internet, COVID-19, geopolitical tensions, increased public awareness of climate change) has introduced unique and as-of-yet insufficiently understood pressures on older adults' psychological well-being (see e.g., Ayalon et al., 2022). For instance, recent research has indicated that, contrary to expectations expressed during the beginning of the COVID-19 pandemic (Vahia et al., 2020), older adults did not adapt well to the novel psychosocial stressors posed by the COVID-19 pandemic, reporting significant decreases in quality of life (Zaninotto et al., 2022). Understanding how older adults can maintain and deepen their psychological well-being whilst ageing in today's complex world presents a pertinent scientific question.

Over the past decades, research and theory on psychological well-being has aimed to offer answers to these questions by understanding the conditions that predict and constitute human flourishing. Since the pioneering days of well-being research in the 1960s, the field has evolved substantially (Diener et al., 1999, 2018). Psychological well-being is increasingly

conceptualised as a trainable skill that can be cultivated by specific practices (Dahl et al., 2020). This perspective is rooted in Greco-Roman philosophical schools (Hadot, 1997) as well as Buddhist meditative traditions (Gethin et al., 1998). The cultivation of inner capacities and the alleviation of suffering have been central tenets of these traditions for millennia but only recently have researchers begun to explicitly synthesise these contemplative perspectives with contemporary scientific models of well-being (Dahl et al., 2015, 2020). Particularly Buddhist meditation practices, including types of mindfulness and compassion practices, have received a substantial amount of scientific and popular attention (Van Dam et al., 2018). Thousands of studies have been published on the effects of meditation practice on a wide range of cognitive, affective, and neuroscientific variables (Fox et al., 2016; Goyal et al., 2014; Grossman et al., 2004; Sedlmeier et al., 2012; Tang et al., 2015). Research has also explored how aspects of meditation training can be integrated into psychotherapy (Hayes et al., 2006; Kabat-Zinn, 2013; Linehan et al., 1999; Segal et al., 2012), education (Zenner et al., 2014), and health care (e.g., Irving et al., 2009) to support the alleviation of stress and mental suffering.

Despite this interest and the notable increase in publications on meditation practices, the field is still young and thus has some noteworthy lacunae (Davidson & Kaszniak, 2015; Van Dam et al., 2018), such as the striking lack of research on the effects of meditation training in ageing populations (see Goldberg et al., 2022). The conceptualisation of well-being as a skill that can be trained not only during periods of seemingly heightened plasticity but across the entire lifespan warrants empirical investigation (Dahl et al., 2020). Older adults' potential to actively enhance their well-being through specific practices might be greater than hitherto assumed. Other important questions of this nascent research field regard the understanding of the mechanisms of specific meditation practices and the delineation of those well-being dimensions that are particularly amenable to meditation training. Similarly,

there is a need for research comparing the utility of meditation training-based theories of human flourishing to prominent scientific models of well-being whose development has not been informed by contemplative perspectives (e.g., cf. Dahl et al., 2020; Ryff, 1989; The Whoqol Group, 1998).

No line of research or theoretical model can address these questions single-handedly. Nonetheless, this thesis aims to offer a meaningful contribution to the maturation of this field. At the empirical core of this endeavour are the results from two large randomised controlled trials of meditation training and their effects on psychological well-being in older adults. Several theory-based outcome measures of well-being will be utilised to appreciate the conceptual richness of this field. The following background sections will (i) elaborate on traditional and contemporary approaches to well-being, (ii) discuss the relationship between age and well-being, (iii) introduce definitions and maps of meditation practice, and (iv) offer frameworks for understanding why meditation training might be a promising intervention for the cultivation of human flourishing amidst the challenges of ageing in today's complex world.

Perspectives on psychological well-being

Psychological well-being is a multidimensional construct (Dahl et al., 2020; Ryff, 1989a; The Whoqol Group, 1998). In the following, we will briefly trace the evolution of contemporary well-being research and then delve deeper into the multidimensional nature of psychological well-being, introducing and developing the specific definitions and dimensions proposed by Dahl et al. (2020), Ryff (1989a), and the WHOQOL Group (1998), which form the bases for our understanding and definition of well-being in this thesis.

The possibilities and range of human well-being are deep and wide. Naturally, the conceptions of well-being that have been introduced over the past decades have tended to emphasise different dimensions of human flourishing. How have researchers conceptualised

and attempted to measure well-being over the past decades? At the dawn of this research field, during the 1960s and 1970s, large-scale sociological surveys conducted in the United States began to include questions on happiness and satisfaction with life (Andrews & Withey, 2012; Bradburn, 1969), which can be considered constructs that, like well-being, are encapsulated by the wider conceptual space of human flourishing. Several decades would pass before psychologists also turned their attention to the study of well-being (see Diener et al., 1999). In addition to measures of life satisfaction, these researchers were interested in participants' self-reported levels of positive and negative affect (Lucas et al., 1996) and relating these indicators of well-being to trait-like characteristics such as personality, invariant factors such as heredity, and contextual conditions such as housing (DeNeve & Cooper, 1998; Lykken & Tellegen, 1996; Veenhoven, 1991). Parallel to these developments, researchers in the fields of humanistic, clinical, and existential psychology formulated conceptions of well-being that were grounded in the notion of positive functioning to capture mental states and behaviours that contribute to personal growth, life satisfaction, and self-actualisation (e.g., Allport, 1961; Erikson, 1959; Maslow, 1968; Rogers, 1995).

Surveying the contemporary field of well-being research, Ryan and Deci (2001) suggested that two strands can be distinguished, both of which have their roots in ancient Greco-Roman philosophical schools. The first strand of research emphasises hedonic well-being, which is commonly associated with the term 'pleasure'. The other emphasises eudaimonic well-being, which is less about achieving a pain-free, pleasurable life and more about fulfilling one's human potential and cultivating virtue (Ryan & Deci, 2001; Ryff, 2014). The evolution of contemporary well-being research was also influenced by the work of philosophers such as Jon Stuart Mill (1893/1989) and Bertrand Russel (1958). Mill, a prominent utilitarian, viewed happiness as a concomitant of virtuous actions aimed at the welfare of humanity and not as an end in itself (Mill, 1893/1989). Russell later echoed these

sentiments and suggested that effort, interest, and engagement are needed to achieve happiness (Russell, 1930). It does not simply happen by itself. We need to actively strive for happiness to be granted the opportunity to feel it. Viewed through the dichotomous lens of Greco-Roman thought, these influential conceptions of well-being could be said to have combined both hedonic and eudaimonic aspects. Contemporary well-being research has suggested that although hedonic and eudaimonic conceptions of well-being are related, they can be meaningfully distinguished in empirical studies using factor analysis (Keyes et al., 2002). Measures that have been used to capture hedonia include global life satisfaction and positive and negative affect. Measures of eudaimonia have included purpose in life, meaningful relations with others, realising personal potential, self-awareness, autonomy, and acting in accordance with one's values (Keyes et al., 2002; Ryan & Deci, 2001).

Although the hedonia-eudaimonia distinction has generated valuable hypotheses and insights for contemporary well-being research over the past decades (Diener et al., 1999, 2018; Ryff, 2014; Ryff & Singer, 2008), recent work on human flourishing has decreasingly made explicit reference to this approach. Particularly work that synthesised literature from clinical, cognitive, and contemplative perspectives has proposed ways of taxonomising dimensions of well-being that are primarily based on their capacity to be trained (Dahl et al., 2020). In this line of research, the focus is on understanding the specific dimensions of well-being that can be cultivated by specific forms of training. Whether these dimensions happen to be classified as hedonic, eudaimonic, or a blend of both is secondary. In fact, practices such as mindfulness meditation tend to cultivate states that are perceived as pleasant/hedonic (e.g., being aware in contrast to being distracted) and that, at the same time, enable improved self-regulation, value-aligned behaviour, and social interactions (Dahl et al., 2020).

The central aim of the present work is to investigate the effects of meditation training on diverse conceptions and aspects of psychological well-being in older adults. For that

purpose, three distinct models of well-being are utilised, namely Carol Ryff's theory of well-being (1989), the World Health Organisation's (WHO) conception of psychological quality of life (The Whoqol Group, 1998), and a novel meditation training-based framework for human flourishing developed by Dahl, Wilson-Mendenhall, and Davidson (2020). The choice of the three models of well-being was motivated by both conceptual and measurement considerations. Each of these models provides a unique perspective on well-being and captures different aspects of the construct. By utilizing these three models, this thesis aims to provide a comprehensive examination of the effects of meditation training on well-being in older adults. A more elaborate explication of the main aims and research questions of this thesis is provided in a subsequent section. Next, the three models of well-being will be introduced in more detail.

Ryff (1989) aimed to offer the first unifying theoretical framework for contemporary scientific perspectives on human flourishing. Ryff's seminal theoretical work (1989) was a departure from the largely data-driven and atheoretical research on well-being that had previously been conducted in this area. Since its publication, Ryff's theory of psychological well-being has significantly shaped the field (Diener et al., 2018; Ryff, 2014; Ryff & Singer, 2008). Ryff aimed to identify the fundamental aspects of positive functioning that could help define what it means to be psychologically well. Distilling the converging aspects of existing approaches, Ryff's model proposed six different dimensions of well-being: self-acceptance, positive relations with others, autonomy (living aligned with personal values and standards), environmental mastery (ability to manage life's demands and the world around oneself), purpose in life, and personal growth (sense of developing and realising one's capacities) (Ryff, 1989a). To empirically capture these distinct dimensions, Ryff , Lee, and Keyes (1995) developed the Psychological Well-being Scale (PWBS), which remains the most cited self-report measure of psychological well-being. When contextualised within the evolution of

contemporary well-being research outlined above, this self-report scale could be classified as an eudaimonic measure of human flourishing. The PWBS has been included in a wide variety of lifestyle and health interventions and much research has accrued on the relationship of PWBS dimensions with other variables including measures of mental health, physical health, biomarkers, personality, family life, work, and ageing (see Ryff, 2014; Ryff et al., 2016).

The World Health Organisation (WHO) defines quality of life as "individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" (The WHOQOL Group, 1995). The WHO frames quality of life as an aspect of well-being. Within this broad conception, the WHO identified four domains of quality of life: physical, psychological, social relationships, and environment. Based on this framework, the WHO group developed the World Health Organisation Quality of Life assessment (WHOQOL). The rationale for the development of this instrument arose from several observations. First, the group perceived that the measurement of health broadened beyond traditional indicators such as morbidity and mortality (e.g., World Bank, 1993; World Health Organization, 1991). Increasingly, there was a focus on how disease impacted measures of daily activities, self-perceived health, and disability. However, this broadening in focus had not yet included measures of well-being per se (Fallowfield, 1990). Second, most measures of health status up to that point had been developed and validated in the UK and North America (Kuyken et al., 1994). The group intended to offer an instrument that could measure the domains of perceived quality of life in a more time-efficient and cross-culturally robust manner. Third, the WHO expressed concern that the predominant model of medicine had become too mechanistic, focussing primarily on the eradication of symptoms and disease while lacking humanistic approaches centred on the patient's well-being (The WHOQOL Group, 1998). The introduction of the WHOQOL was thus also a statement of commitment to promoting a genuinely holistic approach to health and

health care interventions, echoing the WHO's definition of health as "A state of physical, mental and social well-being, not merely the absence of disease and infirmity" (World Health Organization, 1991). In the context of the present work, the psychological domain of the brief version of the WHOQOL will be utilised (The Whoqol Group, 1998). This domain comprises five facets that aim to capture feelings of contentment, peace, happiness, and joy (positive feelings); feelings of despondency, guilt, despair, and nervousness (negative feelings); satisfaction with one's personal looks (body image and appearance); the overall opinion of oneself (self-esteem); and the ability to think, learn, memorise, and concentrate. The psychological domain is computed as a single score comprising these facets. The WHOQOL assessment of psychological well-being thus reflects a more hedonic perspective on well-being than the PWBS introduced above.

While all three models of well-being provide valuable insights into the multidimensional nature of well-being, the framework developed by Dahl et al. (2020) is given particular attention in this thesis due to (i) its direct relevance to meditation practice and (ii) the recency of its publication and the associated lack of research projects that aimed to empirically corroborate its theoretically derived structure. Dahl et al.'s (2020) meditation training-based model of human flourishing integrates insights from neuroscientific and psychological research on well-being with contemplative perspectives. It rests on a skill-based conception of human flourishing, framing dimensions of well-being as trainable capacities. The authors aimed to introduce a set of constructs that could further unify existing theories and interventions in this field while offering a common language to encourage collaboration across related research areas. Of note, this recent model of well-being (Dahl et al., 2020) builds on and expands a previous theoretical model (Dahl et al., 2015), which grouped meditation practices into attentional, constructive, and deconstructive practices based on the psychological capacities that these practices necessitate and train, namely meta-

awareness, perspective taking, and self-inquiry, respectively. The recent well-being model (Dahl et al., 2020) re-labelled the three core dimensions of meta-awareness, perspective taking, and self-inquiry: awareness, connection, and insight. Conceptually, the well-being dimensions of awareness, connection, and insight (Dahl et al., 2020) closely correspond to the psychological capacities of meta-awareness, perspective taking, and self-inquiry (Dahl et al., 2015). No self-report measure has yet been developed that was explicitly derived from either the earlier model (Dahl et al., 2015) or the more recent model (Dahl et al., 2020). This thesis will use the threefold taxonomy to group a range of self-report measures into psychometrically sound and empirically meaningful composite scores, which will then be utilised to measure awareness, connection, and insight, respectively.

Awareness, in this framework (Dahl et al., 2020), describes an enhanced and malleable attentiveness to perceptions, both external and internal (e.g., thoughts, feelings, and bodily sensations). States of high awareness are characterised by being intimately aware of one's perceptual impressions, behaviour, and social interactions (Bernstein et al., 2015; Zedelius et al., 2015). Being distracted and unintentionally absorbed by inner or outer activities and events would be indicators of lower levels of awareness. Heightened awareness also entails the capacity to monitor contents of experience, notice decreasing levels of awareness, and respond adequately to distractions and mind-wandering (Dahl et al., 2015; Lutz et al., 2015). Higher levels of awareness tend to be perceived as pleasant, particularly when compared to the subjective experience of distraction, which are characterised by lower levels of well-being (Killingsworth & Gilbert, 2010). Being distracted is associated with higher levels of anxiety, depression, and stress (Hoffmann et al., 2016; Seli et al., 2019). In addition to facilitating the reduction of mental health problems and the arising of hedonic states of well-being, states of awareness also contribute to successful self-regulation in the

context of pursuing meaningful goals and values (i.e., more eudaimonic aspects; Seli et al., 2017; Zedelius et al., 2015).

Connection, in this framework (Dahl et al., 2020), describes a perceived sense of kinship and care that supports positive relationships with others. Connection entails positive feelings such as appreciation, respect, and gratitude toward other people. It captures an increased capacity for viewing social interactions through a lens of shared humanity (Dahl et al., 2015). States of connection invite compassion and empathy for both the differences and shared characteristics of people within and outside of our proximate social circles (Freeman & Ambady, 2011). Meaningful relationships and caring social interactions are predictors of positive psychological functioning (Vaillant, 2008) and a reduced risk of mortality and mental health problems including anxiety, depression, and substance abuse (Holt-Lunstad et al., 2010, 2015; Santini et al., 2015; Teo et al., 2013).

Insight, in this framework (Dahl et al., 2020), refers to an experiential understanding of the ways in which emotions, thoughts, and views influence the sense of self, others, and the world. Insights offer self-knowledge about the ways in which one actively participates in the shaping of perception (Burbea, 2014). Importantly, insight entails the active investigation of one's experience and facilitates the ability to transform modes of thinking, feeling, and relating that are perpetuating psychological distress and suffering (Dahl et al., 2015). An important aspect of this psychological process is the weakening of reification, which describes the belief in the inherent and independent reality of the contents of one's experience (and of awareness itself) (Lutz et al., 2015). For example, in a state of diminished insight, psychological stress could be maintained and intensified by viewing negative thoughts about the self as accurate reflections of reality. Here, deeper insight would offer an enhanced flexibility in choosing ways of looking that are more conducive to well-being. For instance, one could relate to the negative self-views as impermanent, impersonal mental

events whose arising is dependent on a complex conglomeration of inner and outer conditions (Burbea, 2014). Contemporary scientific models of well-being had hitherto not featured insight as a core dimension of human flourishing (Diener et al., 2018; Ryff, 2014). However, this dimension is a central tenet of contemplative traditions such as Buddhism (Burbea, 2014; Dahl et al., 2015; Gethin et al., 1998) and figures prominently in some schools of contemporary psychotherapy (e.g., Mindfulness-based Cognitive Therapy; Segal et al., 2012) and other insight-based interventions (Goldberg et al., 2020; Singer & Engert, 2019). Negative views of the self and rigid patterns of repetitive, maladaptive thinking have been associated with various mental health problems including depression, anxiety, and psychosis (Cowan et al., 2019; Evans et al., 2005; Williams & Levinson, 2020) as well as subjective cognitive decline (Schlosser, Demnitz-King, et al., 2020). In contrast, heightened insight into one's psychological processes and more compassionate beliefs about the self have been linked to eudaimonic forms of overall well-being (Barnard & Curry, 2011; Harrington & Loffredo, 2011; Muris et al., 2016; Neff, 2003).

Psychological well-being in older adults

Understanding well-being in old age and its determinants is a complex endeavour, given the multifaceted nature of well-being itself. Despite the changes and challenges that accompany ageing (e.g., the loss of loved ones, retirement-related status changes, health deterioration, lower productivity, reduced income), studies conducted over the past several decades have consistently indicated that older adults are able to sustain, and even enhance, their levels of self-reported well-being (Ryff, 1989b; Springer et al., 2011). The phenomenon is sometimes referred to as the 'well-being paradox' and presents an intriguing aspect of ageing that is thought to arise from a variety of factors (see e.g., Charles, 2010). For instance, older adults, through their extensive life experiences, may have developed a repertoire of effective coping strategies to manage stress and adversity. This enhanced resilience to life's

challenges might set them apart from their younger counterparts, who may not yet have had the opportunity to develop such robust coping mechanisms (Charles, 2010). Research indicates that older adults, compared to their younger counterparts, have more positive emotional experiences, greater emotional stability, and lower levels of stress, worry, and anger (Carstensen et al., 2011; Löckenhoff & Carstensen, 2004). Relatedly, the process of ageing may be associated with a shift in priorities and values. Socioemotional Selectivity Theory (SST; Carstensen et al., 1999, 2003), a prominent theory in the field of ageing and well-being, posits that as individuals age, they accumulate emotional wisdom that guides them towards more emotionally satisfying experiences and relationships. This shift in priorities might also be related to a perceived limitation in time, prompting older adults to focus on emotionally meaningful goals and experiences, such as maintaining positive emotional states and investing in close interpersonal relationships (Carstensen et al., 1999).

However, it is worth noting that these patterns of subjective well-being might not apply universally across all populations (for a discussion, see Steptoe et al., 2015) and that individual differences play a significant role, as not all older adults experience high levels of well-being. Thus, while concepts such as the well-being paradox and theories like SST provide poignant encapsulations of potential processes shaping and underlying the relationship between well-being and age, these questions are complex, nuanced, and significantly influenced by an interplay of physical, psychological, behavioural, and social factors (Smith & Baltes, 1997; Steptoe & Fancourt, 2019). These factors include the presence of chronic diseases and mental health condition, the quality and quantity of social relationships, as well as socioeconomic status and financial stability (Diener et al., 1999; Stenholm et al., 2015; Steptoe et al., 2015).

To adequately contextualise the present thesis within the existing body of research on the well-being of older adults, another perspective needs to be highlighted. Although valuable

insights into older adults' ability to sustain relatively high levels of well-being have been distilled over the past decades, today's more rapidly evolving societal landscape might necessitate a re-evaluation of certain aspects of our current understanding. In recent years, several significant changes have emerged that older adults of previous generations did not have to contend with. These changes could potentially exert unique and hitherto unexplored pressures on the psychological well-being of older adults. Firstly, the digital revolution has led to the widespread adoption of smartphones and the internet. While these technological advancements have brought about numerous benefits, they have also introduced new challenges such as smartphone and internet addiction and the adoption of fake or potentially harmful information through discussion forums and online communities (see e.g., Leist, 2013). While the literature on older adults' engagement with social media platforms, entertainment streaming services, and artificial intelligence chatbots is in its infancy, preliminary work highlights both potential benefits and threats to well-being (Alhassan et al., 2018; Busch et al., 2021; Harwood et al., 2014). Secondly, the COVID-19 pandemic has also had a profound impact on the lives of older adults. Contrary to initial expectations, recent studies have suggested that older adults have not adapted well to the psychosocial stressors brought about by the pandemic. A study by Zaninotto et al. (2022) found that older adults reported significant decreases in quality of life during the pandemic. Thirdly, geopolitical tensions and increased public awareness of complex issues such as climate change could impact psychological well-being and add to the complexity of the environment in which older adults are ageing (Clayton, 2020; Ojala et al., 2021). In light of these societal changes, understanding how older adults can maintain and enhance their psychological well-being in today's complex world presents an important scientific question. This line of inquiry is not only crucial for improving the well-being of older adults but also contributes to broader discussions about what it means to be psychologically well in the 21st century. By addressing

these questions, we might be able to better support older adults in navigating the unique challenges of our time and help them achieve a higher quality of life.

The present work aims to understand whether and to what degree meditation training can impact diverse aspects of psychological well-being in older adults. The following section will discuss different types of meditation practice from traditional and scientific perspectives and contextualise them within contemporary meditation research.

Perspectives on meditation practice

Defining meditation practice

Meditation is a multidimensional construct that is notoriously hard to define. In the context of this thesis, meditation is defined as a training in specific ways of perceiving and relating to one's experiences that are aimed at reducing suffering and enabling the realisation of increasingly deep levels of well-being, human flourishing, and transformative insights (Burbea, 2014; Dahl et al., 2015; Lutz et al., 2008). The meditation-based interventions that form the empirical core of this thesis are designed to train participants in specific ways of relating to their experiences, such as through the lenses of mindfulness and compassion. Despite the utility of this seemingly comprehensive definition, meditation remains a demanding explanandum.

The term meditation includes a vast range of distinct practices and mechanisms that can be cultivated to increasing depths of meditative skill, subtlety, and refinement (Burbea, 2014). In attempting to understand and taxonomise meditation practices, researchers have regularly turned to traditional accounts of meditation practice. However, even within a single Buddhist tradition, such as Theravada or Tibetan, several distinct goals and conceptions of meditation can be present (Lutz et al., 2007). What exactly constitutes practice, progress, and insight is dependent on various conditions that have shaped the evolution of traditions across millennia. Cultural contingencies, political dynamics as well as ontological commitments

have played an important role in the moulding of these living wisdom traditions (Gethin et al., 1998; McMahan, 2008; Thompson, 2020).

Given this multi-layered context, researchers have struggled to neatly operationalise meditation practices (Davidson & Dahl, 2018; Van Dam et al., 2018). There is no single unifying consensus framework that can be drawn on to consistently implement meditation practice paradigms within and across empirical studies. Perhaps understandably, scientific explorations into meditation have thus far largely focussed on a subset of Buddhist practices, namely mindfulness practices. It is important to note that the popularity of mindfulness over other traditional practices and components (e.g., devotional practices, jhana practices) is not simply a product of scientific convenience. Recent scholarly work has highlighted the complex history of Buddhist modernism and the Western mindfulness movement (Braun, 2013; Gleig, 2019; McMahan, 2008; Thompson, 2020). Although a treatment of this rich historical evolution is beyond the scope of the present work, it is important to underline that the ongoing scientific difficulties to define meditation are contextualised within a broader historical arc that comprises an unusual conglomerate of factors including the life and awakening of the historical Buddha, the European enlightenment, romanticism, and 19th century political power dynamics in South East Asia (McMahan, 2008; Ṭhānissaro, 2015). Relatedly, debates on the possible benefits and limitations of de- and recontextualising traditional practices continue to shape the discourse on meditation practice in the West (Gleig, 2019; Thompson, 2020).

Nevertheless, despite (or because of) the challenges that have been posed by this rich conceptual and historical context, meditation research has matured (see Van Dam et al., 2018). For instance, although the phenomenological fields of meditation practice are deep and wide, researchers have proposed several key features that can be used to describe and identify different practices (Lutz et al., 2007). First, any type of practice can be expected to

induce distinct states that are characterised by predictable perceptual, cognitive, or physical changes discernible by the practitioner. Second, it is assumed that the cultivation and repeated exposure of the mind and body to such states increasingly enables a practitioner to weaken undesirable traits and embody desirable ones. Third, the amount of time dedicated to practice is predicted to be linked to practitioners' capacity to induce the desired states. Practices must be learned and this process of learning usually requires a meditation teacher or skilled guide to support the practitioner in cultivating certain states. Importantly, the training is assumed to be gradual and expert meditators should thus be more adept at inducing the intended states than beginners. Relatedly, experienced meditators would be expected to have acquired certain reportable cognitive, emotional, and physical traits and experienced specific phenomenological events. Taken together, these aspects were proposed as useful ways for operationalising traditional Buddhist contemplative practices in the context of scientific studies (Lutz et al., 2007).

Classifying meditation practices

Subsequent theoretical advances in the science of meditation (Dahl et al., 2015; Hölzel et al., 2011; Lutz et al., 2015; Nash et al., 2013; Vago & David, 2012) have contributed to a gradual transcendence of the field's mindfulness-centric focus (Van Dam et al., 2018). Hence, systems for classifying and characterising a wider range of meditation practices, such as compassion and loving-kindness practices, have become increasingly pertinent. A central aim of these efforts is the ability to differentiate psychological mechanisms that are related to specific practices and their interactions. Insights into this differentiation can then be applied to the development and optimisation of multicomponent meditation-based interventions and their impact on human flourishing (Dahl et al., 2015, 2020; Trautwein et al., 2020). Importantly, Singer and Engert (2019) emphasized the importance of the type of practice in meditation training, noting differential effects on

subjective experience, behaviour, brain, and body depending on the specific practices employed. In the context of the present work, this underscores the need for a nuanced understanding of different meditation techniques and their respective impacts on psychological well-being.

Several frameworks for categorising meditation practices have been proposed. A heuristic distinction can be made between theory-based, top-down approaches to classifying meditation practices and their psychological mechanisms (e.g., Hölzel et al., 2011; Lutz et al., 2008; Lutz et al., 2015; Vago & David, 2012) and predominantly data-driven, bottom-up approaches (e.g., Farb et al., 2018; Matko et al., 2021). The central aim of both approaches is to effectively measure the latent constructs of interest. The two approaches differ, however, in the range of methods by which this aim is pursued. Whereas theory-based approaches primarily employ literature synthesis, expert guidance, and integration of phenomenological accounts, bottom-up approaches primarily employ data reduction techniques such as exploratory factor analysis.

Meditation-based interventions and models of this thesis

For the present purposes, the theoretical model introduced by Dahl, Lutz, and Davidson (2015) will be utilised to define and discuss the meditation-based interventions that form the core of the empirical part of this thesis. This taxonomy, briefly introduced above, groups the variety of meditation practices into attentional, constructive, and deconstructive families. This model presents a theoretical refinement to previous approaches that have commonly included two-dimensional taxonomies of meditation practice. For instance, a widely-cited model introduced by Lutz et al. (Lutz et al., 2008) differentiated focused attention from open monitoring practices. Similarly, in various Buddhist traditions, meditation training regularly comprises a two-fold distinction between concentration or calming practices and insight practices (see A. Lutz et al., 2007). An advantage of Dahl et

al.'s (2015) framework is that it includes the practices captured by prior twofold taxonomies but transcends them by also including constructive forms of meditation (e.g., loving-kindness, compassion) alongside mindfulness and insight practices.

In the previous section on theoretical approaches to well-being, we have already highlighted the close link between Dahl et al.'s (2015) threefold taxonomy of meditation practice and Dahl et al.'s (2020) subsequent theoretical development that links the attentional, constructive, and deconstructive families of practice to the well-being dimensions of awareness, connection, and insight, respectively. Prototypically, the attentional family encompasses various forms of concentration and mindfulness practices, the constructive family encompasses forms of loving-kindness and compassion practices, and the deconstructive family encompasses forms of insight practices (Dahl et al., 2015). Before elaborating on the types of practices that constitute the meditation-based interventions of the present work, it is important to highlight that Dahl et al's theoretical work (2015, 2020) acknowledges that a well-being dimension primarily associated with one family of practices can also be indirectly trained by or facilitating the practices of other families. For instance, awareness could be directly trained by attentional practices (e.g., mindfulness of breathing) or more indirectly through constructive practices (e.g., compassion) or deconstructive practices (e.g., meditation on the impermanence of body sensations and thoughts). Similarly, heightened awareness cultivated through attentional practices could, in turn, support the cultivation of constructive and deconstructive practices.

The empirical part of the present work presents the effects of two meditation-based interventions. Attentional and constructive practices form the primary constituents of these interventions. Specifically, the meditation-based intervention presented in Chapter 3 consists of an 8-week mindfulness-based intervention (MBI) that follows the format of the widely-implemented mindfulness-based stress reduction (MBSR) programme (Kabat-Zinn, 2013).

MBSR is the gold standard MBI and consists of approximately 26 hours of formal meditation practice (during eight weekly group classes of about 2.5 hours) as well as a retreat day (6 hours of formal practice) and homework practices (about 45 minutes per day, six days a week) (Crane et al., 2017). The practices during MBSR training include focussing attention on the breath, scanning the body with awareness, compassion practices, and gentle yoga exercises. In contrast to regular MBSR programmes, the 8-week MBI utilised here (see Marchant et al., 2018) was specifically tailored to meet the needs of older adults with subjective cognitive decline, a condition that will be elaborated on in the following section.

The meditation-based intervention presented in Chapter 4 comprises a two-component 18-month meditation training for healthy older adults. This intervention presents the longest meditation trial conducted to date and, although informed by existing meditation-based interventions, was specifically designed for this trial (see Poisnel et al., 2018). The first nine months of training focussed on the cultivation of mindfulness practices and the subsequent nine months focussed on compassion and loving-kindness practices. The 18-month training was tailored to support healthy ageing and help participants meet the physical, psychological, and existential challenges that can arise with ageing.

Understanding mindfulness and compassion

To further clarify the nature of these meditation-based interventions, two more key terms warrant further explication, namely mindfulness and compassion. Mindfulness is a construct with significant semantic ambiguity and a rich cultural history (Anālayo, 2019; Dunne, 2011; Olendzki, 2011; Sharf, 2015). Mindfulness researchers have not agreed on a universally accepted definition nor reached consensus on the constituents or latent aspects captured by the term (see Van Dam et al., 2018). These variations in descriptions and understandings of mindfulness have caused considerable confusion within both academic discourse and popular media (Anālayo, 2020b; Ṭhānissaro, 2015; Thompson, 2020).

Importantly, in the nascent field of meditation research, noteworthy efforts have been made to dispel some of the conceptual and empirical mist regarding its core constructs. For instance, in a seminal paper, a group of leading mindfulness researchers offered a critical evaluation of mindfulness research and attempted to outline a prescriptive research agenda for this field (van Dam, et al., 2018). An in-depth treatment of this complex subject requires a multidisciplinary perspective drawing on Buddhist studies, phenomenology, cognitive science, and psychology. For the present purposes, only those aspects necessary for further elucidating the mindfulness practices included in Chapter 3 and 4 will be briefly touched upon. The definition of mindfulness that will be invoked here (and that has been one the most frequently applied definitions) refers to mindfulness as "paying attention in a particular way: on purpose, in the present moment, and non-judgementally" (Kabat-Zinn, 2013). The convenience and operationalisability of this definition, particularly in the context of teaching Western audiences, has contributed to its widespread use (Van Dam et al., 2018). Relatedly, the term 'bare attention' has become a potent trope to teach the capacity to suspend abstractions, interpretations, and concepts that are habitually laid 'on top' of our 'bare' experience (Burbea, 2014). This rendering of mindfulness as the capacity to observe objects of experience (e.g., sensations, thoughts, feelings) with vigilant, attentive, and steady presence and without unnecessary conceptual overlay is employed in the mindfulness practices included in the interventions presented in Chapters 3 and 4.

Compassion is a rich construct that encompasses forms of social intelligence, caring intentions, and sensitivity to context-dependent affective textures (Gilbert, 2019; Khoury, 2019; Seppälä et al., 2017). Compassion is commonly defined as response to suffering that includes the motivation to relieve suffering (Goetz et al., 2010). Responding to ongoing debates on the nature of compassion and a lack of expert agreement on its conceptualisation (Strauss et al., 2016), recent work has attempted to identify core characteristics of

compassion by drawing on Buddhist and psychological definitions. Five constituents of compassion were proposed, namely recognising suffering, understanding its universality, feeling empathic concern in the face of suffering, tolerating the distress associated with witnessing suffering, and the motivation to alleviate suffering (Gu et al., 2017; Strauss et al., 2016). The compassion practices included in the meditation-based interventions of Chapter 3 and 4 are aimed at cultivating these core characteristics of compassion. It may be worth highlighting that the challenges encountered in defining and operationalising complex constructs such mindfulness and compassion are not unique to meditation research. Similar difficulties have arisen in other fields including the study of intelligence (see, e.g., Neisser et al., 1996) and wisdom (see, e.g., Walsh, 2015).

Effects of meditation practice on well-being

Research indicates that meditation training and mindfulness-based interventions can have a significant positive impact on various aspects of psychological well-being. For instance, a meta-analysis by Eberth and Sedlmeier (2012) found that mindfulness meditation has a broad range of effects on psychological health, including improvements in attention, depression, anxiety, and pain. On the more hedonic side, meditation-based interventions have been found to enhance life satisfaction and positive affect, and to reduce negative affect (Khoury et al., 2015, 2017). On the more eudaimonic side, meditation has been associated with increased self-acceptance, personal growth, and a sense of purpose in life (Carmody & Baer, 2008). Similarly, Khoury et al. (2013) conducted a comprehensive meta-analysis on mindfulness-based therapy, demonstrating its effectiveness across a range of psychological disorders. Goyal et al.'s (2014) systematic review and meta-analysis found that meditation programmes can reduce multiple dimensions of psychological stress. These findings were echoed by Goldberg et al. (2022), whose systematic review of 44 meta-analyses of randomised controlled trials concluded that mindfulness-based interventions have wide-

ranging effects across diverse populations, settings, and formats. Neuroscientific evidence indicated that mindfulness meditation can lead to alterations in brain and immune function, suggesting a potential physiological basis for improved well-being (Davidson et al., 2003). Further, Hirshberg et al. (2022) demonstrated the real-world applicability of an app-based meditation training, showing improved well-being and reduced stress and burnout among public school employees. In summary, this body of research underscores the potential of meditation training and mindfulness-based interventions for enhancing psychological well-being across diverse contexts and populations.

After having attempted to offer practical answers to the complex questions regarding the nature of psychological well-being and meditation practice as they relate to the present work, the next section will synthesise and build upon these explorations in order to discuss why and how meditation training could be a promising intervention for enhancing human flourishing in older adults. While the effects of meditation on well-being have been well-documented in general, less is known about its effects in older adults specifically.

Why could meditation practice foster psychological well-being in older adults?

The world is ageing. The life expectancy and the number and proportion of people above the age of 60 is increasing worldwide (Chang et al., 2019; Desa, 2022). Older adults are confronted with various factors that affect their capacity to maintain their quality of life and to continue thriving in their personal lives amidst the challenges of ageing (see Chételat et al., 2018; A. Lutz et al., 2021). Thus, research that aims to support healthy ageing and promote well-being in older adults has become particularly pertinent. A priority is to understand how healthy life years can be increased and major neurodegenerative diseases prevented (Livingston et al., 2020). Research on eudaimonic well-being across the lifespan has indicated that higher levels of purpose in life are predictive of increased longevity, but that purpose in life and personal growth tend to decline with age (Ryff et al., 2016). The

conditions that are associated with declining psychological well-being in ageing populations include anxiety, depression, stress, worry, and sleep disturbances (see Klimecki et al., 2019; Ryff et al., 2016). Moreover, these factors increase the risk of cognitive decline and dementia – conditions that present a tremendous burden for the individual, their loved ones and caregivers, and incur large economic costs on society (Livingston et al., 2020; Marchant & Howard, 2015; Wimo et al., 2013).

