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Psychology

MINDFUL EATING

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Abstract

Maladaptive eating behaviors such as emotional eating, external eating, and loss-of-control eating are widespread in the general population. Moreover, they are associated to adverse health outcomes and well-known for their role in the development and maintenance of eating disorders and obesity (i.e., *eating and weight disorders*). Eating and weight disorders are associated with crucial burden for individuals as well as high costs for society in general. At the same time, corresponding treatments yield poor outcomes. Thus, innovative concepts are needed to improve prevention and treatment of these conditions.

The Buddhist concept of *mindfulness* (i.e., paying attention to the present moment without judgement) and its delivery via *mindfulness-based intervention programs* (MBPs) has gained wide popularity in the area of maladaptive eating behaviors and associated eating and weight disorders over the last two decades. Though previous findings on their effects seem promising, the current assessment of mindfulness and its mere application via multi-component MBPs hampers to draw conclusions on the extent to which mindfulness-immanent qualities actually account for the effects (e.g., the modification of maladaptive eating behaviors). However, this knowledge is pivotal for interpreting previous effects correctly and for avoiding to cause harm in particularly vulnerable groups such as those with eating and weight disorders.

To address these shortcomings, recent research has focused on the context-specific approach of *mindful eating* (ME) to investigate underlying mechanisms of action. ME can be considered a subdomain of generic mindfulness describing it specifically in relation to the process of eating and associated feelings, thoughts, and motives, thus including a variety of different attitudes and behaviors. However, there is no universal operationalization and the current assessment of ME suffers from different limitations. Specifically, current measurement instruments are not suited for a comprehensive assessment of the multiple facets of the construct that are currently discussed as important in the literature. This in turn hampers comparisons of different ME facets which would allow to evaluate their particular effect on maladaptive eating behaviors. This knowledge is needed to tailor prevention and treatment of associated eating and weight disorders properly and to explore potential underlying mechanisms of action which have so far been proposed mainly on theoretical grounds.

The dissertation at hand aims to provide evidence-based fundamental research that contributes to our understanding of how mindfulness, more specifically its context-specific form of ME, impacts maladaptive eating behaviors and, consequently, how it could be used appropriately to enrich the current prevention and treatment approaches for eating and weight disorders in the future.

Specifically, in this thesis, three scientific manuscripts applying several qualitative and quantitative techniques in four sequential studies are presented. These manuscripts were published in or submitted to three scientific peer-reviewed journals to shed light on the following questions:

I. How can ME be measured comprehensively and in a reliable and valid way to advance the understanding of how mindfulness works in the context of eating?

II. Does the context-specific construct of ME have an advantage over the generic concept in advancing the understanding of how mindfulness is related to maladaptive eating behaviors?

III. Which ME facets are particularly useful in explaining maladaptive eating behaviors?

IV. Does training a particular ME facet result in changes in maladaptive eating behaviors?

To answer the first research question (Paper 1), a multi-method approach using three subsequent studies was applied to develop and validate a comprehensive self-report instrument to assess the multidimensional construct of ME - the *Mindful Eating Inventory* (MEI). Study 1 aimed to create an initial version of the MEI by following a three-step approach: First, a comprehensive item pool was compiled by including selected and adapted items of the existing ME questionnaires and supplementing them with items derived from an extensive literature review. Second, the preliminary item pool was complemented and checked for content validity by experts in the field of eating behavior and/or mindfulness ($N = 15$). Third, the item pool was further refined through qualitative methods: Three focus groups comprising laypersons ($N = 16$) were used as a check for applicability. Subsequently, think-aloud protocols ($N = 10$) served as a last check of comprehensibility and elimination of ambiguities.

The resulting initial MEI version was tested in Study 2 in an online convenience sample ($N = 828$) to explore its factor structure using exploratory factor analysis (EFA). Results were used to shorten the questionnaire in accordance with qualitative and quantitative criteria yielding the final MEI version which encompasses 30 items. These items were assigned to seven ME facets: (1) '**A**ccepting and **N**on-attached **A**ttitude towards one's own eating experience' (ANA), (2) '**A**wareness of **S**enses while **E**ating' (ASE), (3) '**E**ating in **R**esponse to awareness of **F**ullness' (ERF), (4) '**A**wareness of eating **T**riggers and **M**otives' (ATM), (5) 'Inter**con**nectedness' (CON), (6) '**N**on-**R**eactive **S**tance' (NRS) and (7) **F**ocused **A**ttention on **E**ating' (FAE).

Study 3 sought to confirm the found facets and the corresponding factor structure in an independent online convenience sample ($N = 612$) using confirmatory factor analysis (CFA). The study served as further indication of the assumed multidimensionality of ME (the correlational seven-factor model was shown to be superior to a single-factor model). Psychometric properties of the MEI, regarding factorial validity, internal consistency, retest-reliability, and observed criterion validity using a wide range of eating-specific and general health-related outcomes, showed the inventory to be suitable for a comprehensive, reliable and valid assessment of ME. These findings were complemented by demonstrating measurement invariance of the MEI regarding gender. In accordance with the factor structure of the MEI, Paper 1 offers an empirically-derived definition of ME, succeeding in overcoming ambiguities and problems of previous attempts at defining the construct.

To answer the second and third research questions (Paper 2) a subsample of Study 2 from the MEI validation studies ($N = 292$) was analyzed. Incremental validity of ME beyond generic mindfulness was shown using hierarchical regression models concerning the outcome variables of maladaptive eating behaviors (emotional eating and uncontrolled eating) and nutrition behaviors (consumption of energy-dense food). Multiple regression analyses were applied to investigate the impact of the seven different ME facets (identified in Paper 1) on the same outcome variables. The following ME facets significantly contributed to explaining variance in maladaptive eating and nutrition behaviors: *Accepting and Non-attached Attitude towards one`s own eating experience (ANA), Eating in Response to awareness of Fullness (ERF), the Awareness of eating Triggers and Motives (ATM),* and a *Non-Reactive Stance (NRS,* i.e., an observing, non-impulsive attitude towards eating triggers). Results suggest that these ME facets are promising variables to consider when a) investigating potential underlying mechanisms of mindfulness and MBPs in the context of eating and b) addressing maladaptive eating behaviors in general as well as in the prevention and treatment of eating and weight disorders.

To answer the fourth research question (Paper 3), a training on an isolated exercise ('9 Hunger') based on the previously identified ME facet ATM was designed to explore its particular association with changes in maladaptive eating behaviors and thus to preliminary explore one possible mechanism of action. The online study was realized using a randomized controlled trial (RCT) design. Latent Change Scores (LCS) across three measurement points (before the training, directly after the training and three months later) were compared between the intervention group ($n = 211$) and a waitlist control group ($n = 188$). Short- and longer-term effects of the training could be shown on maladaptive eating behaviors (emotional eating,

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external eating, loss-of-control eating) and associated outcomes (intuitive eating, ME, self-compassion, well-being). Findings serve as preliminary empirical evidence that MBPs might influence maladaptive eating behaviors through an enhanced non-judgmental awareness of and distinguishment between eating motives and triggers (i.e., ATM). This mechanism of action had previously only been hypothesized from a theoretical perspective. Since maladaptive eating behaviors are associated with eating and weight disorders, the findings can enhance our understanding of the general effects of MBPs on these conditions.

The integration of the different findings leads to several suggestions of how ME might enrich different kinds of future interventions on maladaptive eating behaviors to improve health in general or the prevention and treatment of eating and weight disorders in particular. Strengths of the thesis (e.g., deliberate specific methodology, variety of designs and methods, high number of participants) are emphasized. The main limitations particularly regarding sample characteristics (e.g., higher level of formal education, fewer males, self-selected) are discussed to arrive at an outline for future studies (e.g., including multi-modal-multi-method approaches, clinical eating disorder samples and youth samples) to improve upcoming research on ME and underlying mechanisms of action of MBPs for maladaptive eating behaviors and associated eating and weight disorders.

This thesis enriches current research on mindfulness in the context of eating by providing fundamental research on the core of the ME construct. Thereby it delivers a reliable and valid instrument to comprehensively assess ME in future studies as well as an operational definition of the construct. Findings on ME facet level might inform upcoming research and practice on how to address maladaptive eating behaviors appropriately in interventions. The ME skill 'Awareness of eating Triggers and Motives (ATM)' as one particular mechanism of action should be further investigated in representative community and specific clinical samples to examine the validity of the results in these groups and to justify an application of the concept to the general population as well as to subgroups with eating and weight disorders in particular.

In conclusion, findings of the current thesis can be used to set future research on mindfulness, more specifically ME, and its underlying mechanism in the context of eating on a more evidence-based footing. This knowledge can inform upcoming prevention and treatment to tailor MBPs on maladaptive eating behaviors and associated eating and weight disorders appropriately.

Zusammenfassung

Maladaptives Essverhalten wie emotionales Essen, externales Essen und Essen mit Kontrollverlust sind in der Allgemeinbevölkerung weit verbreitet. Neben anderen negativen Auswirkungen auf die Gesundheit, ist maladaptives Essverhalten bekannt für seine Rolle bei der Entwicklung und Aufrechterhaltung von Essstörungen und Adipositas (die unter dem Begriff Ess- und Gewichtsstörungen zusammengefasst werden können). Ess- und Gewichtsstörungen sind mit einer erheblichen Belastung für den Einzelnen und hohen Kosten für die Gesellschaft im Allgemeinen verbunden. Gleichzeitig zeigen bisherige Behandlungsansätze keine zufriedenstellende Wirksamkeit. Daher werden innovative Konzepte benötigt, um die Entwicklung von Präventions- und Behandlungsansätzen zu unterstützen.