This thesis will evaluate the effects of meditation training in both healthy older adults and those with subjective cognitive decline (SCD). SCD describes self-reported worsening of cognitive functioning despite unimpaired performance on objective tests of cognition (Jessen et al., 2020). Clinical and epidemiological data suggest that older adults with SCD, especially those recruited from memory clinics, are at a higher risk of subsequently developing dementia (Mitchell et al., 2014). An important aspect of living with SCD is the impact that perceiving increasing cognitive difficulties has on an individual's psychological well-being. The subjective experience of individuals with SCD is commonly marked by stress, fear of dementia, anger, and feelings of anxiety and depression (Metternich et al., 2010; Molinuevo et al., 2017). This aspect can be overlooked within research contexts that focus primarily on the maintenance of cognition or the prevention of amyloid deposition in the brain, a process involving the accumulation of the amyloid-beta peptide, which plays a pivotal role in the onset and development of Alzheimer's disease (Cheignon et al., 2018).

Research on meditation practice in older adults is sparse (see Chételat et al., 2018; Goldberg et al., 2022). Although preliminary evidence indicates that meditation practice is a feasible and acceptable intervention for older adults and could decrease levels of anxiety, depression, stress, and feelings of loneliness in ageing populations (K. W. Chen et al., 2012; Innes & Selfe, 2014), the existing research is of preliminary nature and suffers from the common limitations of this field (e.g., small sample size, lack of active control groups; see

Davidson & Kaszniak, 2015; Van Dam et al., 2018). Of particular relevance to the present work is the striking lack of meditation-based interventions in older adults that utilised direct measures of psychological well-being. Thus far, mostly proxy measures of well-being such as mental health problems (e.g., anxiety, depression) and other maladaptive manifestations (e.g., worry, sleep disturbances, cognitive decline) have been used to reflect well-being and quality of life (K. W. Chen et al., 2012; Chételat et al., 2018; see A. Lutz et al., 2021). One potential reason for this is that most research on meditation practice in older adults has been embedded within a disease prevention framework and primarily focussed on the assessment of cognitive trajectories or the accumulation of dementia biomarkers. This strand of research commonly includes anxiety, depression, and trait-level psychological measures (e.g., neuroticism) because they have been associated with an increased dementia risk (Byers & Yaffe, 2011; Low et al., 2013; Marchant & Howard, 2015). Alongside these psychological risk factors for cognitive decline and dementia, potential protective factors (e.g., purpose in life) have also been investigated (Bartrés-Faz et al., 2018; Boyle et al., 2010; Kim et al., 2019). However, there is a lack of research in this domain that frames the cultivation of well-being as an end in itself and not as a means for decreasing morbidity or mortality. Importantly, as outlined above, in contemporary models of psychological well-being, human flourishing is not merely the absence of disease, problems, or stress (Dahl et al., 2020; World Health Organization, 1991). The present work aims to address the conceptual gaps of this nascent research field by framing psychological well-being as a primary outcome in itself.

Despite the paucity of empirical evidence regarding the impact of meditation training on well-being in older adults, important theoretical contributions have been made on this topic (Acevedo et al., 2016; Chételat et al., 2018; Fountain-Zaragoza & Prakash, 2017; Innes & Selfe, 2014; Kurth et al., 2017; Malinowski & Shalamanova, 2017). Here, I will highlight a model that was developed as part of the European Medit-Ageing Project (Lutz et al., 2021).

This model represents a refinement of earlier approaches to understanding the link between meditation and ageing because it integrates compassion and loving-kindness practices alongside mindfulness practices, which, until recently, have been the primary or sole focus of research in this field (see Klimecki et al., 2019). Using Lutz et al.'s (2021) model, the strands of research on psychological well-being and meditation practice introduced in the previous sections will be brought together. To briefly recap, the interventions that are evaluated in the empirical part of this thesis primarily comprise mindfulness and compassion and loving-kindness practices. The main outcome of these interventions are well-being measures based on Ryff's (1989) eudaimonic theory of well-being (i.e., autonomy, self-acceptance, environmental mastery, positive relations with others, personal growth, and purpose in life), the WHO's conception of psychological quality of life (i.e., positive feelings, negative feelings, body image and appearance, self-esteem, and the ability to think and concentrate; The Whoqol Group, 1998), and Dahl et al.'s (2020) meditation training-based framework of human flourishing (i.e., awareness, connection, insight).

In Lutz et al.'s (2021) model of meditation and ageing, mindfulness practices are hypothesised to cultivate psychological well-being by training attentional control, emotion regulation, and meta-cognitive capacities. Mindfulness practices are expected to weaken habitual maladaptive mental schemes and the automatic reactivity to pleasant and unpleasant experiences, enabling more emotionally balanced and equanimous states. Mindfulness training can also contribute to the dereification (a construct introduced above) of objects of awareness (Lutz et al., 2015). The vigilant, steady presence of mindfulness practices can facilitate the experiential insights that thoughts, feelings, and sensations are not inherently real. In this framework, mindfulness practices are thus predicted to facilitate a heightened awareness of unhealthy behaviours, an increased capacity to prevent stress reactions that

trigger unhelpful habitual patterns, and the ability to make decisions that are conducive to the pursuit of meaningful goals and positive interactions with others.

Compassion practices, in this model (Lutz et al., 2021), are hypothesised to cultivate psychological well-being by training perspective taking and cognitive reappraisal. Perspective taking describes the ability to actively consider the experience one would have in a given situation. Cognitive reappraisal captures the ability to alter one's mode of relating to a situation such that this change would impact one's perception of the situation and the available responses. These capacities facilitate motivational processes and positive schemes that form the basis of caring expressions, perceptions of kinship and shared humanity, and prosocial behaviour. Relatedly, compassion and loving-kindness practices, whether directed towards self or others, are expected to reduce social stress reactivity through an empathy-based resilience that includes a broader and less constricted view of self, other, and world.

In this framework (Lutz et al., 2021), mindfulness and compassion and loving-kindness practices thus have distinct and overlapping mechanisms by which they are predicted to exert their beneficial effects on psychological well-being. For instance, both sets of practices include the training of meta-awareness and attention control. An important distinction is made in relation to regulatory processes. Mindfulness practices are hypothesised to downregulate maladaptive mental patterns by increasing the malleability, flexibility, and availability of different views and interpretations. Compassion and loving-kindness practices, in contrast, primarily manifest their salutary impact via the upregulation of positive emotions, caring attitudes, and benevolent intentions for self and others. Based on this model, the combination of mindfulness and compassion practices within a single meditation-based intervention is hypothesised to optimise and synergise the effects of meditation training in older adults (Lutz et al., 2021). Understanding how to best sequence and combine the variety of meditation practices during particular periods along the

contemplative path is also an integral aspect of meditation training in many Buddhist traditions (Gethin et al., 1998).

Overview of research questions and empirical chapters

The overarching research question of this thesis is: "What are the effects of meditation training on psychological well-being in older adults?" This question is addressed through a series of studies, each contributing a unique perspective to our understanding. The main research question can be broken down into several sub-questions that highlight methodological, conceptual, and applied and clinical aspects, each addressed by separate chapters of this thesis:

1. Conceptual and methodological: "How can we adequately measure meditation-based dimensions of well-being in older adults?" This question is addressed in Chapter 2, where we use a novel conceptual framework for training human flourishing to develop composite scores that can capture the aspects of psychological well-being that may be particularly sensitive to the effects of meditation training.
2. Applied and clinical: "What are the effects of shorter-term (8-week) and longer-term (18-month) meditation training on psychological well-being in different populations of older adults (i.e., SCD and healthy)?" This question is addressed in both Chapter 3, where we aim to test the effects of an 8-week MBI on a range of well-being outcomes in older adults with SCD, and Chapter 4, where we aim to test the effects of an 18-month meditation training on the same set of well-being outcomes in healthy older adults. Both interventions also include the meditation-based well-being measures developed in Chapter 2.
3. Conceptual and methodological: "How can we adequately measure compassion for others, a key outcome of meditation training?" This question is explored in Chapter 5,

where we present the development and validation of the 7-item Compassion for Others Scale in both English and German.

Each of these chapters contributes to our understanding of the main research question, providing a comprehensive picture of the role of meditation training in promoting psychological well-being in older adults. This structure allows us to explore the topic from multiple angles, ensuring a thorough examination of the potential benefits of meditation for this population. In the following paragraphs, more details about the empirical chapters are provided. Each empirical chapter consists of the 'author accepted manuscript' version (i.e., the version that has been accepted by the publisher after peer review).

Meditation-based well-being dimensions (Chapter 2)

Chapter 2 presents the results from a theory-driven psychometric validation study of three meditation-based composite scores of well-being dimensions (i.e., awareness, connection, and insight). Cross-sectional data was used to compute well-being composite scores in meditation-naïve older adults with subjective cognitive decline (n = 147), meditation-naïve healthy older adults (n = 135), and healthy long-term meditators (≥10,000 hours of practice including one three-year meditation retreat; n=29). This preliminary cross-sectional work provided a primary well-being outcome for the subsequent longitudinal analyses presented in Chapter 3 and 4.

This chapter reflects the following publication: Schlosser, M., Barnhofer, T., Requier, F., Deza-Araujo, Y. I., Abdoun, O., Marchant, N. L., ... & Lutz, A. (2022). Measuring psychological mechanisms in meditation practice: Using a phenomenologically grounded classification system to develop theory-based composite scores. *Mindfulness*, 13(3), 600-614. https://doi.org/10.1007/s12671-021-01816-0.

Effects of meditation in older adults with SCD (Chapter 3)

Chapter 3 presents the findings from an international, multi-centre randomised controlled trial comparing the effects of an 8-week meditation-based intervention to a structurally matched health self-management programme on psychological well-being dimensions in older adults with SCD. This trial randomised a total of 147 older adults with SCD. The meditation-based intervention included mindfulness and compassion and loving-kindness practices. Psychological well-being was measured at three time points (pre-intervention, post-intervention, 6-month follow-up) using Carol Ryff's Psychological Well-being Scale (PWBS), the World Health Organisation's Psychological Quality of Life Assessment, and previously published composite scores capturing Dahl et al.'s (2020) meditation-based well-being dimensions.

This chapter reflects the following published preprint: Schlosser, M., Demnitz-King, H., Barnhofer, T., Collette, F., Gonneaud, J., Chételat, G., Jessen, F., Kliegel, M., Klimecki, O. M., Lutz, A., & Marchant, N. L. (2022). Effects of a mindfulness-based intervention and a health self-management programme on psychological well-being in older adults with subjective cognitive decline: Secondary analyses from the SCD-Well randomised clinical trial. *MedRxiv*. https://doi.org/10.1101/2022.09.08.22279715

Effects of meditation in healthy older adults (Chapter 4)

Chapter 4 presents results from a large-scale, monocentric randomised controlled trial comparing the effects of an 18-month meditation training to a structurally matched English language training and a passive no-intervention control condition on psychological well-being dimensions in healthy older adults. This trial randomised a total of 137 participants. The meditation training comprised two 9-month modules. The first module introduced participants to mindfulness practices and the subsequent one to compassion and loving-kindness practices. Psychological well-being was captured at three time points (pre-

intervention, mid-intervention, post-intervention) using the same measures that were utilised in Chapter 3.

This chapter reflects the following publication: Schlosser, M., et al. (2022). An 18-month meditation training selectively improves psychological well-being in older adults: A Secondary Analysis of a Randomised Controlled Trial. *PloS One*. https://doi.org/10.1371/journal.pone.0294753

Development of the 7-item Compassion for Others Scale (Chapter 5)

Chapter 5 introduces a psychometric validation study that we conducted in response to several articles (Gu et al., 2017; Strauss et al., 2016) that questioned the conceptual and psychometric quality of a compassion scale (Compassionate Love Scale; CLS) that formed part of the meditation-based well-being composite scores used in the randomised controlled trials of Chapter 3 and 4. This validation study empirically assessed the psychometric properties of the CLS and validated a new short scale of compassion for others in both English and German.

This chapter reflects the following publication: Schlosser, M., Pfaff, N. G., Schweinberger, S. R., Marchant, N. L., & Klimecki, O. M. (2021). The psychometric properties of the Compassionate Love Scale and the validation of the English and German 7-item Compassion for Others Scale (COS-7). *Current Psychology*. https://doi.org/10.1007/s12144-020-01344-5

Addressing open questions in meditation research

Despite the growing interest in meditation research, several critical gaps remain. Notably, there is a scarcity of studies focusing on meditation training among ageing populations, encompassing both healthy older adults and those with pre-existing conditions (Goldberg et al., 2022). Most existing trials have primarily focused on short-term meditation training, often lacking active comparison groups, and have not incorporated theory-based

models of meditation practice that draw from multidisciplinary perspectives (Goyal et al., 2014). Additionally, the evaluation of a broad range of psychological well-being dimensions has been largely overlooked in previous meditation trials involving older adults. These gaps in the literature highlight the need for comprehensive, methodologically rigorous studies that can provide more refined answers. This thesis aims to address these open points and contribute to the ongoing discourse in this field. The subsequent chapters will delve into each of these areas, providing empirical evidence and theoretical discussions to advance our understanding of the impact of meditation on the psychological well-being of older adults.

2. Measuring meditation-based dimensions of well-being

Abstract

Objectives: Deepening our understanding of the mechanisms by which meditation practices impact well-being and human flourishing is essential for advancing the science of meditation. A recent phenomenologically grounded classification system distinguishes attentional, constructive, and deconstructive forms of meditation based on the psychological mechanisms these practices primarily target or necessitate. Our main aim was to understand whether this theory-based taxonomy could be used as a guiding principle for combining established psychological self-report measures of meditation-related mechanisms into psychometrically adequate composite scores.

Methods: We used cross-sectional data to compute meditation composite scores in three independent samples, namely meditation-naïve healthy older adults from the Age-Well trial (n = 135), meditation-naïve older adults with subjective cognitive decline from the SCD-Well trial (n = 147), and healthy long-term meditators (≥10,000 hours of practice including one three-year meditation retreat) from the Brain & Mindfulness project (n=29). The psychometric properties of the composite scores were assessed via floor and ceiling effects, composite intercorrelations, interpretability, and convergent validity in relation to well-being, anxiety, and depression.

Results: Three theoretically derived meditation composite scores, reflecting mechanisms involved in attentional, constructive, and deconstructive practices, displayed adequate psychometric properties. Separate secondary confirmatory factor analyses empirically corroborated the theoretically predicted three-factor structure of this classification system.

Conclusions: Complementing data-driven approaches, this study offers preliminary support for using a theoretical model of meditation-related mechanisms to create empirically meaningful and psychometrically sound composite scores. We conclude by suggesting conceptual and methodological considerations for future research in this area.

Keywords: expert meditators; meta-awareness; mindfulness; compassion; well-being; mental health

Introduction

Meditation is a multidimensional construct whose conceptual and phenomenological fields are deep and wide (Burbea, 2014; Dahl et al., 2020; Lutz et al., 2007). Its depth encompasses spectra of increasing meditative skill, subtlety, and refinement. Its width describes a vast range of distinct practices and mechanisms. As the science of meditation is moving beyond its mindfulness-centric focus (Van Dam et al., 2018), classification systems for meditation practices become increasingly important as they can help differentiate practice-specific psychological mechanisms (Trautwein et al., 2020). This differentiation can have pertinent implications for the development, optimisation, and efficacy of tailored meditation training and its effects on well-being and human flourishing.

Several ways of classifying traditional and contemporary meditation practices and their purported mechanisms have been proposed. Methodologically, it can be beneficial to tentatively distinguish theory-based, top-down approaches to categorising meditation practices and mechanisms (e.g., Hölzel et al., 2011; Lutz et al., 2008; Lutz et al., 2015; Vago & David, 2012) from primarily data-driven, bottom-up approaches (e.g., Farb et al., 2018; Matko & Sedlmeier, 2019). Both approaches aim to effectively measure the underlying constructs of interest and employ data reduction techniques that can range from theory-guided classification by experts to data-driven exploratory factor analysis.

Here, we used a theory-based approach because (i) it is less reliant on specific measures and factor analysis and thus less psychometrically volatile, (ii) it can flexibly respond to the introduction of new measures by assessing their conceptual fit to the model, (iii) it can be used as a guiding principle to parsimoniously compare studies that administer similar, yet distinct measures of the same latent constructs (e.g., compassion) in different populations (e.g., clinical, non-clinical), and because (iv) there is a paucity of attempts to empirically evaluate theoretical models of meditation practice.

We utilised the theoretical model introduced by Dahl, Lutz, and Davidson (2015), which is grounded in phenomenology and informed by a synthesis of the relevant literature in clinical psychology, cognitive neuroscience, and contemplative studies. This model categorises the complex web of meditation practices into attentional, constructive, and deconstructive families based on the psychological mechanisms that are necessitated, trained, and primarily targeted by different forms of meditation. Attentional, constructive, and deconstructive families can be conceptualised as theory-based psychological mechanisms by which the practice of meditation is purported to exert its impact on well-being (Dahl et al., 2020). Other theory-based approaches have proposed twofold taxonomies of meditation practices. For example, the model introduced by Lutz et al. (2008) distinguishes between focused attention and open monitoring practices. In many contemplative traditions, prevailing models often contrast concentration and calming practices (e.g., samadhi, samatha) to insight practices (e.g., vipassana; see Lutz et al., 2007). A particular advantage of Dahl et al.'s (2015) model is its ability to include and transcend many twofold classification systems by capturing concentration, mindfulness, and insight practices while also including constructive forms of meditation (e.g., loving-kindness, compassion).

In Dahl et al.'s (2015) framework, the attentional family comprises practices that cultivate the capacity to initiate, direct, and sustain meta-awareness, which is the primary psychological mechanism of this type of meditation. Meta-awareness can be defined as a form of attention regulation that allows a heightened awareness of thinking, feeling, and perceiving (Dahl et al., 2020; Schooler et al., 2011). It involves monitoring the contents of experience without becoming unintentionally absorbed by them. The attentional family includes forms of concentration and mindfulness-based practices.

The constructive meditation family comprises practices that train skilful psychological habits aimed at nurturing prosocial qualities, healthy interpersonal dynamics, a

commitment to embodying ethical values, and weakening maladaptive self-schemata. Perspective taking and cognitive reappraisal have been proposed as the primary psychological mechanisms of this type of meditation. Perspective taking is the capacity to consider the thoughts, feelings, and perceptions one would have in a specific situation or context. Cognitive reappraisal is the capacity to change one's way of relating to contexts and situations in such a way that it affects one's perception of and response to them. The constructive family includes forms of loving-kindness and compassion practices.

The deconstructive meditation family comprises practices that primarily intend to understand and weaken unhelpful modes of thinking, feeling, and conceiving that are causing psychological and existential stress. Self-inquiry, the primary psychological mechanism of this type of meditation, is the capacity to actively investigate the complex dynamics of experience in order to transform patterns of cognitive and perceptual reification. Reification can be defined as a way of perceiving that is imbued with the implicit belief in the inherent and independent existence of perceptions (e.g., sensations, thoughts, the sense of self) and of consciousness itself (Lutz et al., 2015). In this context, cultivating insight through self-inquiry can be conceptualised as strengthening, to whatever degree, the understanding that the unskilful reification of phenomena causes suffering and prevents well-being and human flourishing. The deconstructive family includes forms of insight practices and meditations on emptiness and dependent origination.

Importantly, Dahl et al. (2015) acknowledge that a psychological capacity primarily cultivated by one family can also be trained by, or necessary for, practices in other families, albeit in a more indirect manner. For instance, as detailed above, the delineation between attentional and deconstructive capacities is based primarily on a distinction between meta-awareness and dereification. Meta-awareness and dereification, despite being regularly conflated in the literature, can be conceptualised as locally orthogonal constructs (see Lutz et

al., 2015). That is, a meditator could be aware of having anxious thoughts without being able to weaken the reification of these thoughts. However, some degree of meta-awareness is required for the process of dereification. Empirically, we would thus predict the attentional, constructive, and deconstructive families to be highly correlated in individuals who have undergone long-term meditation training, but not so highly as to indicate a simpler underlying structure (e.g., a unidimensional general meditation capacity). In contrast, in individuals without prior meditation training, we would not expect the composite scores of conceptually distinct meditation-related families to be highly correlated because the measures comprising each meditation composite were developed to capture specific constructs in a discriminant manner.

Preliminary empirical evidence offers tentative support for the predictive value of this threefold classification system for meditation research. For instance, a recent longitudinal magnetic resonance imaging study (Valk et al., 2017) assessed the effects of three mental training modules: attentional skills including mindfulness-based practices, socio-affective skills including loving-kindness and prosocial motivation, and socio-cognitive skills including perspective-taking and metacognition. These training modules share some of the phenomenological features and mechanisms that characterises Dahl et al.'s (2015) typology. Attention training, socio-affective training, and sociocognitive training induced changes in cortical morphology in prefrontal regions, frontoinsular regions, and inferior frontal and lateral temporal cortices, respectively (Valk et al., 2017).

Our aim was to offer a methodological blueprint for creating theoretically meaningful meditation composite scores using established self-report measures commonly employed in meditation research. To that end, we tested whether the classification system introduced by Dahl et al. (2015) could be used as a guiding principle for combining psychological self-report measures into attentional, constructive, and deconstructive composite scores with

satisfactory psychometric properties. We tested whether these composite scores would show adequate intercorrelations, no floor and ceiling effects, adequate interpretability, and convergent validity (in relation to well-being, anxiety, and depression). In line with previous research indicating sex differences in levels of compassion (Pommier et al., 2020; Schlosser et al., 2021), empathy (Eisenberg & Lennon, 1983), and prosocial behaviour (Caprara et al., 2005) in healthy samples, female participants were expected to display higher constructive composite scores. We hypothesised that these sex differences in constructive composite scores would be attenuated by intensive meditation practice and thus be less pronounced in the sample of long-term meditators. We did not predict sex differences in attentional and deconstructive scores. Further, age and education were not expected to be associated with meditation composite scores. We investigated these properties in three independent samples that comprised meditation-naïve healthy older adults, meditation-naïve older adults with subjective cognitive decline, and healthy long-term meditators (≥10,000 hours of practice including one three-year meditation retreat). When identical self-report measures were administered across studies, we expected that long-term meditators would report higher raw scores than meditation-naïve participants on the scales comprising the meditation composites. As a secondary statistical verification, we used confirmatory factor analysis to compare the theoretically predicted latent variable structure (i.e., an intercorrelated three-factor model) to a structure reflecting a general meditation capacity (i.e., a one-factor model).

Methods

Participants

We utilised cross-sectional data from three different studies, namely the Age-Well randomised controlled trial (Poisnel et al., 2018) and the SCD-Well randomised controlled trial (Marchant et al., 2021) of the European Union's Horizon 2020-funded Medit-Ageing

project (public name: Silver Santé Study), and the European Research Council-funded Brain & Mindfulness project (Abdoun et al., 2018).

The Age-Well randomised controlled trial (Poisnel et al., 2018) compares an 18-month meditation training aimed at promoting mental health and well-being in the ageing population to a structurally matched English language training and a passive control condition. A total of 157 community-dwelling older adults were assessed and 137 participants were subsequently randomised in the Age-Well trial. Two participants were excluded from the Age-Well trial after randomisation: one participant presented with amyotrophic lateral sclerosis and one participant experienced a head trauma with loss of consciousness for more than one hour. The present study thus included baseline data from 135 cognitively unimpaired, older adults (≥ 65 years) who had no major neurological or psychiatric disorder, no present or past regular or intensive practice of meditation, were native French speakers, were retired for at least one year, and had completed at least seven years of formal education.

The SCD-Well randomised controlled trial (Marchant et al., 2021) compares the effects of a mindfulness-based intervention versus a health self-management programme on mental health in participants with subjective cognitive decline (SCD), which is associated with a heightened risk of developing dementia. The present study included baseline data from 147 older adults (aged ≥60 years) with no major neurological or psychiatric disorder, and no present or past regular or intensive practice of meditation, recruited from memory clinics at four European sites, and meeting the research criteria for SCD proposed by the SCD-I working group (Jessen et al., 2014).

The Brain & Mindfulness project (Abdoun et al., 2018) is a cross-sectional study that investigates the relationship between meditation expertise and affective, cognitive, and phenomenological processes. The present study included data from 29 long-term meditators

(aged between 35 and 65 years) with no neurological or psychiatric disorder, no psychotropic drug use, a minimum of 10,000 hours of formal meditation practice in the Kagyu or Nyingma school of Tibetan Buddhism (including one traditional three-year meditation retreat), and a daily practice during the 12 months preceding inclusion.

Procedure

Details of the recruitment procedure, settings, and design of the three studies and a comprehensive list of the measures and domains sampled can be found in the trial protocols and manual (Age-Well: Poisnel et al., 2018; SCD-Well: Marchant et al., 2018; Brain & Mindfulness: Abdoun et al., 2018).

Measures

The present study drew from the self-report measures employed in the Age-Well trial, the SCD-Well trial, and the Brain & Mindfulness project (Table 1). The following scales were considered for inclusion in the meditation composites: the *Compassionate Love Scale* (CLS; stranger-humanity version; Sprecher & Fehr, 2005), the *Compassion for Others Scale* (COS-7; Schlosser et al., 2021), the *Compassion Scale* (Pommier, 2010), the *Drexel Defusion Scale* (DDS; Forman et al., 2012), the *39-item Five Facet Mindfulness Questionnaire* (FFMQ-39; Baer et al., 2006), the *15-item Five Facet Mindfulness Questionnaire* (FFMQ-15; Baer et al., 2008), the *Interpersonal Reactivity Index* (IRI; Davis, 1983), the *Multidimensional Assessment of Interoceptive Awareness* questionnaire (MAIA; Mehling et al., 2012), the *Prosocialness Scale* (Caprara et al., 2005), and the reappraisal subscale of the *Emotion Regulation Questionnaire* (ERQ; Gross & John, 2003). Detailed descriptions of the scales are included in the supplementary material.

To assess the convergent validity of the meditation composite scores, we used established self-report measures of anxiety, depression, and well-being, namely the trait scale of the State-Trait Anxiety Inventory (Spielberger et al., 1983), the Geriatric Depression Scale

(Sheikh & Yesavage, 1986), the Beck Depression Inventory (Beck et al., 1961), and the 42-item Psychological Well-being Scale (PWBS-42; Ryff et al., 1995) and 18-item Psychological Well-being Scale (PWBS-18; Ryff, 1989).

Meditation composite scores were developed based on the psychological capacities that Dahl et al. (2015) described as the primary mechanisms of attentional, constructive, and deconstructive types of meditation. Using this threefold taxonomy of meditation practices, five researchers (MS, AL, TB, OK, YIDA) assessed which psychological self-report measures could potentially capture the relevant psychological capacities. Given the absence of self-report measures of meta-awareness and dereification whose development and validation have been informed by contemplative perspectives, we aimed to select meaningful proxy measures of attentional and deconstructive capacities. Next, four researchers (MS, AL, TB, OK) independently evaluated the items from each of the selected scales and assigned them to the attentional, constructive, or deconstructive practice family. Any disagreements were resolved via group discussions. Scales and subscales were retained if most of their items were judged to clearly measure one of the meditation types' mechanisms. In other words, we did not remove individual items from the scales and subscales that we assigned to the meditation composites. We reasoned that the benefits of this approach outweigh the level of noise introduced by the few items that we judged to not clearly reflect one of the psychological capacities of interest. Furthermore, deriving the composite scores from a combination of scale and subscale scores rather than individual item scores maintains each measures' psychometric integrity, eases the conceptual comparison between studies using similar yet slightly distinct measures of the same construct (e.g., different mindfulness measures), and allows more parsimonious and replicable factor analytic modelling (i.e., factor structures with fewer indicators).

Before computing the meditation composite scores, we reverse-scored scale scores if lower total scores reflected better functioning so that higher composite scores would indicate higher meditation-related psychological capacities. Scale scores were then standardised using their baseline mean and standard deviation. Each meditation composite score was computed by averaging the standardised scores of the scales that were assigned to the respective composite, yielding composite scores with a baseline mean of 0 and a standard deviation smaller than one. Lastly, we re-standardised each composite score so that estimates from regression analyses can be directly interpreted in standard deviation units. Participants with missing scale scores were not included in the composite score to which this scale was assigned. No participant data were excluded based on very high or low scale scores.

Data Analyses

Distribution and floor/ceiling effects of the meditation composite scores were assessed using skewness and kurtosis estimates and visual inspection of the histograms. In an initial step, interpretability was assessed by comparing meditation composite scores based on age, sex, and education. A mixed effects regression model was fit that included the re-standardised composite scores as the outcome and age, sex, education, type of composite, and three interaction terms (i.e., sex/age/education by type of composite) as the predictors. Convergent validity was assessed using Pearson's correlation coefficients. We expected higher meditation composite scores to be correlated with greater well-being and lower levels of anxiety and depression. Based on the theoretical model, we expected the attentional, constructive, and deconstructive composite scores to be correlated – but not so highly (>0.8) as to suggest conceptual redundancy (i.e., lack of differentiation between meditation-related mechanisms) – and that these intercorrelations would be higher in the sample of long-term meditators. To test this hypothesis, we used the R package *cocor* (Diedenhofen & Musch, 2015) to compare two correlations based on two independent samples with different sample

sizes. For the equality tests, we used the Benjamini-Hochberg procedure (Benjamini & Hochberg, 1995) to control the false discovery rate in multiple testing.

We utilised confirmatory factor analysis with maximum likelihood estimation as a secondary statistical verification to the primary theory-driven scale evaluation. In other words, the confirmatory factor analysis did not influence the development and computation of the meditation composite scores. We compared a one-factor model to a three-factor model in which factors were allowed to covary. The one-factor solution modelled a general meditation capacity as a single latent variable and scale scores as indicators. The three-factor solution modelled the psychological mechanisms characterising the attentional, constructive, and deconstructive meditation types as latent variables and their respective scale scores as indicators. Two comparative measures of model fit were used to compare the one- and three-factor solutions, namely the Akaike's Information Criterion (AIC; Akaike, 1973) and Bayesian Information Criterion (BIC; Schwarz, 1978). Lower AIC and BIC values indicate a better fit. In addition, three global measures of model fit were reported (Kenny, 2015): the Comparative Fit Index (CFI), the Tucker Lewis Index (TLI), and the Standardised Root Mean Square Residual (SRMR). Because confirmatory factor analysis was only used as a secondary verification of our theory-based approach, we assessed global measures of fit using liberal criteria: values above 0.80 for the CFI, above 0.90 for TLI, and below 0.10 for the SRMR were deemed as indicating an acceptable fit (Bentler & Bonett, 1980; Browne & Cudeck, 1993; Hu & Bentler, 1999). In line with recommendations for not computing the root mean square error of approximation (RMSEA) for models with small degrees of freedom and small sample size (Kenny et al., 2015), we decided to not use the RMSEA to assess model fit. Analyses were conducted in Stata/MP version 16.0 and R version 4.0.2. Data used in the Medit-Ageing project and the Brain & Mindfulness project are available upon request.

Results

Scale and Item Assessment

Among the measures administered to participants of the Age-Well trial, the SCD-Well trial, and the Brain & Mindfulness project, seven scales were judged to primarily capture attentional aspects: noticing (MAIA subscale), attention regulation (MAIA), emotional awareness (MAIA), self-regulation (MAIA), body listening (MAIA), observing (FFMQ), and acting with awareness (FFMQ). Five scales were judged to primarily capture constructive aspects: the CLS, empathic concern (IRI subscale), perspective taking (IRI), the Prosocialness Scale, and the Compassion Scale. Another four scales were judged to primarily capture deconstructive aspects: the DDS, non-judging (FFMQ), non-reactivity (FFMQ), and personal distress (IRI). Although the definition of defusion (Forman et al., 2012; Hayes et al., 1999) comprises aspects of both dereification and meta-awareness, defusion, as measured by the DDS, was judged to primarily capture deconstructive capacities and to a lesser extent attentional capacities. Table 1 reports the mean (SD) of all scale scores.

The 6-item reappraisal subscale (ERQ; Gross & John, 2003) was not included in the constructive composite because its items reflect conceptualisations of cognitive reappraisal that differ in important ways from those commonly employed in meditation and mindfulness research. For example, items such as "When I want to feel less *negative* emotion, I *change the way I'm thinking* about the situation" [original italics] seem to suggest a more forced change in evaluating than the gentle process of interrogating meaning that is typical of meditative approaches and may be difficult to unambiguously differentiate from cognitive forms of avoidance. However, given that this is a debated issue in the mental health literature, we also conducted a sensitivity analysis that included the reappraisal subscale in the three-factor model to see whether our theory-based omission of this scale would be empirically corroborated. The reappraisal scale was included in the Age-Well trial to answer research

questions not addressed in the present study. Table 1 presents the scales that comprised the meditation composite scores in the three independent samples.

Meditation-naïve Healthy Older Adults

Floor and ceiling effects. The distributions of the three meditation composite scores did not markedly diverge from normality as indicated by estimates of skewness (attentional: -0.59; constructive: -0.42; deconstructive: 0.14) and kurtosis (attentional: 3.36; constructive: 3.46; deconstructive: 2.81) and visual inspection of the histograms. The meditation composite scores captured a wide range of values and did not display floor or ceiling effects.

Interpretability. As expected, female participants displayed higher constructive scores than male participants (estimated mean difference = 0.45, 95% CI: 0.10 to 0.80, p = 0.011), whereas attentional and deconstructive scores did not display sex differences. The three meditation composite scores were not linked to age or education.

Composite intercorrelations and convergent validity. Attentional scores were correlated with deconstructive scores (Pearson's correlation coefficient r = 0.20, 95% CI: 0.03 to 0.36, p = 0.019), but not with constructive scores (r = 0.17, 95% CI: -0.001 to 0.33, p = 0.051). Constructive and deconstructive scores were uncorrelated (r = -0.02, 95% CI: -0.19 to 0.15, p = 0.789). Correlations of the composite scores with levels of anxiety, depression, and well-being are displayed in Table 2.

Sensitivity analyses that used the COS-7 instead of the CLS to compute the constructive composites scores replicated this pattern of results. The COS-7 and CLS were highly correlated (r = 0.96, 95% CI: 0.94 to 0.97, p < 0.001).

Meditation-naïve Older Adults with SCD

No constructive scores were computed because SCD-Well included only one of the scales assigned to the constructive composite (Table 1).

Floor and ceiling effects. The distributions of the attentional and deconstructive scores did not markedly diverge from normality as indicated by estimates of skewness (attentional: -0.16; deconstructive: -0.56) and kurtosis (attentional: 3.46; deconstructive: 3.2) and visual inspection of the histograms. Both composite scores captured a wide range of values and did not display floor or ceiling effects.

Interpretability. As expected, the two meditation composite scores computed in SCD-Well (i.e., attentional and deconstructive scores) did not display sex differences. More years of education were associated with higher deconstructive scores (estimate = 0.05, 95% CI: 0.01 to 0.10, p = 0.020). Attentional scores were not associated with education. None of the two composite scores was linked to age.

Composite intercorrelations and convergent validity. Attentional scores were moderately correlated with deconstructive scores (r = 0.22, 95% CI: 0.05 to 0.38, p = 0.010). Table 2 displays the correlations of the composite scores with levels of anxiety, depression, and well-being.

Healthy Long-term Meditators

Floor and ceiling effects. The distributions of the meditation composite scores did not markedly diverge from normality as indicated by estimates of skewness (attentional: 0.16; constructive: 0.28; deconstructive: -0.27) and kurtosis (attentional: 2.96; constructive: 2.34; deconstructive: 1.84). However, visual inspection of the histograms indicated that the distribution of the deconstructive scores included more scores at the lower and higher ends of the distribution than in the centre.

Interpretability. The three meditation composite scores were not related to age, sex, or education. Although not statistically significant, the sex difference in constructive scores (estimated mean difference = 0.50, 95% CI: -0.19 to 1.18, p = 0.156) was similar in direction and magnitude to the one found in meditation-naïve healthy older adults.

Composite intercorrelations and convergent validity. Attentional scores were moderately correlated with constructive scores (r = 0.48, 95% CI: 0.13 to 0.72, p = 0.009) and highly correlated with deconstructive scores (r = 0.62, 95% CI: 0.32 to 0.81, p < 0.001). Constructive and deconstructive scores were moderately correlated (r = 0.43, 95% CI: 0.07 to 0.69, p = 0.023). Correlations of the composite scores with levels of anxiety, depression, and well-being are displayed in Table 2.

Equality tests of correlation coefficients. Long-term meditators displayed higher correlations between attentional scores and deconstructive scores (r = 0.62) than meditation-naïve healthy older adults (r = 0.20; difference = 0.42, p = 0.008) and meditation-naïve older adults with SCD (r = 0.22; difference = 0.40, p = 0.011). Long-term meditators also displayed higher correlations between constructive scores and deconstructive scores (r = 0.43) than meditation-naïve healthy older adults (r = -0.02; difference = 0.45, p = 0.014). However, long-term meditators did not display higher correlations between attentional scores and constructive scores (r = 0.48) than meditation-naïve healthy older adults (r = 0.17; difference = 0.31, p = 0.051). This pattern of results remained unchanged after applying the Benjamini-Hochberg to control for multiple testing. These findings largely confirmed our prediction that meditation scores are more interrelated in long-term meditators than in meditation-naïve older adults.

Secondary Confirmatory Factor Analysis

We used Age-Well data to compare a one-factor solution to a three-factor solution. We did not use SCD-Well data because this trial included only one of the scales we had assigned to the constructive composite, which did not allow us to meaningfully model the theory-based three-part division. We did not use Brain & Mindfulness data to avoid introducing replicability issues related to the small sample size (n =29).

The comparative measures of fit suggested that the three-factor solution (AIC = 9125, BIC = 9264) displayed a better model fit than the one-factor solution (AIC = 9298, BIC = 9428). Based on global measures of model fit, the three-factor solution displayed a slightly less than acceptable fit (CFI = 0.84, TLI = 0.80, SRMR = 0.107). Standardised factor loadings ranged from 0.27 to 0.84 (all associated with $p < 0.005$, mean = 0.68) for the attentional factor, from 0.32 to 0.79 (all associated with $p < 0.001$, mean = 0.64) for the constructive factor, and from 0.35 to 0.75 (all associated with $p < 0.001$, mean = 0.58) for the deconstructive factor. Intercorrelations among the composite factors were consistent with those among the observed composite scores. Standardised factor loadings and correlations are displayed in Table 3. Based on global measures of model fit, the one-factor solution displayed a poor model fit (CFI = 0.61, TLI = 0.54, SRMR = 0.145). Standardised factor loadings ranged from -0.04 to 0.85 (mean = 0.40; Table 3).

A sensitivity analysis indicated that additionally including the reappraisal subscale of the ERQ in the three-factor solution resulted in a decline in model fit (CFI = 0.80, TLI = 0.76, SRMR = 0.122). Reappraisal loaded only weakly onto the constructive factor (0.20, associated with $p = 0.045$), offering empirical support for our theory-based omission of this subscale.

Discussion

The present study aimed to empirically test if a selection of commonly used psychological self-report measures can be meaningfully categorised in line with an established theoretical model of meditation-related mechanisms (Dahl et al., 2015). Our findings offer preliminary empirical support for the theory-based delineation of attentional, constructive, and deconstructive capacities in meditation practice. Using this threefold taxonomy to group psychological self-report measures, we were able to derive three meditation composite scores with adequate psychometric properties.

In line with previous research that found sex differences in compassion for others, empathy, and prosocial behaviour (Caprara et al., 2005; Eisenberg & Lennon, 1983; Pommier et al., 2020; Schlosser et al., 2021), meditation-naïve healthy older women displayed higher constructive composite scores than meditation-naïve healthy older men. However, our findings did not support the hypothesis that sex differences in constructive capacities would be attenuated by intensive meditation practice and, therefore, less pronounced in the smaller sample of long-term meditators (i.e., >10,000 hours of practice). The sex differences in constructive capacities, although not statistically significant, were similar in direction and magnitude to those found in meditation-naïve healthy older adults. The absence of the predicted attenuation in sex differences could imply that older women and men show similar meditation-related increases in constructive capacities, even though women already display higher constructive capacities prior to meditation training. Future longitudinal work is needed to investigate contextual factors (e.g., intentions, practice intensity, teacher-student relations) that potentially moderate meditation training responses related to sex. Further, neither age nor levels of education were related to meditation-related capacities, except for the link between greater deconstructive capacities and higher levels of education in meditation-naïve older adults with SCD.

Another theory-based assumption was that psychological mechanisms primarily trained by one family of practices would also be indirectly cultivated by or necessary for practices in other families. Thus, we predicted that a relationship between meditation composites would be present in meditation-naïve healthy older adults and long-term meditators, but that this link would be accentuated in long-term meditators because of the extensive time they had spent cultivating attentional, constructive, and deconstructive capacities, either directly (e.g., training perspective taking through loving-kindness practices) or indirectly (e.g., training meta-awareness through compassion practices). Our findings

largely confirmed this prediction. The relationship between attentional and deconstructive capacities as well as between constructive and deconstructive capacities was stronger in long-term meditators, whereas the association between attentional and constructive capacities did not significantly differ between the samples ($p = 0.051$), possibly due to unequal or insufficient sample sizes. In meditation-naïve healthy older adults, attentional capacities were associated with deconstructive capacities. One possible explanation is that mobilising deconstructive capacities requires at least a minimal level of attentional capacities (i.e., meta-awareness), thus leading to a shared variance between these dimensions, despite being statistically differentiable. An alternative interpretation is that the self-report measures used here are not specific enough to psychometrically map this typology. Further methodological and conceptual developments will be necessary to improve the measurement of theory-based meditation-related capacities. Of note, the present study constituted a principally pragmatic attempt to define meditation composite scores in the context of two large randomised controlled trials of meditation training (Marchant et al., 2021; Poisnel et al., 2018). Our findings suggest that theory-based psychological mechanisms of meditation practice can indeed be empirically differentiated and that this differentiation is less distinct in long-term meditators. Longitudinal studies are now needed to evaluate alterations in meditation-related capacities and their coupling over time.

Among meditation-naïve older adults, meditation composite scores were associated with greater well-being. This pattern was expected as the psychological capacities characterising each meditation family are hypothesised to be critical for nourishing well-being (Dahl et al., 2020). Diverging from our predictions, in long-term meditators, none of the meditation composites were linked to well-being. Perhaps even more surprisingly, the observed well-being scores of long-term meditators were similar to those of meditation-naïve older adults with SCD and lower than those of meditation-naïve older adults. As the well-

being measures used in the present study (Ryff, 1989; Ryff et al., 1995) were developed and validated in participants without intensive meditation experience, it is possible that this might be due to differential item functioning as dedicated long-term meditators may interpret well-being items, such as “I sometimes feel as if I’ve done all there is to do in life”, in other ways than meditation-naïve adults. In other words, qualities of well-being and human flourishing purported to be cultivated by dedicated long-term meditation practice (Dahl et al., 2020) might not be captured adequately by the well-being measures we employed. The development of new scales or the modification of existing scales that can measure wider and subtler ranges of human well-being might be required to meaningfully compare long-term meditators to individuals without intensive meditation experience.

In all samples, greater deconstructive capacities were strongly linked with lower levels of anxiety. The trait-STAI (Spielberger, 1983), which we used to measure anxiety here, has recently been proposed as a nonspecific measure of negative affectivity rather than a specific measure of trait anxiety (Knowles & Olatunji, 2020). Greater deconstructive capacities were also associated with lower levels of depression across samples. The relationship of attentional and constructive capacities with clinical outcomes was less consistent than expected. Greater attentional capacities were associated with lower levels of anxiety in both long-term meditators and meditation-naïve healthy older adults, but not in meditation-naïve older adults with SCD. Surprisingly, constructive capacities displayed no relationship with either anxiety or depression in both long-term meditators or meditation-naïve healthy older adults (in meditation-naïve older adults with SCD, constructive scores were not computed due to a lack of scales). The relationship between meditation-related capacities and depression should be interpreted in the context of limited variability in levels of depression in long-term meditators and meditation-naïve healthy older adults. In contrast, anxiety scores did not display a limited variability in any of our samples. Across samples,

deconstructive capacities emerged as the strongest and most consistent correlate of clinical outcomes. One potential explanation is that the skill to undermine the belief in the inherent and seemingly real existence of sensations, thoughts, and feelings plays a more central role than other meditation-related psychological capacities in reducing maladaptive cognitive and perceptual patterns characteristic of anxiety and depression. Conversely, it could be the case that older adults with lower levels of depression and anxiety are more interested, willing, or capable of actively investigating the contents of their experience. The cross-sectional nature of our data prevents us from drawing any causal conclusions. Future longitudinal research is required to elucidate to what extent attentional, constructive, and deconstructive capacities differentially affect mental health.

Separate secondary confirmatory factor analysis indicated that a three-factor model reflecting the threefold division into attentional, constructive, and deconstructive capacities fit the data more adequately than a one-factor model reflecting a general meditation capacity. The mean factor loading of the three-factor model was high and factor intercorrelations were consistent with the observed composite score intercorrelations.

In the present study, we judged the reappraisal scale to not clearly measure the form of cognitive reappraisal characteristic of constructive meditation practices. Specifically, we concluded that avoidant cognitive and affective patterns cannot be unambiguously differentiated from the item content of the reappraisal subscale of the ERQ. However, we wanted to acknowledge that differing conceptualisations of reappraisal continue to be debated in the literature and that our decision to exclude the reappraisal scale could be perceived as overly stringent. We therefore conducted a sensitivity confirmatory factor analysis of the three-factor solution that also included the reappraisal scale in the constructive composite. This analysis provided empirical evidence that corroborated our theoretically informed omission of the reappraisal scale: reappraisal loaded only weakly onto the constructive factor

and its addition reduced the model fit. We recommend that researchers interested in meditation-related mechanisms carefully assess whether the item-level content of their chosen reappraisal scale is sufficiently conceptually aligned with the theoretical meditation framework they intend to utilise. Overall, the literature might benefit from the introduction of a new measure of cognitive reappraisal whose development and validation are informed by cognitive, clinical, and contemplative perspectives.

Limitations and Future Research

Although promising, the findings of the present study need to be considered in the light of several important limitations. The Age-Well trial and SCD-Well trial included only older adults, the median age of long-term meditators in the Brain & Mindfulness project was >50 years, and across samples, participants' level of education was high. Future work is necessary to evaluate the psychometric properties of the meditation composite scores and the relationship between life span development and meditation-related capacities in larger and demographically more diverse samples. Importantly, a pool of gold standard instruments for measuring process-focussed mechanisms does not yet exist as the science of meditation has only just begun to clearly characterise and delineate the processes related to specific forms of meditation practice. Given this absence, the present study used self-report measures that were originally developed to measure trait-like individual differences. Using trait-based scales may be inadequate for substantially advancing our understanding of meditation-related mechanisms. It is also important to note that the development of the meditation composites required the independent evaluation of the scale items by four meditation researchers but that other meditation research teams assessing the same items might have produced composites with divergent compositions. Further, the unequal sample sizes of long-term meditators and meditation-naïve older adults might have affected the equality tests of composite intercorrelations and the assessment of sex differences in constructive composite scores. We

also acknowledge that no single classification system of meditation practices can be definitive and even widely used theoretical models will require further conceptual delineations as the field matures. We suggest that future research evaluates the utility of other theoretical models and self-report measures for measuring psychological mechanisms in meditation practice.

The science of meditation is evolving, including the theory and study of meditation-related mechanisms. Higher levels of conceptual and methodological differentiation to capture distinct mechanisms could contribute to a *precision science of meditation* (cf. precision medicine, Haendel et al., 2018) that predicts how, when, and under what circumstances particular forms of practice best serve a meditator's intentions and goals, taking into account their individual differences (e.g., personality traits, affective and cognitive style, worldviews, cultural context). In this section, we would like to suggest conceptual and methodological considerations that could be pertinent for future work in this area.

We recommend that the specific (dis)advantages of theory-based and data-driven approaches to measuring meditation-related mechanisms are assessed in light of three relevant challenges encountered in contemporary meditation research. First, a substantial number of psychological self-report measures have been published, but there is growing consensus that many scales used to capture meditation-related constructs, including established gold standard measures, are psychometrically and conceptually limited (e.g., Grossman, 2019; Strauss et al., 2016). Second, the field is witnessing the introduction of a quickly growing number of new self-report measures purported to more adequately capture already established constructs or to capture new constructs for meditation research (see Van Dam et al., 2018). Third, new and modified meditation-based programmes are increasingly complex, combining multiple practice modalities each targeting specific psychological

capacities (e.g., Cullen et al., 2021; Goldberg et al., 2020). Importantly, the evaluation of the efficacy of these programmes will be affected by methodological decisions regarding the measurement of meditation-related mechanisms (e.g., data-driven vs. theory-based approaches, established scales vs. new scales).

Data-driven approaches have the potential to reduce bias attributable to scale selection based on allegiance or researcher expectations. For instance, in a secondary analysis of a trial that compared the extent to which cognitive therapy versus mindfulness-based cognitive therapy prevented relapse/recurrence in major depressive disorder, an exploratory factor analysis of a large and varied pool of measures (i.e., 34 subscales from 17 questionnaires measuring regulatory strategies) was conducted to identify the most relevant intervention-related mechanisms (Farb et al., 2018). Three latent variables emerged: decentering, distress tolerance, and residual symptoms. These three latent variables were subsequently modelled as predictors for relapse/recurrence prevention. The authors suggest that this form of data-driven approach might elucidate patterns of change that would not emerge when administering fewer measures. However, a potential disadvantage is that data-driven approaches that include a substantial number of scales can introduce replicability issues related to model stability and factor structure, especially in the context of longitudinal studies (Kline, 2015), which seldom accrue sample sizes that would be considered sufficient for structural equation modelling.

Theory-based approaches are less reliant on specific measures, more responsive to the introduction of new measures, and allow researchers to compare studies within the context of a single theoretical framework even though distinct measures of the same construct (e.g., mindfulness) might have been administered. Theory-based approaches to scale assessment can also optimise the development of new scales for meditation research, by identifying scales that lack content validity when viewed from a particular theoretical model or that lack

psychometric quality when used alongside similar but more recently developed scales, or by informing the choice of measures used for establishing discriminant and convergent validity of new scales. Importantly, theoretical models can highlight psychological mechanisms that are purported to be of primary significance for deepening well-being (e.g., malleability of perception, subtlety of attention; Burbea, 2014), but for which no conceptually adequate and psychometrically robust measures have been developed and validated. However, the use of limited theories might result in excluding important psychological mechanisms or in combining mechanisms that might be phenomenologically distinct (e.g., meta-awareness and dereification, cf. Bernstein et al., 2015; Farb et al., 2018; Lutz et al., 2015).

Additionally, theory-based approaches can include and transcend already established meditation-related mechanisms. This can be illustrated by considering the constructs of dereification (e.g., Lutz et al., 2015), decentering (e.g., Bernstein et al., 2015), and defusion (e.g., Forman et al., 2012; Hayes et al., 2006) in the context of Dahl et al.'s (2015) deconstructive family. Conceptualisations of decentering and defusion – which, by themselves, are not embedded in a broader theoretical model of meditation – are commonly used in meditation and clinical research, such as the ability to psychologically distance oneself from objects of consciousness (e.g., sensations, thoughts, feelings) and not seeing them as accurate reflections of reality (Forman et al., 2012). Importantly though, the capacity to dis-identify from and weaken the reification of subtler objects of consciousness (e.g., the intention to pay attention) or consciousness itself (here, a sense of knowing) is neither theoretically nor psychometrically appreciated by existing measures of decentering or defusion. One advantage of the model we used in the present study (Dahl et al., 2015) is its ability to conceptually map the spectrum of increasing meditative skill, depth, and subtlety that can be cultivated through practice, even though relevant self-report measures to assess this level of meditative expertise do not yet exist.

Generally, we recommend placing more importance on the detailed assessment of mechanisms than of specific forms of practices and techniques. Two recent cross-sectional studies involving over 1,000 regular meditators (Schlosser et al., 2019, 2020) highlighted important challenges and limitations that arise when grouping participants based on generic types of meditation (e.g., loving-kindness, vipassana). Firstly, a large proportion of meditators engaged in both attentional, constructive, and deconstructive forms of meditation. The high heterogeneity in practice, a finding corroborated by other large-scale surveys of regular meditators (e.g., Vieten et al., 2018), complicates a methodologically unambiguous comparison of differential mechanisms. Secondly, if the relevant mechanisms are not explicitly measured, a given meditation practice is simply assumed to cultivate the practice-specific psychological capacities the model purports. This assumption, however, might not hold if we consider that the practice of loving-kindness, for instance, can be engaged in so as to function primarily as an attentional practice (e.g., loving-kindness meditation aimed at deepening mental collectedness), a constructive practice (e.g., loving-kindness meditation aimed at cultivating prosocial qualities), or a deconstructive practice (e.g., loving-kindness meditation aimed at investigating its effects on perception; Burbea, 2014). An advantage of the present study was its focus on psychological mechanisms targeted by specific forms of practice, not on practices themselves. In settings that do not allow for the detailed assessment of meditation-related mechanisms, more detailed descriptions provided by participants about their practice(s) could, to a certain extent, improve the validity of practice classification based on psychological mechanisms.

Declarations

Funding

The Age-Well and SCD-Well Randomised Controlled Trials are part of the Medit-Ageing project funded through the European Union's Horizon 2020 programme related to the

call PHC22 “Promoting mental well-being in the ageing population” and under grant agreement Nº667696. The part of the Brain & Mindfulness project from which data was used in the present study was funded by a European Research Council Consolidator Grant awarded to Antoine Lutz under grant agreement Nº617739. FC was supported by Fonds National de la Recherche Scientifique (FRS-FNRS, Belgium). The funders had no role in the study design, data acquisition, data analysis, data interpretation or manuscript writing.

Conflicts of Interest

GC has received research support from the EU’s Horizon 2020 research and innovation programme (grant agreement number 667696), Inserm, Fondation d’entreprise MMA des Entrepreneurs du Futur, Fondation Alzheimer, Programme Hospitalier de Recherche Clinique, Région Normandie, Association France Alzheimer et maladies apparentées and Fondation Vaincre Alzheimer (all to Inserm), and personal fees from Fondation d’entreprise MMA des Entrepreneurs du Futur. All other authors have no relevant financial or non-financial interests to disclose.

Ethics Approval

Written informed consent was obtained from all participants after the procedures had been explained to them and prior to participation. The Age-Well trial received ethics approval from the Comité de Protection des Personnes CPP Nord-Ouest III in Caen (trial registration number: EudraCT 2016-002441-36). The multi-centre SCD-Well trial received ethics approval from the committees and regulatory agencies of all centres: London, UK (Queen Square Research Ethics Committee: Nº 17/LO/0056 and Health Research Authority National Health Service, IRAS project ID: 213008); Lyon, France (Comité de Protection des Personnes Sud-Est II Groupement Hospitalier Est: Nº 2016-30-1 and Agence Nationale de Sécurité du Médicament et des Produits de Santé: IDRCB 2016-A01298-43); Cologne, Germany (Ethikkommission der Medizinischen Fakultät der Universität zu Köln: Nº 17-059);

and Barcelona, Spain (Comité Etico de Investigacion Clinica del Hospital Clinic de Barcelona: Nº HCB/2017/0062). The Brain & Mindfulness project received ethics approval from the Comité de Protection des Personnes CPP Sud-Est IV in Lyon (Nº 2015-A01472-47). All studies have been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Data Availability

Data used in the Medit-Ageing project and the Brain & Mindfulness project are available upon request.

Author Contributions

MS: wrote the first draft of the manuscript; substantial contributions to conception and design of the work; statistical analysis; interpretation of data; and incorporation of manuscript feedback. TB: substantial contributions to conception and design of the work; interpretation of data; and revision of the manuscript for important intellectual content. FR: substantial contributions to the analysis of data; and revision of the manuscript for important intellectual content. YIDA: substantial contributions to the design of the work; and revision of the manuscript for important intellectual content. OA: substantial contributions to the analysis of data; and revision of the manuscript for important intellectual content. NLM: substantial contributions to the conception of the work; and revision of the manuscript for important intellectual content. GC: substantial contributions to the conception of the work; and revision of the manuscript for important intellectual content. FC: substantial contributions to the conception of the work; and revision of the manuscript for important intellectual content. OMK: substantial contributions to the conception and design of the work; interpretation of data; and revision of the manuscript for important intellectual content. AL: substantial contributions to conception and design of the work; contributions to writing the first draft of the manuscript; interpretation of data; and revision of the manuscript for

important intellectual content. All authors approved the final version of the manuscript for submission.

Acknowledgments

The Medit-Ageing Research Group includes: Claire André, Nicholas Ashton, Florence Allais, Julien Asselineau, Eider Arenaza-Urquijo, Romain Bachelet, Sebastian Baez, Martine Batchelor, Axel Beaugonin, Viviane Belleoud, Clara Benson, Beatriz Bosch, Maelle Botton, Maria Pilar Casanova, Pierre Champetier, Anne Chocat, Nina Coll, Sophie Dautricourt, Pascal Delamillieure, Vincent De La Sayette, Marion Delarue, Harriet Demnitz-King, Titi Dolma, Stéphanie Egret, Francesca Felisatti, Eglantine Ferrand-Devouges, Eric Frison, Francis Gheysen, Karine Goldet, Julie Gonneaud, Abdul Hye, Agathe Joret Philippe, Elizabeth Kuhn, Brigitte Landeau, Gwendoline Ledu, Valérie Lefranc, Maria Leon, Dix Meiberth, Florence Mezenge, Ester Milz, Inès Moulinet, Hendrik Mueller, Theresa Mueller, Valentin Ourry, Cassandre Palix, Léo Paly, Géraldine Poisnel, Anne Quillard, Alfredo Ramirez, Géraldine Rauchs, Leslie Reyrolle, Ana Salinero, Eric Salmon, Lena Sannemann, Yamna Satgunasingam, Christine Schwimmer, Hilde Steinhauser, Edelweiss Touron, Denis Vivien, Patrik Vuilleumier, Cédrick Wallet, Tim Whitfield, and Janet Wingrove. The Brain & Mindfulness Research Group includes: Kristien Aarts, Eléa Perraud, and Jelle Zorn. Many people helped in implementing these projects. The authors would like to thank all the contributors listed in the Medit-Ageing Research Group and Brain & Mindfulness Research Group as well as Rhonda Smith, Charlotte Reid, the sponsor (Pôle de Recherche Clinique at Inserm), Inserm Transfert (Delphine Smagghe), and the participants in the Medit-Ageing project and the Brain & Mindfulness project.

Table 1 Demographic and descriptive characteristics

Variable	Meditation-naïve healthy older adults (Age-Well; n =135)	Meditation-naïve older adults with SCD (SCD-Well; n =147)	Long-term meditators (Brain & Mindfulness; n =29)
Age, years	68.9 (3.8), range: 65 to 84	72.7 (6.9), range: 60 to 91	52.0 (8.1), range: 35 to 65
Female, *n* (%)	83 (61.5%)	95 (64.6%)	12 (41.4%)
Education incl. university, years	13.2 (3.1)	13.6 (3.6)	15.0 (2.7)
Attentional composite			
MAIA noticing	3.4 (1.1)	2.9 (1.2)[a]	3.9 (0.8)
MAIA attention regulation	2.8 (0.9)	2.7 (1.0)[b]	4.1 (0.6)
MAIA emotional awareness	3.5 (1.0)	3.4 (1.1)[c]	4.2 (0.7)
MAIA self-regulation	3.1 (1.0)	2.6 (1.1)[d]	4.2 (0.6)
MAIA body listening	2.5 (1.2)[e]	1.8 (1.2)[f]	3.5 (1.1)
FFMQ observing[1]	9.5 (2.9)	9.5 (2.7)[g]	33.7 (3.7)
FFMQ acting with awareness[1]	11.7 (2.2)	10.5 (2.8)[g]	31.7 (5.2)
Constructive composite			
Compassionate Love Scale	90.6 (21.1)	92.3 (20.4)[a]	-
IRI empathic concern	19.8 (4.2)	-	22.3 (3.8)
IRI perspective taking	17.4 (3.5)	-	21.7 (3.4)
Prosocialness Scale	60.4 (8.3)	-	-
Compassion Scale	-	-	4.3 (0.3)
Deconstructive composite			
Drexel Defusion Scale	34.4 (5.6)	31.7 (8.5)[f]	39.1 (6.6)[h]
FFMQ non-judging[1]	11.6 (2.3)	11.8 (2.6)[g]	33.7 (4.3)
FFMQ non-reactivity[1]	9.7 (2.2)	9.5 (2.9)[g]	28.1 (4.3)
IRI personal distress[2]	10.2 (5.2)	-	5.6 (3.2)
Measures of construct validity			
STAI trait	34.6 (7.0)	39.9 (10.0)[i]	33.9 (8.4)
Geriatric Depression Scale	1.3 (1.7)	2.5 (2.3)	-
Psychological Well-being Scale[3]	5.4 (0.7)	4.5 (1.2) [g]	4.6 (0.8)
Beck Depression Inventory	-	-	3.0 (4.5)

Note. All statistics are mean (*SD*) unless otherwise specified. MAIA = Multidimensional Assessment of Interoceptive Awareness; FFMQ = Five Facet Mindfulness Questionnaire; IRI = Interpersonal Reactivity Index; STAI = State-Trait Anxiety Inventory.

[a]*n* = 141, [b]*n* = 138, [c]*n* = 139, [d]*n* = 137, [e]*n* = 134, [f]*n* = 140, [g]*n* = 142, [h]*n* = 28, [i]*n* = 146

[1]The 15-item FFMQ was used in Age-Well and SCD-Well, and the 39-item version was used in Brain & Mindfulness.

[2]Here, higher scores indicate higher levels of distress. Before their inclusion in the deconstructive composite score, these values were reverse-scored.

[3]The 42-item Psychological Well-being Scale was used in Age-Well and SCD-Well, and the 18-item version was used in Brain & Mindfulness.

Table 2 Correlations (and their accompanying 95% confidence interval) of the meditation composite scores with well-being, anxiety, and depression

	Meditation-naïve healthy older adults (n =135)			Meditation-naïve older adults with SCD (n =147)			Long-term meditators (n =29)		
	PWBS-42	STAI trait	GDS	PWBS-42	STAI trait	GDS	PWBS-18	STAI trait	BDI
Attentional	0.29**	-0.17*	0.001	0.27*	-0.14	-0.21*	0.15	-0.68**	-0.30
	(0.13 to 0.44)[a]	(-0.33 to -0.002)[a]	(-0.17 to 0.17)[a]	(0.11 to 0.42)[b]	(-0.30 to 0.031)[c]	(-0.37 to -0.04)[b]	(-0.23 to 0.49)	(-0.84 to -0.42)	(-0.60 to 0.08)
Constructive	0.21*	0.11	-0.02	-	-	-	0.05	-0.26	0.05
	(0.04 to 0.36)	(-0.07 to 0.27)	(-0.19 to 0.15)				(-0.32 to 0.41)	(-0.57 to 0.12)	(-0.33 to 0.41)
Deconstructive	0.45**	-0.61**	-0.18*	0.17*	-0.57**	-0.39**	0.08	-0.77**	-0.40*
	(0.30 to 0.57)	(-0.71 to -0.49)	(-0.33 to -0.01)	(0.004 to 0.33)[d]	(-0.67 to -0.45)[e]	(-0.53 to -0.24)[d]	(-0.30 to 0.44)[f]	(-0.89 to -0.56)[f]	(-0.67 to -0.03)[f]

Note. PWBS = Psychological Well-being Scale; STAI = State-Trait Anxiety Inventory, GDS = Geriatric Depression Scale.

[a]n = 134, [b]n = 136, [c]n = 135, [d]n = 140, [e]n = 139, [f]n = 28

*$p < 0.05$, **$p < 0.001$

Table 3 Standardised factor loadings and 95% confidence intervals of the three- and one-factor models of theory-based mechanisms of meditation practice

	Three-factor model[a]			One-factor model[a]		
	Loadings	95% CI	p-value	Loadings	95% CI	p-value
Attentional factor						
MAIA noticing	0.68	0.58 to 0.79	<0.001	0.67	0.57 to 0.78	<0.001
MAIA attention regulation	0.84	0.77 to 0.90	<0.001	0.83	0.76 to 0.90	<0.001
MAIA emotional awareness	0.80	0.72 to 0.87	<0.001	0.78	0.71 to 0.86	<0.001
MAIA self-regulation	0.84	0.77 to 0.91	<0.001	0.85	0.79 to 0.91	<0.001
MAIA body listening	0.83	0.76 to 0.90	<0.001	0.84	0.77 to 0.90	<0.001
FFMQ observing	0.53	0.40 to 0.66	<0.001	0.52	0.39 to 0.66	<0.001
FFMQ acting with awareness	0.27	0.10 to 0.44	0.001	0.27	0.11 to 0.44	0.001
Constructive composite						
Compassionate Love Scale	0.69	0.57 to 0.81	<0.001	0.15	-0.03 to 0.32	0.097
IRI empathic concern	0.74	0.62 to 0.86	<0.001	0.02	-0.16 to 0.20	0.804
IRI perspective taking	0.32	0.14 to 0.49	<0.001	0.30	0.14 to 0.47	<0.001
Prosocialness Scale	0.79	0.68 to 0.91	<0.001	0.12	-0.05 to 0.30	0.168
Deconstructive composite						
Drexel Defusion Scale	0.75	0.60 to 0.90	<0.001	0.30	0.13 to 0.46	<0.001
FFMQ non-judging	0.35	0.17 to 0.53	<0.001	-0.04	-0.22 to 0.14	0.663
FFMQ non-reactivity	0.59	0.43 to 0.75	<0.001	0.20	0.03 to 0.37	0.021
IRI personal distress[1]	0.62	0.46 to 0.77	<0.001	0.27	0.10 to 0.43	0.002
Factor intercorrelations						
Attentional and Constructive	0.13	-0.07 to 0.33	0.200			
Attentional and Deconstructive	0.33	0.13 to 0.52	0.001			
Constructive and Deconstructive	-0.04	-0.28 to 0.20	0.726			

Note. MAIA = Multidimensional Assessment of Interoceptive Awareness; FFMQ = Five Facet Mindfulness Questionnaire; IRI = Interpersonal Reactivity Index.

[a]n = 134

[1]Here, higher scores indicate lower levels of distress. Before their inclusion in the confirmatory factor analysis, these values were reverse-scored.

Supplementary Material A

This section describes the scales that were considered for inclusion in the meditation composites.

The *Compassionate Love Scale* (CLS; stranger-humanity version; Sprecher & Fehr, 2005) and the *Compassion Scale* (Pommier, 2010) were used to measure compassion for others. Compassion can be conceptualised as a complex response to suffering – entailing affective, behavioural, and cognitive aspects – that, importantly, includes the intention to reduce suffering. The CLS comprises 21 items with a 7-point Likert scale anchored at 1 (not at all true of me) and 7 (very true of me). Total scales scores are computed by averaging the 21 item scores. Higher total scores reflect higher levels of compassion for others. The CLS has shown high levels of internal consistency (Cronbach's alpha = 0.95; Sprecher & Fehr, 2005); however, a recent evaluation of the CLS recommended the use of a shorter 7-item version (i.e., COS-7; Schlosser et al., 2021) instead due to its improved psychometric quality and content validity. Here, the COS-7 will be used in secondary sensitivity analyses. The Compassion Scale (Pommier, 2010) comprises 24 items with a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always). Total scale scores are derived by averaging the 24 item scores, with higher scores indicative of greater levels of compassion. The Compassion Scale has displayed good psychometric properties (Cronbach's alpha = 0.90; Pommier, 2010).

The *Drexel Defusion Scale* (DDS; Forman et al., 2012) was used to measure levels of defusion, the capacity to psychologically distance oneself from subjective experiences including body sensations, thoughts, emotions and perceptions in general. To be in a state of defusion implies that the seemingly inherent reality commonly assigned to subjective experiences is, to a certain degree, softened, thus making other ways of relating to experience more accessible (e.g. seeing sensations and thoughts as mere phenomenological events or as

"just a perception"). The DDS comprises 10 items with a 6-point Likert scale ranging from 0 (not at all) to 5 (very much). Total scores are derived by summing the 10 item scores. Higher total scores reflect a greater ability to defuse from subjective experience. The DDS has displayed good psychometric properties including adequate levels of internal consistency (Cronbach's alpha = 0.95; Forman et al., 2012).

The *39-item Five Facet Mindfulness Questionnaire* (FFMQ-39; Baer et al., 2006) and the *15-item Five Facet Mindfulness Questionnaire* (FFMQ-15; Baer et al., 2008) were used to measure five trait-like facets of mindfulness, namely observing (noticing experiences), describing (labelling experiences), acting with awareness (attending to activities non-mechanically), non-judging (non-evaluative stance towards experiences), and non-reactivity (allowing experiences). The FFMQ-39 comprises one 7-item scale (non-reactivity) and four 8-item scales using a 5-point Likert scale anchored at 1 (never or very rarely true) and 5 (very often or always true). The FFMQ-15 includes the same five facets but includes only three items for each facet. After reverse scoring some items, the subscale scores are derived by summing their respective item scores. Higher subscale scores are indicative of a greater tendency to display the mindfulness facets in daily life. The FFMQ subscales have demonstrated adequate psychometric properties including good internal consistency (Cronbach's alpha ranging from 0.75 to 0.91; Baer et al., 2006, 2008; Gu et al., 2016).

The *Interpersonal Reactivity Index* (IRI; Davis, 1983) was used to measure empathic tendencies. The IRI comprises four 7-item scales using a 5-point Likert scale ranging from A (does not describe me well) to E (describes me very well). The four scales capture four facets of empathy, namely perspective taking (adopting another's view), empathic concern (feelings of sympathy for others), fantasy (transposing oneself into fictitious characters' experience), and personal distress (feelings of unease in interpersonal dynamics). After converting the letters A-E to 0-4 and reverse scoring some items, scale scores are derived by summing their

respective item scores. Higher scale scores reflect higher levels of empathic tendencies and lower personal distress. The IRI scales have shown adequate internal consistency (Cronbach's alpha ranging from 0.75 to 0.82; Davis, 1983).

The *Multidimensional Assessment of Interoceptive Awareness* (MAIA; Mehling et al., 2012) questionnaire was used to measure eight state-trait facets of interoceptive awareness, which describe the nervous system's ability to sense, interpret, and integrate signals produced within the body. The 32-item MAIA comprises eight subscales with a 6-point Likert scale anchored at 0 (*never*) and 5 (*always*): noticing (awareness of body sensations; 4 items), not-distracting (not ignoring uncomfortable sensations; 6 items), not-worrying (not distressed by uncomfortable sensations; 5 items), attention regulation (sustaining and controlling attention on sensations; 7 items), emotional awareness (awareness of connection between sensations and emotions; 5 items), self-regulation (regulating distress by attention to sensations; 4 items), body listening (listening to the body for insight; 3 items), and trusting (experiencing the body as safe; 3 items). After reverse scoring some items, subscale scores are computed by averaging their respective item scores. Higher subscale scores are indicative of greater interoceptive awareness accessible to self-report. The MAIA subscales have displayed satisfactory to good levels of internal consistency (Cronbach's alpha ranging from 0.64 to 0.83; Mehling et al., 2012).

The *Prosocialness Scale* (Caprara et al., 2005) was used to measure individual differences in prosocialness including sharing, helping, and taking care of others' needs. The scale comprises 16 items with a 5-point Likert scale anchored at 1 (never/almost never true) and 5 (almost always/always true). Total scores are derived by averaging the 16 item scores. Higher total scores reflect higher levels of prosocialness. The Prosocialness Scale has demonstrated good levels of internal consistency (Cronbach's alpha of 0.91; Caprara et al., 2005).