Das buddhistische Konzept der Achtsamkeit (d.h. die Aufmerksamkeit auf den gegenwärtigen Moment zu richten, ohne zu urteilen) und seine Umsetzung in Form von achtsamkeitsbasierten Interventionsprogrammen (englisch: *mindfulness-based intervention programs;* MBPs) hat in den letzten zwei Jahrzehnten im Kontext von maladaptivem Essverhalten und damit assoziierten Ess- und Gewichtsstörungen große Popularität erlangt. Obwohl die bislang gefundenen Effekte vielversprechend sind, lässt die derzeitige Messung von Achtsamkeit sowie ihre vorherrschende Anwendung im Rahmen von MBPs mit mehreren Komponenten keine Rückschlüsse darauf zu, inwieweit die der Achtsamkeit innewohnenden Qualitäten selbst für die gefundenen Effekte verantwortlich sind (z. B. für die Veränderung maladaptiven Essverhaltens). Dieses Wissen ist jedoch von zentraler Bedeutung, um Interventionen richtig zuzuschneiden und potenziell schädliche Effekte in besonders vulnerablen Gruppen - wie beispielsweise denjenigen mit Ess- und Gewichtsstörungen - zu vermeiden.

Um die derzeitigen Limitationen bezogen auf die Erforschung zugrunde liegender Wirkmechanismen zu adressieren, hat sich jüngste Forschung auf den kontextspezifischen Ansatz des achtsamen Essens (englisch: *mindful eating*, ME) konzentriert. ME kann als ein Unterkonstrukt der generischen Achtsamkeit betrachtet werden, welches sich speziell auf den Prozess des Essens selbst sowie die damit verbundenen Gefühle, Gedanken und Motive bezieht und somit eine Vielzahl unterschiedlicher Einstellungen und Verhaltensweisen umfasst. Allerdings existiert bislang keine allgemeingültige Operationalisierung. Zudem ist die derzeitige Erfassung von ME von unterschiedlichen Limitationen betroffen. Insbesondere sind die derzeitigen Messinstrumente nicht für eine umfassende Erfassung der zahlreichen Facetten des Konstrukts geeignet, die derzeit in der Literatur als wichtig diskutiert werden. Dies

wiederum erschwert den Vergleich verschiedener ME-Facetten, der es ermöglichen würde, ihre jeweils spezifische Wirkung auf maladaptives Essverhalten zu bewerten. Dieses Wissen wird benötigt, um die Prävention und Behandlung von Ess- und Gewichtsstörungen angemessen zu gestalten und um mögliche, bisher hauptsächlich theoretisch angenommenen Wirkmechanismen näher zu erforschen.

Die vorliegende Dissertation zielt darauf ab, evidenzbasierte Grundlagenforschung zu betreiben, die zu unserem gegenwärtigen Verständnis darüber beitragen kann, wie Achtsamkeit, und genauer gesagt ihre kontextspezifische Form von ME, bei der Veränderung von maladaptivem Essverhalten wirkt und wie sie folglich in geeigneter Weise eingesetzt werden könnte, um die derzeitigen Präventions- und Behandlungsansätze für Ess- und Gewichtsstörungen in Zukunft zu bereichern.

Auf dieser Grundlage werden in der vorliegenden Dissertation drei wissenschaftliche Manuskripte präsentiert, die die folgenden Fragen beleuchten:

I. Wie kann ME umfassend und auf reliable und valide Weise gemessen werden, um besser zu verstehen, wie Achtsamkeit im Kontext des Essens funktioniert?

II. Hat das kontextspezifische Konstrukt von ME einen Vorteil gegenüber dem generischen Konzept, um zu verstehen, wie Achtsamkeit mit maladaptivem Essverhalten zusammenhängt?

III. Welche Facetten von ME sind besonders nützlich, um maladaptives Essverhalten zu erklären?

IV. Führt das Training einer bestimmten ME-Facette zu Veränderungen im maladaptiven Essverhalten?

Diese Forschungsfragen wurden mit Hilfe von vier Studien beantwortet, die in drei Artikeln in wissenschaftlichen peer-reviewed Journals veröffentlicht oder zur Begutachtung eingereicht wurden und verschiedene qualitative und quantitative Techniken beinhalteten.

Zur Beantwortung der ersten Forschungsfrage (Paper 1) wurde ein multimethodaler Ansatz mit drei aufeinander folgenden Studien angewandt, um ein umfassendes Selbstauskunftsinstrument zur Erfassung des multidimensionalen Konstrukts ME zu entwickeln und zu validieren - das *Mindful Eating Inventar* (MEI). Studie 1 zielte auf die Erstellung einer ersten Version des MEI mit Hilfe von drei Schritten ab: Erstens wurde ein umfassender Itempool zusammengestellt, indem Items aus den bestehenden ME-Fragebögen ausgewählt und angepasst wurden. Zudem wurden Items ergänzt, die aus einer umfangreichen

Literaturrecherche abgeleitet wurden. Zweitens wurde dieser vorläufige Itempool durch Experten (*N* = 15) aus dem Bereich Essverhalten und/oder Achtsamkeit ergänzt und die Inhaltsvalidität überprüft. Drittens wurde dieser vorläufige Itempool durch Einbeziehung der Meinung von Laien mittels zweier qualitativer Methoden verfeinert: Drei Fokusgruppen (*N* = 16) prüften die Anwendbarkeit der Items im Alltag. Schließlich dienten Think-Aloud-Protokolle (*N* = 10) der letzten Überprüfung der Verständlichkeit und der Beseitigung von Unklarheiten. Die daraus resultierende erste MEI-Version wurde in Studie 2 mit Hilfe einer Online-Stichprobe (*N* = 828) getestet, um die Faktorenstruktur mittels explorativer Faktorenanalyse (EFA) zu untersuchen. Anschließend wurde der Fragebogen nach qualitativen und quantitativen Kriterien gekürzt. Hieraus resultierte die finale MEI-Version mit 30 Items. Diese Items sind den folgenden sieben ME-Facetten zugeordnet: (1) '*Akzeptierende, nicht-anhaftende Haltung gegenüber der eigenen Essenserfahrung*' (ANA), (2) '*Gewahrsein der Sinneserfahrung während des Essens*' (ASE), (3) '*Essen in Abhängigkeit zum Gewahrsein der Magenfülle*' (ERF), (4) '*Gewahrsein von Essmotiven- und -triggern*' (ATM), (5) '*Verbundenheit*' (CON), (6) '*Nicht-reaktive Haltung*' (NRS) und (7) '*Auf das Essen fokussierte Aufmerksamkeit*' (FAE). Studie 3 diente dazu, diese finale Faktorenstruktur in einer unabhängigen Online-Stichprobe (N = 612) mittels konfirmatorischer Faktorenanalyse (CFA) zu bestätigen und die angenommene Multidimensionalität des Konstrukts ME zu belegen (das korrelative Sieben-Faktoren-Modell erwies sich dem Ein-Faktoren-Modell überlegen). Die psychometrischen Eigenschaften des MEI hinsichtlich faktorieller Validität, interner Konsistenz, Retest-Reliabilität und beobachteter Kriteriumsvalidität unter Verwendung eines breiten Spektrums essensspezifischer und allgemeiner gesundheitsbezogener Outcomes zeigten, dass das Inventar für eine umfassende, reliable und valide Bewertung von ME geeignet ist. Diese Ergebnisse wurden durch den Nachweis der Messinvarianz des MEI in Bezug auf das Geschlecht ergänzt. In Anlehnung an die Faktorenstruktur des MEI konnte eine empirisch abgeleitete, operationale Definition bereitgestellt werden, die die Probleme und Ambiguitäten bisheriger, meist theoriegeleiteter Definitionsversuche überwindet.

Zur Beantwortung der zweiten und dritten Forschungsfrage (Paper 2) wurde eine Teilstichprobe der Studie 2 aus den MEI-Validierungsstudien (*N* = 292) analysiert. Die inkrementelle Validität von ME über die allgemeine Achtsamkeit hinaus in Bezug auf die Outcomevariablen maladaptives Essverhalten (emotionales Essen und unkontrolliertes Essen) und Ernährungsverhalten (selbstberichteter Verzehr von energiereichen Nahrungsmitteln) konnte mit Hilfe hierarchischer Regressionsmodelle gezeigt werden. Multiple Regressionsanalysen wurden angewandt, um den Einfluss der sieben verschiedenen Facetten

von ME, die in Paper 1 identifiziert wurden, auf dieselben Outcomes zu untersuchen. Die folgenden ME-Facetten erklärten deren Varianz signifikant: '*Akzeptierende, nicht-anhaftende Haltung gegenüber der eigenen Essenserfahrung*' (ANA), '*Essen in Abhängigkeit zum Gewahrsein der Magenfülle*' (ERF), '*Gewahrsein von Essmotiven- und -triggern*' (ATM), '*Nicht-reaktive Haltung*' (NRS, d.h. eine beobachtende, nicht-impulsive Haltung gegenüber Essenstriggern). Die Ergebnisse deuten darauf hin, dass diese ME-Facetten vielversprechend sein könnten, um a) die zugrunde liegenden Mechanismen von Achtsamkeit und MBPs im Kontext von Essen zu untersuchen und b) maladaptives Essverhalten direkt oder im Rahmen der Prävention und Behandlung von Ess- und Gewichtsstörungen korrekt und gewinnbringend zu adressieren.

Zur Beantwortung der vierten Forschungsfrage (Paper 3) wurde ein Training zu einer klar umschriebenen, isolierten Übung ('9 Hunger') auf der Grundlage der zuvor identifizierten ME-Facette ATM konzipiert, um deren potenziellen Zusammenhang mit Veränderungen im maladaptiven Essverhalten zu erforschen und sich so einem möglichen Wirkmechanismus anzunähern. Die Online-Studie wurde in Form einer randomisiert kontrollierten Studie (RCT) durchgeführt. Latent Change Scores (LCS) über drei Messzeitpunkte (vor dem Training, direkt nach dem Training und drei Monate später) wurden zwischen der Interventionsgruppe ($n = 211$) und einer Wartelisten-Kontrollgruppe ($n = 188$) verglichen. Es konnten kurz- und längerfristige Effekte des Trainings auf maladaptives Essverhaltens (emotionales Essen, externes Essen, Essen mit Kontrollverlust) und assoziierte Outcomes (intuitives Essen, achtsames Essen, Selbstmitgefühl, Wohlbefinden) gefunden werden. Die Ergebnisse dienen als vorläufige empirische Unterstützung des bislang nur theoretisch angenommenen Mechanismus, dass MPBs maladaptives Essverhalten und damit Ess- und Gewichtsstörungen durch ein verbessertes, nicht-wertendes Gewahrsein unterschiedlicher Essmotiven und Trigger sowie deren Unterscheidung beeinflussen könnten.

Die Integration der Ergebnisse erlaubte die Ableitung mehrerer Vorschläge, wie ME zukünftige Interventionen für maladaptives Essverhalten bereichern könnte, um die Gesundheit im Allgemeinen sowie die Prävention und Behandlung von Ess- und Gewichtsstörungen zu verbessern. Die Stärken der Dissertation (z. B. aufeinander aufbauende, spezifische Methodik, Vielfalt von Designs und Methoden, großer Stichprobenumfang) werden hervorgehoben. Die wichtigsten Einschränkungen, insbesondere in Bezug auf die Stichprobencharakteristika der inkludierten Studien (z.B. höheres Bildungsniveau, weniger Männer, selbst-selektiert) werden kritisch diskutiert, um Ideen und Notwendigkeiten für kommende Forschung abzuleiten (z.B. Einschluss multimodaler und multimethodaler Ansätze, klinischer Essstörungsstichproben und

Jugendlichenstichproben), um die zukünftige Forschung zu ME und den zugrundeliegenden Mechanismen von MBPs im Kontext von maladaptivem Essverhalten und assoziierten Ess- und Gewichtsstörungen zu verbessern.

Diese Arbeit bereichert die aktuelle Forschung zu Achtsamkeit im Kontext von Essverhalten und assoziierten Ess- und Gewichtsstörungen, indem sie Grundlagenforschung zum Kern des Konstrukts ME liefert. Dabei stellt sie ein reliables und valides Instrument zur umfassenden Erfassung von ME in zukünftigen Studien sowie eine operationale Definition zur Verfügung. Die Ergebnisse auf der Ebene der ME-Facetten können von Forschung und Praxis genutzt werden, maladaptives Essverhalten in der Prävention und Behandlung angemessen zugeschnitten zu adressieren. Der vorläufig identifizierte Wirkmechanismus von ATM sollte in repräsentativen Bevölkerungsstichproben und spezifischen klinischen Stichproben weiter untersucht werden, um die Gültigkeit der Ergebnisse in diesen Gruppen zu prüfen und eine breitere Anwendung des Konzepts in der Allgemeinbevölkerung sowie in spezifischen Gruppen mit Ess- und Gewichtsstörungen zu rechtfertigen.

Zusammenfassend können die Ergebnisse der vorliegenden Arbeit dazu beitragen, die Forschung zu ME und zugrundeliegenden Mechanismen auf eine stärker evidenzbasierte Grundlage zu stellen. Dieses Wissen kann genutzt werden, um künftige MBPs in Prävention und Behandlung von Ess- und Gewichtsstörungen entsprechend anzupassen.

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CHAPTER 1

THEORETICAL BACKGROUND

1 Introduction

> *Gute Laune.*
> **Erstmal Essen.**
> *Schlechte Laune.*
> **Erstmal Essen.**
> *Keine Laune.*
> **Erstmal Essen.**
>
> Uber **Eats**

In a charming and humorous manner, this current advertisement reflects our changed relationship towards eating in our modern food environment and the shifting paradigm of the concept of hunger during the last century. On the one hand, it alludes to the widespread tendency to cope emotions – whether positive, negative, or neutral – with food (i.e., *emotional eating*). On the other hand, it plays on our behavioral tendency to follow the temptation to eat all the time - regardless of our emotions, but also regardless of the presence of physiological hunger signals - since food (here via the delivery service Uber Eats) is available all the time (i.e., *external eating*). Both tendencies, which can be understood as two different motivations to eat, have been shown to significantly influence our subjective perception of hunger and thus our eating behavior as well as the subsequent regulation of food intake (Bilman et al., 2017; Brytek-Matera, 2021). However, these complex associations are thought to be highly automatized and often unconscious (Brewer et al., 2018). This hampers their modification and might be one reason why dysregulated or so called *maladaptive eating behaviors* (such as emotional and external eating) remain common in the general population, contributing to adverse health outcomes and the rise of eating disorders and obesity (Nagl, Hilbert, Zwaan, Braehler, & Kersting, 2016; Ouwens, van Strien, & van Leeuwe, 2009).

This dissertation seeks to advance our understanding of how a context-specific form of *mindfulness*, a popular concept referring to a certain form of focused, non-judgmental attention (Kabat-Zinn, 2013), might help to (re)gain awareness of these complex processes around eating in order to make conscious adjustments. Concretely, it aims to investigate the *mindful eating* (ME) approach for its suitability in modifying maladaptive eating behaviors, also with a view to potential uses in the prevention and treatment of eating disorders and obesity. To this end, I developed a comprehensive ME instrument (Paper 1) to examine the concept of ME and important facets of it in more depth (Paper 2). On this basis, I developed a training to explore

one promising previously hypothesized underlying mechanism of how *mindfulness-based intervention programs* (MBPs) might influence maladaptive eating behaviors (Paper 3).

The following sections of this first chapter contextualize the structure of the dissertation and the publications it comprises. To provide a general theoretical foundation on the concept of hunger, I will first introduce a psychobiological view on its perception and the involvement of maladaptive eating behaviors. In the same section, I will also present a model of the development and maintenance of maladaptive eating behaviors to illustrate the potential of mindfulness in addressing these behaviors. In the subsequent section, I will describe forms of maladaptive eating behaviors to demonstrate their associations with broader adverse health outcomes and their particular role in the prevention and treatment of eating and weight disorders. I will then describe the characteristics of mindfulness and MBPs. Previously reported effects of both in the application to the whole spectrum of eating- and weight-related issues as well as current shortcomings in investigating underlying mechanism of action will also be presented in this section. Finally, the context-specific approach of ME will be introduced as one possible way to address current shortcomings. Opportunities and problems regarding ME's assessment will be presented to arrive at an outline of the core rationale of the dissertation at hand (chapter 2). In this outline, the central research questions, the aims, and the methods as well as the three publications included in this thesis will be introduced.

2 The Perception of Hunger

A Complex Interplay between Different Motivations to Eat

For a long time, hunger was seen from a merely evolutionary perspective, solely being defined as a biological status of acute energy deficiency that drives our behavior to eat (Lowe & Butryn, 2007). According to this view, we stop eating once the body's need for energy supply is satisfied (i.e., to keep up overall bodily functions) and energy homeostasis has been re-established. However, considering our modern food environment and living conditions, newer research applies a broader, psychobiological framework including not only biological, but also individual and environmental factors to approach the concept (Beaulieu & Blundell, 2021).

This psychobiological framework also considers the perception of hunger to be primarily shaped by physiological processes. These physiological processes (mediated by signals and associated hormones) are both tonic and episodic (Beaulieu, Hopkins, Blundell, & Finlayson, 2018). Tonic signals depend on the individual body composition and stem from the basic cellular metabolism. They are constant and transmit information on energy availability and energy needs to the central nervous system. In contrast, most episodic processes occur periodically since they are related to the current presence or absence of nutrients in the gastrointestinal tract. The primary perception of hunger arises from tonic signals (e.g., energy deficit) and is inhibited by episodic signals (e.g., satiety hormones released due to the sufficient presence of nutrients in the body) (Beaulieu et al., 2018).

However, the psychobiological framework postulates that, additionally, the ongoing balance of these bodily homeostatic processes - and thus the overall drive to eat - strongly interacts with non-homeostatic processes (Beaulieu & Blundell, 2021). These refer to a variety of triggers such as food pleasure, characteristics of particular (palatable) foods, further external cues (e.g., mealtime, food availability), and learned behavioral patterns (e.g., emotion regulation through food). Those non-homeostatic signals have the potential to override homeostatic signals, consequently influencing our subjective moment-to-moment perception of hunger (Beaulieu et al., 2018; Bilman, van Kleef, & van Trijp, 2017; Brytek-Matera, 2021). Investigating the complex relationship between homeostatic and non-homeostatic mechanisms may contribute to our understanding of why we often eat regardless of physiological needs and, more specifically, why we often struggle to distinguish between our bodies actually needing food or wanting to eat for other reasons. For example, Renner, Sproesser, Strohbach, and Schupp (2012) identified 15 different motivations to eat of which a biological energy deficit represents just one. Accordingly, research on the variety of motivations to eat has shown that large parts of human eating behavior are guided by external, food-related cues (Bilman et al.,

2017; Lowe & Butryn, 2007) as well as internal cues such as emotions (Brytek-Matera, 2021). The subsequent expressions of external and emotional eating can be subsumed under the umbrella term *maladaptive eating behaviors* since they are not adaptively in line with physiological needs (Brewer et al., 2018). Maladaptive eating behaviors can be considered as the behavioral manifestation of the non-homeostatic processes leading to eating in the absence of a physiological energy deficit.