The reappraisal subscale of the *Emotion Regulation Questionnaire* (ERQ; Gross & John, 2003) was used to measure individual differences in cognitive reappraisal. The ERQ items are theoretically derived from a process model of emotion regulatory strategies. To cognitively reappraise a situation refers to changing one's view of a situation in such a way that its emotional impact is altered. The reappraisal subscale comprises six items with a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Subscale scores are computed by averaging the item scores. Higher subscale scores indicate higher levels of cognitive reappraisal. The reappraisal subscale has displayed adequate levels of internal consistency (Cronbach's alpha ranging from 0.75 to 0.82; Gross & John, 2003).

To assess the convergent validity of the meditation composite scores, we used established self-report measures of anxiety, depression, and well-being (Table 1), namely the trait scale of the State-Trait Anxiety Inventory (Spielberger et al., 1983), the Geriatric Depression Scale (Sheikh & Yesavage, 1986), the Beck Depression Inventory (Beck et al., 1961), and the 42-item Psychological Well-being Scale (PWBS-42; Ryff et al., 1995) and 18-item Psychological Well-being Scale (PWBS-18; Ryff, 1989).

3. Effects of an 8-week mindfulness-based intervention in older adults with SCD

Abstract

Objectives: Older adults with subjective cognitive decline (SCD) recruited from memory clinics have an increased risk of developing dementia and regularly experience reduced psychological well-being related to memory concerns and fear of dementia. Research on improving well-being in SCD is limited and lacks non-pharmacological approaches. We investigated whether mindfulness-based and health education interventions can enhance well-being in SCD.

Methods: The SCD-Well trial (ClinicalTrials.gov: NCT03005652) randomised 147 older adults with SCD to an 8-week caring mindfulness-based approach for seniors (CMBAS) or an active comparator (health self-management programme [HSMP]). Well-being was assessed at baseline, post-intervention, and 6-month post-randomisation using the Psychological Well-being Scale (PWBS), the World Health Organisation's Quality of Life (QoL) Assessment psychological subscale, and composites capturing meditation-based well-being dimensions of awareness, connection, and insight. Mixed effects models were used to assess between- and within-group differences in change.

Results: CMBAS was superior to HSMP on changes in connection at post-intervention. Within both groups, PWBS total scores, psychological QoL, and composite scores did not increase. Exploratory analyses indicated increases in PWBS autonomy at post-intervention in both groups.

Conclusion: Two non-pharmacological interventions were associated with only limited effects on psychological well-being in SCD. Longer intervention studies with waitlist/retest control groups are needed to assess if our findings reflect intervention brevity and/or minimal base rate changes in well-being.

Keywords: meditation; well-being; quality of life; compassion; RCT

Introduction

Subjective cognitive decline (SCD) describes self-reported worsening of cognitive functioning despite unimpaired performance on objective tests of cognition (Jessen et al., 2020). Clinical and epidemiological data suggest that older adults with SCD, especially those recruited from memory clinics, are at a higher risk of subsequently developing dementia (Mitchell et al., 2014). The aetiology of SCD is heterogeneous and its phenomenology complex (Jessen et al., 2020). Although the condition could be an indication of prodromal Alzheimer's disease (AD), which is the most common form of dementia (Livingston et al., 2020), SCD has also been related to other factors (e.g., physical and mental illness, sleep disturbances, personality traits, effects of drugs). Partly due to the heterogeneity of this population and the fact that SCD symptoms frequently remit, there is no consensus on best treatment and management for SCD. Nonetheless, in the absence of effective interventions for curing or treating AD, interest in SCD continues to grow as targeted interventions at this earlier stage could reduce the risk of cognitive decline and progression to AD.

An important aspect of living with SCD is the impact that perceiving increasing cognitive difficulties has on an individual's psychological well-being. The lived subjective experience of individuals with SCD is commonly marked by stress, fear of dementia, anger, and feelings of anxiety and depression (Metternich et al., 2010; Molinuevo et al., 2017). This aspect can be overlooked within research contexts that focus primarily on the maintenance of cognition or the prevention of amyloid deposition. A recent meta-analysis indicated that group psychological interventions moderately increased psychological well-being in SCD (Hedges' $g = 0.40$; Bhome et al., 2018) although none of the included studies, when considered individually, found statistically significant improvements. The authors concluded that existing research on enhancing psychological well-being in SCD is of low quality (e.g.,

lacking active comparison conditions) and highlighted the striking lack of research on non-pharmacological approaches including lifestyle and mindfulness-based interventions (MBIs).

In line with prior research and theory (Dahl et al., 2020; Gu et al., 2015), MBIs have been proposed as a promising strategy for increasing psychological well-being and human flourishing. However, prior to the SCD-Well trial (Marchant et al., 2021), only one study – a small pilot randomised controlled trial (n = 15; Smart et al., 2016) – had evaluated the effects of mindfulness training in individuals with SCD. This trial primarily focussed on reaction time and EEG correlates, change in brain volume, self-reported cognitive complaints, and memory self-efficacy; it did not include measures of psychological well-being or related constructs. Understanding how psychological well-being in SCD, irrespective of its aetiology, could be improved through MBIs remains an important lacuna in this emerging field.

Other promising non-pharmacological interventions for SCD include psychoeducation programmes that provide information on healthy diet, physical exercise, and management of existing health conditions (Jessen et al., 2020). Strengthening self-efficacy and thus enabling individuals with SCD to live a more active life could be a mechanism by which psychoeducation maintains or improves psychological well-being. A particularly pertinent feature of both MBIs and psychoeducation is their potential to be feasibly implemented in clinical settings. Furthermore, non-pharmacological interventions could empower individuals with SCD to actively learn skills that could enhance their psychological well-being and mental health instead of passively observing how their clinical trajectory unfolds.

Research on the dimensions of psychological well-being has expanded substantially over the past decade, delivering valuable insights into the conditions that predict and contribute to positive functioning (e.g., Dahl et al., 2020; Ryff, 2014). To appreciate the conceptual richness of this field and to capture diverse aspects of psychological well-being,

we utilised outcome measures derived from three distinct, prominent theoretical models of human flourishing, namely Ryff's theory of well-being (1989), the World Health Organisation's conception of psychological quality of life (The Whoqol Group, 1998), and a recent meditation training-based framework for human flourishing developed by Dahl et al. (2020).

Ryff (1989) offered the first attempt at providing a unifying theoretical framework for contemporary scientific perspectives on human flourishing. Ryff's influential work (1989) was a response to the largely data-driven and atheoretical research on well-being that had hitherto characterised this area. In this model, Ryff aimed to identify the fundamental aspects of positive functioning that could help define what it means to be psychologically well. The Psychological Well-being Scale (PWBS; Ryff et al., 1995), which was developed to empirically capture Ryff's proposed dimensions of well-being, is the most cited self-report measure of well-being to date.

The World Health Organisation (WHO) defines quality of life as "individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" (The Whoqol Group, 1998) and frames quality of life as an aspect of well-being. The WHO Quality of Life (WHOQOL) assessment was developed to capture aspects of quality of life. The introduction of the WHOQOL was a statement of commitment to promoting a genuinely holistic approach to health and health care interventions, echoing the WHO's definition of health as "A state of physical, mental and social well-being, not merely the absence of disease and infirmity" (The Whoqol Group, 1998).

Dahl et al.'s (2020) meditation training-based model of human flourishing integrates insights from neuroscientific and psychological research on well-being with contemplative perspectives. It rests on a skill-based conception of human flourishing, framing dimensions of

well-being as trainable capacities. The authors aimed to introduce a set of constructs that could further unify existing theories and interventions in this field while offering a common language to encourage collaboration across related research areas. No self-report measure has yet been developed that was explicitly derived from this model. However, recent research (Schlosser, Barnhofer, et al., 2022) has used this model to group already published self-report measures into psychometrically sound composites of meditation-based well-being.

The present study aimed to compare the effects of an 8-week MBI adapted for older adults with SCD (caring mindfulness-based approach for seniors; CMBAS) on measures of mental well-being derived from the three approaches described above to a structurally matched health self-management programme (HSMP). We hypothesised that both interventions would improve well-being but that CMBAS would be superior to HSMP, because, based on previous research and theory (Dahl et al., 2015, 2020; Lutz et al., 2021), we predicted embodied meditative practices aimed at deep human flourishing to be a more potent catalyst of well-being than health educational instructions.

Methods

This study utilised longitudinal data from the SCD-Well randomised controlled trial of the European Union's Horizon 2020-funded Medit-Ageing European project (public name: Silver Santé Study). Detailed information about the recruitment procedures, eligibility criteria, design of the interventions, and assessments can be found in the trial protocol (Marchant et al., 2018).

Study design

SCD-Well was a multi-center, randomised, controlled, superiority trial with two intervention arms: an 8-week CMBAS and a structurally matched HSMP. Randomisation to one of the two groups was performed at a ratio of 1:1. Participants were assessed at three visits: pre-intervention at baseline (V1), post-intervention (V2), and at follow-up 6 months

after randomisation (V3). The primary outcome of the SCD-Well trial was mean change in anxiety symptoms from V1 to V2 (Marchant et al., 2021).

The intervention was delivered at four European sites (Barcelona, Cologne, London, and Lyon). Written informed consent was obtained from all participants after the procedures had been explained to them and prior to participation. The multi-centre SCD-Well trial received ethics approval from the committees and regulatory agencies of all centres: London, UK (Queen Square Research Ethics Committee: n° 17/LO/0056 and Health Research Authority National Health Service, IRAS project ID: 213008); Lyon, France (Comité de Protection des Personnes Sud-Est II Groupement Hospitalier Est: n° 2016-30-1 and Agence Nationale de Sécurité du Médicament et des Produits de Santé: IDRCB 2016-A01298-43); Cologne, Germany (Ethikkommission der Medizinischen Fakultät der Universität zu Köln: n° 17-059); and Barcelona, Spain (Comité Etico de Investigacion Clinica del Hospital Clinic de Barcelona: n° HCB/2017/0062). The SCD-Well trial was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Participants

A total of 147 older adults (age range: 60 to 91 years in CMBAS; 60 to 87 years in HSMP) were randomised. Participants had no major neurological or psychiatric disorders, and no present or past regular or intensive practice of meditation, were recruited from memory clinics at four European sites, and met the research criteria for SCD proposed by the SCD-I working group (Jessen et al., 2014).

Interventions

Caring mindfulness-based approach for seniors (CMBAS)

CMBAS followed the structure of a mindfulness-based stress reduction (MBSR) programme and was tailored to the needs of older adults with a focus on compassion and loving-kindness meditation. CMBAS also included psychoeducational components that

offered participants approaches to deal with cognitive concerns and tendencies to worry in skilful ways. The intervention consisted of eight weekly group sessions of approximately 2 hours, home practice (e.g., guided meditations, informal practices) for 1 hour per day on six days per week, and one retreat day during the sixth week of the intervention that involved 5 hours of practice. CMBAS was delivered to groups of 7 to 12 participants by clinically trained facilitators who had completed training that aligned with the good practice guidelines for mindfulness teachers developed by The Mindfulness Network UK.

Health self-management programme (HSMP)

HSMP followed the same format and structure as CMBAS, and was matched in administration, duration, and dosage of group meetings including a retreat day with a healthy lunch and topical discussions. HSMP was based on a published manual that included guidance on exercise, stress, memory, communication, healthy eating, and the management of sleep (Lorig et al., 2012). Home practice included creating 'action plans' that focussed on activities to enhance health and well-being. HSMP was delivered to groups of 7 to 13 participants by clinically trained facilitators with at least three years of experience in leading group-based clinical or psychoeducational interventions.

Measures of well-being

The 42-item *Psychological Well-being Scale* (PWBS; Ryff et al., 1995) was used to measure psychological well-being as conceptualised by Ryff (1989). The PWBS is grounded in a theoretical model of psychological well-being that comprises six dimensions, namely self-acceptance, positive relations with others, autonomy (independence), environmental mastery (ability to manage life's demands), purpose in life, and personal growth (sense of developing and growing; Ryff, 1989). Each dimension is measured by a 7-item subscale using a 7-point Likert scale ranging from 1 (strongly agree) to 7 (strongly disagree). After reverse scoring 21 items, subscale scores were derived by averaging their respective item

scores; a total score was derived by averaging all items. Higher scores reflect higher levels of psychological well-being. The subscales of the PWBS have displayed low to moderate levels of internal consistency (Cronbach's alpha ranging from 0.33 to 0.56; Ryff et al., 1995).

The psychological domain of the *World Health Organization WHOQOL-BREF Quality of Life Assessment* (The Whoqol Group, 1998) was used to measure psychological quality of life. The WHOQOL Group conceptualises quality of life as a subjective evaluation of one's position in life in relation to the goals, expectations, and concerns that emerge from one's cultural, social, and environmental context. The psychological subscale of the WHOQOL-BREF captures levels of positive feelings (e.g., sense of meaningfulness) and body image, self-esteem, the ability to concentrate, and the lack of negative feelings (e.g., anxiety). The 6-item psychological subscale uses a 5-point Likert scale anchored at 0 (not at all) and 5 (completely). After reverse scoring one item, psychological subscale scores were derived by summing the six item scores. Higher scores are indicative of higher levels of psychological quality of life. The psychological subscale of the WHOQOL-BREF has displayed good levels of internal consistency (Cronbach's alpha = 0.81; The Whoqol Group, 1998).

Three composite scores were used to measure the meditation-related well-being dimensions of awareness, connection, and insight as introduced by Dahl et al. (2020). In this framework, awareness describes a heightened and malleable attentiveness to perceptions (e.g., thoughts, feelings, and sensations) and a capacity to notice when levels of awareness decrease and the likelihood to be distracted increases. Connection describes a sense of care toward others that supports positive interactions and relationships. Connection encompasses feelings of gratitude, appreciation, and kinship, and a heightened capacity to understand and empathise with others' perspectives. Insight describes the capacity to experientially understand the ways in which thoughts, feelings, assumptions, and worldviews shape and

participate in one's perception of self, other, and world. Awareness, connection, and insight correspond to the attentional, constructive, and deconstructive psychological capacities previously introduced by Dahl et al. (2015). Details of the theory-guided development and psychometric properties of the composites used in the present study have been published (Schlosser, Barnhofer, et al., 2022). The three composite scores include scales or subscales from four self-report measures (see Table 2): The *Multidimensional Assessment of Interoceptive Awareness* (MAIA; Mehling et al., 2012) questionnaire and the *39-item Five Facet Mindfulness Questionnaire* (FFMQ-39; Baer et al., 2006) subscales of observing (noticing experiences) and acting with awareness (attending to activities non-mechanically) were used as measures of awareness. The *Compassionate Love Scale* (stranger-humanity version; Schlosser et al., 2021; Sprecher & Fehr, 2005) was used as a measure of connection. The *Drexel Defusion Scale* (Forman et al., 2012) and the FFMQ subscales of non-judging (non-evaluative stance towards experiences) and non-reactivity (allowing experiences) were used as measures of insight. Detailed descriptions of the self-report measures included in the composite scores can be found in S1 Table.

To derive the three scores of meditation-related dimensions of well-being, we subtracted each scale score at each time point from the baseline pooled mean. We then divided this difference by the baseline pooled standard deviation. Next, each score was computed by averaging the z-scores of the scales that were assigned to the respective composite, yielding three composite scores with a baseline mean of 0 and a standard deviation smaller than one. Finally, to ease longitudinal data interpretation, we re-standardised each composite score so that longitudinal changes in each composite score reflect changes in standard deviation units.

Statistical analyses

Sample size

Sample size calculations in SCD-Well were based on the expected effect size (0.5, based on a meta-analysis of the efficacy of meditation-based interventions for reducing anxiety symptoms; Chen et al., 2012) with 80% power and two-sided type I error of 5% for the mean change in trait-STAI scores from V1 to V2 between CMBAS and HSMP, resulting in a minimum total number of 128 (64 per group), which has been exceeded (n = 147; detailed in Marchant et al., 2018).

Comparative analyses

To assess between-group differences in mean changes in outcomes, we built one mixed effects linear regression model for each outcome incorporating data from all time points with an interaction term between visit and group. In all analyses, positive (negative) estimated mean between-group differences reflect higher (lower) changes in outcome scores in CMBAS. In accordance with the pre-registered statistical analysis plan for secondary outcomes of the Medit-Ageing Project, in all mixed effects regression models, missing data of the well-being outcomes were not replaced and assumed to be missing-at-random. The data and analysis plan underlying this paper are made available on request following approval by the executive committee and a formal data sharing agreement (https://silversantestudy.eu/2020/09/25/data-sharing). No participant data were excluded based on very high or low scale scores. Primary analyses of PWBS total scores, psychological QoL, and composite scores (awareness, connection, insight) were adjusted for multiple comparison (Bonferroni correction for multiple testing). Exploratory analyses of PWBS subscales were not adjusted for multiple comparison.

To test the potential moderating effect on measures of well-being within both groups, we built linear regression models with change in well-being scores from V1 to V2 as the outcome and the moderator variables of interest as the predictors. These variables included session attendance (out of a maximum of nine sessions, i.e. 8 weekly meetings plus one

retreat day), baseline neuroticism measured by the neuroticism subscale of the 44-item Big Five Inventory (John & Srivastava, 1999), and baseline scores of the well-being outcomes. Analyses were conducted in R version 4.0.2 and Stata/MP version 16.0.

Results

Demographic characteristics are reported in Table 1. Descriptive statistics of well-being outcomes (based on all available data) are displayed in Table 2 and Figure 1. Results from mixed effects regression models assessing differential change in well-being outcomes (based on all participants who provided data at V1, V2, and V3) are shown in Table 3. There were no significant differences between the interventions for the mean number of sessions attended (CMBAS = 6.7; HSMP = 6.8), the proportion of participants who attended at least four sessions (CMBAS = 81%; HSMP = 85%), or the proportion of participants who reported continued engagement with intervention activities between V2 and V3 (CMBAS = 59%; HSMP = 54%). There were no significant differences between the proportions of participants who completed home practice on at least four occasions (CMBAS = 55 [75%]; HSMP = 51 [69%]).

PWBS

CMBAS and HSMP did not increase PWBS total scores, and no differences were observed between CMBAS and HSMP on changes in PWBS total scores (Table 3).

Exploratory analyses indicated that across PWBS dimensions, only PWBS autonomy increased within both groups from V1 to V2 (CMBAS: Cohen's d: 0.22 [95% CI: 0.02, 0.42], p = 0.023; HSMP: Cohen's d: 0.24 [95% CI: 0.03, 0.44], p = 0.018) and from V1 to V3 in HSMP only (Cohen's d: 0.22 [95% CI: 0.02, 0.41], p = 0.026; S2 Table). Neither CMBAS nor HSMP increased other PWBS dimensions from V1 to V2 or from V1 to V3.

Psychological QoL

No differences were observed between CMBAS and HSMP on changes in psychological QoL from V1 to V2 (Cohen's d: 0.15 [95% CI: -0.08, 0.37], p = 0.206) and from V1 to V3 (Cohen's d: 0.15 [95% CI: -0.08, 0.37], p = 0.206). No within-group changes were found.

Meditation-based well-being dimensions

CMBAS was superior to HSMP on changes in connection from V1 to V2 (Cohen's d: 0.38 [95% CI: 0.12, 0.64], p = 0.004). From V1 to V2, connection did not change within CMBAS (Cohen's d: 0.20 [95% CI: -0.02, 0.42], p = 0.082) or within HSMP (Cohen's d: -0.18 [95% CI: -0.40, 0.04], p = 0.132). From V1 to V3, a significant decrease in connection was observed within HSMP (Cohen's d: -0.31 [95% CI: -0.53, -0.10], p = 0.002). No differences were observed between CMBAS and HSMP on changes in awareness and insight (all p-values > 0.284), and no within-group changes were observed for these outcomes.

Moderator analyses

Exploratory moderator analyses were conducted within both groups to assess the association between baseline characteristics and intervention response (i.e., from V1 to V2). For a selected number of outcomes (CMBAS: awareness, connection, insight, psychological QoL; HSMP: insight), higher baseline scores were associated with weaker improvements. Neuroticism did not moderate the effects of CMBAS or HSMP. Session attendance showed a moderating effect on connection, with higher session attendance predicting a greater decrease in connection in CMBAS and a greater increase in connection in HSMP. All moderator analyses can be found in S3 Table.

Discussion

Utilising three theory-based conceptions of well-being (Dahl et al., 2020; Ryff, 1989a; The Whoqol Group, 1998) in this large, multinational clinical trial of older adults with SCD, an 8-week CMBAS and a structurally matched HSMP were associated with only

limited effects on psychological well-being. CMBAS was superior to HSMP on changes in connection at post-intervention. Within both groups, PWBS total scores, psychological QoL, and composite scores did not increase significantly from baseline to post-intervention or follow-up. Exploratory analyses suggested that levels of autonomy increased within both groups during the intervention. In Ryff's framework of well-being (Ryff et al., 1995), increasing levels of autonomy reflect an increased capacity to be independent, self-determined, and able to view oneself and regulate one's behaviour based on personal standards rather than social and cultural pressures.

Overall, however, our findings contrast with our hypotheses. Based on previous research and theory (Chételat et al., 2018; Dahl et al., 2020; Lutz et al., 2021), we expected CMBAS to positively impact various dimensions of psychological well-being and human flourishing. The primary outcome of the SCD-Well trial was mean change in levels of trait anxiety from pre- to post-intervention (Marchant et al., 2018). Within both CMBAS and HSMP, trait anxiety was reduced in statistically significant and clinically meaningful ways (Marchant et al., 2021). The magnitude of these effects on the primary outcome did not fully translate to the well-being measures presented here. Despite decreases in trait anxiety, CMBAS' limited effects on psychological well-being raise concerns about the utility and specificity of an 8-week MBI in older adults with SCD.

Several potential explanations for these unexpected findings can be considered. For instance, one explanation relates to the limitations of the well-being measures we employed. The PWBS (Ryff et al., 1995) and WHOQOL-BREF Quality of Life Assessment (The Whoqol Group, 1998) were not informed by contemplative perspectives or developed to measure the effects of meditation training. These well-being measures might be limited in their ability to capture those dimensions of well-being that meditation theories would predict long-term practice to cultivate (Dahl et al., 2015, 2020). In fact, a recent cross-sectional study

suggested that expert meditators (≥10,000 hours of practice including one 3-year meditation retreat) displayed lower PWBS total scores than meditation-naïve individuals (Schlosser, Barnhofer, et al., 2022). Nonetheless, from a clinical perspective, we still expected an improvement in the general type of well-being that is captured by these measures. Importantly, the present study did include composite measures that were theoretically derived from meditation-based dimensions of well-being (i.e., awareness, connection, insight, Dahl et al., 2020). Although the impact of CMBAS on awareness and insight was arguably trending towards a meaningful effect size post-intervention, this impact was not detectable anymore at the 6-month follow-up. Another explanation for the limited effects on psychological well-being could be related to the length of the meditation training period. Although 8-week MBIs in younger healthy populations have exerted a positive impact on measures of global well-being as well as dimensions of awareness, connection, and insight (e.g., Goldberg et al., 2020), in older adults with SCD, eight weeks of practice might be too brief for measurable and clinically meaningful changes in facets of psychological well-being to manifest. Notably, in MBIs in younger healthy populations, effect sizes of change in measures of psychological distress tend to be larger than those of changes in well-being dimensions (e.g., Goldberg et al., 2020; Hirshberg et al., 2022). This pattern also emerges in the context of the SCD-Well trial and is in line with the fact that standard MBIs, derived from the generic mindfulness-based stress reduction programme, are mainly targeted at helping participants develop more adaptive responses to psychological distress. One potential explanation for this pattern is that greater intervention duration is required for psychological well-being to improve than for psychological distress (e.g., anxiety) to decrease. In that regard, a potential lack of statistical power could have also contributed to the limited effects on well-being as the SCD-Well trial was designed to primarily detect effects on levels of trait anxiety (Marchant et al., 2018). Further, the limited intervention effects could also be related to factors that have been

associated with SCD but were not sufficiently captured in the context of the present study (e.g., sleep disturbances measured by polysomnography). Longitudinal studies with longer training periods and additional measures of physical and mental health are needed to further elucidate these questions and other potential dose-response relationships between meditation practice and diverse aspects of psychological well-being in older adults. The ongoing Age-Well trial (Poisnel et al., 2018), which includes the longest meditation training conducted to date and utilises similar measures of well-being to the present study, could contribute to begin answering these questions.

Trajectories of change in outcomes might vary substantially depending on participants' baseline characteristics; yet only few moderators of meditation training have been consistently found or considered (Goldberg et al., 2022). Previous work has suggested that individuals who display better/poorer functioning at baseline might show a smaller/larger response to meditation-based interventions (see Rosenkranz et al., 2019). For individuals who are relatively psychologically well at baseline, longer training periods might be required to achieve noticeable levels of improvement. Here, we evaluated the moderating effects of baseline levels of neuroticism (i.e., proneness to experience distress) and well-being. In line with prior predictions, higher levels of awareness, connection, insight, and psychological QoL at baseline were associated with smaller improvements post-CMBAS. The opposite pattern in which higher baseline scores predicted stronger intervention response was not found for any outcome. Baseline scores of neuroticism did not predict participants' response to CMBAS. Further, session attendance showed no moderating effects on well-being outcomes except on connection, with higher session attendance predicting, unexpectedly, a greater decrease in connection. Given the exploratory nature of these moderation analyses and the lack of prior studies investigating the effects of MBIs on well-being in patients with SCD, we hesitate to offer explanations for this counterintuitive moderation finding.

The SCD-Well trial has important strengths. Aiming to address several previously-identified limitations of meditation research (Dahl et al., 2020; Rosenkranz et al., 2019; Van Dam et al., 2018), the trial included a theory-based active comparison condition; the mindfulness-based intervention was based on a tailored, manualised training paradigm that was informed by the strengths and limitations of previous work; we utilised theoretical models of meditation practice that were informed by psychological, neuroscientific, and contemplative perspectives (Dahl et al., 2015); we compared established scientific models of psychological well-being to a recent meditation-based framework for human flourishing (Dahl et al., 2020); and we addressed the need for studies of meditation-based interventions in older adults (see Goldberg et al., 2022).

The trial also has important limitations. The generalisability of our findings to other populations of older adults is reduced because our sample consisted of well-educated and largely white participants. Further, we did not include a passive control group to assess fluctuations in wellbeing independent of the interventions. Importantly, no self-report measures that specifically reflect the dimensions of Dahl et al.'s training-based framework for well-being (Dahl et al., 2020) have been developed. Therefore, we utilised previously developed composite scores of meditation-related capacities that were based on self-report measures of trait-like individual differences (Schlosser, Barnhofer, et al., 2022). These trait-level scales may be suboptimal for capturing the process-level aspects of meditation-related dimensions of psychological well-being.

Acknowledgments

The Medit-Ageing Research Group includes: Claire André, Nicholas Ashton, Florence Allais, Julien Asselineau, Eider Arenaza-Urquijo, Romain Bachelet, Martine Batchelor, Axel Beaugonin, Viviane Belleoud, Clara Benson, Beatriz Bosch, Maelle Botton, Maria Pilar Casanova, Pierre Champetier, Anne Chocat, Nina Coll, Sophie Dautricourt, Pascal Delamillieure, Vincent De La Sayette, Marion Delarue, Harriet Demnitz-King, Titi Dolma, Stéphanie Egret, Francesca Felisatti, Eglantine Ferrand-Devouges, Eric Frison, Francis Gheysen, Karine Goldet, Julie Gonneaud, Abdul Hye, Agathe Joret Philippe, Elizabeth Kuhn, Brigitte Landeau, Gwendoline Ledu, Valérie Lefranc, Maria Leon, Dix Meiberth, Florence Mezenge, Ester Milz, Inès Moulinet, Hendrik Mueller, Theresa Mueller, Valentin Ourry, Cassandre Palix, Léo Paly, Géraldine Poisnel, Anne Quillard, Alfredo Ramirez, Géraldine Rauchs, Florence Requier, Leslie Reyrolle, Ana Salinero, Eric Salmon, Lena Sannemann, Yamna Satgunasingam, Christine Schwimmer, Hilde Steinhauser, Edelweiss Touron, Denis Vivien, Patrik Vuilleumier, Cédrick Wallet, Tim Whitfield, and Janet Wingrove. Many people helped in implementing these projects. The authors would like to thank all the contributors listed in the Medit-Ageing Research Group as well as Rhonda Smith, Charlotte Reid, the sponsor (Pôle de Recherche Clinique at Inserm), Inserm Transfert (Delphine Smagghe), and the participants in the Medit-Ageing project. Please address any correspondence relating to the Medit-Ageing Research Group to the project lead Gaël Chételat (chetelat@cyceron.fr).

Table 1 Baseline demographic characteristics

	CMBAS (n = 73)	HSMP (n= 74)
Age, in years	72.1 (7.5)	73.2 (6.2)
Female, n (%)	47 (64.4%)	48 (64.9%)
Education, in years	13.9 (3.8)	13.4 (3.4)

Note. All variables are mean (standard deviation) unless otherwise specified. CMBAS = Caring Mindfulness-based Approach for Seniors; HSMP = Health Self-Management Programme.

Table 2 Descriptive statistics for well-being outcomes by group and visit based on all available data.

	CMBAS						**HSMP**					
	V1		V2		V3		V1		V2		V3	
Outcome	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)
PWBS												
Total	72	4.5 (1.2)	59	4.4 (1.3)	58	4.5 (1.2)	70	4.5 (1.2)	56	4.6 (1.3)	63	4.6 (1.2)
Autonomy	71	4.7 (1)	59	4.9 (1)	59	4.8 (0.9)	70	4.9 (0.9)	56	5.1 (0.9)	63	5.1 (0.9)
Environmental mastery	72	4.6 (1.5)	59	4.5 (1.7)	59	4.6 (1.6)	70	4.5 (1.5)	57	4.5 (1.6)	63	4.6 (1.5)
Personal growth	72	4.4 (1.3)	59	4.3 (1.3)	58	4.3 (1.3)	70	4.3 (1.3)	56	4.4 (1.4)	63	4.3 (1.3)
Positive relations	71	4.7 (1.5)	59	4.5 (1.6)	59	4.5 (1.6)	70	4.8 (1.5)	56	4.8 (1.6)	63	4.8 (1.5)
Purpose in life	72	4.3 (1.4)	59	4.2 (1.5)	58	4.3 (1.4)	70	4.2 (1.4)	56	4.2 (1.4)	63	4.3 (1.4)
Self-acceptance	72	4.4 (1.4)	59	4.3 (1.5)	59	4.4 (1.4)	70	4.5 (1.5)	56	4.5 (1.5)	63	4.5 (1.5)
Psychological QoL	71	21.6 (3.8)	59	22.3 (3.8)	59	22.2 (4.7)	69	22.3 (3.1)	58	22.7 (3.5)	62	22.9 (3.4)
Awareness												
MAIA noticing	72	3.0 (1.2)	59	3.1 (1.2)	59	3.2 (1.2)	69	2.8 (1.2)	58	3.1 (1.2)	61	2.9 (1.3)
MAIA attention regulation	71	2.6 (1.1)	59	2.8 (1.0)	59	2.7 (0.9)	67	2.8 (0.9)	56	2.8 (0.9)	62	2.9 (0.8)
MAIA emotional awareness	72	3.3 (1.1)	59	3.3 (1.1)	59	3.3 (1.1)	67	3.5 (1.0)	58	3.4 (1.1)	62	3.4 (1.1)
MAIA self-regulation	71	2.4 (1.1)	59	3.0 (1.1)	59	3.0 (1.0)	66	2.7 (1.0)	57	2.9 (1.0)	62	2.8 (1.0)
MAIA body listening	71	1.8 (1.2)	59	2.4 (1.0)	58	2.3 (1.0)	69	1.9 (1.2)	58	2.1 (1.2)	62	2.2 (1.1)
FFMQ observing	72	9.6 (2.6)	59	9.3 (2.2)	60	9.2 (2.6)	70	9.5 (2.7)	58	9.6 (2.7)	62	9.6 (2.8)
FFMQ act with awareness	72	10.3 (3.0)	59	10.2 (3.1)	59	10.0 (3.0)	70	10.6 (2.6)	58	10.5 (2.9)	62	11.0 (2.9)
Connection												
Compassionate Love Scale	71	89.5 (22.1)	58	89.2 (21.5)	59	86.9 (23.1)	70	95.2 (18.1)	58	92.2 (24.7)	62	90.0 (22.5)
Insight												
Drexel Defusion Scale	71	30.1 (8.3)	59	31.7 (9.7)	60	32.7 (8.3)	69	33.4 (8.4)	58	34.6 (6.7)	62	34.2 (7.0)
FFMQ non-judging	72	11.8 (2.8)	59	12.1 (2.6)	60	11.7 (3.0)	70	11.8 (2.5)	58	12.1 (2.6)	62	11.7 (3.0)
FFMQ non-reactivity	72	9.6 (2.9)	59	9.4 (3.1)	59	9.6 (2.5)	70	9.3 (3)	58	9.1 (2.9)	62	9.0 (2.8)

Note. PWBS = Psychological Well-being Scale; QoL = Quality of Life; SD = standard deviation; CMBAS = Caring Mindfulness-based Approach for Seniors; HSMP = Health Self-Management Programme; PWBS = Psychological Well-being Scale; QoL = quality of life; MAIA = Multidimensional Assessment of Interoceptive awareness; FFMQ = Five Facet Mindfulness Questionnaire.

Table 3 Results from mixed effects models assessing differential change in well-being outcomes

		Standardised estimated change		Difference in change CMBAS vs. HSMP	
Outcome	Time	CMBAS	HSMP	Mean (95% CI)	p
PWBS total	V1 to V2	0.02 (-0.11, 0.14)	0.05 (-0.07, 0.17)	0.03 (-0.11, 0.18)	0.638
	V1 to V3	0.01 (-0.12, 0.13)	0.09 (-0.03, 0.21)	0.08 (-0.06, 0.23)	0.253
Psychological QoL	V1 to V2	0.18 (-0.06, 0.43)	0.04 (-0.21, 0.29)	0.14 (-0.15, 0.44)	0.337
	V1 to V3	0.09 (-0.35, 0.17)	0.10 (-0.15, 0.34)	-0.002 (-0.29, 0.29)	0.990
Awareness	V1 to V2	0.17 (-0.07, 0.40)	0.10 (-0.15, 0.35)	0.08 (-0.22, 0.36)	0.628
	V1 to V3	0.05 (-0.19, 0.29)	0.14 (-0.10, 0.38)	-0.08 (-0.37, 0.20)	0.556
Connection	V1 to V2	0.20 (-0.02, 0.42)	-0.18 (-0.40, 0.04)	**0.38** (0.12, 0.64)	0.004
	V1 to V3	-0.01 (-0.22, 0.21)	-0.31 (-0.53, -0.10)	0.30 (0.05, 0.56)	0.020
Insight	V1 to V2	0.12 (-0.10, 0.35)	0.02 (-0.21, 0.25)	0.10 (-0.16, 0.37)	0.454
	V1 to V3	0.10 (-0.12, 0.33)	-0.04 (-0.26, 0.18)	0.14 (-0.12, 0.41)	0.284

Note. Only participants who provided data at all three time points were included in the analyses. All analyses were adjusted for baseline scores of the outcome. Estimates in bold were associated $p < 0.005$ (significance threshold adjusted using the Bonferroni correction for multiple testing). PWBS = Psychological Well-being Scale; QoL = Quality of Life; SCD = subjective cognitive decline; CI = confidence interval; CMBAS = Caring Mindfulness-based Approach for Seniors; HSMP = Health Self-Management Programme.