To explain the development and maintenance of such maladaptive eating behaviors in order to modify them, Brewer et al. (2018) present a model of associative learning (i.e., operant conditioning) through brain-related reward mechanisms (Figure 1). Based on the original theory of operant behavior (Skinner, 1963) and more recent neurobiological findings, the authors propose that eating behavior is formed in the course of early life through positive and negative reinforcement processes, which lead to a certain consequence experienced in the brain (reward). On the one hand, eating may increase positive affect (e.g., through eating a palatable meal), representing positive reinforcement. On the other hand, eating may decrease negative affect (e.g., by subsequently reducing difficult emotions), representing negative reinforcement. In sum, the repetition of the link between eating and reinforcement leads to certain memories and establishes a habit loop, which prompts us to perform this behavior again and again in the future. The constant reactivation of this habit loop, which is assumed to be continuously triggered by the constant availability of food in our modern food environment, shifts our eating behavior towards unconscious automaticity over the course of our lives (Brewer et al., 2018). This hampers the modification of certain eating behaviors such as maladaptive ones, which are also amplified by further associated neurocognitive changes (e.g., regarding increased salience of food cues, perception of certain foods and altered reward circuitry in the brain). The acquired unconscious habit loop as proposed by these researchers further impedes the ability to differentiate between homeostatic processes (e.g., perception of physiological hunger and satiety signals) and non-homeostatic cues (e.g., external or emotional) and thus makes a conscious, health-promoting regulation of food intake more difficult.

Consequently, becoming aware of these eating-related learning processes in a particular, non-judgmental way offers a promising starting point to rewiring them. This might in turn help to regain our capacity to make more conscious decisions about when, what and how much we eat in balance between homeostatic and non-homeostatic signals (Brewer et al., 2018).
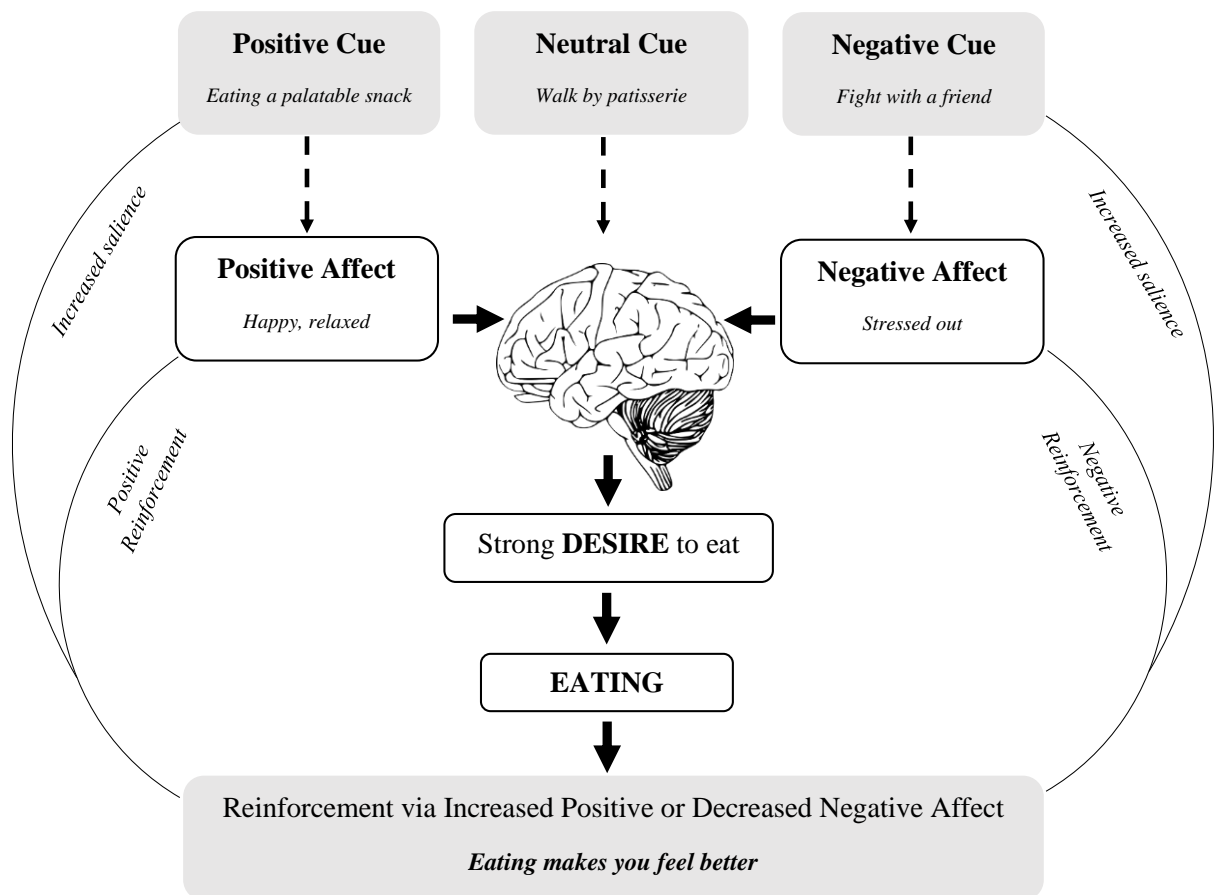
Figure 1. The Habit Loop. Development of Habitual Maladaptive Eating Behavior (based and simplified on Brewer et al., 2018)

The structure of the current chapter follows this line of thought by focusing on *maladaptive eating behaviors* (section 3 below) and their potential modification through the application of non-judgmental awareness called *mindfulness* (section 4), and more precisely, its context-specific form of *ME* (section 5).

3 Maladaptive Eating Behaviors

Maladaptive eating behaviors have become one major focus of research investigating non-homeostatic processes leading to eating in the absence of a physiological energy deficit and its effects on overall health (Brytek-Matera, 2021).

The most common forms of maladaptive eating behaviors in terms of disinhibited eating (difficulties/inability in restricting eating once begun; Stunkard & Messick, 1985; van Strien, Frijters, Bergers, & Defares, 1986) addressed in the thesis at hand will be introduced in the following paragraph. In addition to these disinhibited forms of maladaptive eating behaviors, inhibited forms such as restrained eating behavior (continual and intentional food intake restriction and/or dieting; Stunkard & Messick, 1985; van Strien et al., 1986) form another

extensive area of research. They will not be introduced further since they are beyond the scope of this dissertation (see page 14 for explanation). Consequently, the following sections will refer to maladaptive eating behaviors meaning their disinhibited variants only.

3.1 Forms of Maladaptive Eating Behaviors

3.1.1 Emotional Eating

The term *emotional eating* defines a tendency to eat - often highly palatable or energy-dense foods - in response to internal cues such as positive or negative emotion, affect or mood states (Konttinen, van Strien, Männistö, Jousilahti, & Haukkala, 2019; van Strien et al., 1986). Emotional eating is considered a dysfunctional emotion regulation strategy since it is assumed to be a maladaptive response to stress or difficult emotions, and might also be influenced by additional factors such as high dietary restraint and poor interoceptive awareness (Brytek-Matera, 2021; van Strien, 2018). Poor interoceptive awareness is thought to aggravate difficulties in distinguishing bodily hunger and satiety signals from emotional cues, and thus in making conscious eating decisions.

3.1.2 External Eating

External eating can be defined as eating in response to external cues such as smell or sight regardless of a perceived sensation of hunger or satiety (van Strien et al., 1986). Since external eating is mainly triggered by the existence and presentation of food-related cues, the designation of our contemporary food environment as an *obesogenic environment* (Lowe & Butryn, 2007) becomes clear: Our modern surroundings are full of food-related cues in the form of product placements and advertisements in the media/social media as well as cheap and easily accessible highly palatable foods. Under these circumstances, external (eating) signals are assumed to override and/or undermine physiological hunger and satiety signals, increasing the likelihood to overeat and thus, to gain weight (Bilman et al., 2017).

3.1.3 Loss-of-Control Eating

Loss-of-control eating (LOC) or *binge eating* describes the subjective experience of being obliged to eat and/or the perceived inability to resist or stop eating (Latner, Mond, Kelly, Haynes, & Hay, 2014). Even though the presence of both features is required for a *binge eating disorder* (BED) diagnosis (American Psychiatric Association, 2013), it has been shown that it is more the perceived loss of control than the overconsumption of food which accounts for the disorder's individual burden and related psychopathological outcomes (Conceição, Moreira, Lourdes, Ramalho, & Vaz, 2021).

3.2 Association with Broader Adverse Health Outcomes

Maladaptive eating behaviors are widespread in the general population (Abdulkadir et al., 2020; Nagl et al., 2016). In one of the rare studies on maladaptive eating behaviors in a representative German sample ($N = 2513$), Nagl et al. (2016) identified external eating as the most prevalent maladaptive eating behavior which supports the theory of an obesogenic environment (Lowe & Butryn, 2007).