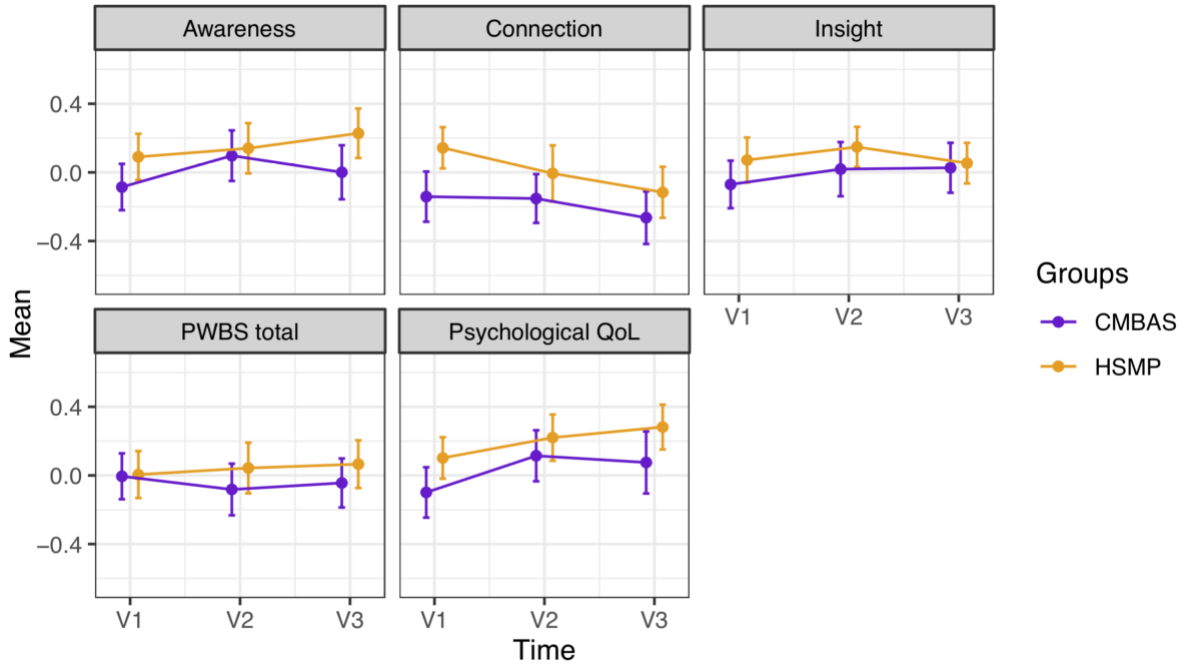

Figure 1. Longitudinal changes in meditation-based well-being composite scores (awareness, connection, insight), Psychological Well-being Scale (PWBS) total scores, and WHOQOL-BREF Psychological Quality of Life (QoL) by group (CMBAS = Caring Mindfulness-based Approach for Seniors, HSMP = Health Self-Management Programme). The figure displays observed standardised means and SEs (error bars = 1 SE) based on all available data.

Supplementary Material B

Table S1 Descriptions of the self-report measures included in the meditation-based well-being composites

The *Compassionate Love Scale* (CLS; stranger-humanity version) was used to measure compassion for others. Compassion can be conceptualised as a complex response to suffering – entailing affective, behavioural, and cognitive aspects – that, importantly, includes the intention to reduce suffering. The CLS comprises 21 items with a 7-point Likert scale anchored at 1 (not at all true of me) and 7 (very true of me). Total scales scores are computed by averaging the 21 item scores. Higher total scores reflect higher levels of compassion for others. The CLS has shown high levels of internal consistency (Cronbach's alpha = 0.95); however, a recent evaluation of the CLS recommended the use of a shorter 7-item version (i.e., COS-7).
The *Drexel Defusion Scale* (DDS) was used to measure levels of defusion, the capacity to psychologically distance oneself from subjective experiences including body sensations, thoughts, emotions and perceptions in general. To be in a state of defusion implies that the seemingly inherent reality commonly assigned to subjective experiences is, to a certain degree, softened, thus making other ways of relating to experience more accessible (e.g. seeing sensations and thoughts as mere phenomenological events or as "just a perception"). The DDS comprises 10 items with a 6-point Likert scale ranging from 0 (not at all) to 5 (very much). Total scores are derived by summing the 10 item scores. Higher total scores reflect a greater ability to defuse from subjective experience. The DDS has displayed good psychometric properties including adequate levels of internal consistency (Cronbach's alpha = 0.95).
The *39-item Five Facet Mindfulness Questionnaire* (FFMQ-39) was used to measure five trait-like facets of mindfulness, namely observing (noticing experiences), describing (labelling experiences), acting with awareness (attending to activities non-mechanically), non-judging (non-evaluative stance towards experiences), and non-reactivity (allowing experiences). The FFMQ-39 comprises one 7-item scale (non-reactivity) and four 8-item scales using a 5-point Likert scale anchored at 1 (never or very rarely true) and 5 (very often or always true). After reverse scoring some items, the subscale scores are derived by summing their respective item scores. Higher subscale scores are indicative of a greater tendency to display the mindfulness facets in daily life. The FFMQ subscales have demonstrated adequate psychometric properties including good internal consistency (Cronbach's alpha ranging from 0.75 to 0.91).
The *Multidimensional Assessment of Interoceptive Awareness* (MAIA) questionnaire was used to measure eight state-trait facets of interoceptive awareness, which describe the nervous system's ability to sense, interpret, and integrate signals produced within the body. The 32-item MAIA comprises eight subscales with a 6-point Likert scale anchored at 0 (*never*) and 5 (*always*): noticing (awareness of body sensations; 4 items), not-distracting (not ignoring uncomfortable sensations; 6 items), not-worrying (not distressed by uncomfortable sensations; 5 items), attention regulation (sustaining and controlling attention on sensations; 7 items), emotional awareness (awareness of connection between sensations and emotions; 5 items), self-regulation (regulating distress by attention to sensations; 4 items), body listening (listening to the body for insight; 3 items), and trusting (experiencing the body as safe; 3 items). After reverse scoring some items, subscale scores are computed by averaging their respective item scores. Higher subscale scores are indicative of greater interoceptive awareness accessible to self-report. The MAIA subscales have displayed satisfactory to good levels of internal consistency (Cronbach's alpha ranging from 0.64 to 0.83).

Table S2 Results from exploratory mixed effects models assessing differential change in PWBS dimensions

		Standardised estimated change		Difference in change CMBAS vs. HSMP	
Outcome	Time	CMBAS	HSMP	Mean (95% CI)	p
Autonomy	V1 to V2	0.22 (0.02, 0.42)	0.24 (0.03, 0.44)	0.01 (-0.22, 0.25)	0.907
	V1 to V3	0.09 (-0.10, 0.29)	0.22 (0.02, 0.41)	0.12 (-0.11, 0.36)	0.305
Environmental mastery	V1 to V2	0.01 (-0.13, 0.14)	0.03 (-0.07, 0.13)	0.02 (-0.14, 0.18)	0.784
	V1 to V3	-0.004 (-0.14, 0.13)	0.12 (-0.01, 0.26)	0.13 (-0.03, 0.28)	0.121
Personal growth	V1 to V2	0.02^{e-3} (-0.15, 0.16)	0.07 (-0.09, 0.23)	0.07 (-0.11, 0.26)	0.440
	V1 to V3	-0.02 (-0.18, 0.13)	0.05 (-0.10. 0.20)	0.07 (-0.11, 0.25)	0.438
Positive relations	V1 to V2	-0.02 (-0.15, 0.12)	-0.03 (-0.17, 0.11)	-0.01 (-0.18, 0.15)	0.875
	V1 to V3	-0.10 (-0.24, 0.04)	0.01 (-0.13, 0.14)	0.10 (-0.06, 0.27)	0.203
Self-acceptance	V1 to V2	-0.02 (-0.17, 0.12)	-0.01 (-0.16, 0.14)	0.02 (-0.16, 0.19)	0.858
	V1 to V3	0.01 (-0.13, 0.16)	0.04 (-0.11, 0.18)	0.02 (-0.15, 0.20)	0.792
Purpose in life	V1 to V2	-0.03 (-0.18, 0.12)	0.01 (-0.15, 0.16)	0.03 (-0.15, 0.21)	0.717
	V1 to V3	0.07 (-0.08, 0.22)	0.06 (-0.09, 0.20)	0.01 (-0.19, 0.16)	0.893

Note. Only participants who provided data at all three time points were included in the analyses. All analyses were adjusted for baseline scores of the outcome. PWBS = Psychological Well-being Scale; SCD = subjective cognitive decline; CI = confidence interval; CMBAS = Caring Mindfulness-based Approach for Seniors; HSMP = Health Self-Management Programme.

Table S3 Exploratory moderator analyses using linear regression models to predict change in well-being outcomes from pre- (V1) to post-intervention (V2)

Moderator	PWBS total	Psychological QoL	Awareness	Connection	Insight
CMBAS					
Session attendance	0.03 (-0.09, 0.15)	-0.02 (-0.23, 0.20)	0.01 (-0.26, 0.27)	**-0.40** (-0.65, -0.15)	0.09 (-0.19, 0.38)
Neuroticism at V1	-0.01 (-0.13, 0.11)	-0.14 (-0.34, 0.05)	-0.10 (-0.32, 0.12)	-0.05 (-0.25, 0.15)	-0.06 (-0.32, 0.20)
Outcome at V1	0.04 (-0.08, 0.16)	**-0.22** (-0.42, -0.02)	**-0.29** (-0.52, -0.07)	**-0.22** (-0.44, -4^{e-5})	**-0.28** (-0.53, -0.03)
HSMP					
Session attendance	0.02 (-0.08, 0.17)	0.21 (-0.20, 0.62)	0.19 (-0.28, 0.67)	**0.66** (0.21, 1.12)	-0.09 (-0.48, 0.29)
Neuroticism at V1	0.04 (-0.09, 0.17)	-0.17 (-0.39, 0.06)	0.15 (-0.13, 0.43)	0.16 (-0.07, 0.39)	-0.16 (-0.37, 0.05)
Outcome at V1	-0.02 (-0.14, 0.10)	-0.21 (-0.43, 0.02)	-0.15 (-0.41, 0.10)	-0.01 (-0.25, 0.23)	**-0.42** (-0.63, -0.21)

Note. All estimates are accompanied by their 95% confidence intervals. Estimates in bold were associated with $p < 0.05$. PWBS = Psychological Well-being Scale; QoL = quality of life; CMBAS = Caring Mindfulness-based Approach for Seniors; HSMP = Health Self-Management Programme.

4. Effects of an 18-month meditation training in healthy older adults

Abstract

Objectives: As the world population is ageing, it is vital to understand how older adults can maintain and deepen their psychological well-being as they are confronted with the unique challenges of ageing in a complex world. Theoretical work has highlighted the promising role of intentional mental training such as meditation practice for enhancing human flourishing. However, meditation-based randomised controlled trials in older adults are lacking. We aimed to investigate the effects of meditation training on psychological well-being in older adults.

Methods: This study presents a secondary analysis of the Age-Well trial (ClinicalTrials.gov: NCT02977819), which randomised 137 healthy older adults (age range: 65 to 84 years) to an 18-month meditation training, an active comparator (English language training), or a passive control. Well-being was measured at baseline, mid-intervention, and 18-month post-randomisation using the Psychological Well-being Scale (PWBS), the World Health Organisation's Quality of Life (QoL) Assessment psychological subscale, and composite scores reflecting the meditation-based well-being dimensions of awareness, connection, insight, and a global score comprising the average of these meditation-based dimensions.

Results: The 18-month meditation training was superior to English training on changes in the global score (0.54 [95% CI: 0.26, 0.82], p = 0.0002) and the subscales of awareness, connection, insight, and superior to no-intervention only on changes in the global score (0.54 [95% CI: 0.26, 0.82], p = 0.0002) and awareness. Between-group differences in psychological QoL in favour of meditation did not remain significant after adjusting for multiple comparisons. There were no between-group differences in PWBS total score. Within the meditation group, psychological QoL, awareness, insight, and the global score increased significantly from baseline to 18-month post-randomisation.

Conclusion: The longest randomised meditation training conducted to date enhanced a global composite score reflecting the meditation-based well-being dimensions of awareness, connection, and insight in older adults. Future research is needed to delineate the cognitive, affective, and behavioural factors that predict responsiveness to meditation and thus help refine the development of tailored meditation training.

*Keywords***:** meditation; well-being; quality of life; mindfulness; compassion; awareness

Introduction

We live in a complex society confronted with unprecedented existential risks and a growing mental health crisis unfolding across generations (Ehrlich & Ehrlich, 2013; Storm, 2021; Vahia et al., 2020; Wu et al., 2021). These complex challenges can disrupt established lifestyles and narratives and expose limitations in both personal and collective capacities for meaning-making (Koltko-Rivera, 2004; Park, 2010; Stein, 2019). The world population is ageing rapidly and older adults present a particularly vulnerable group during these challenging times (Chang et al., 2019; Desa, 2022; Zaninotto et al., 2022). The physical, social, and psychological difficulties associated with ageing are, today, compounded by the challenges of navigating a fast and uncertain world. Research conducted over the past decades suggested that older adults, despite the physical and cognitive changes associated with ageing, maintain high levels of well-being (Lee et al., 2019; Ryff, 1989b; Springer et al., 2011). However, changes over recent years (widespread use of smart phones/internet, COVID-19, geopolitical tensions, increased public awareness of existential risks [e.g., climate change]) might have introduced unique and as-of-yet insufficiently understood pressures on older adults' psychological well-being (see e.g., Ayalon et al., 2022; Vahia et al., 2020). For instance, recent research has indicated that, contrary to expectations expressed during the beginning of the COVID-19 pandemic (Vahia et al., 2020), older adults did not adapt well to the novel psychosocial stressors posed by the COVID-19 pandemic, reporting significant decreases in quality of life, insufficient sleep, and significant increases in the prevalence of depressive and anxiety symptoms (Bäuerle et al., 2020; Tull et al., 2020; Zaninotto et al., 2022). Moreover, the pandemic has led to an increase in the use of at least one psychotropic drug compared to pre-lockdown periods, further highlighting the profound impact of the pandemic on mental health (Vindegaard & Benros, 2020). Understanding how

older adults can maintain and deepen their psychological well-being amidst the perils of ageing in today's complex world presents a pertinent scientific and cultural question.

Over the past decades, research and theory on psychological well-being has aimed to offer answers by understanding the conditions that predict and constitute psychological well-being (Diener et al., 1999; Huppert, 2009; Ryff, 2014). Psychological well-being is a multidimensional construct. The possibilities and range of human flourishing are deep and wide (VanderWeele, 2017). Naturally, the conceptions of well-being that have been introduced tended to emphasise different dimensions of human flourishing. In addition to this differentiation, recent theoretical work has increasingly conceptualised psychological well-being as a trainable skill that can be cultivated by specific practices (Dahl et al., 2020). The cultivation of inner flourishing and the alleviation of suffering have been central tenets of the Greco-Roman philosophical schools as well as Buddhist meditative traditions for millennia but only recently have researchers begun to explicitly synthesise these contemplative perspectives with contemporary scientific models of well-being (Dahl et al., 2015, 2020; Lutz et al., 2021).

Particularly Buddhist meditation practices and secular forms of meditation practice derived from Buddhist traditions, including types of mindfulness and loving-kindness and compassion practices, have received a substantial amount of scientific and popular attention (Fox et al., 2016; Goyal et al., 2014; Khoury et al., 2017; Sedlmeier et al., 2012; Van Dam et al., 2018). Despite this interest and the notable increase in publications on meditation practices, little is known about how these forms of mental training may contribute to human flourishing. Another noteworthy lacuna is the striking lack of research on the effects of meditation training in ageing populations (see Goldberg et al., 2022). The assumption that well-being is a skill that can be trained not only during periods of seemingly heightened plasticity but across the entire lifespan warrants empirical investigation and suggests that

older adults could have the potential to meaningfully enhance their well-being through specific practices (Chételat et al., 2018; Dahl et al., 2020; Klimecki et al., 2019; Lutz et al., 2021).

Other important questions of this nascent research field regard the impact of specific meditation practices and the delineation of those well-being dimensions that are particularly amenable to meditation training. Similarly, there is a need for research comparing the utility of meditation training-based theories of human flourishing to prominent scientific models of well-being whose development has not been informed by contemplative perspectives. No line of research or theory can address these complex questions single-handedly. To that end, we employed well-being outcomes that were based on three distinct models of human flourishing: Ryff's theory of well-being (Ryff, 1989a), the World Health Organisation's model of quality of life (QoL; The Whoqol Group, 1998), and the mental training-based framework for well-being developed by Dahl et al. (2020).

Ryff (1989) proposed a theoretical framework for contemporary scientific perspectives on human flourishing that could unify the largely data-driven and atheoretical research on well-being that had been conducted in this area. Ryff aimed to identify the fundamental dimensions of positive functioning that characterise what it means to be psychologically well. This work proposed six dimensions of well-being, namely self-acceptance, positive relations with others, autonomy (independence), environmental mastery (ability to manage life's demands), purpose in life, and personal growth (sense of developing and growing; 31). Ryff's theory, its accompanying questionnaire (i.e., the 42-item Psychological Well-being Scale; Ryff et al., 1995), and the vast body of empirical work it generated have significantly shaped the field of well-being research over the past decades (Diener et al., 2018; Ryff, 2014).

The World Health Organisation (WHO) conceptualises quality of life as an aspect of well-being that reflects “individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns” (The Whoqol Group, 1998). Focused on a holistic, cross-cultural approach to health care, the WHO’s work in this area underscores the notion that health is a subjective state of physical and psychological well-being, not simply the absence of disease (The Whoqol Group, 1998). The widely used WHO Quality of Life (WHOQOL) assessment includes a psychological domain, which aims to reflect levels of self-esteem, positive feelings (e.g., sense of meaningfulness) and body image, negative feelings (e.g., anxiety), and concentration abilities (i.e., a lack of mind-wandering and distraction, which are associated with lower levels of well-being [see Killingsworth & Gilbert, 2010]).

Dahl et al.’s (20) mental training-based theory of well-being draws on neuroscientific, psychological, and contemplative perspectives on human flourishing. This model includes a skill-based conception of the well-being dimensions of awareness, connection, and insight. In this framework, awareness can be defined as a heightened, malleable, and undistracted attentiveness to one’s lived experience (including thoughts, feelings, and sensations). Connection encompasses a felt sense of kinship, empathy, gratitude, and understanding toward others that forms the foundation for meaningful interactions and relationships. Insight describes the experiential understanding of how thoughts, feelings, and worldviews contribute to the shaping of one’s perception of self and world (Dahl et al., 2015, 2020; Lutz et al., 2015).

In a recent randomised controlled trial of an 8-week mindfulness-based intervention in older adults at heightened risk of dementia (Schlosser, Demnitz-King, et al., 2022), we used outcome measures derived from Ryff’s (Ryff, 1989a), the WHO’s (The Whoqol Group, 1998), and three dimensions of Dahl et al.’s (Dahl et al., 2020) models of well-being (i.e.,

awareness, connection, insight) and found only limited effects. The mindfulness-based intervention was superior to its active comparator (health self-management programme) only on changes in connection at post-intervention, but, in both groups, none of the well-being measures indicated an increase. We concluded that longer intervention studies with waitlist control groups are required to assess if the limited effects could be due to the interventions' brevity (i.e., 8 weeks) or small base rate changes in well-being in older adults (Schlosser, Demnitz-King, et al., 2022). In contrast to the previous 8-week trial, the present study includes a longer meditation training period (i.e., 18 months), two specific training modules (mindfulness, loving-kindness and compassion), a no-intervention control group, and a different population (i.e., healthy older adults).

We aimed to compare the effects of an 18-month meditation training for older adults on measures of psychological well-being reflective of the three approaches introduced above to a structurally matched English training and a no-intervention condition. These comparisons present a secondary analysis of the Age-Well randomised controlled trial, in which the primary outcomes (mean change in volume and perfusion of the anterior cingulate cortex and insula from pre- to post-intervention) were not significantly modified by the 18-month intervention (Chételat et al., 2022). Whereas the primary outcome paper only provided data from two time points (i.e., baseline and post-intervention) and compared the meditation group only to the English training group, the present study also presents data from mid-intervention at 9 months, thus offering (i) a more fine-grained analysis of the trajectories of these outcomes in relation to the mindfulness module and loving-kindness and compassion module, (ii) a comparison between the meditation training and no-intervention, and (iii) and a description of the specificity of the newly developed meditation-based composite score (i.e., assessing its trajectory compared those of two established measures of well-being).

In line with prior theory (Dahl et al., 2020; Lutz et al., 2021), we hypothesised *a priori* that meditation training would cultivate awareness, connection, and insight, and thus, more broadly, also the forms of well-being captured by the PWBS and the WHO's psychological QoL subscale. We expected these changes in well-being during the meditation training to be superior to English training and no-intervention. We also predicted that during the two-module meditation training, the initial 9-month mindfulness module would primarily train the meditation-based well-being dimensions of awareness and insight, whereas the subsequent 9-month loving kindness and compassion module would primarily cultivate connection. These hypotheses are based on a model of meditation and ageing developed by the European Medit-Ageing Project (Lutz et al., 2021). In this model, mindfulness practices are hypothesised to enhance psychological well-being by training attentional control, emotion regulation, and meta-cognitive capacities, thereby weakening maladaptive mental schemes and enabling more emotionally balanced states. Compassion practices in this model are hypothesised to enhance well-being by training perspective taking and cognitive reappraisal, fostering caring expressions, perceptions of kinship, and prosocial behaviour. These practices, whether directed towards the self or others, are expected to reduce social stress reactivity through an empathy-based resilience. In this framework, mindfulness and compassion practices have distinct and overlapping mechanisms for improving well-being. Both train meta-awareness and attention control, yet mindfulness practices primarily downregulate maladaptive mental patterns by increasing the malleability, flexibility, and availability of different views and interpretations. Compassion and loving-kindness practices, in contrast, primarily manifest their salutary impact via the upregulation of positive emotions, caring attitudes, and benevolent intentions for self and others. The combination of these practices within a single meditation-based intervention is hypothesised to optimise and synergise the effects of meditation training on older adults (Lutz et al., 2021). Furthermore,

we aimed to assess the potential moderating effects of total amount of practice, responsiveness, expectancy, baseline, sex, cognition, and baseline well-being scores.

Methods

This study used longitudinal data from the Age-Well randomised controlled trial of the European Union's Horizon 2020-funded Medit-Ageing European project (public name: Silver Santé Study). The published trial protocol includes detailed information on intervention design, recruitment procedure, eligibility criteria, and assessments (Poisnel et al., 2018). The present study presents a secondary analysis of the Age-Well trial.

Study design

Age-Well was a monocentric, randomised, controlled superiority clinical trial targeting mental health and well-being in older adults. The three parallel arms comprise a two-module (i.e. mindfulness, and loving-kindness and compassion) 18-month meditation training, a structurally matched 18-month foreign language (English) training, and a passive no-intervention control condition. Participants in the no-intervention group were asked to not engage in meditation or foreign language training during the 18-month period. Randomisation to one of the three groups was performed at a ratio of 1:1:1. Participants were assessed at three visits: pre-intervention at baseline (V1), mid-intervention at 9 months (V2), and post-intervention at 18 months (V3). The primary outcomes of the Age-Well trial, mean change in volume and perfusion of the anterior cingulate cortex and insula from pre- to post-intervention, are reported elsewhere (Chételat et al., 2022).

The intervention was delivered in Caen (France). Written informed consent was obtained from all participants after the procedures had been explained to them and prior to participation. Age-Well received ethics approval from the Comité de Protection des Personnes CPP Nord-Ouest III in Caen (trial registration number: EudraCT: 2016-002441-36; IDRCB: 2016-A01767-44; ClinicalTrials.gov Identifier: NCT02977819). The Age-Well

trial has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Participants

A total of 137 participants were randomised. Two participants were excluded from the trial after randomisation: one participant presented with amyotrophic lateral sclerosis and one participant had previously experienced a head trauma with loss of consciousness for more than one hour. Another participant died before the end of the trial. The present study thus included data from 134 cognitively unimpaired, older adults (age range: 65 to 78 years [meditation]; 65 to 84 years [English training]; 65 to 75 years [no-intervention]), who had no major neurological or psychiatric disorder, no present or past regular or intensive practice of meditation, were native French speakers, were retired for at least one year, and had completed at least seven years of formal education (Table 1).

Interventions

Meditation training

The 18-month meditation training consisted of weekly group sessions (2 hours), daily home practice (≥20 minutes), and one retreat day that involved 5 hours of practice. Informed by existing meditation-based interventions (for details see Poisnel et al., 2018), the meditation training included two 9-month modules that were specifically designed for Age-Well with a focus on developing mindfulness, kindness, and compassion to support healthy ageing and to skilfully meet the physical and psychological challenges associated with ageing. The first 9-month module of the intervention emphasised the training of mindfulness practices, whereas the subsequent 9-month module emphasised the cultivation of loving-kindness and compassion practices.

English language training

The English language training followed the same format and structure as the meditation training, and was matched in administration, duration, and dosage of group meetings and home practice. English training (for French native speakers) consisted of exercises aimed at improving participants' vocabulary and grammatical skills and their application to reading, writing, and speaking. Whereas the meditation training was expected to exert effects on both cognitive control and emotion regulation, the English training was hypothesised to affect cognitive control only.

Measures of well-being

The 42-item *Psychological Well-being Scale* (PWBS; Ryff et al., 1995) was used to capture psychological well-being. The PWBS is based on a conceptual model of well-being that includes six dimensions: self-acceptance, positive relations with others, autonomy (independence), environmental mastery (ability to manage life's demands), purpose in life, and personal growth (sense of developing and growing; Ryff, 1989a). A 7-item subscale with a 7-point Likert scale anchored at 1 (strongly agree) and 7 (strongly disagree) is used to measure each dimension. After reverse scoring 21 items, subscale scores were computed by averaging their respective item scores. The total PWBS score was computed by averaging all items. For all scales, higher scores are indicative of higher levels of psychological well-being. Internal consistency of the PWBS subscales has been low to moderate (Cronbach's alpha ranging from 0.33 to 0.56; Ryff et al., 1995).

The *World Health Organization WHOQOL-BREF Quality of Life Assessment* (The Whoqol Group, 1998) psychological subscale was used to capture psychological quality of life. The WHOQOL-BREF psychological subscale measures levels of positive feelings (e.g., sense of meaningfulness) and body image, self-esteem, the ability to concentrate, and the lack of negative feelings (e.g., anxiety). The 6-item psychological subscale uses a 5-point Likert scale ranging from 0 (not at all) to 5 (completely). After reverse scoring one item, subscale

scores were computed by summing the six item scores. Higher subscale scores reflect higher levels of psychological quality of life. The WHOQOL-BREF psychological subscale has displayed good levels of internal consistency (Cronbach's alpha = 0.81; The Whoqol Group, 1998).

To capture the meditation-based well-being dimensions of awareness, connection, and insight introduced by Dahl et al. (2015, 2020), we used three previously developed composite scores of meditation-based psychological capacities. Detailed information on the theory-guided development and psychometric properties of these composites have been published (Schlosser, Barnhofer, et al., 2022). In addition, a global composite score captured the dimensions of awareness, connection, and insight to an equal extent. These composite scores have already been reported as secondary outcomes within the primary outcome paper of the Age-well study (Chételat et al., 2022). The estimates and p-values presented here slightly differ from the primary outcome paper because the models here used data from all three time points (V1, V2, V3), whereas the primary outcome paper used data from only two time points (V1, V3). Here, we report additional data (i) comparing the trajectories of these composite scores between the mindfulness module and loving-kindness and compassion module (i.e., presenting data from mid-intervention at 9 months), (ii) comparing the meditation training to no-intervention, and (iii) assessing potential moderating effects on the composite scores (see below for a presentation of the potential moderator variables). These additional analyses are exploratory and, therefore, not controlled for multiple comparisons. The three composite scores comprise scales or subscales from six self-report measures (see Table 2), which are described in Supplementary Table S1.

To derive the three composites of meditation-based dimensions of well-being, we first reverse-scored scale scores if lower total scores reflected better functioning so that higher composite scores would indicate higher well-being at all time points. Second, we computed

the difference between each scale score at each time point and the baseline pooled mean. Third, we divided these differences by the baseline pooled standard deviation. Fourth, the z-scores of the scales that were assigned to each composite were averaged, yielding three composite scores with a baseline mean of 0 and a standard deviation smaller than one. A global score was computed by averaging the three composite scores. Fifth, to simplify the interpretation of longitudinal data, we re-standardised the composite scores so that within- and between-group changes in the composite scores present changes in standard deviation units.

Statistical analyses

Sample size

Sample size calculations were based on an expected effect size of 0.75 with 80% power and a Bonferroni-corrected two-sided type I error of 1.25% for the two primary outcomes (i.e., the mean change in volume and perfusion of the anterior cingulate cortex from pre- to post-intervention between the meditation and passive control group), resulting in a minimum total number of 126 participants (42 per group), which has been exceeded (n = 137; detailed in Poisnel et al., 2018).

Comparative analyses

To evaluate between-group and within-group differences in mean changes in outcomes, we used one mixed effects linear regression model for each outcome including data from all time points, an interaction term between visit and group, and controlling for baseline scores of the outcome. Positive (negative) estimates of mean between-group differences in changes indicate greater (lower) changes in well-being in the meditation group. Missing data were not replaced and assumed to be missing-at-random. Participant data were not excluded based on very high or low scale scores. Analyses of the well-being outcomes not previously published (i.e., PWBS total scores, psychological QoL) were adjusted for

multiple comparison (Bonferroni correction for multiple testing). Exploratory analyses of PWBS subscales and meditation module-specific effects on composite scores (i.e., from V1 to V2 and V2 to V3) were not adjusted for multiple comparison.

To allow for an effect size comparison with previously published meditation-based interventions, we also reported the unstandardised mean change in FFMQ total scores from V1 to V2 and V1 to V3. The FFMQ is a gold standard indicator of the efficacy of meditation-based interventions.

To assess the potential moderating effect on well-being within meditation and English, we used linear regression models with change in well-being scores from V1 to V3 as the outcome and the potential moderator variables as the predictors. Moderator variables included total amount of practice (i.e., combined time spent in class and formal home practice), responsiveness (i.e., combining self-perceived and teacher-rated response to the intervention), expectancy ("How much do you think will the intervention have positively impacted your well-being after 18 months?"), baseline neuroticism (measured by the neuroticism subscale of the 44-item Big Five Inventory (John & Srivastava, 1999), sex, cognition (measured by the Preclinical Alzheimer's Cognitive Composite 5 (Papp et al., 2017), and baseline scores of the well-being outcome. Additional details of variables included in the moderation analysis can be found in Supplementary Table S2. R version 4.0.2 and Stata/MP version 16.0 was used for statistical analysis.

Results

Demographic characteristics are displayed in Table 1. Descriptive statistics of well-being outcomes are reported in Table 2 and visualised in Figure 1 (based on all available data). Results from mixed effects regression models evaluating differential change in well-being outcomes are displayed in Table 3 (based on all participants who provided data at V1, V2, and V3).

PWBS

The differences in the mean PWBS total score changes over 18 months between meditation and English training (Cohen's d: -0.10 [95% CI: -0.37, 0.18]) or no-intervention (-0.11 [95% CI: -0.38, 0.17]) were not statistically significant (p = 0.48 and p = 0.44, respectively). PWBS total scores did not change during meditation, English training, and no-intervention (Table 3).

Exploratory analyses suggested that across PWBS dimension, PWBS self-acceptance increased over 18 months within English training (0.24 [95% CI: 0.02, 0.47], p = 0.033). No other PWBS dimension changed during meditation, English training, and no-intervention (Supplementary Table S3).

Psychological QoL

Differences in the mean psychological QoL changes over 18 months in favour of meditation compared to English training (Cohen's d: 0.36 [95% CI: 0.03, 0.69], p = 0.037) and no-intervention (0.34 [95% CI: 0.01, 0.68], p = 0.045) were found. However, these differences were not statistically significant after adjusting for multiple comparisons (Bonferroni-corrected significance threshold of $p < 0.025$). We suggest that the effect sizes of these between-group differences are nonetheless meaningful. Post-hoc analyses indicated that meditation increased psychological QoL (0.25 [95% CI: 0.01, 0.48], p = 0.041), whereas English training (-0.11 [95% CI: -0.35, 0.13], p = 0.362) and no-intervention did not (-0.10 [95% CI: -0.33, 0.14], p = 0.423).

Meditation-based well-being dimensions

Meditation was superior on changes in awareness to English training (Cohen's d: 0.41 [95% CI: 0.13, 0.69], p = 0.0045) and no-intervention (0.58 [95% CI: 0.29, 0.86], p = 0.0001). For connection, differences were observed in the mean changes in favour of meditation compared to English training (0.30 [95% CI: 0.04, 0.56], p = 0.024) but not

compared to no-intervention (0.22 [95% CI: -0.04, 0.48], p = 0.101). Similarly, for insight, differences were found in the mean changes in favour of meditation compared to English training (0.31 [95% CI: 0.04, 0.58], p = 0.026) but not compared to no-intervention (0.22 [95% CI: -0.05, 0.49], p = 0.113). Meditation was superior on changes in global meditation composite scores to both English training (0.54 [95% CI: 0.26, 0.82], p = 0.0002) and no-intervention (0.54 [95% CI: 0.26, 0.82], p = 0.0002; Table 3).

A frequently used indicator of the efficacy of meditation-based interventions is the mean change in FFMQ total scores. In Age-Well, meditation did not increase FFMQ total scores from V1 to V2 (unstandardised estimate: -0.09 [95% CI: -1.76, 1.94], p = 0.993) or V1 to V3 (1.58 [95% CI: -0.27, 3.43], p = 0.112).

In the meditation group, exploratory analyses assessing the differential effects of the two meditation training modules indicated that the initial 9-month mindfulness module did not significantly increase awareness, connection, insight, or global scores (Table 4, Figure 1), whereas the subsequent 9-month loving kindness and compassion module significantly improved awareness (Cohen's d: 0.25 [95% CI: 0.01, 0.49], p = 0.034) and global scores (0.38 [95% CI: 0.14, 0.62], p = 0.001). Meditation training was superior to no-intervention only on changes in awareness and global scores during the subsequent 9-month loving kindness and compassion module (i.e., V2 to V3; Table 4).

Moderator analyses

Exploratory moderator analyses were conducted within meditation and English training groups to evaluate the relationship between baseline characteristics and intervention response over 18 months.

In the meditation group, higher baseline scores of PWBS total, psychological QoL, awareness, insight, and global scores were associated with weaker improvements over 18 months. In the English training group, sex and higher baseline scores of PWBS total,

psychological QoL, and awareness were associated with weaker improvements in PWBS total, psychological QoL, and awareness over 18 months. Total amount of practice, responsiveness, and expectancy, neuroticism, and cognition did not consistently moderate the intervention response in either group. Results from the moderator analyses are displayed in Supplementary Table S4.

Discussion

The longest randomised meditation training conducted to date enhanced a global composite score reflecting the meditation-based well-being dimensions of awareness, connection, and insight in older adults. We utilised three theory-based conceptions of well-being (Dahl et al., 2020; Ryff, 1989a; The Whoqol Group, 1998) to test the effects of the longest randomised meditation training to date on psychological well-being in healthy older adults. The 18-month meditation training was superior to English training on changes in awareness, connection, insight, and global scores (comprising awareness, connection, and insight) and superior to no-intervention only on changes in awareness and global scores. Compared to English training and no-intervention, the differences in the mean changes in psychological QoL over 18 months also favoured the meditation training but these between-group differences in change did not remain significant when adjusting for multiple comparisons. There was no evidence for between-group differences in PWBS total score. Post-hoc analyses indicated that within the meditation group, psychological QoL, awareness, insight, and global scores increased significantly over 18 months, whereas none of the well-being outcomes improved within the English training or no-intervention group. Importantly, however, the within-group effect of meditation training on psychological QoL could also have been due to a regression to the mean as raw psychological QoL scores in the meditation group were substantially lower at baseline (and remained lower post-intervention) than those in the English training and no-intervention groups.