The common occurrence of maladaptive eating behaviors is concerning in light of their association with a variety of adverse health outcomes such as higher rates of depression, lower psychological well-being, higher blood pressure, and weight gain (Brytek-Matera, 2021; Ouwens et al., 2009; van Strien, Konttinen, Homberg, Engels, & Winkens, 2016; Wade et al., 2017). Moreover, they are related to other potentially harmful behaviors like eating high-caloric food with low nutritional value and high sugar and fat content (Brytek-Matera, 2021; Konttinen et al., 2019). Accordingly, they have been shown to be a shared risk factor for the development and maintenance of both eating disorders and obesity (Colles, Dixon, & O'Brien, 2008; Greeno, Wing, & Shiffman, 2000; He, Cai, & Fan, 2017; Patel & Schlundt, 2001; Ricca et al., 2012; Tanofsky-Kraff et al., 2011).

Consequently, addressing maladaptive eating behaviors in interventions has the potential to enhance the ability to make conscious decisions about when, what and how much to eat in balance between homeostatic and non-homeostatic signals in order to promote population health as well as to prevent and treat eating disorders and obesity in an integrated way. This is one important reason why maladaptive eating behaviors were chosen as the main outcome of interest in the studies presented in this thesis.

3.3 Specific Association with Eating and Weight Disorders: Potential for Preventment and Treatment

Both individuals with eating disorders and/or obesity showed higher rates of maladaptive eating behaviors than individuals without these conditions (Kornstein, Kunovac, Herman, & Culpepper, 2016; Patel & Schlundt, 2001; Ricca et al., 2012). Therefore, addressing these behaviors may help to prevent these conditions in the general population (primary prevention/universal prevention), in populations at risk or with a sub-threshold manifestation (secondary prevention/indicated prevention), and in treating populations with a full clinical manifestation of these conditions.

Eating disorders such as *Binge eating disorder* (BED), *Bulimia nervosa* (BN), and *Anorexia nervosa* (AN) are characterized by abnormal eating or weight control behaviors (Dilling, 2015). BED, BN and AN are considered to be particularly severe psychological

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disorders, associated with the highest mortality rates among all psychiatric diagnoses: Newer studies showed the mortality risk for individuals diagnosed with AN to be up to 6.5 times higher compared to the general population (van Eeden, van Hoeken, & Hoek, 2021; van Hoeken & Hoek, 2020). Prevalence rates range from below 1% to 4 % for AN, below 1% to 2% for BN, below 1% to 4% for BED, and 2% to 3% for subthreshold eating disorders (Keski-Rahkonen & Mustelin, 2016). Treatment outcomes can be considered as unsatisfactory: Summarizing a series of very long-term follow-up studies (10 to more than 20 years) across eating disorders showed that even in those who receive treatment, 35% to 70% still had eating disorder symptoms or met full diagnostic criteria at follow-up. Moreover, transitioning from one eating disorder to another is a common phenomenon: For example, an eight-year prospective community study showed 20% crossing over to BN from BED and 23% to BED from BN (Stice, Marti, & Rohde, 2013).

Overweight (defined by a BMI of 25 and above) and its extreme form *obesity* (BMI of 30 and above; World Health Organization, 2014) is considered a multi-etiological phenomenon, in which different factors (e.g., metabolic, genetic, socio-cultural, environmental, psychological, and behavioral) account for a chronic energy imbalance (Chooi, Ding, & Magkos, 2019). According to a current study by the Robert Koch Institute, more than half (54%) of the German adult population is overweight, nearly one fifth (19%) is obese, with the trend pointing upward (Schienkiewitz, Kuhnert, Blume, & Mensink, 2022). Since obesity rates are rising worldwide, the phenomenon is referred to as the "obesity pandemic" (Blüher, 2019, p.2). Considering only the outcome of BMI, weight-normative treatment approaches for obesity in particular yield small effects: Findings based on systematic reviews and meta analyses showed that within the first year after conservative therapy (i.e., common lifestyle interventions focusing on dietary restraint and physical exercise) on average only 54% maintained the initial weight loss (Barte et al., 2010); after 5 years, about 80% of lost weight was regained on average (Anderson, Konz, Frederich, & Wood, 2001).

Because both eating disorders and obesity are associated with crucial physical (e.g., cardiovascular disease, mortality) and psychological/psychosocial (e.g., co-occurring mental disorders, stigmatization) burden for individuals as well as high costs for society in general, their constantly growing rates represent global health challenges (Dai et al., 2020; Jastreboff, Kotz, Kahan, Kelly, & Heymsfield, 2019; Keski-Rahkonen & Mustelin, 2016; Ng et al., 2014; Schmidt et al., 2016; van Hoeken & Hoek, 2020; World Health Organization, 2014). Hence, innovative concepts are needed to support the prevention of these conditions and improve treatment outcomes.

Eating disorders and obesity are significantly interrelated (e.g., up to one third of individuals with obesity also fulfill the criteria of BED and vice versa; Agüera et al., 2021; Ivezaj, White, & Grilo, 2016) and share a variety of risk factors (see Stabouli, Erdine, Suurorg, Jankauskienė, & Lurbe, 2021 for an overview), among them maladaptive eating behaviors. Thus, they are often referred to as *eating and weight disorders* (Neumark-Sztainer, 2009; see also the Springer Journal 'Eating and Weight Disorders'). The consideration under this umbrella term encourages research fields focused on only one of the two to learn and mutually benefit from each other (Neumark-Sztainer, 2009). Hence, seeing eating disorders and obesity as parts of a spectrum of eating- and weight-related issues instead of distinct entities, and addressing their shared risk factors simultaneously, is currently discussed as an encouraging way to improve their prevention and treatment in order to avoid adverse effects within single-focused interventions, such as weight stigmatization (Russell-Mayhew & Grace, 2016; Stabouli et al., 2021).

One approach which has been shown to be promising in facilitating the prevention and treatment of eating and weight disorders, and particularly their shared risk factor of maladaptive eating behaviors, is based on the Buddhist concept of mindfulness (Braun, Park, & Gorin, 2016; Rogers, Ferrari, Mosely, Lang, & Brennan, 2017; Wanden-Berghe, Sanz-Valero, & Wanden-Berghe, 2011).

4 Mindfulness

4.1 Definition

Mindfulness is rooted in Buddhist culture and can be described as a particular form of awareness which results from deliberately paying attention to the present moment without judgment (Kabat-Zinn, 2013). Application in the scientific context has led to different operationalizations, varying in their number of mindfulness facets specified and therefore including different mindfulness qualities and skills (Bergomi, Tschacher, & Kupper, 2013a). There is consensus that at least two facets are essential to the description of mindfulness: 'Attention to and awareness of the experience in the present moment' (the so called _what_ of mindfulness) while bringing 'an accepting, open, kind, and curious attitude towards this experience' (the so called _how_ of mindfulness) (Baer, Crane, Miller, & Kuyken, 2019; Bishop, 2004). Frameworks that provide a more comprehensive picture of mindfulness-immanent qualities have identified five facets ('observing'/'noticing', 'describing', 'acting with awareness', 'non-judging of experience', & 'non-reactivity to inner experience'; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) or even eight facets of mindfulness ('awareness of

internal experiences', 'awareness of external experiences', 'acting with awareness', 'accepting and non-judgmental orientation', 'decentering and non-reactivity', 'openness to experience', 'relativity of thoughts', & 'insightful understanding'; Bergomi, Tschacher, & Kupper, 2014). Across operationalizations, mindfulness is regarded as a multidimensional construct reflecting a set of these related qualities, attitudes, and skills, which can be developed with practice (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Bergomi et al., 2013a; van Dam et al., 2018). Because different facets of mindfulness have been found to be associated with different outcomes, these facet-specific findings should be considered as evidence in tailoring MBPs properly (Bergomi et al., 2013a; Sala, Shankar Ram, Vanzhula, & Levinson, 2020).

4.2 Mindfulness-Based Intervention Programs

Mindfulness has gained broad international attention through its application in *mindfulness-based intervention programs* (MBPs), which have been researched extensively over the past decades (van Dam et al., 2018; Zhang, Lee, Mak, Ho, & Wong, 2021). Most MBPs are designed as multi-component interventions: A strong focus on teaching mindfulness-based qualities and skills is combined with other behavioral and cognitive elements (Baer et al., 2019; Tapper, 2022).

Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 2013) and *Mindfulness-Based Cognitive Therapy* (MBCT; Segal, Williams, & Teasdale, 2018) can be considered as the most widely-used MBPs. While MBSR was developed as an add-on for chronic pain treatment, MBCT built on and extended MBSR to help patients with chronic, treatment-resistant depression. Both are manualized, intensive 8-week programs with 2-2½-hour-long weekly sessions including home practice (approximately 45 minutes per day). In addition to psycho-educative elements and group exchange, they mainly incorporate a variety of formal and informal mindfulness practices. Formal practices describe meditation techniques (e.g., sitting meditation, body scan, mindful yoga/movement) while informal practices foster a non-judgmental awareness of senses, body sensation, emotions, and thoughts in daily life (i.e., exercises on everyday activities such as mindful walking or mindful tooth brushing) (Querstret, Morison, Dickinson, Cropley, & John, 2020). Both formal and informal practices aim to increase the ability to be aware of the present moment and to recognize habitual behavior in a non-judgmental and non-reactive manner. This, in turn, is meant to facilitate the replacement of habitual behaviors with more conscious responses (Katterman, Kleinman, Hood, Nackers, & Corsica, 2014; Schuman-Olivier et al., 2020). Many MBPs follow the MBSR structure and its delivery, especially in terms of the primary focus on mindfulness techniques, but are tailored

very differently to their respective specific target populations or outcomes (e.g., *Mindfulness-Based Eating and Awareness Training*, MB-EAT; Kristeller & Wolever, 2011). Mindfulness practices have also been incorporated into so called third wave cognitive-behavioral therapies such as *Acceptance and Commitment Therapy* (ACT; Hayes, Strosahl, & Wilson, 2011) or *Dialectical Behavior Therapy* (DBT; Linehan, 1987). These interventions include larger proportions of non-mindfulness-related elements within their programs and are consequently not considered to be part of the "MBSR-inspired family" (Baer et al., 2019, p. 102) but rather display "mindfulness-informed programs" (Crane et al., 2017, p. 991). Nevertheless, they are often taken into consideration when analyzing general effects of MBPs and are thus mentioned here (Ruffault et al., 2017; Turgon, Ruffault, Juneau, Blatier, & Shankland, 2019).