Our predictions regarding the differential effects of the 9-month mindfulness module and the subsequent 9-month loving kindness and compassion module meditation-based well-being dimensions (awareness, connection, insight, global) could only be partially confirmed. Exploratory analyses without correction for multiple comparison indicated that the mindfulness module did not significantly increase any of the meditation-based well-being dimensions, although awareness was impacted to a degree that could be deemed meaningful (Cohen's d = 0.23). One potential explanation is that the 9-month mindfulness module was not long or intense enough to significantly improve meditation-based well-being dimensions in older adults who have never meditated regularly before. The loving-kindness and compassion module, which we expected to exert its most notable effect on connection, significantly increased awareness and global scores while also showing a substantial but non-significant impact on connection and insight (all Cohen's ds > 0.20). Taken together, in terms of effect sizes, awareness showed a steady increase across both modules, whereas connection, insight, and global scores increased only during the loving-kindness and compassion module. Importantly, our study design does not allow us to conclude that training in loving-kindness and compassion practices is more beneficial for increasing psychological well-being in older adults than mindfulness training, because the prior mindfulness training could have facilitated the impact of the loving-kindness and compassion module. Future dismantling trials with varying trainings are needed to understand potential practice order and interaction effects.

Nonetheless, our results suggest that the duration of meditation training may not be linearly related to improvement in well-being (i.e., a linear dose-response relationship). More frequent sampling of outcome measures of interest during longitudinal studies will help elucidate different trajectories of change for different types of outcomes and meditation practices. Another potential explanation relates to challenging meditation-related experiences that can commonly occur in novice meditators (Lindahl et al., 2017; Schlosser et al., 2019;

Sparby, 2022; but see also Anālayo, 2020b, 2021) and which might have contributed to the unexpected trajectories of connection (i.e., substantial decline) and insight (i.e., no change) during the first nine months of meditation training. Unfortunately, we cannot evaluate to what extent meditation-related difficulties contributed to these counterintuitive results. Although we captured general adverse events in both trials, we did not include a fine-grained, standardised assessment of difficulties that were particularly related to the practice of meditation.

Exploratory moderator analyses indicated that, in line with previous research (Schlosser, Demnitz-King, et al., 2022) and theory (e.g., Rosenkranz et al., 2019), participants who reported higher levels of psychological well-being at baseline showed a smaller improvement in well-being during the 18-month meditation training (except for connection). Older adults who are psychologically well at baseline seem to benefit less from meditation training than older adults with lower self-rated well-being. This finding, however, might not be specific to meditation training but rather reflective of a general baseline dependence of training outcomes evident in a wide variety of interventions (Vet et al., 2015). Future work is needed to also assess the degree to which this pattern reflects potential ceiling effects associated with the measures we employed. The current gold standard measures of well-being were not conceived (and thus might not sufficiently capture) the forms, qualities, and depth of well-being that can potentially be cultivated by long-term meditation training (e.g., meditative absorptions [Pali: jhanas], see Anālayo, 2020a; Arbel, 2017; Burbea, 2014; Hagerty et al., 2013).

Notably, higher responsiveness did not consistently predict higher improvements on well-being outcomes during the 18-month meditation training. In other words, those participants whose overall response to the meditation training was perceived by both themselves and their meditation teachers as beneficial did not report greater increases in well-

being dimensions than those for whom the impact of the intervention was perceived as less favourable. Furthermore, the total amount formal meditation practice (in class and at home), neuroticism, expectancy, sex, and cognition also did not moderate the effects of the meditation training on well-being measures. In addition, it is worth highlighting that the meditation group consisted of more female participants (68.9%) than the English (55.6%) and no-intervention groups (59.1%). This larger ratio of female participants in the meditation-based group is consistent with our previous 8-week multinational trial (i.e., 64.4%; 39). Although the literature on differential sex-related responsiveness to meditation training is under-investigated and equivocal (Katz & Toner, 2013), some studies indicate that female practitioners show a greater response to meditation training (Rojiani et al., 2017). Although the sex imbalance of the present study could have potentially influenced the effects of the intervention on psychological well-being, our moderator analysis did not support this conclusion. Identifying more cognitive, affective, and behavioural factors that can predict positive responses to meditation training remains an important domain for future research as this line of investigation has the potential to substantially impact the development, refinement, and effectiveness of tailored meditation training.

Two more surprising findings are noteworthy. First, connection actually decreased during the first 9 months of English training and no-intervention. A similar pattern was found in the aforementioned SCD-Well trial (Schlosser, Demnitz-King, et al., 2022) in which compassion for others, which was used as a proxy measure for connection, significantly declined within the active comparator group (health self-management programme) over a 6-month period (i.e., from pre-intervention to follow-up). Second, in the present study, 18 months of meditation training had no impact on FFMQ total scores, which, despite its limitations (see Lutz et al., 2015), is the current 'gold standard' measure of mindfulness and commonly used as a marker of MBIs' efficacy. In the light of the substantial effects of the

18-month meditation training on other meditation-based dimensions of well-being, this surprising lack of an effect on FFMQ scores further corroborates doubts surrounding the widely used questionnaire's validity (see Lutz et al., 2015; Van Dam et al., 2018).

The Age-Well trial has important strengths. The 18-month meditation training substantially surpasses the shorter-term meditation training periods of previous trials, which have not exceeded several months (Goyal et al., 2014) and represent the largest meditation-based intervention in older adults conducted to date. The meditation intervention followed a manualised training paradigm that was tailored to the needs of older adults and included two training modules to assess the differential effects of specific practices. Acknowledging the strengths and limitations of previous work, we included a theory-based active comparator alongside a no-intervention control, and utilised three distinct theoretical models of well-being to capture diverse dimensions of human flourishing.

The Age-Well trial also has several limitations. Our sample comprised mostly well-educated, healthy participants that were recruited from a single geographic location, whose cultural, economic, and social characteristics may not be representative of other regions, limiting the generalisability of our results to populations of older adults with more demographically diverse compositions. Furthermore, we used previously published composite scores of meditation-based psychological capacities to reflect the well-being dimensions of Dahl et al.'s training-based framework for human flourishing (Dahl et al., 2020). These self-report scales were designed to capture trait-level individual differences and may be less sensitive to measuring process-level aspects of meditation-based well-being dimensions. Furthermore, the study's reliance on self-reported data may have introduced a degree of bias, as participants' responses could have been influenced by their perceptions, memory, or understanding of the questions. Lastly, the present study did not present follow-

up data that could assess the trajectory of psychological well-being beyond the intervention period.

Taken together, our findings suggest that meditation training meaningfully impacted select dimensions of psychological well-being (most notably awareness and insight) in healthy older adults, and that these changes were not captured by established standard measures of well-being. Meditation-based interventions could present a promising non-pharmacological approach for the cultivation and enhancement of human flourishing amidst the challenges of ageing in today's complex world.

Future directions

We would like to propose several considerations for future work in this area. Beyond the assessment of specific forms of meditation practice and their mechanisms, we recommend assessing meditators' intentions for practice and other contextual factors (Condon, 2019; Condon & Makransky, 2020). The range of intentions for practice is likely wider than the therapeutic, medical, or even soteriological goals hitherto acknowledged by the science of meditation. Intentions, and a meditator's relationship to their intentions, might be crucially important for sustaining longer-term meditative training, for deepening meditative skills, and for realising the most desired benefits (e.g., specific states and traits, transformations of perception). In support of this idea, recent evidence showed that combining ethical teachings on virtuous human qualities with mindfulness training led to higher levels of prosocial behaviour than mindfulness training that did not involve such discussions (S. Chen & Jordan, 2020). In general, it will be pertinent for the field to identify and characterise additional factors – including teacher-student relations, the worldviews embedding meditation practices (Lutz et al., 2007; Vörös, 2021), and prior psychedelic experience (Griffiths et al., 2018; Simonsson et al., 2023; Smigielski et al., 2019) – that could predict and potentially augment the effects of meditation training.

Moreover, another layer of complexity is added to meditation research if we consider that a certain meditation instruction could induce different experiences for different practitioners, or for that matter, the same practitioner at different times. Despite advances in quantifying the effects of meditation practice in psychological and physiological terms, the science of meditation lacks insight into what it is like to meditate. Therefore, whenever possible, we suggest complementing the triangulation aimed at understanding the correlates of meditative states and the effects of meditation training on well-being with first-person phenomenological methods (Lutz et al., 2015; Petitmengin et al., 2019; Poletti et al., 2021; Varela & Shear, 1999). Relatedly, scientific theories of meditation that are informed by nuanced meditation training paradigms (e.g., see Burbea, 2014; Sparby, 2022) and the lived experience and perceptual skills of long-term meditators will be essential for the maturation of meditation research. It remains to be discussed whether, and to what extent, intensive meditation training for meditation researchers can support this maturation.

Conclusion

Taken together, this study suggests that longer-term meditation training can enhance important dimensions of psychological well-being in healthy older adults and could thus present a promising non-pharmacological approach for the cultivation of human flourishing. While this finding presents an important contribution to our understanding of the potential of meditation training for enhancing well-being in older adults, there is much more to explore. As we continue this line of research, it will be essential to adopt an interdisciplinary approach that integrates insights from gerontology, psychology, biology (e.g., biomarkers including telomere length), neuroscience, and contemplative studies, and that carefully considers the complexities and nuances of the ageing process. By doing so, future research can further contribute to the development of interventions that support older adults in navigating the challenges of ageing and flourishing in later life.

Acknowledgments

The Medit-Ageing Research Group includes: Claire André, Florence Allais, Julien Asselineau, Eider Arenaza-Urquijo, Sebastian Baez, Martine Batchelor, Axel Beaugonin, Maelle Botton, Pierre Champetier, Anne Chocat, Nina Coll, Sophie Dautricourt, Pascal Delamillieure, Vincent De La Sayette, Marion Delarue, Harriet Demnitz-King, Yacila I. Deza-Araujo, Titi Dolma, Stéphanie Egret, Francesca Felisatti, Eglantine Ferrand-Devouges, Eric Frison, Francis Gheysen, Agathe Joret Philippe, Elizabeth Kuhn, Brigitte Landeau, Gwendoline Ledu, Valérie Lefranc, Maria Leon, Florence Mezenge, Inès Moulinet, Theresa Mueller, Valentin Ourry, Cassandre Palix, Léo Paly, Géraldine Poisnel, Anne Quillard, Géraldine Rauchs, Florence Requier, Eric Salmon, Lena Sannemann, Christine Schwimmer, Edelweiss Touron, Denis Vivien, Patrik Vuilleumier, Cédrick Wallet, and Tim Whitfield. The authors would like to thank all the contributors listed in the Medit-Ageing Research Group as well as Rhonda Smith, Charlotte Reid, the sponsor (Pôle de Recherche Clinique at Inserm), Inserm Transfert (Delphine Smagghe), and the participants in the Medit-Ageing project.

Table 1 Demographic characteristics

	Meditation (n = 45)	English training (n = 45)	No intervention (n = 44)
Age, years	69.5 (3.7)	70.3 (4.5)	67.6 (2.5)
Female, n (%)	31 (68.9%)	25 (55.6%)	26 (59.1%)
Education, years	13.1 (3.1)	12.2 (3.0)	14.3 (2.8)

Note. All variables are mean (standard deviation) unless otherwise specified.

Table 2 Descriptive statistics for well-being outcomes by group and visit based on all available data.

	Meditation						**English training**						**No intervention**					
	Pre		Mid		Post		Pre		Mid		Post		Pre		Mid		Post	
Outcome	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)
PWBS																		
Total	45	5.4 (0.6)	45	5.3 (0.7)	45	5.3 (0.7)	45	5.3 (0.7)	45	5.4 (0.7)	45	5.4 (0.7)	44	5.6 (0.6)	44	5.5 (0.6)	44	5.6 (0.6)
Autonomy	45	5.2 (0.8)	45	5.1 (0.7)	45	5.2 (0.7)	45	5.2 (1.0)	45	5.3 (1)	45	5.2 (0.9)	44	5.3 (0.9)	44	5.4 (0.8)	44	5.5 (0.8)
Environmental mastery	45	5.6 (1.0)	45	5.5 (1)	45	5.5 (1.0)	45	5.7 (1.0)	45	5.7 (0.9)	45	5.7 (1.0)	44	5.9 (0.7)	44	5.7 (0.7)	44	5.9 (0.7)
Personal growth	45	5.5 (0.8)	45	5.5 (0.9)	44	5.4 (0.9)	45	5.4 (1.0)	45	5.4 (1)	45	5.1 (0.8)	44	5.7 (0.9)	44	5.7 (0.8)	44	5.5 (0.8)
Positive relations	45	5.7 (0.9)	45	5.5 (1)	45	5.7 (0.9)	45	5.6 (1.0)	45	5.5 (1.1)	45	5.6 (1.0)	44	5.6 (0.9)	44	5.6 (0.9)	44	5.7 (0.9)
Purpose in life	45	5.5 (0.7)	45	5.2 (0.9)	45	5.3 (0.8)	45	5.3 (0.8)	45	5.3 (0.8)	45	5.2 (0.8)	44	5.5 (0.8)	44	5.4 (0.8)	44	5.6 (0.8)
Self-acceptance	45	5.0 (1.0)	45	5 (1)	45	5.0 (1.0)	45	4.9 (1.0)	45	5 (1)	45	5.2 (1.0)	44	5.4 (0.9)	44	5.2 (0.9)	44	5.4 (0.7)
Psychological QoL	45	22.8 (3.1)	-	-	45	23.6 (3.4)	45	24.0 (3.4)	-	-	45	23.6 (3.3)	-	24.1 (3.1)	-	-	44	23.8 (3.0)
Awareness																		
MAIA noticing	45	3.1 (1.2)	45	3.4 (1.1)	45	3.5 (0.9)	45	3.3 (1.1)	45	3.6 (1.1)	45	3.5 (1.0)	44	3.6 (1.1)	44	3.4 (1)	44	3.4 (1.1)
MAIA attention regulation	45	2.7 (1.0)	45	3.1 (0.8)	45	3.4 (0.8)	45	2.8 (0.9)	45	2.9 (0.8)	45	3.0 (0.7)	44	3.0 (0.9)	44	2.9 (0.9)	44	2.9 (0.9)
MAIA emotional awareness	45	3.5 (1.0)	45	3.5 (1)	45	3.8 (0.9)	45	3.5 (1.0)	45	3.5 (0.9)	45	3.6 (0.9)	44	3.4 (1.1)	44	3.6 (1)	44	3.3 (1.0)
MAIA self-regulation	45	3.1 (0.9)	45	3.4 (0.9)	45	3.7 (0.8)	45	3.2 (1.0)	45	3.2 (1)	45	3.4 (0.8)	44	3.0 (1.1)	44	3.3 (1)	44	3.0 (1.0)
MAIA body listening	44	2.3 (1.2)	45	2.8 (1.2)	45	3.2 (1.0)	45	2.7 (1.2)	45	2.7 (1.2)	45	2.7 (1.1)	44	2.5 (1.2)	44	2.7 (1.2)	44	2.5 (1.2)
FFMQ observing	45	9.4 (2.9)	45	9.5 (2.8)	45	9.4 (2.6)	45	8.8 (2.9)	45	8.5 (2.7)	45	9.0 (3.0)	44	10.3 (2.9)	44	9.9 (3.3)	44	9.9 (2.9)
FFMQ act with awareness	45	11.6 (2.1)	45	11 (2.4)	45	11.6 (2.2)	45	11.8 (2.2)	45	11.7 (2.4)	45	11.2 (2.3)	44	11.8 (2.3)	44	12 (2.1)	44	11.8 (2.2)
Connection																		
Compassionate Love Scale	45	92.8 (22.1)	45	95.6 (19.8)	45	98.2 (18.8)	45	88.6 (21.7)	45	85.5 (22.6)	45	85.2 (22.7)	44	90.3 (20.0)	44	90.7 (20.4)	44	89.1 (20)
IRI empathic concern	45	19.4 (4.8)	45	19.4 (4.6)	45	19.4 (4.4)	45	20.2 (4.0)	45	19.6 (3.9)	45	19.1 (4.6)	44	19.9 (4.0)	44	19 (4)	44	18.7 (3.7)
IRI perspective taking	45	17.8 (3.6)	45	17.5 (3.3)	45	17.9 (3.9)	45	16.8 (3.8)	45	16.5 (3.4)	45	16.5 (2.9)	44	17.8 (3.0)	44	17.1 (4.3)	44	17.5 (2.8)
Prosocialness Scale	45	61.8 (7.6)	45	57.3 (9.3)	45	60.6 (9.4)	45	60.1 (7.3)	45	54.7 (10.4)	45	58.2 (10.7)	44	59.1 (9.7)	44	55.7 (10.3)	44	58.3 (7.7)
Insight																		
Drexel Defusion Scale	45	34.4 (5.7)	45	33.5 (6.3)	45	34.6 (6.4)	45	33.8 (5.8)	45	34.1 (6.9)	45	34.0 (7.1)	44	35.1 (5.4)	44	35.4 (7)	44	35.5 (5.7)
FFMQ non-judging	45	11.1 (2.7)	45	11.3 (2.6)	45	11.2 (2.5)	45	11.7 (1.9)	45	11.4 (2.1)	45	11.6 (2.4)	44	12.1 (2.3)	44	12.1 (2.2)	44	12.2 (1.8)
FFMQ non-reactivity	45	9.2 (2.4)	45	9.8 (2.4)	45	10.5 (2.5)	45	9.7 (2.0)	45	9.7 (2)	45	9.3 (2.1)	44	10.3 (2.3)	44	9.9 (2.6)	44	10.0 (2.3)
IRI personal distress[1]	45	18.4 (5.0)	45	18.3 (4.6)	45	18.9 (5.1)	45	17.0 (5.0)	45	17.2 (5.2)	45	17.4 (5.4)	44	18.0 (5.8)	44	18.5 (5.2)	44	18.7 (4.6)

Note. PWBS = Psychological Well-being Scale; QoL = Quality of Life; SD = standard deviation; CMBAS = Caring Mindfulness-based Approach for Seniors; HSMP = Health Self-Management Programme; PWBS = Psychological Well-being Scale; QoL = quality of life; MAIA = Multidimensional Assessment of Interoceptive Awareness; FFMQ = Five Facet Mindfulness Questionnaire.

[1]Here, higher scores indicate lower levels of distress.

Table 3 Results from mixed effects models assessing differential change in well-being outcomes

		Standardised estimated change			Difference in change Meditation vs. English training		Difference in change Meditation vs. No-intervention	
Outcome	Time	Meditation	English training	No-intervention	Mean (95% CI)	p	Mean (95% CI)	p
PWBS total[1]	V1 to V3	-0.06 (-0.29, 0.17)	0.04 (-0.20, 0.27)	0.05 (-0.19, 0.28)	-0.10 (-0.37, 0.18)	0.482	-0.11 (-0.38, 0.17)	0.441
Psychological QoL[1]	V1 to V3	0.25 (0.01, 0.48)	-0.11 (-0.35, 0.13)	-0.10 (-0.33, 0.14)	0.36 (0.02, 0.69)	0.037	0.34 (0.01, 0.68)	0.045
Awareness	V1 to V3	0.48 (0.25, 0.72)	0.08 (-0.16, 0.31)	-0.09 (-0.33, 0.15)	0.41 (0.13, 0.69)	**0.0045**	0.58 (0.29, 0.86)	**0.0001**
Connection	V1 to V3	0.04 (-0.18, 0.26)	-0.26 (-0.48, -0.04)	-0.18 (-0.40, 0.05)	0.30 (0.04, 0.56)	**0.024**	0.22 (-0.04, 0.48)	0.101
Insight	V1 to V3	0.27 (0.05, 0.50)	-0.03 (-0.26, 0.20)	0.05 (-0.18, 0.29)	0.31 (0.04, 0.58)	**0.026**	0.22 (-0.05, 0.49)	0.113
Global[2]	V1 to V3	0.43 (0.19, 0.67)	-0.11 (-0.35, 0.12)	-0.11 (-0.35, 0.13)	0.54 (0.26, 0.82)	**0.0002**	0.54 (0.26, 0.82)	**0.0002**

Note. Only participants who provided data at all three time points were included in the analyses. All analyses were adjusted for baseline scores of the outcome. CI = confidence interval; PWBS = Psychological Well-being Scale; QoL = quality of life.

[1]These analyses used a significance threshold of 0.025 adjusted using the Bonferroni correction for multiple testing.

[2]The global composite score reflects the mean score of awareness, connection, and insight.

Table 4 Results from exploratory mixed effects models assessing differential change in meditation-based well-being composite scores in the meditation group by training module compared to no-intervention

		Meditation	No-intervention	Difference in change Meditation vs. No-intervention	
Outcome	Time / module[1]	Mean (95% CI)		Mean (95% CI)	p
Awareness	V1 to V2	0.23 (-0.01, 0.47)	0.08 (-0.15, 0.32)	0.15 (-0.13, 0.43)	0.303
	V2 to V3	**0.25** (0.01, 0.49)	-0.18 (-0.41, 0.06)	**0.43** (0.15, 0.71)	0.003
Connection	V1 to V2	-0.17 (-0.39, 0.05)	**-0.27** (-0.49, -0.05)	0.10 (-0.16, 0.36)	0.455
	V2 to V3	0.21 (-0.01, 0.43)	0.09 (-0.13, 0.32)	0.12 (-0.14, 0.38)	0.370
Insight	V1 to V2	0.06 (-0.17, 0.29)	0.01 (-0.22, 0.24)	0.05 (-0.22, 0.32)	0.713
	V2 to V3	0.22 (-0.01, 0.45)	0.05 (-0.18, 0.28)	0.17 (-0.10, 0.44)	0.224
Global[2]	V1 to V2	0.05 (-0.19, 0.29)	-0.09 (-0.33, 0.14)	0.14 (-0.13, 0.43)	0.305
	V2 to V3	**0.38** (0.14, 0.62)	-0.02 (-0.26, 0.22)	**0.40** (0.12, 0.68)	0.006

Note. All analyses were adjusted for baseline scores of the outcome. CI = confidence interval. Estimates in bold were associated with $p < 0.05$.

[1]V1 to V2 corresponds to the 9-month mindfulness module. V2 to V3 corresponds to the 9-month loving kindness and compassion module.

[2]The global composite score reflects the mean score of awareness, connection, and insight.

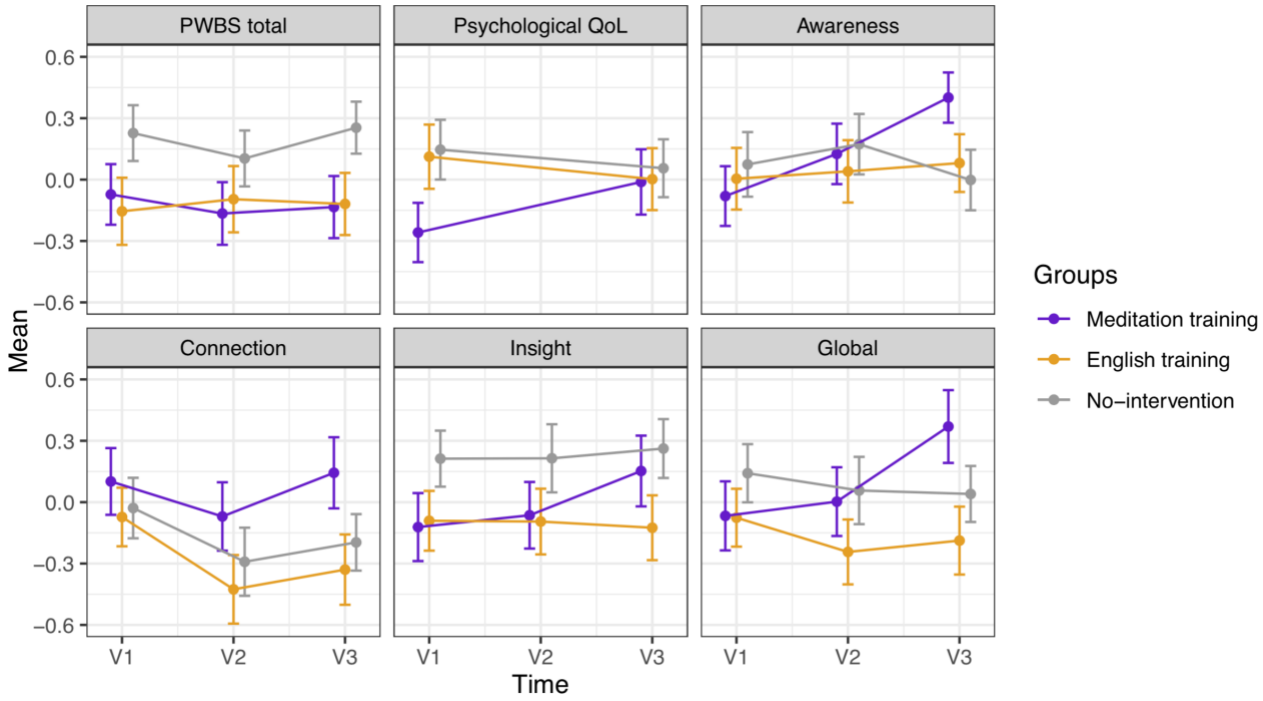

Figure 1. 18-month longitudinal changes in Psychological Well-being Scale (PWBS) total scores, and WHOQOL-BREF Psychological Quality of Life (QoL), and meditation-based well-being composite scores (awareness, connection, insight, global) by group. In the meditation group, pre- to mid-intervention (V1 to V2) corresponds to the 9-month mindfulness module, and mid- to post-intervention (V2 to V3) corresponds to the loving kindness and compassion module. The figure displays observed standardised means and SEs (error bars = 1 SE) based on all available data.

Supplementary Material C

Table S1 Descriptions of the self-report measures included in the meditation-based well-being composites

The *Compassionate Love Scale* (CLS; stranger-humanity version) was used to measure compassion for others. Compassion can be conceptualised as a complex response to suffering – entailing affective, behavioural, and cognitive aspects – that, importantly, includes the intention to reduce suffering. The CLS comprises 21 items with a 7-point Likert scale anchored at 1 (not at all true of me) and 7 (very true of me). Total scales scores are computed by averaging the 21 item scores. Higher total scores reflect higher levels of compassion for others. The CLS has shown high levels of internal consistency (Cronbach's alpha = 0.95); however, a recent evaluation of the CLS recommended the use of a shorter 7-item version (i.e., COS-7).
The *Drexel Defusion Scale* (DDS) was used to measure levels of defusion, the capacity to psychologically distance oneself from subjective experiences including body sensations, thoughts, emotions and perceptions in general. To be in a state of defusion implies that the seemingly inherent reality commonly assigned to subjective experiences is, to a certain degree, softened, thus making other ways of relating to experience more accessible (e.g. seeing sensations and thoughts as mere phenomenological events or as "just a perception"). The DDS comprises 10 items with a 6-point Likert scale ranging from 0 (not at all) to 5 (very much). Total scores are derived by summing the 10 item scores. Higher total scores reflect a greater ability to defuse from subjective experience. The DDS has displayed good psychometric properties including adequate levels of internal consistency (Cronbach's alpha = 0.95).
The *39-item Five Facet Mindfulness Questionnaire* (FFMQ-39) was used to measure five trait-like facets of mindfulness, namely observing (noticing experiences), describing (labelling experiences), acting with awareness (attending to activities non-mechanically), non-judging (non-evaluative stance towards experiences), and non-reactivity (allowing experiences). The FFMQ-39 comprises one 7-item scale (non-reactivity) and four 8-item scales using a 5-point Likert scale anchored at 1 (never or very rarely true) and 5 (very often or always true). After reverse scoring some items, the subscale scores are derived by summing their respective item scores. Higher subscale scores are indicative of a greater tendency to display the mindfulness facets in daily life. The FFMQ subscales have demonstrated adequate psychometric properties including good internal consistency (Cronbach's alpha ranging from 0.75 to 0.91).
The *Multidimensional Assessment of Interoceptive Awareness* (MAIA) questionnaire was used to measure eight state-trait facets of interoceptive awareness, which describe the nervous system's ability to sense, interpret, and integrate signals produced within the body. The 32-item MAIA comprises eight subscales with a 6-point Likert scale anchored at 0 (*never*) and 5 (*always*): noticing (awareness of body sensations; 4 items), not-distracting (not ignoring uncomfortable sensations; 6 items), not-worrying (not distressed by uncomfortable sensations; 5 items), attention regulation (sustaining and controlling attention on sensations; 7 items), emotional awareness (awareness of connection between sensations and emotions; 5 items), self-regulation (regulating distress by attention to sensations; 4 items), body listening (listening to the body for insight; 3 items), and trusting (experiencing the body as safe; 3 items). After reverse scoring some items, subscale scores are computed by averaging their respective item scores. Higher subscale scores are indicative of greater interoceptive awareness accessible to self-report. The MAIA subscales have displayed satisfactory to good levels of internal consistency (Cronbach's alpha ranging from 0.64 to 0.83).

The *Interpersonal Reactivity Index* (IRI) was used to measure empathic tendencies. The IRI comprises four 7-item scales using a 5-point Likert scale ranging from A (does not describe me well) to E (describes me very well). The four scales capture four facets of empathy, namely perspective taking (adopting another's view), empathic concern (feelings of sympathy for others), fantasy (transposing oneself into fictitious characters' experience), and personal distress (feelings of unease in interpersonal dynamics). After converting the letters A-E to 0-4 and reverse scoring some items, scale scores are derived by summing their respective item scores. Higher scale scores reflect higher levels of empathic tendencies and lower personal distress. The IRI scales have shown adequate internal consistency (Cronbach's alpha ranging from 0.75 to 0.82).

The *Prosocialness Scale* was used to measure individual differences in prosocialness including sharing, helping, and taking care of others' needs. The scale comprises 16 items with a 5-point Likert scale anchored at 1 (never/almost never true) and 5 (almost always/always true). Total scores are derived by averaging the 16 item scores. Higher total scores reflect higher levels of prosocialness. The Prosocialness Scale has demonstrated good levels of internal consistency (Cronbach's alpha of 0.91).

Table S2 Details of additional measures included in moderation analysis

Responsiveness We assessed whether and to what degree participants responded to the interventions using data gathered from both participants and teachers. For the meditation training group, a continuous measure of responsiveness was computed by combining standardised scores from two domains: (i) meditation teachers' ratings of participants' response to the intervention and (ii) participants' perceived response to the intervention. Teachers were asked to rate the extent to which they believed each participant benefited from the intervention using a Likert scale ranging from 0 (not at all) to 5 (very much) in addition to rating their perception of participants' levels of connection, positive emotions, negative emotions, and meta-awareness. Participants were asked to rate the levels of connection, positive emotions, negative emotions, and meta-awareness they experienced during the sessions and in daily life. To create the continuous measure of responsiveness for participants in the meditation group, the two teacher-rated and the two participant-rated scores were each standardised and averaged to create a one teacher and one participant score. These two scores, in turn, were then averaged and re-standardised to yield a single responsiveness score with a mean of 0 and a standard deviation of 1. For the English training group, a continuous measure of responsiveness was computed by combining standardised scores from two domains: (i) change from V1 to V3 on an English test and (ii) teacher ratings of participants' response to the intervention. To create a continuous measure of responsiveness for participants in the English training group, both subscores were first standardised using the relevant means and standard deviations. The two standardised domain scores were then averaged and re-standardised create the final responsiveness variable, with a mean of 0 and standard deviation of 1.
Expectancy The question assessing expectancy was adapted from the Credibility Expectancy Questionnaire, a self-report six-item questionnaire aimed at assessing intervention credibility and expectancy for improvement. The question measuring expectancy ("A combien pensez-vous que sera l'impact positif sur votre bien-être après l'intervention de 18 mois?"; English translation: "How much do you think will the intervention have positively impacted your well-being after 18 months?") used a Likert scale ranging from 0% (not at all) to 100% (very much).
Cognition as measured by the Preclinical Alzheimer's Cognitive Composite 5 (PACC-5) The PACC-5 is a global cognitive composite used to detect and track cognitive decline related to pre-clinical Alzheimer's disease (AD). The PACC-5 captures episodic memory, executive function, semantic memory, and global cognition. In Age-Well, the PACC-5 included the Logical Memory test (delayed recall), California Verbal Learning Test (CVLT; delayed free recall), Wechsler Adult Intelligence Scale (WAIS)-IV Coding (raw score), category fluency (total correct) and the Mattis Dementia Rating Scale-2 (total score).

Table S3 Results from exploratory mixed effects models assessing differential change in PWBS dimensions

		Standardised estimated change			Difference in change Meditation vs. English training		Difference in change Meditation vs. No intervention	
Outcome	Time	Meditation	English training	No intervention	Mean (95% CI)	p	Mean (95% CI)	p
Autonomy	V1 to V3	0.04 (-0.22, 0.29)	0.09 (-0.17, 0.34)	0.15 (-0.10, 0.41)	-0.05 (-0.35, 0.25)	0.743	-0.12 (-0.42, 0.18)	0.442
Environmental mastery	V1 to V3	-0.08 (-0.33, 0.16)	0.02 (-0.23, 0.26)	0.09 (-0.16, 0.33)	-0.10 (-0.39, 0.19)	0.489	-0.17 (-0.46, 0.12)	0.241
Personal growth	V1 to V3	-0.10 (-0.38, 0.18)	-0.24 (-0.52, 0.04)	-0.23 (-0.51, 0.04)	0.14 (-0.19, 0.47)	0.404	0.14 (-0.19, 0.46)	0.418
Positive relations	V1 to V3	0.02 (-0.23, 0.27)	0.08 (-0.17, 0.33)	0.09 (-0.17, 0.34)	-0.06 (-0.36, 0.23)	0.678	-0.07 (-0.36, 0.23)	0.664
Self-acceptance	V1 to V3	0.05 (-0.18, 0.28)	**0.24** (0.02, 0.47)	0.05 (-0.17, 0.28)	-0.19 (-0.46, 0.08)	0.159	-0.004 (-0.27, 0.27)	0.977
Purpose in life	V1 to V3	-0.23 (-0.55, 0.09)	-0.07 (-0.39, 0.25)	0.05 (-0.28, 0.37)	-0.16 (-0.54, 0.22)	0.415	-0.28 (-0.66, 0.10)	0.153

Note. Only participants who provided data at all three time points were included in the analyses. All analyses were adjusted for baseline scores of the outcome. Estimates in bold were associated $p < 0.05$. CI = confidence interval; PWBS = Psychological Well-being Scale.

Table S4 Exploratory moderator analyses using linear regression models to predict change in well-being outcomes from V1 to V3

Moderator	PWBS total	Psychological QoL	Awareness	Connection	Insight	Global
Meditation						
Practice	0.06 (-0.19, 0.31)	0.04 (-0.23, 0.31)	0.11 (-0.1, 0.33)	0.11 (-0.13, 0.35)	0.02 (-0.22, 0.26)	0.13 (-0.16, 0.42)
Responsiveness	0.2 (-0.09, 0.49)	**0.37** (0.07, 0.66)	**0.24** (0.001, 0.48)	0.02 (-0.24, 0.28)	0.09 (-0.17, 0.35)	0.19 (-0.13, 0.51)
Expectancy	0.04 (-0.22, 0.29)	-0.18 (-0.47, 0.1)	0.04 (-0.18, 0.27)	0.07 (-0.18, 0.32)	-0.03 (-0.29, 0.22)	0.06 (-0.24, 0.36)
Neuroticism at V1	-0.17 (-0.41, 0.07)	-0.23 (-0.48, 0.01)	0.03 (-0.16, 0.22)	-0.09 (-0.3, 0.12)	-0.22 (-0.53, 0.09)	-0.18 (-0.48, 0.12)
Sex (female)	0.03 (-0.47, 0.53)	-0.29 (-0.88, 0.29)	-0.11 (-0.54, 0.31)	0.04 (-0.49, 0.58)	-0.23 (-0.72, 0.25)	-0.01 (-0.6, 0.58)
Cognition	0.15 (-0.2, 0.49)	0.13 (-0.24, 0.5)	-0.02 (-0.32, 0.28)	-0.08 (-0.41, 0.24)	0.17 (-0.17, 0.51)	0.11 (-0.28, 0.51)
Outcome at V1	**-0.42** (-0.71, -0.13)	**-0.5** (-0.8, -0.21)	**-0.59** (-0.81, -0.37)	-0.19 (-0.43, 0.05)	**-0.37** (-0.68, -0.07)	**-0.4** (-0.68, -0.11)
English training						
Practice	0.03 (-0.27, 0.32)	0.2 (-0.16, 0.57)	-0.02 (-0.32, 0.29)	0.03 (-0.24, 0.3)	-0.05 (-0.33, 0.24)	-0.05 (-0.37, 0.27)
Responsiveness	0.16 (-0.05, 0.37)	**0.3** (0.03, 0.56)	0.01 (-0.21, 0.23)	0.12 (-0.08, 0.31)	0.18 (-0.05, 0.41)	0.21 (-0.02, 0.44)
Expectancy	0.1 (-0.11, 0.3)	-0.08 (-0.33, 0.18)	-0.04 (-0.25, 0.17)	-0.07 (-0.25, 0.11)	0.01 (-0.2, 0.21)	-0.08 (-0.3, 0.14)
Neuroticism at V1	-0.14 (-0.42, 0.14)	-0.04 (-0.4, 0.31)	-0.07 (-0.31, 0.18)	-0.08 (-0.3, 0.14)	-0.3 (-0.6, 0.01)	-0.19 (-0.46, 0.09)
Sex (female)	**-0.52** (-1.03, -0.01)	**-0.78** (-1.37, -0.2)	**-0.52** (-1.02, -0.02)	-0.25 (-0.68, 0.18)	-0.39 (-0.86, 0.08)	**-0.66** (-1.18, -0.14)
Cognition	0.21 (-0.27, 0.7)	0.32 (-0.29, 0.92)	0.56 (0.05, 1.08)	0.06 (-0.39, 0.51)	0.12 (-0.36, 0.6)	0.44 (-0.1, 0.97)
Outcome at V1	**-0.3** (-0.52, -0.07)	**-0.51** (-0.79, -0.22)	**-0.29** (-0.5, -0.09)	0.02 (-0.18, 0.22)	-0.28 (-0.57, 0.01)	-0.15 (-0.4, 0.1)

Note. All estimates are accompanied by their 95% confidence intervals. Estimates in bold were associated with $p < 0.05$. PWBS = Psychological Well-being Scale; QoL = quality of life.