Meta-analytic overviews have shown that MBPs exert positive effects on a wide range of different outcomes: They have been found to be effective for treating several biopsychosocial conditions such as pain, hypertension, cancer-related symptoms, depression, anxiety, stress, and psychosis in various settings and populations (Gotink et al., 2015; Zhang et al., 2021). Moreover, consistent findings on the enhancement of psychological health and well-being in non-clinical samples have been reported (Querstret et al., 2020), indicating the potential of mindfulness for public health interventions.

Based on these promising findings and the simplicity of application, there has been a surge of interest in mindfulness not only in research but also in the general public in the past two decades, which is sometimes referred to as a real "hype": Scientific publications on the topic as well as media pieces have increased more than tenfold (for a broad overview see van Dam et al., 2018). Since "contemplative science (i.e., the scientific study of contemplative practices including […] mindfulness meditation) is particularly vulnerable to "hype" of various sorts (i.e., tendencies to tout exaggerated positive and negative claims)" (van Dam et al., 2018; p. 42), several critical publications have warned of exaggeration around mindfulness and its effect on overall health in recent years. Authors caution seeing mindfulness as a panacea or even using it as a replacement for psychotherapy and other conventional treatments. Instead, the need for further methodologically rigorous research to apply the concept properly on the basis of an evidence-based framework is required to rule out contraindications, adverse effects and potential misleading of vulnerable patient groups with serious disorders (Baer et al., 2019; Briggs & Killen, 2013; van Dam et al., 2018).

4.3 Mindfulness and its Effects in the Context of Eating

Following the broad interest in other areas, mindfulness has also been increasingly applied to the context of eating in recent years. Since 2011, 22 evidence syntheses on the effects of a wider range of different MBPs on eating- and weight-related issues were published, including structured literature and scoping reviews (Dunne, 2018; Mantzios & Wilson, 2015b; O'Reilly, Cook, Spruijt-Metz, & Black, 2014; Tapper, 2017, 2022; Warren, Smith, & Ashwell, 2017), systematic reviews (Barney, Murray, Manasse, Dochat, & Juarascio, 2019; Grider, Douglas, & Raynor, 2021; Katterman et al., 2014; Olson & Emery, 2015; Wanden-Berghe et al., 2011; Yu, Song, Zhang, & Wei, 2020), and meta-analyses (Carrière, Khoury, Günak, & Knäuper, 2018; Godfrey, Gallo, & Afari, 2015; Grohmann & Laws, 2021; Lawlor et al., 2020; Mercado et al., 2021; Rogers et al., 2017; Ruffault et al., 2017; Turgon et al., 2019). However, it should be noted that most of these evidence syntheses were based on uncontrolled studies with pre-post designs and studies with low power. Moreover, they include a variety of different interventions: They range from very broad MBPs such as standard MBSR and MBCT to eating-specific MBPs such as *Mindful Eating – Conscious Living* (ME-CL; Bays & Wilkins, 2017) or MB-EAT (Kristeller, Wolever, & Sheets, 2014). Moreover, mindfulness-informed programs (see above) which solely include mindfulness techniques as one treatment element among others were integrated (for a critical overview see Tapper, 2022). Newer syntheses solely focus on randomized controlled trials (RCT) and MBPs with a main focus on mindfulness-immanent techniques (e.g., Mercado et al., 2021; Yu et al., 2020).

Regarding eating disorders, the synthesis of several studies showed promising results in treating eating disorder pathology with MBPs (Dunne, 2018; Godsey, 2013; Turgon et al., 2019; Wanden-Berghe et al., 2011). For example, meta-analytic findings on 22 studies revealed a large within-condition effect ($d = 1.05$), indicating reductions of eating disorder symptoms across all eating disorders (including AN, BN, and BED) (Turgon et al., 2019). In accordance with this meta-analysis and other reviews, the application of mindfulness seems to be particularly suitable for treating BED and has been mostly researched in this clinical eating disorder group (Barney et al., 2019; Godfrey et al., 2015; Grohmann & Laws, 2021; Turgon et al., 2019).

On the benefits of MBPs for weight management, the evidence is inconclusive (Katterman et al., 2014; Warren et al., 2017): While some meta-analyses revealed small to moderate effects on weight loss in overweight and obese samples (Carrière et al., 2018; Rogers et al., 2017), newer meta-analyses using more strict methodology by including only data of RCTs found no effects on BMI reduction (Mercado et al., 2021; Ruffault et al., 2017).

The strongest evidence was found on the effects of MBPs on the modification of maladaptive eating behaviors: Medium to high effect sizes could be shown in samples with overweight and obesity (Carrière et al., 2018; Rogers et al., 2017; Ruffault et al., 2017), samples with overweight and obesity and additional BED (Godfrey et al., 2015; Mercado et al., 2021), clinical eating disorder samples (Turgon et al., 2019; Wanden-Berghe et al., 2011), and mixed clinical and non-clinical samples including sub-threshold eating disorders and healthy individuals with normal weight (Grohmann & Laws, 2021; Katterman et al., 2014; O'Reilly et al., 2014; Warren et al., 2017; Yu et al., 2020).

Moreover, meta-analytic findings of 74 correlational studies on the relationship between mindfulness and eating disorder symptoms across clinical and non-clinal eating disorder samples with and without overweight and obesity showed: the disinhibited maladaptive eating behaviors emotional eating, external eating, and LOC/binge eating were most strongly associated with mindfulness while the inhibited maladaptive eating behavior of restrained eating was the least associated (Sala, Shankar Ram, et al., 2020). The authors hypothesized from these findings that restrained eating might be more strongly influenced by processes other than mindfulness while disinhibited maladaptive eating behaviors might offer several mindfulness-associated mechanisms worth exploring (see Sala, Shankar Ram, et al., 2020 for an overview). Results substantiate the assumption that particularly disinhibited forms of maladaptive eating behaviors might be influenced by applying mindfulness techniques and should therefore be the focus when attempting to explore potential underlying mechanisms of action like in the dissertation at hand.

4.4 Gaps in Understanding how Mindfulness Works in the Context of Eating

Despite the constantly growing number of literature reviews, which reflect the rising interest in the application of mindfulness to eating- and weight-related issues, empirical research on the underlying mechanisms of the observed effects is scarce (Barney et al., 2019; Rogers et al., 2017; Tapper, 2017). Only a few empirical studies have actually addressed the exploration of such mechanisms (Barney et al., 2019). Instead, there is a whole body of literature on theoretical assumptions about mechanisms of action and the particular mindfulness qualities involved: They range from the cultivation of a kinder and more accepting stance towards oneself to the increase of general interoceptive awareness; from improved working memory to a replacement of self-control with enhanced autonomous self-regulation skills as well as a particularly improved regulation of emotional states, reduced affective reactivity and thus a higher resilience in the face of stress (Kristeller & Wolever, 2011; Tapper, 2017, 2022).

Beyond these more general explanations, one possible pathway regarding the modification of eating behavior itself grounds in the theory described above (Figure 1) on how habitually learned and thus highly automated eating behaviors limit the ability to differentiate homoeostatic and non-homeostatic eating signals which drive food consumption (Brewer et al., 2018; Kristeller & Wolever, 2011). Following the general theory of MBPs when applying mindfulness to behavior change (Schuman-Olivier et al., 2020), cultivating a non-judgmental awareness of inner and outer signals which influence initiation and determination of food intake is thought to interrupt and thus reduce automatic and inattentive reactions and decisions around food (Katterman et al., 2014; Mantzios & Wilson, 2015b). In other words, one possible pathway of how mindfulness works in the context of eating might be through an increased awareness of interoceptive hunger and satiety signals as well as an enhanced awareness of and reduced reactivity to internal cues like difficult emotions as well as external cues (Warren et al., 2017). In the applied model (Figure 1), Brewer et al. (2018) describe this process as a replacement of habitually learned eating behaviors with more conscious and adaptive eating decisions. However, like other assumed mechanisms, this mechanism was partly derived from findings on neural mechanisms in related research areas (Brewer et al., 2018; Warren et al., 2017) and has not been investigated sufficiently in the area of eating behaviors.

In conclusion, the state of research on how and why mindfulness and MBPs affect maladaptive eating behaviors and associated eating and weight disorders is described as "primarily speculative" (Tapper, 2022; p. 13). This has prompted many calls for further research on underlying mechanisms so that future theory development and research activities can build on a solid foundation of evidence (Barney et al., 2019; Tapper, 2017, 2022; Warren et al., 2017). Such research is important not only to explain the partly inconclusive results of intervention studies. It is also crucial to avert potential harm: The current "hype" might lure vulnerable patient groups (such those suffering from eating and weight disorders) into intervention types that are insufficiently understood for their particular disorders or their set of psychosocial and biophysiological risk factors (van Dam et al., 2018). Thus, research on underlying mechanisms of action associated with mindfulness should inform the tailoring of future prevention and intervention of eating and weight disorders and steer the associated research efforts appropriately to identify in advance who are most likely to benefit from which strategy (Barney et al., 2019; Tapper, 2022).

Currently, this research on mechanisms of action is impeded by two main shortcomings:

The first shortcoming regards the application of mindfulness via multi-component interventions. Since most of the investigated MBPs used several other treatment elements in

addition to mindfulness techniques, it remains unclear whether these other components (e.g., group immanent factors, diet education) or indeed mindfulness-immanent qualities led to behavior change (Tapper, 2022).

The second shortcoming regards the current assessment of mindfulness in the context of eating. Several intervention studies used no evaluation measure of mindfulness. Thus, they were not able to identify a direct mediation effect that could justify to regard the concept as the essential underlying mechanism (Carrière, Siemers, & Knäuper, 2022; Olson & Emery, 2015). The studies that implemented a mindfulness measure mostly used generic measures of mindfulness (Mercado et al., 2021; Warren et al., 2017). However, there is a lack of evidence that mindfulness can be generalized across different domains of life such as physical activity or eating (Hulbert-Williams, Nicholls, Joy, & Hulbert-Williams, 2014). There are even findings that non-eating-specific MBPs did not affect maladaptive eating behaviors (Kearney et al., 2012). Moreover, the use of a generic measure hampers the identification of eating-specific effects of mindfulness related to the assumed mechanisms at work mentioned above (e.g., that mindfulness might enhance the awareness and discernment of inner and outer eating triggers and therefore result in eating more in line with physiological needs; Kristeller & Epel, 2014). Consequently, a context-specific approach seems more suitable to shed light on mechanisms of action in the field of eating- and weight-related issues. This is why recent research has focused on ME.

5 Mindful Eating

Other areas of psychological research have repeatedly shown that context-specific outcomes are better predicted by context-specific constructs (e.g., eating self-efficacy or self-efficacy for temptations compared to general self-efficacy; Armitage et al., 2014; Sallis, Pinski, Grossman, Patterson, & Nader, 1988). Thus, they seem more suitable and specific in investigating potential mechanisms of action. The same rationale might apply to the construct of generic mindfulness: There is growing evidence that eating-specific measures are more useful in investigating eating-related outcomes than its generic counterparts (Beshara, Hutchinson, & Wilson, 2013; Mantzios, Egan, Bahia, Hussain, & Keyte, 2018; Mantzios, Egan, Hussain, Keyte, & Bahia, 2018). As a conclusion, expanding the current research focus on the core construct by the context-specific component, namely *Mindful Eating* (ME), seems beneficial to gain a better understanding of how MBPs work in the field.

5.1 Facets of the construct

Comparable to generic mindfulness, which is proclaimed to be a "…human capacity occurring in daily life" (Bergomi, Tschacher, & Kupper, 2013b, p. 21), ME is proposed as a "…natural state, that can be trained and enhanced" (Kristeller & Epel, 2014, p. 930). This context-specific form of mindfulness applies mindfulness-immanent qualities to the process of eating itself as well as related emotions, thoughts, and physical sensations (Framson et al., 2009). Despite the lack of a uniform operationalization (Fung, Long, Hung, & Cheung, 2016; Mantzios, 2021; Warren et al., 2017), there is consensus that, like generic mindfulness, ME seems to be multidimensional, incorporating different ME qualities or skills (Altman et al., 2013).

Depending on the used definition, the following aspects are assumed to belong to the construct: A deliberate form of present moment awareness (*what* of mindfulness) towards all upcoming experiences involved in the process of eating, specifically the sensory properties of food, thoughts, emotions, bodily-related signals, inner and outer eating triggers as well as eating habits. This form of awareness is meant to be non-judgmental (*how* of mindfulness), accepting all of these arising experiences and encompasses the ability to de-center from the experiences by incorporating a non-reactive stance towards certain urges such as strong food desires (i.e., food craving) (Albers, 2009; Tapper, 2022; Warren et al., 2017). Taking into account its Buddhist origin, awareness of and gratefulness for the interconnectedness of all living beings and the earth, is also part of ME (Altman et al., 2013; Fung et al., 2016).

However, agreement upon a uniform operational definition of ME including the most relevant aspects and at least the attention (*what* of mindfulness) and non-evaluative (the *how* of mindfulness) components is pivotal, not only to distinguish ME from just eating attentively (Mantzios, 2021). Similar to the broad discussion in research on generic mindfulness (van Dam et al., 2018), for ME it is also necessary to have a definition of the concept which helps facilitate communication and research on its effectiveness as well as its underlying mechanisms in the context of eating in order to apply the concept appropriately (Fung et al., 2016; Lofgren, 2014).

Self-reported ME was found to be associated negatively with maladaptive eating patterns such as emotional and external eating (Kerin, Webb, & Zimmer-Gembeck, 2019), food preoccupation (Taylor, Daiss, & Krietsch, 2015), and grazing (i.e., repetitively consuming small amounts of food without control; Mantzios, Egan, Bahia, et al., 2018). Positive associations with ME were found for dietary quality such as the consumption of fruit and vegetables (Hutchinson, Charters, Prichard, Fletcher, & Wilson, 2017; Keeler, 2014), reduced fat and/or sugar consumption (Mantzios, Egan, Hussain, et al., 2018), and reduced self-reported

serving size of energy-dense food (Beshara et al., 2013) as well as with well-being (Khan & Zadeh, 2014) and *self-compassion* (Taylor et al., 2015), another Buddhist concept describing an attitude of mindful kindness towards oneself in the face of difficulties (Neff, 2003). Comparable to findings on generic mindfulness, results regarding an association between ME and BMI remain inconclusive: While some studies (Bryan, Parasher, Cahil, & Pinto Zipp, 2013; Clementi, Casu, & Gremigni, 2017; Framson et al., 2009; Hulbert-Williams et al., 2014; Mantzios & Egan, 2018; Mantzios, Egan, Bahia, et al., 2018; Mantzios, Egan, Hussain, et al., 2018; Moor, Scott, & McIntosh, 2013) found small to moderate correlations between ME total score and BMI, other studies failed to show significant associations (Anderson, Reilly, Schaumberg, Dmochowski, & Anderson, 2016; Goodwin, Lucio, Vega-López, & Bruening, 2017; Taylor et al., 2015; Winkens et al., 2018).

ME has been found to be moderately associated with its generic construct (Clementi et al., 2017; Hulbert-Williams et al., 2014). Recent studies underpin the advantage of a context-specific measure assessing ME by showing that several characteristics of eating- and weight-related issues demonstrated stronger associations to ME than to generic mindfulness (Mantzios & Egan, 2018; Mantzios, Egan, Bahia, et al., 2018; Mantzios, Egan, Hussain, et al., 2018) and by first results that the influence of generic mindfulness was mediated by ME (Beshara et al., 2013; Mason, Epel, Kristeller, et al., 2016).

5.2 Assessment of Mindful Eating

The following instruments have been developed to assess ME, each containing different aspects of the proposed multidimensional construct (Tapper, 2022). In the upcoming paragraph, these instruments as well as their advantages and disadvantages will be described in more depth. Chapter 3 includes a table summarizing these characteristics.

5.2.1 Mindful Eating Questionnaire

Framson et al. (2009) contributed uniquely to the field by designing the first questionnaire to assess ME: The *Mindful Eating Questionnaire* (MEQ) has been translated into several languages such as Persian, Malay, and Turkish (e.g., Abbaspoor, Javadifar, Miryan, & Abedi, 2018; Abdul Basir et al., 2021; Köse, Tayfur, Birincioglu, & Donmez, 2017) and is still the most frequently used questionnaire when investigating ME. The MEQ was inspired by items from questionnaires measuring generic mindfulness and maladaptive eating behaviors. The original validation sample consisted of a convenience sample comprising 303 individuals (77% female) with a mean age of 42 years and an average BMI of 24. In its original version, the MEQ contains five components of ME which are 'awareness', 'emotional response', 'external cues',

'disinhibition', and 'distraction'. Although the MEQ is commonly employed, the size of the validation sample as well as its representativeness (overrepresentation of participants from yoga and weight-loss centers) evoked criticism in literature and prompted the development of new measurements (Winkens et al., 2018; Lofgren, 2015). Furthermore, the five factor structure suggested by the authors of the original MEQ could not be replicated (Apolzan et al., 2016; Clementi et al., 2017). Especially the subscale 'external cues' turned out to be neither reliable nor valid according to qualitative and quantitative analyses, and had to be excluded in an adjusted version of the MEQ (Apolzan et al., 2016). In another abbreviated version, only the two subscales 'awareness' and 'recognition of hunger and satiety' (as the counterpart of 'disinhibition') remained after an expert rating on the items content validity (Questions: "How much does each item represent mindful eating?" "How does each group of items represent the content domain described in the original MEQ study?") and subsequent factor analyses based on the items considered to be suitable. Moreover, Hart, Pierson, Goto and Giampoli (2018) piloted a 12-item version for children (Hart, Pierson, Goto, & Giampaoli, 2018). Like in the abbreviated version of Clementi et al. (2017): Two subscales were retained after conducting a factor analysis: 'awareness' and 'mindless eating' (instead of 'recognition of hunger and satiety').