5. Development and validation of the 7-item Compassion for Others Scale

Abstract

Objectives: An increasing body of scientific research on the nature, correlates, and effects of compassion has accrued over recent years. Expert agreement has not yet been reached on the conceptualisation of compassion for others, and existing self-report measures of compassion for others have often lacked psychometric quality and content validity. Recent publications of longer compassion measures represent significant strides towards ameliorating these issues. However, there is a need for psychometrically sound short scales for measuring compassion in time-constrained research settings. To meet this need, one can assess the psychometric qualities of existing scales in order to develop robust short adaptations of such scales.

Methods: Study 1 (N = 501) empirically assessed the psychometric properties of the widely cited Compassionate Love Scale (CLS) to validate a new short scale of compassion for others (strangers) comprised of items from the CLS – the 7-item Compassion for Others Scale (COS-7). Study 2 (N = 332) addressed the absence of a German measure of compassion for others by validating a German version of the COS-7.

Results: The CLS did not display adequate model fit. Both the English and German versions of the COS-7 demonstrated adequate model fit, factor loadings, internal consistency, interpretability, convergent/divergent validity, and no floor/ceiling effects.

Conclusion: Findings provide support for the English and German versions of the COS-7 as adequate short scales for measuring compassion for others. The German COS-7 is the first German measure of compassion for others published to date.

Keywords: compassion; self-report measure; questionnaire; psychometric validation; meditation; COS-7

Introduction

Compassion is a core element of many contemplative traditions and a wide range of professions spanning the domains of education, justice, and health care (Dahlsgaard et al., 2005; Ricard, 2015). Compassion is a complex construct uniting caring motivations, social intelligences, and context-dependent emotional textures that can be in reference to oneself and others (Gilbert, 2019; Khoury, 2019). Over recent years, compassion has become a major focus of empirical inquiry and vivid conceptual debates in research on prosocial behaviour (e.g., Klimecki, 2019; Seppälä et al., 2017). In general, compassion is understood as a response to suffering, which entails the desire to alleviate suffering (Goetz et al., 2010). Many dictionary definitions of compassion abound, yet there is a lack of consensus on the core characteristics defining compassion and the relationship of compassion with related constructs such as empathy, which denotes the sharing of feelings. For example, some researchers conceptualise compassion as a form of empathy (e.g., Klimecki & Singer, 2013). Others suggest that empathy can be viewed as a domain of compassion (see Strauss et al., 2016) and that affective states are not a necessary condition for compassion (e.g., Gilbert, 2019). Neuroscientific evidence indicates that compassion and empathy are associated with activations in different brain regions (Klimecki et al., 2014).

Compassion for others has been related to higher levels of happiness and well-being, and lower levels of depressive symptoms and some forms of burnout (Gu et al., 2020; Mongrain et al., 2011). However, some research has found inconsistent associations between compassion and other psychological constructs. For instance, several studies found no association between compassion for others and self-compassion, well-being (Durkin et al., 2016), or depressive symptoms (López et al., 2018). A variety of compassion-based interventions have been developed including Compassion Focused Therapy (Gilbert, 2014), Mindful Self-Compassion (Neff & Germer, 2013), and Cognitively-Based Compassion

Training (Pace et al., 2009). Preliminary evidence supports their ability to promote compassion and to positively affect a range of mental health-related outcomes (Gilbert, 2009; see Kirby et al., 2017). These promising findings, however, should be evaluated in the context of ongoing debates around the conceptualisations and measurement of compassion. These caveats are not unlike those encountered in concurrent debates surrounding psychological constructs that are equally difficult to define, operationalise, and capture (e.g., mindfulness; see Van Dam et al., 2018).

Recent efforts have been made to dispel the conceptual mist surrounding the construct of compassion by delineating affective, behavioural, and cognitive aspects that could allow it to be theoretically and statistically distinguished from closely related constructs such as empathy, sympathy, altruism, and kindness. For instance, a recent review has consolidated a variety of existing psychological and Buddhist definitions and identified the following five domains of compassion: (1) recognising suffering, (2) understanding the universality of suffering, (3) feeling concern and empathy for the individual who is suffering, (4) tolerating the personal distress caused by another's suffering, and (5) being motivated to act to alleviate suffering (Strauss et al., 2016). Informed by previous work using this five-element definitional framework (Gu, Cavanagh, Baer, & Strauss, 2017), Gu et al. (2020) developed two new 20-item self-report scales capturing compassion for others and for self, respectively (Sussex-Oxford Compassion Scales; Gu, Baer, Cavanagh, Kuyken, & Strauss, 2020). Another recent study developed and validated the 16-item Compassion Scale (Pommier, Neff, & Tóth-Király, 2020) using the pool of 24 compassion items originally developed by Pommier (2010). This measure of compassion for others was derived from Neff's theoretical framework for self-compassion, which comprises the dimensions of emotional response, cognitive understanding, and paying attention to personal suffering (Neff, 2003). The development of these compassion scales presents a promising step toward establishing a pool

of gold standard instruments that researchers can draw from. Importantly, however, there is still a need for shorter measures of compassion for others, which could be used in time-constrained research settings. To meet this need, the present investigation assessed the psychometric properties of one of the most highly cited self-report measure of compassion, namely the 21-item Compassionate Love Scale (CLS; Sprecher & Fehr, 2005), to validate a psychometrically robust short scale of compassion for others derived from the item pool of the CLS. The nascent field of compassion research has been marked by heterogeneity in defining and measuring compassion, which has made direct between-study comparisons difficult (Strauss et al., 2016). A short, psychometrically robust compassion measure that can be administered across research settings would present an important contribution to the available pool of compassion scales.

The CLS is a 21-item measure with two scale versions intended to capture levels of compassion (i) towards close others or (ii) towards strangers and humanity, respectively. The original item generation of the CLS was theoretically informed by previous work on love and spiritual experiences (Hendrick & Hendrick, 1986; Underwood, 2002) as well as prototype perspectives on love (Fehr & Russell, 1991). As part of a review of the content validity and psychometric quality of all published self-report measures of compassion (Strauss et al., 2016), the CLS was rated to have only partially adequate content validity and partially satisfactory reliability and convergent validity. In a related study, expert groups reviewed the face validity of the 21 CLS items and concluded that four items should be removed as they were inadequate indicators of compassion (Gu et al., 2017). Further, three scale items use the word ‘compassion’ or ‘compassionate’. By only using the word ‘compassion’ without combining it with other psycho-affective terms to capture the latent construct of compassion, one unwarrantedly assumes that individuals understand and define compassion uniformly. A shortened 5-item version of the CLS (Santa Clara CLS; Hwang et al., 2008) and 9-item

version of the CLS (CLS-H-SF; Chiesi et al., 2020), which were developed to measure compassion towards strangers and humanity only, include three and four of these conceptually problematic items, respectively. Psychometrically, the CLS development and validation study (Sprecher & Fehr, 2005) did not propose an *a priori* factor structure, conduct a confirmatory factor analysis, report factor loadings, or assess or report model fit indices. In the light of its prominent role in shaping the body of compassion research to date, it is important to conduct further psychometric assessment of the CLS. While there are potentially meaningful conceptual distinctions between compassion and compassionate love (Strauss et al., 2016), the definition of compassion chosen within the context of the present investigation is informed by the five-element definitional framework introduced above (Gu et al., 2017; Strauss et al., 2016) in so far as compassion is a feeling of care for the suffering of someone accompanied by the motivation to help to alleviate this suffering.

Since the publication of the CLS (Sprecher & Fehr, 2005), researchers have witnessed substantial advances in structural equation modelling approaches including factor analysis (Kline, 2015), an increased availability and accessibility of sophisticated statistical software, and a higher uptake of these methods and tools by researchers. It is particularly important to highlight that the assessment of the factor structure and the associated model fit – commonly based on confirmatory factor analysis or related approaches (e.g., exploratory structural equation modelling) – has become a requirement in best practice guidelines for scale development and validation procedures (Kline, 2015). Without an adequate model fit of the hypothesised factor structure, the interpretation of any estimates derived from the model as well as the correlational or causal association of the scale scores with other measures is unwarranted.

To properly contextualise the present studies, two important points bear repeating: first, there is evidence that the CLS – one of the most frequently employed self-report

measures in compassion research – has limitations when it comes to measuring compassion for others (strangers); and second, compassion research – as any established research field – requires a wide pool of psychometrically robust measures including shorter measures applicable to use in time-constrained research settings. Furthermore, no validated German measure of compassion for others has been published to date.

Study 1

The purpose of Study 1 was to (1) assess the psychometric properties of the CLS for others (strangers) in a large, international community sample; and to (2) validate a short, psychometrically robust measure of compassion for others comprised of select items from the CLS.

Methods

Procedures

This study collected cross-sectional data using an anonymous online survey. The online platform Prolific (see Palan & Schitter, 2018) was used to recruit participants. Individuals were informed that the survey intended to further the scientific understanding of the relationship between compassion, subjective experiences, and social behaviour. A minimum age of 18 years and a good understanding of the English language were the inclusion criteria. Before starting the survey, individuals were asked to indicate whether they have read and understood the explanations and to voluntarily indicate written consent to participate in this study. The survey took approximately 8 minutes to complete and participants were reimbursed with £0.90. All data were collected in June 2019. The study and consent procedures of Study 1 were approved by University College London's research ethics committee (ref no: 10043/002) and performed in line with the Declaration of Helsinki. Prolific verifies and monitors participants and data quality with extensive checks (see Peer et al., 2017). We assessed the standard deviation of each participant's item responses on a given

survey page. Each of the four self-report measures was displayed on a separate survey page. We detected no participants who consistently indicated the same response for each item (i.e., SD = 0) on more than two measures (i.e., 50% of survey). We followed Jackson's (Jackson, 2001) recommendation to recruit at least 200 participants for confirmatory factor analysis with maximum likelihood estimation. A total of 516 individuals from the general population started the survey. Fifteen participants did not complete the CLS and were excluded. Thus, data from 501 participants were included in the analyses. Most participants (n = 384) were asked to provide demographic details and complete measures of compassion, prosocialness, empathy, and social value orientation. Inter-correlations of these measures were computed using data from these participants. The remaining participants (n = 117) were asked to only complete demographic items and the CLS. Data from the participants that only completed the CLS were used to increase the model stability in the context of confirmatory factor analysis. The additional measures used to establish convergent and divergent validity were not required for this factor analytic purpose. Therefore, some participants were asked to complete a much briefer version of the survey. Importantly, this also avoided unnecessary recruitment costs.

Participants

The total sample of 501 participants (269 female) had a mean age of 29.8 years (SD = 10.2, range 18 to 72). Participants had, on average, completed 15.5 years (SD = 3.2) of education and more than two-thirds of participants had attended university (71.7%). The distribution of country of residence was 40% United Kingdom, 13% Portugal, 8% Poland, 6% United States, 4% Australia and New Zealand, 2% Canada, 26% other European countries, and 1% Asian countries.

Measures

Compassion was measured using the stranger-humanity version of the Compassionate Love Scale (Sprecher & Fehr, 2005). The CLS is a 21-item measure that uses a 7-point Likert scale ranging from 1 (*not at all true of me*) to 7 (*very true of me*). Total CLS scores are derived by averaging all item scores. The CLS has no subscales. Higher CLS total scores indicate higher levels of compassion. The CLS has displayed good internal consistency with a Cronbach's alpha of 0.95 (Sprecher & Fehr, 2005).

Prosocialness was measured using the Prosociality Scale (Caprara, Steca, Zelli, & Capanna, 2005). The Prosociality Scale is a 16-item questionnaire with a 5-point Likert scale ranging from 1 (*never/ almost never true*) to 5 (*almost always/ always true*) that captures how much individuals engage in sharing, helping, and empathising with others. Total scores are computed by averaging all item scores, with higher scores indicating higher levels of prosocialness. The Prosociality Scale has displayed good internal consistency (Cronbach's alpha of 0.91; Caprara et al., 2005).

Empathic tendencies were measured using the Interpersonal Reactivity Index (IRI; Davis, 1983). The IRI is a 28-item measure with four 7-item subscales that use a 5-item scale ranging from A (*Does not describe me well*) to E (*Describes me very well*) to capture four distinct aspects of empathy: empathic concern (other-oriented feelings of sympathy and concern), perspective taking (ability to spontaneously adopt another's psychological view), fantasy (tendency to transpose oneself into the psychological experience of fictitious characters in books, movies, etc.), and personal distress (self-oriented feelings of unease in interpersonal dynamics). Letters A to E were converted to numbers 0 to 4. The total subscale scores are computed by summing the respective item scores (after reverse-scoring some items). The IRI has displayed satisfactory internal consistency with a Cronbach's alpha of 0.80, 0.79, 0.82, and 0.75 for empathic concern, perspective taking, fantasy, and personal distress, respectively (Davis, 1983).

The level of concern an individual has for others was measured using the Social Value Orientation (SVO) Slider Measure (Murphy et al., 2011). SVO aims to capture how interrelated decision makers allocate limited resources between themselves and others. The six primary SVO items, each with nine response options, were used in the present study. For each item, participants were asked to distribute money between themselves and one other person, who they remained anonymous to. Each of the nine response options per item described a different allocation distribution participants could choose from (e.g., "You receive $50. Other receives $40."). A single total score was computed (described in detail in Murphy, Ackerman, & Handgraaf, 2011) with higher scores indicating higher levels of concern for others. The SVO has displayed excellent psychometric properties (e.g., test-retest reliability = 0.92; Murphy, Ackerman, & Handgraaf, 2011).

Statistical Analysis

First, confirmatory factor analysis with maximum likelihood estimation was used to assess the model fit of a one-factor solution for the CLS. The following model fit indices were judged to be most informative in the context of the present study: the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the root mean square error of approximation (RMSEA) and its 90% confidence interval, and the standardised root mean square residual (SRMR). CFI and TLI values above 0.95 and SRMR values below 0.8 are commonly interpreted to indicate excellent model fit (Hu & Bentler, 1999). RMSEA values below 0.08 suggest an acceptable fit (Browne & Cudeck, 1993). Results of the more traditional chi-square test were also reported; however, the chi-square test statistic can be considered unreliable in the context of larger sample sizes (Byrne, 2001). The fit indices of the one-factor model of the CLS or the raw data from the original CLS validation paper (Sprecher & Fehr, 2005) were requested from the authors; however, this information was, unfortunately, not available.

Second, we aimed to use items from the 21-item pool of the CLS to create a new compassion scale with optimized psychometric properties. Any items that were judged by experts to display poor or ambiguous content validity were removed. Based on previous research (Gu et al., 2017; Strauss et al., 2016), we *a priori* removed four items (7, 11, 13, 20) because they inadequately capture compassion and three additional items (3, 6, 9) because they assume that participants know and (uniformly) define the construct of compassion or compassionate love. The remaining 14 items from the CLS were then independently evaluated by two authors (MS and OK) for their content validity and classified as either adequate or inadequate. All inadequate items were removed. The remaining items were combined into a new compassion scale and included in a one-factor confirmatory factor analysis in which all items directly loaded on a single compassion factor.

The one-factor model was evaluated using model fit, factor loadings, and commonality. Reliability of the scale was assessed with internal consistency and item-test correlation estimates and alpha-if-item-deleted values. Distribution and floor and ceiling effects of the total scores were tested by assessing the histogram of the total scores, skewness and kurtosis estimates, and the percentage of participants scoring the minimum and maximum total score. Published criteria suggest that, overall, less than 15% of participants should report the lowest or highest total score (Terwee et al., 2007). Interpretability was tested by comparing total compassion scores based on sex and education. In line with previous research (e.g., Gu et al., 2019; Pommier, Neff, & Tóth-Király, 2020), female participants were predicted to report higher levels of compassion than male participants; no differences in relation to education were expected. Convergent validity was assessed by Pearson's correlation coefficients of this adapted compassion scale with the self-report measures listed above. Specifically, total scores of our compassion scale were expected to display substantial correlations with empathic concern, perspective taking, and prosocialness

($r \geq 0.5$) and moderate correlations with social value orientation ($0.3 \leq r < 0.5$). We predicted weaker correlations with personal distress and fantasy, which are facets of empathy and as such related to compassion ($r < 0.30$). We judged correlations at $r > 0.80$ to indicate that measures might capture the same latent construct (i.e., display conceptual redundancy). We thus expected our adapted compassion scale to highly correlate with the CLS. All analyses were conducted in Stata version 13.

Data Availability

All data and analysis scripts of Study 1 are available at the Open Science Framework (https://osf.io/yrq4j/).

Results

Compassionate Love Scale (CLS)

Confirmatory factor analysis. Confirmatory factor analysis indicated that the one-factor model of the CLS did not have an adequate model fit, indicating that the latent construct of compassion is not meaningfully captured (Table 1). For the CLS, Cronbach's alpha was 0.95 and McDonald's omega was 0.95.

7-item Compassion for Others Scale (COS-7)

Item assessment. From the 14 CLS items that remained after *a priori* removing problematic items, a further six items were removed because they did not clearly relate to the suffering of an individual (4, 14, 16, 18, 19, 21), and one item because it displayed a large conceptual overlap with items from established empathy scales (17). Thus, a total of seven items were removed, leaving seven items to form a compassion scale with adequate face validity. Table 2 displays an overview of reasons for item exclusion.

Confirmatory factor analysis. Seven items were included in a one-factor confirmatory factor analysis. Three fit indices indicated an excellent fit (CFI = 0.974; TLI = 0.961; SRMR = 0.028) and one indicated an acceptable fit (RMSEA = 0.079, 90% CI: 0.058 to 0.101) of

the 7-item compassion scale (from here on referred to as the 7-item Compassion for Others Scale [COS-7]). Standardised factor loadings ranged in magnitude from 0.62 to 0.86 (all associated with $p < 0.001$; mean = 0.72). Commonality estimates (all ≥ 0.4) indicated that an adequate proportion of the variance of each item was accounted for by the compassion factor.

Reliability. The COS-7 scale displayed good internal consistency with a Cronbach's alpha of 0.89 and a McDonald's omega of 0.89. Item-test correlation estimates were ≥ 0.70 and alpha-if-item-deleted values were > 0.85. All estimates are reported in Table 3.

Floor and ceiling effects. In the present sample, COS-7 total scores had a mean of 4.20 (SD = 1.20) and a range of 1 to 7. The distributions of COS-7 total scores did not substantially diverge from normality as indicated by estimates of skewness (–0.29) and kurtosis (2.63) and visual inspection of the histogram. Only 0.2% of participants had the highest possible COS-7 total score and 0.5% of participants had the lowest possible COS-7 total score. Thus, the COS-7 total scores captured a wide range of levels of compassion and did not show floor or ceiling effects (Table 4).

Interpretability. Results from two simple linear regression models that used COS-7 total scores as continuous outcome variable and sex and university attendance as binary explanatory variable, respectively, indicated that female participants reported higher COS-7 scores than male participants (unstandardised mean difference = 0.32; 95% CI: 0.11 to 0.53; $p = 0.003$) but that participants who had attended university did not differ in COS-7 scores from those who had not (unstandardised mean difference = –0.02; 95% CI: –0.25 to 0.22; $p = 0.894$).

Convergent and discriminant validity. Pearson's correlation coefficients between the scores of the COS-7 and scores of measures of empathy, prosocialness, and social value orientation are displayed in Table 4. COS-7 were highly correlated with prosocialness ($r = 0.73$, $p < 0.001$) and empathic concern ($r = 0.65$, $p < 0.001$) and moderately correlated with

perspective taking ($r = 0.38$, $p < 0.001$) and social value orientation ($r = 0.26$, $p < 0.001$). COS-7 scores were weakly correlated with fantasy ($r = 0.20$, $p < 0.001$) and personal distress ($r = 0.14$, $p = 0.007$). In sum, two correlations of the COS-7 with related measures were $r \geq 0.5$ and none were $r > 0.8$, thus indicating adequate convergent and discriminant validity. As expected, the COS-7 and CLS were highly correlated ($r = 0.96$, $p < 0.001$).

In sum, these findings suggest that the COS-7 is a psychometrically robust measure of compassion.

Study 2

The primary purpose of Study 2 was to assess the psychometric properties of the German version of the CLS and to validate a German version of the COS-7 and thereby introduce the first validated measure of compassion for others in German.

Methods

German Adaptation of the Scale

The 21 items of the English CLS were independently translated into German by two bilingual experts in psychology and research on compassion. A third bilingual expert judged the precision of both translations and harmonised them into an additional translation. A fourth bilingual expert back-translated this third German version into English and compared it with the original English version of the CLS. A fifth bilingual expert oversaw and judged the validity of the entire translation process, while consulting a German translation of the CLS that is used in the European Commission-funded Horizon 2020 Silver Santé Study (Lutz et al., 2018; Marchant et al., 2018; Poisnel et al., 2018). A German version of the COS-7 is provided in Table 5. The German translation of the CLS is provided in the supplementary material (S1 Appendix).

Procedures

The procedures of Study 2 followed those of Study 1: Cross-sectional data was collected via an anonymous online survey. Participants were recruited via Prolific (see Palan & Schitter, 2018). Individuals were informed that this study aimed to improve the scientific understanding of the relationship between compassion, subjective experiences, and social behaviour. A good understanding of the German language and a minimum age of 18 years were the inclusion criteria. Before starting the survey, individuals had to indicate whether they have read and understood the explanations and to voluntarily indicate written consent to participate. The survey took approximately 6 minutes to complete and participants were reimbursed with £0.80. All data were collected in September 2019. The study and consent procedures of Study 2 were approved by University College London's research ethics committee (ref no: 10043/002) and performed in line with the Declaration of Helsinki.

A total of 361 individuals started the survey. Eleven participants did not complete the CLS and were excluded. A further 18 participants were excluded because they failed an attention check question ("Es ist wichtig, dass Sie diesen Fragebogen mit voller Aufmerksamkeit beantworten. Bitte wählen Sie: Beschreibt mich sehr gut." [English: "It is important that you answer this survey with full attention. Please indicate: Describes me well."]). Thus, data from 332 participants were included in the analyses.

Participants

The total German sample of 332 participants (163 female) had a mean age of 30.1 years (SD = 9.7, range 18 to 67). Participants had, on average, completed 16.0 years (SD = 3.6) of education and 74.1% of participants had attended university. All participants indicated German as their first language. A total of 12.4% of participants indicated that they meditate regularly and had, on average, maintained a regular practice for 3.1 years (SD = 5.1), ranging from 1 month to 25 years.

Measures

Participants completed the German translation of the English CLS (Sprecher & Fehr, 2005), which includes all items from the COS-7 that were validated in Study 1. The CLS and COS-7 use a 7-point Likert scale ranging from 1 (*not at all true of me*) to 7 (*very true of me*) to capture levels of compassion. Total scores are derived by averaging all item scores. Higher total scores indicate higher levels of compassion for others (strangers).

To measure prosocial tendencies, we used the German version of the Revised Prosocial Tendencies Measure (Rodrigues et al., 2017). The Revised Prosocial Tendencies Measure is a 23-item questionnaire with a 5-point Likert scale ranging from 1 (*does not describe me at all*) to 5 (*describes me very well*). Six subscales capture six domains of prosocial behaviour: altruistic, anonymous, public, emotional, dire, and compliant prosocial behaviour. Subscale total scores are computed by averaging their respective item scores, with higher scores indicating higher levels of the respective construct. The altruistic subscale items must be reverse-scored before computing the altruistic subscale total score. The Revised Prosocial Tendencies Measure has displayed good psychometric properties (Rodrigues et al., 2017).

To measure empathic tendencies, we used the German version of the Interpersonal Reactivity Index (SPF-IRI; Paulus, 2009). In contrast to the original IRI (Davis, 1983) described in Study 1, the German IRI includes only 16 items, none of which are reverse scored. The German IRI has displayed satisfactory internal consistency with a Cronbach's alpha of 0.71, 0.71, 0.74, and 0.66 for empathic concern, perspective taking, fantasy, and personal distress, respectively (Paulus, 2009).

To measure the level of concern an individual has for others, we used the German version of the Social Value Orientation Slider Measure (SVO; Murphy, Ackerman, & Handgraaf, 2011) described in Study 1.

Statistical Analysis

Confirmatory factor analysis with maximum likelihood estimation was used to assess the model fit of a one-factor solution for the German CLS and German COS-7. The assessment of the model fit and reliability followed the factor analytic approach described in Study 1. Interpretability was tested by comparing COS-7 total scores based on sex, education, and meditation experience. Based on previous research (e.g., Gu et al., 2019; Pommier, Neff, & Tóth-Király, 2020), we expected female participants and regular meditators to report higher COS-7 total scores.

Data Availability

All data and analysis scripts of Study 2 are available at the Open Science Framework (https://osf.io/yrq4j/).

Results

Confirmatory factor analysis. Confirmatory factor analysis indicated that the one-factor model of the German CLS did not have an adequate model fit, suggesting that the compassion factor is not meaningfully captured. The German COS-7 displayed a good model fit (Table 1). For the German CLS, Cronbach's alpha was 0.95 and McDonald's omega was 0.95.

Reliability. The German COS-7 scale displayed good internal consistency with a Cronbach's alpha of 0.89 and a McDonald's omega of 0.89. Item-test correlation estimates were ≥ 0.68 and alpha-if-item-deleted values were ≥ 0.86. All estimates are reported in Table 5.

Floor and ceiling effects. In the present sample, German COS-7 total scores had a mean of 4.20 (SD = 1.21) and a range of 1 to 7. The distributions of COS-7 total scores did not substantially diverge from normality as indicated by estimates of skewness (–0.18) and kurtosis (2.41) and visual inspection of the histogram. Only 0.3% of participants had the highest possible COS-7 total score and 0.3% of participants had the lowest possible COS-7

total score. Thus, the German COS-7 total scores captured a wide range of levels of compassion and did not display floor or ceiling effects.

Interpretability. Results from three simple linear regression models that used German COS-7 total scores as continuous outcome variable and sex, meditation practice, and university attendance as binary explanatory variable, respectively, indicated that female participants reported higher COS-7 total scores than male participants (unstandardised mean difference = 0.77; 95% CI: 0.53 to 1.01; $p < 0.001$), that participants with a regular meditation practice reported higher COS-7 total scores (unstandardised mean difference = 0.70; 95% CI: 0.30 to 1.09; $p = 0.001$), and that participants who had attended university reported higher COS-7 total scores than those who had not (unstandardised mean difference = 0.34; 95% CI: 0.05 to 0.63; $p = 0.021$).

Convergent and discriminant validity. Pearson's correlation coefficients between the scores of the German COS-7 and scores of measures of prosocial tendencies, empathy, and social value orientation are displayed in Table 6. The German CLS and German COS-7 were highly correlated ($r = 0.96$, $p < 0.001$).

Taken together, these findings suggest that the German COS-7 is a psychometrically sound measure of compassion.

Discussion

The present studies aimed to refine the measurement of compassion by building on the widely used CLS (Sprecher & Fehr, 2005). Three key findings emerged. First, we offer psychometric evidence that the widely used CLS is a suboptimal measure of compassion for others (strangers). Second, altering this measure using *a priori* determined criteria provides a more psychometrically robust measure of compassion for others, the 7-item Compassion for Others Scale (COS-7). Third, we introduce a psychometrically robust German version of the

COS-7, which is the first validated German measure of compassion for others published to date.

So far, the psychometric properties of the CLS have not been sufficiently tested or reported. For instance, no assessment of model fit of the proposed one-factor structure of the CLS has previously been published. Using a large international community sample, we show that the model fit indices of the widely used CLS are not satisfactory. These findings underscore the value of two recently developed longer measures of compassion for others that have displayed good psychometric properties, namely the Sussex-Oxford Compassion Scale-Other (Gu et al., 2019) and the Compassion Scale (Pommier, Neff, & Tóth-Király, 2020).

In developing the English COS-7, the choice of scale items from the 21-item pool of the CLS was guided by expert judgment and informed by previous research indicating that the CLS contains several items with inadequate content validity (Gu et al., 2017; Strauss et al., 2016). In our international sample, a model with seven indicators loading directly on one compassion factor was fit to the data. All items displayed very high factor loadings and model fit indices were acceptable to excellent. Further, the COS-7 displayed good internal consistency and adequate item-test correlation estimates. COS-7 total scores displayed no floor or ceiling effects. Consistent with previous research (Pommier, 2010; Pommier, Neff, & Tóth-Király, 2020), female participants in the international sample had significantly higher COS-7 scores.

Our findings suggest that the English COS-7 also displayed adequate levels of convergent and discriminant validity. As predicted, the COS-7 was highly correlated with levels of empathic concern for others and prosocialness (i.e., the inclination to help and share with others), but not so highly correlated as to be indicative of conceptual redundancy. Slightly diverging from our predictions, the correlation between the COS-7 and perspective

taking (i.e., the ability to adopt another's view) was only moderate in size. This finding, however, is partially echoed by recent research (Gu et al., 2019) – which was published after the collection of our data and thus did not inform our predictions – indicating a high correlation between perspective taking and compassion in a sample of health care staff but only a moderate correlation between these two measures in a student sample. There were weak associations of COS-7 scores with two other aspects of empathy: fantasy (i.e., the ability to imagine oneself having the experience of a protagonist in a book or film) and personal distress (i.e., the levels of personal anxiety and difficulty one experiences in tense interpersonal dynamics). This is in line with research that did not consider fantasy a core part of empathy (Neff & Pommier, 2013) and research that found only a small correlation between distress and compassion for others (Pommier, 2010).

Given that the English COS-7 consists of items of the widely used CLS, it also allows researchers to re-analyse previously collected data using the current 7-item version. For instance, previous research with established compassion measures (see Strauss et al., 2016) did not find evidence for a relationship between compassion for others and measures of mental health and well-being (e.g., Durkin et al., 2016; López et al., 2018). Moreover, several theoretical frameworks conceptualise compassion for others and self-compassion as components of an overarching construct (e.g., Burbea, 2014; Feldman & Kuyken, 2011), but empirical studies did not find a strong relationship between these forms of compassion (e.g., Gu et al., 2019; Pommier, Neff, & Tóth-Király, 2020). Re-evaluating previous findings using the English COS-7 could increase the confidence in this nascent research field and present an important step towards ameliorating the measurement limitations and validity concerns currently affecting the empirical literature on compassion (Strauss et al., 2016).

For Study 2, we translated the items of the CLS into German. These items were then administered to a large community sample of participants who spoke German as their first

language. A pattern of findings emerged that mirrored those found in Study 1: the German CLS lacked adequate model fit, whereas the German COS-7 displayed good psychometric properties including adequate levels of convergent and discriminant validity. Mean total scores of the English COS-7 (Study 1) and the German COS-7 did not differ. The German COS-7 scores were most highly correlated with empathic concern, emotional prosocial behaviour (i.e., the tendency to help others under emotionally evocative circumstances) and dire prosocial behaviour (i.e., the tendency to help others in crisis situations). Public prosocial behaviour that captures the tendency to engage in altruistic behaviour to appear altruistic in public or to increase one's self-esteem were not related to German COS-7 scores. Further, there was no association between the German COS-7 and altruistic prosocial behaviour, which aims to measure voluntary helping behaviour driven by internalised altruistic principles and concerns for others. Future research including alternative German measures of altruism is needed to understand whether this absence of an association might be related to the characteristics of the altruism measure utilised in Study 2. More specifically, the items of the altruistic prosocial behaviour subscale (e.g., "Ich denke, eines der besten Dinge daran anderen zu helfen ist, dass es mich gut aussehen lässt." [Original English: "I think that one of the best things about helping others is that it makes me look good."]; Rodrigues et al., 2017) are reverse-scored and may capture the absence of self-interest more than the active presence of altruism.

Study 2 also collected information on meditation experience. Meditation is an overarching term that covers a wide range of practices aimed at cultivating and strengthening specific psychological processes including attentional control, meta-awareness, perspective taking, and insights into the nature of perception (Dahl, Lutz, & Davidson, 2015; Lutz, Slagter, Dunne, & Davidson, 2008). The growing body of research on meditation has investigated the potential (mental) health benefits as well as the difficulties associated with a

regular practice of meditation (Farias et al., 2020; Schlosser et al., 2019; Sedlmeier et al., 2012). In the context of the present investigation, it is important to highlight that compassion for others and self-compassion have frequently been posited as theoretically consistent mechanisms of action underlying some of the effects of meditation on mental health – a hypothesis that has been corroborated by empirical evidence (e.g., Khoury et al., 2017; Schlosser, Jones, et al., 2020). As predicted based on previous cross-sectional research (e.g., Gu et al., 2019; Pommier, Neff, & Tóth-Király, 2020), regular meditators in our sample displayed significantly higher levels of compassion than meditation-naïve participants.

The German COS-7 is the first psychometrically validated German measure of compassion for others published to date and complements the German version of the Self-Compassion Scale (Coroiu et al., 2018).

Limitations and Future Research

Our findings should be interpreted in the context of several important limitations. Firstly, in both studies only one method of data collection was applied (i.e., online questionnaires). Secondly, the cross-sectional nature of our data did not allow us to assess other psychometric properties such as predictive validity and test-retest reliability. Future longitudinal studies including compassion-based interventions (e.g., Compassion Focused Therapy, Gilbert, 2014; Cognitively-Based Compassion Training, Pace et al., 2009) that administer the COS-7 at several time points are needed to examine these statistical properties as well as the sensitivity of the COS-7 to compassion training. Thirdly, although our sample size in Study 1 was much larger and more representative (i.e., not constrained to undergraduate students) than the samples utilised in the development and validation of the CLS (Sprecher & Fehr, 2005), we only collected few variables to characterise our samples (i.e., age, sex, education, country of residence; plus meditation experience in Study 2) and thereby might have missed potentially important characteristics that could have influenced

our findings (e.g., personality, medical history, profession). Relatedly, participants in both studies were highly educated. Future research is needed to assess if the present findings can be replicated in demographically more diverse samples. The present samples were recruited from non-clinical populations. Given that many compassion-based interventions are also tailored for participants with existing mental health problems, it is vital to examine the psychometric properties of the COS-7 in clinical and help-seeking samples.

Conclusions

In sum, our findings help advance empirical research on compassion by introducing short and psychometrically validated scales to measure compassion for others (strangers) in English and German. Importantly, they address previous conceptual concerns and measurement limitations: they only include items with high content validity as judged by experts; their psychometric properties are adequate; and their brevity meets the need for adequate compassion measures suitable to research in time-constrained settings including large-scale trials and epidemiological cohort studies. Unrelated to its brevity, the German COS-7 presents the first German measure of compassion for others. Refining and expanding the range of compassion measures available to researchers remains an important task to support the progress and maturation of the research field.

Table 1 Fit indices for one-factor confirmatory factor analyses of the English and German CLS and COS-7

Model	CFI	TLI	RMSEA (90% CI)	SRMR	Chi-square (*df*)
CLS[a]	0.849	0.832	0.104 (0.099-0.109)	**0.057**	1215.13 (189)
German CLS[b]	0.858	0.843	0.099 (0.092-0.106)	**0.059**	803.71 (189)
COS-7[a]	**0.974**	**0.961**	**0.079** (0.058-0.101)	**0.028**	57.67 (14)
German COS-7[b]	**0.989**	**0.984**	**0.052** (0.019-0.082)	**0.023**	26.59 (14)

Note. CLS = Compassionate Love Scale; COS-7 = 7-item Compassion for Others Scale; CI = confidence interval; *df* = degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = root mean square error of approximation; SRMR = standardised root mean square residual. Bold indices indicate acceptable fit (RMSEA < 0.08) and excellent fit (CFI > 0.95; TLI > 0.95; SRMR < 0.8).

[a]*N* = 501

[b]*N* = 332

Table 2 CLS items and Reasons for Exclusion in the English COS-7 if applicable

CLS item[a]	Reasons for exclusion
1. **When I see people I do not know feeling sad, I feel a need to reach out to them.**	–
2. **I spend a lot of time concerned about the well-being of humankind.**	–
3. When I hear about someone (a stranger) going through a difficult time, I feel a great deal of compassion for him or her.	Includes the term "compassion"
4. It is easy for me to feel the pain (and joy) experienced by others, even though I do not know them.	Not clearly related to suffering only
5. **If I encounter a stranger who needs help, I would do almost anything I could to help him or her.**	–
6. I feel considerable compassionate love for people from everywhere.	Includes the term "compassionate"
7. I would rather suffer myself than see someone else (a stranger) suffer.	Ambiguous (Gu et al. 2019; Strauss et al. 2016)
8. **If given the opportunity, I am willing to sacrifice in order to let people from other places who are less fortunate achieve their goals.**	–
9. I tend to feel compassion for people, even though I do not know them.	Includes the term "compassion"
10. **One of the activities that provides me with the most meaning to my life is helping others in the world when they need help.**	–
11. I would rather engage in actions that help others, even though they are strangers, than engage in actions that would help me.	Ambiguous (Gu et al. 2019; Strauss et al. 2016)
12. **I often have tender feelings toward people (strangers) when they seem to be in need.**	–
13. I feel a selfless caring for most of humankind.	Ambiguous (Gu et al. 2019; Strauss et al. 2016)
14. I accept others whom I do not know even when they do things I think are wrong.	Not clearly related to suffering
15. **If a person (a stranger) is troubled, I usually feel extreme tenderness and caring.**	–
16. I try to understand rather than judge people who are strangers to me.	Not clearly related to suffering
17. I try to put myself in a stranger's shoes when he or she is in trouble.	Overlap with IRI (perspective taking, item 25): "When I'm upset at someone, I usually try to put myself in his shoes."
18. I feel happy when I see that others (strangers) are happy.	Not clearly related to suffering
19. Those whom I encounter through my work and public life can assume that I will be there if they need me.	Not clearly related to suffering
20. I want to spend time with people I don't know well so that I can find ways to help enrich their lives.	Ambiguous (Gu et al. 2019; Strauss et al. 2016)
21. I very much wish to be kind and good to fellow human beings.	Not clearly related to suffering

Note. CLS = Compassionate Love Scale; COS-7 = 7-item Compassion for Others Scale; IRI = Interpersonal Reactivity Index.

[a]Bold items have been judged by experts to have adequate face validity.

Table 3 Distribution of item responses, reliability and item-test correlations; and factor loadings and model fit for the English COS-7 (*N* = 501)

	COS-7				
Item	Mean (*SD*)	Factor loading[a]	Commonality[b]	Item-test correlation	Alpha if item deleted
1. When I see people I do not know feeling sad, I feel a need to reach out to them.	4.15 (1.60)	0.62	0.4	0.71	0.88
2. I spend a lot of time concerned about the well-being of humankind.	4.39 (1.58)	0.65	0.4	0.73	0.88
3. If I encounter a stranger who needs help, I would do almost anything I could to help him or her.	4.24 (1.48)	0.62	0.4	0.70	0.88
4. If given the opportunity, I am willing to sacrifice in order to let people from other places who are less fortunate achieve their goals.	3.93 (1.62)	0.71	0.5	0.77	0.87
5. One of the activities that provides me with the most meaning to my life is helping others in the world when they need help.	4.28 (1.60)	0.75	0.6	0.79	0.86
6. I often have tender feelings toward people (strangers) when they seem to be in need.	4.39 (1.50)	0.85	0.7	0.84	0.86
7. If a person (a stranger) is troubled, I usually feel extreme tenderness and caring.	3.99 (1.55)	0.86	0.7	0.85	0.86

Note. COS-7 = 7-item Compassion for Others Scale; *SD* = standard deviation.

[a]Factor loadings are derived from confirmatory factor analyses of a one-factor solution.

[b]Commonality is the proportion of the variance of an item accounted for by the factor.

Table 4 Correlations of the English COS-7 and CLS (N = 501)

	COS-7		CLS	
	Correlation	95% CI	Correlation	95% CI
Prosocialness[a]	0.73**	0.67 to 0.77	0.77**	0.73 to 0.81
Social value orientation[b]	0.26**	0.16 to 0.35	0.30**	0.21 to 0.39
Interpersonal reactivity index[c]				
Empathic concern	0.65**	0.59 to 0.71	0.68**	0.62 to 0.73
Perspective taking	0.38**	0.29 to 0.46	0.48**	0.40 to 0.56
Fantasy	0.20**	0.11 to 0.30	0.23**	0.13 to 0.32
Personal distress	0.14*	0.04 to 0.23	0.12*	0.03 to 0.22
CLS	0.96**	0.95 to 0.97	–	–

Note. COS-7 = 7-item Compassion for Others Scale; CLS = Compassionate Love Scale; CI = confidence interval.

[a]n = 382, [b]n = 366, [c]n = 384

*$p < 0.05$, **$p < 0.001$

Table 5 Distribution of item responses, reliability and item-test correlations; and factor loadings and model fit for the German COS-7 (*N* = 332)

German COS-7					
Item	Mean (*SD*)	Factor loading[a]	Commonality[b]	Item-test correlation	Alpha if item deleted
1. Wenn ich sehe, dass Menschen, die ich nicht kenne, traurig sind, fühle ich das Bedürfnis, mich ihnen zuzuwenden.	4.40 (1.66)	0.76	0.6	0.80	0.87
2. Ich verbringe viel Zeit damit, mich mit dem Wohlergehen der Menschheit zu befassen.	4.10 (1.63)	0.70	0.5	0.77	0.88
3. Wenn ich einer fremden Person begegne, die Hilfe braucht, würde ich fast alles tun, was ich kann, um ihr zu helfen.	4.23 (1.47)	0.65	0.4	0.72	0.88
4. Wenn sich die Gelegenheit bietet, bin ich dazu bereit, auf etwas zu verzichten, damit Personen von anderswo, die weniger Glück haben, ihre Ziele erreichen können.	4.35 (1.51)	0.59	0.3	0.68	0.89
5. Eine der Tätigkeiten, die mich am meisten in meinem Leben erfüllt, ist es, anderen in der Welt zu helfen, wenn sie Hilfe brauchen.	3.82 (1.62)	0.75	0.6	0.79	0.87
6. Ich habe oft warmherzige Gefühle gegenüber anderen (Fremden), wenn es scheint, dass diese Menschen ein Bedürfnis haben.	4.15 (1.54)	0.85	0.7	0.85	0.86
7. Wenn eine fremde Person in Schwierigkeiten ist, fühle ich in der Regel ein starkes Mitgefühl und Fürsorge.	4.31 (1.47)	0.84	0.7	0.84	0.86

Note. COS-7 = 7-item Compassion for Others Scale; *SD* = standard deviation.

[a]Factor loadings are derived from confirmatory factor analyses of a one-factor solution. [b]Commonality is the proportion of the variance of an item accounted for by the factor.

Table 6 Correlations of the German COS-7 and CLS (N = 332)

	German COS-7		German CLS	
	Correlation	95% CI	Correlation	95% CI
Prosocial tendencies				
Altruism	0.07	-0.04 to 0.17	0.10	-0.01 to 0.20
Anonymous	0.41**	0.32 to 0.50	0.41**	0.32 to 0.50
Public	0.10	-0.01 to 0.20	0.08	-0.03 to 0.18
Emotional	0.62**	0.55 to 0.68	0.62**	0.54 to 0.68
Dire	0.53**	0.45 to 0.60	0.54**	0.46 to 0.61
Compliant	0.46**	0.37 to 0.54	0.47**	0.38 to 0.55
Social value orientation[a]	0.39**	0.30 to 0.48	0.40**	0.30 to 0.48
Interpersonal reactivity index				
Empathic concern	0.73**	0.68 to 0.78	0.75**	0.70 to 0.79
Perspective taking	0.46**	0.37 to 0.54	0.53**	0.45 to 0.60
Fantasy	0.40**	0.31 to 0.49	0.42**	0.33 to 0.51
Personal distress	0.17*	0.06 to 0.27	0.17*	0.07 to 0.28
German CLS	0.96**	0.95 to 0.96	–	–

Note. COS-7 = 7-item Compassion for Others Scale; CLS = Compassionate Love Scale; CI = confidence interval.

[a]n = 330

*p < 0.01, **p < 0.001

Supplementary Material

Table S1 German translation of the Compassionate Love Scale

1.	Wenn ich sehe, dass Menschen, die ich nicht kenne, traurig sind, fühle ich das Bedürfnis, mich ihnen zuzuwenden.
2.	Ich verbringe viel Zeit damit, mich mit dem Wohlergehen der Menschheit zu befassen.
3.	Wenn ich höre, dass jemand (eine fremde Person) gerade eine schwierige Zeit durchlebt, empfinde ich großes Mitgefühl für sie/ihn.
4.	Es fällt mir leicht, den Schmerz (und die Freude) anderer zu empfinden, selbst wenn ich die anderen nicht kenne.
5.	Wenn ich einer fremden Person begegne, die Hilfe braucht, würde ich fast alles tun, was ich kann, um ihr zu helfen.
6.	Ich empfinde in hohem Maße mitfühlende Liebe für Menschen aus aller Welt.
7.	Ich würde eher selbst leiden, als eine andere fremde Person leiden zu sehen.
8.	Wenn sich die Gelegenheit bietet, bin ich dazu bereit, auf etwas zu verzichten, damit Personen von anderswo, die weniger Glück haben, ihre Ziele erreichen können.
9.	Ich neige dazu, Mitgefühl für andere Menschen zu empfinden, auch wenn ich sie nicht kenne.
10.	Eine der Tätigkeiten, die mich am meisten in meinem Leben erfüllt, ist es, anderen in der Welt zu helfen, wenn sie Hilfe brauchen.
11.	Ich würde mich eher an Vorhaben beteiligen, die anderen zu Gute kommen, auch wenn es sich um Fremde handelt, als an Vorhaben, die mir selbst helfen.
12.	Ich habe oft warmherzige Gefühle gegenüber anderen (Fremden), wenn es scheint, dass diese Menschen ein Bedürfnis haben.
13.	Ich empfinde eine selbstlose Anteilnahme für den Großteil der Menschheit.
14.	Ich akzeptiere andere, die ich nicht kenne, auch wenn sie Dinge tun, die ich für falsch halte.
15.	Wenn eine fremde Person in Schwierigkeiten ist, fühle ich in der Regel ein starkes Mitgefühl und Fürsorge.
16.	Ich versuche eher, mir fremde Personen zu verstehen, als über sie zu urteilen.
17.	Ich versuche mich in die Lage einer fremden Person zu versetzen, wenn diese Person in Schwierigkeiten ist.
18.	Ich fühle mich glücklich, wenn ich sehe, dass andere (Fremde) glücklich sind.
19.	Personen, die mir in meinem beruflichen oder öffentlichen Leben begegnen, können davon ausgehen, dass ich für sie da sein werde, wenn sie mich brauchen.
20.	Ich möchte Zeit mit Menschen verbringen, die ich nicht gut kenne, damit ich Möglichkeiten finden kann, die ihnen helfen, ihr Leben zu bereichern.
21.	Es liegt mir sehr viel daran, freundlich und gut zu meinem Mitmenschen zu sein.

6. Concluding discussion

Understanding how older adults can deepen their well-being and flourish whilst ageing in a complex world presents a pertinent scientific question. This thesis aimed to contribute to our understanding of the effects of meditation training on psychological well-being in older adults.

The concluding discussion of this thesis serves as a synthesis and reflection on the work undertaken, encapsulating the research journey and pointing the way for subsequent investigations. It begins with a summary of key findings, providing a succinct overview of the most significant results. The subsequent section delves deeper into the specific outcomes of the meditation-based interventions, discussing the extent to which older adults were responsive to these practices. The next subsection highlights the contributions that this research offers to the existing body of knowledge on meditation and psychological well-being in older adults. The subsection on limitations discusses the constraints of this work and provides critical reflections that form the basis for the final subsection, which explores potential avenues and considerations for future research in this area.

Summary of key findings

In Chapter 2, we empirically tested if a selection of commonly used psychological self-report measures can be meaningfully categorised in line with an established theoretical model of meditation-based dimensions of well-being (Dahl et al., 2015, 2020). Findings offer empirical support for the theory-based delineation of awareness, connection, and insight. Using this threefold taxonomy to group psychological self-report measures, we were able to derive three composite scores of meditation-based well-being with adequate psychometric properties.

In Chapter 3, we utilised several theory-based measures of well-being – including the composite scores developed in Chapter 2 – to test the effects of two 8-week non-

pharmacological interventions (i.e., MBI versus HSMP) on psychological well-being in older adults with SCD. Within both groups, PWBS total scores, psychological QoL, and meditation-based composite scores did not increase significantly from baseline to post-intervention or follow-up. The MBI was superior to HSMP only on changes in connection. Although the maintenance of connection scores in the MBI could be a clinically meaningful finding, such an assessment cannot be made in the absence of a passive control group needed to allow the identification of base rate changes in well-being in this population.

In Chapter 4, we tested the effects of an 18-month meditation training on psychological well-being in healthy older adults using the same set of well-being outcomes utilised in the 8-week interventions of Chapter 3. Findings suggest that meditation training improved awareness, insight, and a global composite score (reflecting awareness, connection, and insight), while being superior to English language learning on changes in awareness, connection, and insight but superior to the no-intervention group only on changes in awareness and the global composite score.

In Chapter 5, we developed and validated the 7-item Compassion for Others Scale (COS-7) in both English and German. The German COS-7 is the first German measure of compassion for others published to date. The COS-7 was developed in response to prior work (Gu et al., 2017; Strauss et al., 2016) that questioned the conceptual and psychometric quality of the Compassionate Love Scale, which formed part of the meditation-based well-being composite score used to measure connection in Chapters 2, 3, and 4.

Responsiveness to meditation training

In contrast to our hypotheses, the effect of the 8-week MBI in older adults with SCD was limited. Before the commencement of our SCD-Well trial, only a single study, a small pilot RCT with a sample size of 15 (Smart et al., 2016), had explored the impact of mindfulness training on individuals with SCD. The focus of this trial was primarily on

reaction time, EEG correlates, changes in brain volume, self-reported cognitive complaints, and memory self-efficacy. Since the publication of the primary outcome paper of our SCD-Well trial (Marchant et al., 2021), another large-scale RCT of mindfulness training in older adults with SCD was published (n = 585; Lenze et al., 2022). The two primary outcomes of this 18-month MBI were composites of episodic memory and executive function based on neuropsychological tests; secondary measures included brain volume, functional cognitive capacity (related to completing everyday activities), and self-reported cognitive concerns. None of the primary and secondary outcomes were significantly impacted by the 18-month MBI compared to no-intervention, suggesting that MBIs might not be suitable for improving cognition in older adults with SCD. In contrast to our SCD-Well trial, however, neither the pilot study (Smart et al., 2016) nor the large-scale RCT (Lenze et al., 2022) incorporated measures of psychological well-being. Findings from a recent meta-analysis indicated that group psychological interventions have a moderate effect on enhancing psychological well-being in individuals with SCD, with a Hedges' g of 0.40 (Bhome et al., 2018). However, when each study was examined individually, none showed statistically significant improvements. Although these limited effects are in line with our SCD-Well trial, the authors of the meta-analysis concluded that the quality of existing research on improving psychological well-being in SCD is subpar, often lacking active comparison conditions. They also underscored the noticeable absence of research on non-pharmacological approaches. Given the scarcity and lack of quality of prior research on psychological well-being in older adults with SCD, further trials are needed to draw comparisons and contextualise our present findings. Nonetheless, we would like to offer some potential explanations, one of which could be related to the length of the meditation training. Although 8-week MBIs in younger healthy populations have exerted a positive impact on measures of global well-being as well as dimensions of awareness, connection, and insight (e.g., Goldberg et al., 2020), in older

adults with SCD, eight weeks of practice might be too brief for measurable and clinically meaningful changes in these facets of psychological well-being to manifest. It is also possible that older adults with SCD might deal with not-yet-understood challenges and factors that affect their receptivity to meditation training. Individuals who perceive their cognitive abilities as significantly impaired or declining might experience very particular forms of stress and anxieties in relation to meditation training that could influence their perception of its effects. As such, our findings should be interpreted in light of the specific challenges and complexities associated with ageing and perceived cognitive decline. In this regard, it is possible that the intervention was not sufficiently tailored to the unique needs and circumstances of older adults with SCD. As more research on meditation training in this population accrues, it is possible that important adaptations – beyond the ones that were already considered in the development of the 8-week intervention utilised here – become apparent. Further, the measures we used might not have fully captured the aspects of well-being that are most relevant and meaningful in this population. Given the nascent stage of this research field, further research is needed to elucidate potential reasons for limited or unique effects of meditation and related well-being interventions in this population.

Findings from the 18-month meditation training presented in Chapter 4 were able to further elucidate the extent to which the conjectures related to the duration of the training period might be valid. Indeed, a more nuanced picture emerged. Using the same set of well-being measures administered during the 8-week MBI, the 18-month meditation training significantly improved the meditation-based well-being dimensions of awareness and insight in healthy older adults. Strikingly, however, the 18-month meditation training was not superior to the no-intervention group on changes in PWBS total scores, psychological QoL, connection, or insight. Beyond ascribing these surprising findings simply to a limited effect of meditation training in older adults, this section will provide potential explanations.

To assess the degree to which individual differences could have impacted the change in well-being scores over the course of the interventions, exploratory moderator analyses were conducted. None of the potential moderator variables (SCD-Well: session attendance, neuroticism, baseline well-being; Age-Well: total amount formal meditation practice in class and at home, responsiveness, neuroticism, expectancy, sex, cognition, baseline well-being) had a consistent influence on changes in well-being except baseline well-being scores, with participants who reported higher levels of psychological well-being at baseline consistently showing smaller improvements in well-being. Older adults who are psychologically well at baseline seem to benefit less from meditation training than older adults with lower self-rated well-being. This finding, however, might not be specific to meditation training but rather reflective of a general baseline dependence of training outcomes evident in a wide variety of interventions (see, e.g., Vet et al., 2015).

Another explanation for the limited effects of meditation training on psychological well-being could lie in potential ceiling effects associated with the well-being measures that were employed. In other words, the current gold standard measures of well-being, such as the PWBS and the WHOQOL-BREF, may be limited in capturing important forms, qualities, and depths of well-being. However, even the meditation-based composite measures employed in the present thesis were comprised of self-report measures whose conceptual and psychometric qualities have been questioned (e.g., Grossman, 2019; Strauss et al., 2016; see Van Dam et al., 2018). The field currently lacks a pool of validated well-being measures that were explicitly developed to capture the dimensions, possibilities, and range of human well-being – deep and wide as they are (see, for instance, the literature on meditative absorptions [Pali: jhanas]; Anālayo, 2020a; Arbel, 2017; Burbea, 2014; Hagerty et al., 2013) – that could be cultivated through long-term meditation practice.

Surprisingly, greater perceived responsiveness to the 18-month meditation training did not consistently predict greater increases in well-being outcomes. The responsiveness variable captured a combination of self-perceived and teacher-rated responses to meditation training. In other words, those participants whose overall response to the meditation training was perceived by both themselves and their meditation teachers as beneficial did not report greater increases in well-being dimensions than those for whom the impact of the intervention was perceived as less favourable. Identifying more cognitive, affective, and behavioural factors that can predict positive responses to meditation training remains an important domain for future research as this line of investigation has the potential to substantially impact the development, refinement, and effectiveness of tailored meditation training. Potential cognitive predictors of positive responses to meditation training could include factors such as cognitive flexibility and metaphysical beliefs, which may affect engagement with contemplative frameworks that posit views of the self and world quite distinct from the Judeo-Christian conception more commonly expected amongst the populations recruited here. Relatedly, individuals' relationship with spirituality, more generally, and their views around the value of a contemplative path in life could be meaningful predictors. Affective predictors could encompass baseline levels of trait equanimity, influencing both the perceived need for and impact of such training. Behavioural predictors might involve existing habits or routines that could either facilitate or hinder the integration of meditation into daily life. Additionally, broader contextual factors, such as social support or family members' attitudes towards meditation, could impact the acceptability, perceived relevance of the intervention, and motivation to maintain a regular practice.

Contribution to the literature

Meditation research is characterised by several important limitations. For instance, there is a paucity of research on meditation training in ageing populations including both healthy older adults and those with pre-existing conditions (Goldberg et al., 2022). Most published trials in this field have included only shorter-term meditation training periods, frequently lacked active comparison groups, and did not integrate theory-based models of meditation practice that are grounded in multidisciplinary perspectives (Goyal et al., 2014). Further, the assessment of diverse psychological well-being dimensions has not been included in previous meditation trials in older adults.

Conceptual and methodological contributions

Conceptually, this thesis has expanded our understanding of how meditation-based dimensions of well-being can be measured and quantified. Specifically, the cross-sectional study presented in Chapter 2 was the first attempt at using the seminal theoretical work of Dahl et al. (2015, 2020) to create psychometrically sound composites of meditation-based well-being dimensions. Importantly, we offered empirical support for the theory-based delineation of awareness, connection, and insight as meaningful dimensions of well-being. In this field, our research stands as the inaugural effort to evaluate well-being dimensions in older adults through a comprehensive lens. We have incorporated measures rooted in well-established scientific models (Ryff, 1989; The Whoqol Group, 1998) and juxtaposed them with measures that reflect the latest theoretical progress in the field, such as the meditation-based model of human flourishing introduced by Dahl et al. (2020).

Methodologically, this thesis has broken new ground by conducting the first large-scale RCT that tested the effects of an 8-week MBI on psychological well-being in older adults with SCD, and by conducting the longest active meditation-based intervention (18 months excluding follow-up) conducted in any population to date. These studies have not

only provided valuable data on the shorter-term and longer-term effects of meditation training but also demonstrated the feasibility of conducting such interventions in these specific populations. Responding to the limitations of previous intervention studies in this area, both trials compared the effects of meditation training to a structurally matched active control condition. These control conditions were grounded in theory, from which specific hypotheses regarding the differential mechanisms of action could be drawn. Further, the meditation-based interventions of both trials utilised tailored training manuals that were based on the strengths and limitations of prior existing work in this field and informed by theoretical perspectives from psychological, neuroscientific, and contemplative studies (see Marchant et al., 2018; Poisnel et al., 2018).

Methodologically, the thesis also responded to concerns about the psychometric validity surrounding one of the most frequently employed self-report measures in compassion research, namely the Compassionate Love Scale (CLS; Sprecher & Fehr, 2005). We developed a short 7-item adaptation of the CLS that we evaluated to be superior to the original 21-item version in both content validity and psychometric quality. We validated this shorter scale in both English and German, adding two new scales to meditation and compassion research to address the need for a wide pool of psychometrically robust measures, particularly shorter measures applicable to use in time-constrained research settings. Our work introduces the first German measure of compassion for others published to date, providing the German-speaking research world with a reliable tool for future research to assess a key outcome in the fields of psychological well-being, mental health, and contemplative research.

Applied and clinical implications

The findings of this thesis also carry important applied and clinical implications, particularly for the design and implementation of non-pharmacological interventions for

healthy older adults and those with SCD. In the clinical context of providing care for older adults with SCD, our findings highlight the need for further research and a more nuanced understanding of how to effectively enhance psychological well-being in this population. While MBIs have shown promise in other populations, their utility for contributing to human flourishing in older adults with SCD may be limited, particularly over shorter-term periods. This underscores the need for further research to determine the optimal duration and intensity of such interventions for this population. The limited effects observed in the SCD-Well trial also raise important questions about the base rate changes in well-being in older adults with SCD. It is possible that minimal changes in well-being over time are a characteristic of this population, which could have implications for the design of future studies.

The 18-month intervention indicated that longer-term meditation training can foster key dimensions of psychological well-being in healthy older adults. Given the remarkably low attrition rate over the 18-month intervention period and the enthusiasm that was displayed by participants to continue their weekly meditation classes beyond the study duration, it is possible that such meditation-based programmes could be feasibly implemented in various community settings, such as senior centres, healthcare facilities, and online platforms. Relatedly, incorporating (recommendations for) meditation-based programmes into public health and social care policies could be a cost-effective strategy for enhancing psychological well-being among a wide range of healthy older adults, taking into account the specific needs and preferences of this population to ensure the effectiveness and uptake of such programmes.

Limitations and critical reflection

While the narrative of this thesis has largely been focussed on meditation training and the complexities of psychological well-being, it is crucial to consider the gerontological context in which this research was conducted. Ageing is a complex process that brings about

numerous changes, both physically and psychologically (Baltes & Smith, 2003). The experience of ageing might influence one's receptivity to and engagement with meditation training. For instance, older adults may have more time and motivation to engage in practices like meditation, but they may also face barriers such as physical limitations, cognitive changes, or ingrained habits and beliefs. Moreover, as discussed above, concepts of well-being and flourishing may take on different meanings in the context of ageing, reflecting shifts in priorities, values, and self-perceptions. Reflecting on our research, the intervention studies could have benefitted from a deeper integration of gerontological perspectives. For example, the inclusion of age-related well-being constructs such as generativity and wisdom as utilised in the gerontology and life course literature could have offered additional insights. Generativity, arguably a very specific form of connection, encompasses the sense of fulfilling meaningful obligations and contributing to others, particularly younger generations (Cheng, 2009). Correlational and experimental findings suggest that generativity and activities that may promote it, such as volunteering and other forms of prosocial behaviour, can positively impact the well-being and health of older adults (An & Cooney, 2006; Moieni et al., 2020). Furthermore, research indicates that the well-being of grandparents is closely tied to the quality and content of their intergenerational relationships and their family identity (Tabuchi et al., 2015). Future research assessing the effects of meditation could benefit from a more explicit conceptualisation and measurement of psychological well-being that takes into account the family environment of older adults, including their wider family networks and relationships with grandchildren, and their family's attitude toward their engagement in contemplative practices like meditation. Another potentially important outcome measure for deepening our understanding of the effects of meditation-based interventions on well-being in older adults is wisdom. This construct plays a role in both the contemplative and gerontological literature, albeit in the context of differing theoretical backgrounds, conceptual

emphases, and operationalisations. From the perspective of various contemplative traditions, the cultivation of wisdom is one of the pivotal goals of meditation training and often associated with insights into the nature of perception and suffering (Burbea, 2014; Karunamuni & Weerasekera, 2019). From the perspective of gerontology and adult development, although various conceptualisations of wisdom exist (Grossmann et al., 2020; Zacher & Staudinger, 2018), a widely adopted definition of wisdom encompasses the integration of cognitive, reflective, and benevolent personality characteristics (Ardelt, 2003). Research indicates that this conception of wisdom is associated with higher levels of hedonic, eudaimonic, and physical well-being in older adults (Ardelt, 2016; Bangen et al., 2013) and lower levels of loneliness (Lee et al., 2019). Some researchers have gone so far as to conclude that well-being in older adults is largely attributed to wisdom as defined by a process of psychosocial maturation and development that has occurred throughout the life course (Ardelt, 2004). In sum, generativity and wisdom, as conceptualised and measured in the gerontological literature, present important constructs but were not explicitly included in this thesis. These reflections suggest a more refined approach to interventions for well-being in older adults than initially considered in our study. They also underscore the importance of maintaining a flexible interdisciplinary dialogue for exchanging diverse theoretical and empirical perspectives in future research on meditation training and well-being in older adults.

The science of meditation is evolving but key issues remain to be addressed. In addition to the limitations that we have discussed in the empirical chapters above, some additional points warrant critical reflection. In the introduction, I briefly highlighted the historical evolution and the complex multicultural context from which meditation research has emerged and continues to be shaped. Rather than remaining an abstraction, we can see that this history is directly reflected in methodological choices made in the context of the

present thesis; choices that are also characteristic of the broader contemporary meditation research literature. For instance, the MBIs presented here did not consider and capture the role of participants' intentions for practice and the worldviews through which they make sense of the practice and its goals. Arguably, this level of decontextualisation of intentions and worldviews from the effects of meditation training presents a pertinent conceptual blind spot of the present work. Any meditative practice is inevitably embedded in a particular framework, and any framework is inevitably steeped in a particular set of worldviews, assumptions, and beliefs. These frameworks impact the range of possible intentions for practice. The worldviews and ontological commitments of a given framework delineate the possibilities for practice and explicitly or implicitly dictate which avenues and inquiries are worth pursuing on a meditative path. Contemporary scientific approaches to studying meditation, of which the current thesis is a reflection, tend to exclude intentions and worldviews from the ambit of potential variables that predict the effects of meditation training. I suggest that intentions and worldviews constitute crucial higher-order belief structures that inadvertently shape and participate in the practice of meditation and its effects, thus providing potentially crucial variables to be included in future studies.

A related ongoing tension in this context relates to scientists' need for verifiable and descriptive traditional accounts of meditation practice that can be operationalised for empirical analysis. From an empirical vantage point, metaphysical and soteriological views tend to be framed as unverifiable claims that might not be necessary for meditation practice to exert its effects. It is important to remain open to considering the extent to which the effects of meditation practices are influenced by the conceptual frameworks and paradigms they are embedded within. These frameworks and paradigms are themselves shaped by a variety of cultural, historical, and personal factors. For meditation researchers, it remains vital to explore the views of meditation practice that are present, whether explicitly or

implicitly, when developing and conducting meditation studies. Such exploration also entails considering if and when a decontextualisation of formal technique from metaphysical and soteriological levels of meditation practice could prevent the exploration of vital and important research questions. For instance, how could the exploration of concepts itself – whether consciously adopted or unconsciously inherited – become a fruitful part of meditation practice? To what extent does a commitment to certain views participate in shaping how we perceive ourselves, others, and the world? Science and meditation practice coalesce in the context of questions that consider the extent to which our view of what-meditation-really-is impacts our meditation research.

Future directions

In addition to the directions that were discussed in the empirical chapters, I would like to suggest several conceptual and empirical avenues that could help in transcending the limitations of the present work and opening out new vistas of inquiry. From a gerontological perspective, future research could explore the potential synergies between meditation training and other approaches hypothesised to enhance well-being. This could include physical exercise, cognitive training, and social engagement activities, which have all shown promise in previous research (Colcombe & Kramer, 2003; Fratiglioni et al., 2004; Kelly et al., 2014). Additionally, incorporating techniques from psychotherapy-based and positive psychology interventions, designed to foster cognitive, behavioural, and emotional resourcefulness, could further amplify the effects on well-being (Davidson & McEwen, 2012; Hayes et al., 2006; Sin & Lyubomirsky, 2009). By integrating these diverse approaches, we can create a multi-faceted intervention strategy that leverages the unique strengths of each technique and offers a more holistic approach to enhancing well-being in older adults. Experimental studies that compare the effects of combined interventions with those of each intervention alone could provide valuable insights into the additive or interactive effects of these approaches. Further,

the use of more diverse and age-relevant measures of well-being could enrich our understanding of the impact of meditation training on older adults. This could include measures of constructs such as generativity or wisdom, which are particularly relevant in the context of ageing (as discussed in the previous section).

We add another layer of complexity to meditation research when we consider that a single meditation instruction can yield different experiences for different practitioners, or even for the same practitioner at different times. Despite the progress made in quantifying the effects of meditation practice in psychological and physiological terms, there remains a gap in our understanding of the subjective experience of meditation. This highlights the need for a more nuanced approach to meditation research, one that considers the variability and subjectivity of the meditation experience. In order to gain a fuller understanding of the meditation experience, future work could consider including first-person (micro)phenomenological methods (Lutz et al., 2015; Petitmengin et al., 2019; Poletti et al., 2020; Varela & Shear, 1999). These methods could provide valuable insights into the subjective experience of meditation (i.e., of what it is like to meditate). Without explicit measurement of phenomenological aspects, we might risk making assumptions about the psychological capacities cultivated by a given meditation practice. For instance, the practice of loving-kindness can serve different functions depending on the practitioner's intention, whether it be deepening concentration, cultivating prosocial qualities, or investigating its effects on perception. Therefore, it is crucial that our scientific theories of meditation are informed by nuanced meditation training paradigms (e.g., Burbea, 2014) and the experiences of long-term meditators. To address these considerations, it could be beneficial to involve philosophers and Buddhist scholars throughout the research process, including the early stages of developing large-scale meditation trials as well the later stages that focus on analysis and interpretation of the findings. Their expertise could help to refine our

understanding of meditation and its effects, thereby enhancing the quality and relevance of our research.

In general, it will be crucial for the field to identify and study additional aspects of meditation training that could predict and potentially improve its efficacy. Factors that have received no or only limited empirical attention include teacher-student relations, prior or concurrent psychedelic use, and, as mentioned above, the role of worldviews and ontological commitments within which the practices are embedded. Particularly teacher-student relations present a crucial aspect of traditional meditation training, and the quality of this relationship could have a significant impact on the student's motivation, understanding, and practice. However, the role of the teacher has often been overlooked in meditation research, which has tended to focus on the effects of specific techniques or practices. Future research could explore the impact of different aspects of the teacher-student relationship, such as the teacher's experience and teaching style, the quality of the interpersonal relationship, psychodynamic transference and countertransference phenomena, and the student's perceptions and expectations of the teacher.

Further, it is important to acknowledge that no single classification system of meditation practices and meditation-based well-being dimensions can be definitive, and even widely used theoretical models will require further conceptual delineations as the field matures. For the science of meditation to substantially evolve, a knowledge base is required that would allow us to more reliably predict how, when, and under what circumstances particular forms of practice best serve a meditator's intentions and goals, taking into account their individual differences (e.g., personality traits, affective and cognitive style, worldviews, cultural context including the acceptability of meditation practice in their peer groups). For this maturation of the field to occur, new ways of measuring the impact of meditation training are also needed. A substantial number of scales have been published, but there is growing

consensus that many scales used to assess the effects and mechanisms of meditation training have important psychometric and conceptual limitations (e.g., see Grossman, 2019; Van Dam et al., 2018). Another relevant challenge encountered in contemporary meditation research concerns the understanding of when to train in specific meditation practices during particular periods along the contemplative path. Understanding for whom a given practice is helpful or needed at a given point will present an integral aspect of tailoring meditation training.

In conclusion, while this thesis has made important contributions to our understanding of the potential of meditation training for enhancing well-being in older adults, there is much more to explore. As we continue this line of research, it will be essential to adopt an interdisciplinary approach that integrates insights from gerontology, psychology, neuroscience, and contemplative studies, and that takes into account the complexities and nuances of the ageing process. By doing so, we can contribute to the development of interventions that truly support older adults in navigating the challenges of ageing and flourishing in later life.

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