Although the adjusted versions of the MEQ for adults (Apolzan et al., 2016; Clementi et al., 2017) should be preferred as they were shown to be more reliable and valid than the original version, the concomitant elimination of problematic subscales causes a loss of important information regarding ME and its impact on eating. For example, the excluded subscales 'emotional response' and 'external cues' represent important constructs in the context of ME. Their assessment in the original version allows for the exploration of important motives for eating besides physiological hunger and thus selected non-homeostatic processes interfering with the biological drive to eat, which influence eating in the absence of physiological hunger. Since the awareness of these motives is assumed to be one potential mechanism of action underlying the effects of mindfulness in the context of eating (Brewer et al., 2018; Kristeller & Epel, 2014) and is therefore a major focus in eating-specific MBPs (Bays & Wilkins, 2017; Kristeller & Epel, 2014), the omission of these subscales within the valid und reliable forms of the MEQ is highly problematic for the exploration of underlying mechanisms.

5.2.2 Mindful Eating Scale

Hulbert-Williams et al. (2014) enriched the field by developing the *Mindful Eating Scale* (MES): The authors aimed to design a parsimonious scale of eating-specific mindfulness that

corresponds to the above-mentioned standard operationalization and factor structure of generic mindfulness (Baer et al., 2006) more closely than the MEQ. Thus, it allows for the comparison of results across contexts (i.e., generic vs. specific). To design the MES, the authors adapted items from two instruments of generic mindfulness to the context of eating-related behaviors, which were then reviewed by six clinical and research experts. Beyond the attention and awareness elements of ME, the MES allows for the assessment of two crucial components of mindfulness (Baer et al., 2006) in relation to eating that were not assessable before: 'acceptance' and 'non-reactivity' (the _how_ of mindfulness). Acceptance related to generic mindfulness (in the scientific context often used synonymously with 'non-judging'; Tapper, 2017) is often discussed as one central aspect of the construct (Baer, Smith, & Allen, 2004) and has been found to influence relevant criteria such as food cravings (Forman et al., 2007). Non-reactivity (i.e., awareness of triggers without reacting to them) is thought to have the potential to disrupt the maintenance of automatic maladaptive health behavior (Michalak et al., 2016). Nevertheless, the non-reactivity component of the MES mainly focuses on perceived hunger and the drive to eat (e.g., 'When I get hungry, I can't think of anything else') neglecting other relevant eating triggers such as emotional cues or food craving impulses (Renner et al., 2012). Furthermore, the non-reactivity items have been criticized to rather reflect behaviors which result from ME practice itself than ME-immanent aspects (Winkens et al., 2018).

The first version of the MES was validated in a sample of 127 college students (77% female) with a mean age of 25 years and an average BMI of 24. The subject to item ratio was criticized to be below the required level (Hart et al., 2018). An exploratory factor analysis on the MES item pool yielded the following six subscales: 'acceptance', 'awareness', 'act with awareness', 'non-reactivity', 'routine', and 'unstructured eating' (Hulbert-Williams et al., 2014). Items were predominantly negatively formulated, measuring the negation of ME. Confirmatory factor analysis (CFA) in an independent sample of 203 participants (82% female; mean age of 28 and mean BMI of 25) resulted in a shortened version of MES with 16 items assigned to five subscales ('unstructured eating' was omitted; Hulbert-Williams, Nicholls, Flynn, & Hulbert-Williams, 2015). So far, the MES is the only ME instrument which has been shown to possess change sensitivity (Czepczor-Bernat, Brytek-Matera, & Staniszewska, 2021).

5.2.3 Mindful Eating Behavior Scale

The *Mindful Eating Behavior Scale* (MEBS; Winkens et al., 2018) consists of selected items from MES, MEQ and the Intuitive Eating Scale 2 (Tylka & van Kroon Diest, 2013). The MEBS aimed for an exclusive assessment of the ME attention element, neither including items

on emotional or external eating triggers (resp. eating motives) nor items regarding acceptance. However, the MEBS was based on a specific mindfulness theory (Grossman, 2011; Grossman and Van Dam, 2011) which has been criticized extensively for overemphasizing the attention element (the _what_ of mindfulness). In the translation to eating, the MEBS was criticized for assessing attentive eating more so than ME (Mantzios, 2021). In sum, the focus of the MEBS obstructs an exhaustive assessment of the so far less researched construct ME. Thus, the 17 items of the MEBS reflect four domains of ME named 'focused eating', 'hunger and satiety cues', 'eating with awareness' and its counterpart 'eating without distraction'. The MEBS was tested in a sample of 1227 adults with a mean BMI of 27. This sample included participants aged 55 years and older (mean age of 68) and did not consider young women, who are most at risk of developing eating disorders (Hoek & van Hoeken, 2003). Though the factor structure was successfully replicated within CFA, results for the criterion validity were particularly low ($\leq .3$) compared to those of the MES (Hulbert-Williams et al., 2014) and the MEQ (Apolzan et al., 2016).

5.2.4 Summing up of ME Assessment Options

As shown by taking a closer look at the previously developed ME instruments: All of them made an exceptional contribution to the comparatively young research field of mindfulness in the context of eating by emphasizing different aspects of the multidimensional construct. However, due to shortcomings regarding the validation samples, item formulation, and factorial validity, current ME measures are mostly not suitable for a comprehensive assessment of ME, which is pivotal to test different ME facets against each other and investigate underlying mechanisms of action in more depth.

The following quote summarizes the current state of research on ME and further steps to take: "The field needs to come together prior to disseminating any further ME research to meet consensus as to what ME is and what it is not, and respond by appropriately identifying ways to measure ME and create corresponding practices. Past critical literature in mindfulness has suggested that there is a need for methodological rigor (Van Dam et al., 2018), and the same is true for ME" (Mantzios, 2021; p. 2).

CHAPTER 2

DISSERTATION OUTLINE

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RATIONALE,

RESEARCH QUESTIONS, AIMS, AND METHODS

1 Rationale

There has been a surge of interest in the concept of mindfulness in recent decades. Based on the promising effects of MBPs on a variety of different physiological and psychological health outcomes, mindfulness has also been increasingly used in recent years to underpin the treatment for eating and weight disorders, which represent global health challenges.

Effects of MBPs in this field are generally promising. However, it remains largely unclear whether these effects are actually due to mindfulness-immanent qualities or other (unrelated) treatment components. Although a variety of potential mechanisms of action have been theoretically proposed, empirical research on the underlying pathways is scarce. Hence, little is known at the present time about whether - and which aspects of mindfulness itself - work for whom, and under what circumstances. However, this knowledge is pivotal to the correct interpretation of the effects of MBPs in the context of eating and to the customization of MBPs to the specific needs of target populations, which would allow to optimize current prevention and treatment more effectively and protect vulnerable groups such as those of eating and weight disorders from potential harm.

To put research on mindfulness and related MBPs in the context of eating on a more evidence-based footing and to facilitate the investigation of mechanisms of action in future studies, two of the main shortcomings in the field need to be addressed first. These pertain to 1) how mindfulness (and ME more specifically) has been assessed in previous studies and 2) how multi-component MBPs have typically been used to evaluate impacts of mindfulness on eating- and weight-related issues. These shortcomings and subsequent gaps in understanding of underlying mechanisms motivated the dissertation at hand.

Presenting and building on three scientific manuscripts it focuses on the eating-specific approach of ME, which has shown to be promising in explaining the underlying effects of mindfulness and MBPs on eating- and weight-related issues. To address problems related to its assessment, this thesis seeks to contribute to a comprehensible ME assessment and to provide an empirically based definition of the construct (Paper 1). This first work of research aims to provide a basis for future research on ME in general and for the following work presented in this dissertation in particular. Building on a sound assessment of the construct ME, the aim of the second work of research is to investigate both its characteristics and its association with outcomes relevant to eating and weight disorders (Paper 2). This leads to the third work, where one possible underlying mechanism is approached through the investigation of an isolated ME exercise extracted from a multi-component eating-specific MBP (Paper 3).

In this dissertation, maladaptive eating behaviors were chosen as the specific outcome to address. The most stable and largest effects of mindfulness and MBPs (correlation and intervention studies) have been found on maladaptive eating behaviors across persons with and without eating and weight disorders. Therefore, these were considered as a reasonable starting point in approaching underlying mechanisms of action of MBPs in the context of eating.

The overarching goal of this thesis is to support fundamental research on mindfulness in the context of eating. The intention is to provide evidence on the core of the ME construct to create a foundation for future explorations of the utility of mindfulness in the prevention and treatment of eating and weight disorders. Specifically, the research presented aims to advance our understanding of how the eating-specific form of mindfulness (i.e., ME) might affect maladaptive eating behaviors. This knowledge can be used to investigate possible pathways underlying the effects of MBPs for associated eating and weight disorders and thus to facilitate the development of tailored and specific prevention and treatment strategies in the future.

2 Research Questions, Aims, & Methods

The rationale presented above led to the formulation of four research questions. Since they build on each other, they were answered with the help of four sequential studies incorporated into three scientific manuscripts. Table 1 gives an overview of the research questions as well as the corresponding studies, samples, methods and research designs.

The following paragraph introduces the respective research questions and how they were addressed methodologically in the three scientific manuscripts at the core of this dissertation. Chapters 3 through 5, which comprise the complete articles for Studies 1-4, have their own methods sections, presenting information on the respective samples, study designs and methodological procedures including statistical analyses in more detail.

Research Question I:

How can ME be measured comprehensively and in a reliable and valid way to advance understanding of how mindfulness works in the context of eating?

Research question I was addressed in Paper 1.

Paper 1

Although no operational definition of ME has been established so far, there is a consensus on its multidimensionality. To date, different attempts to assess ME exist. However, the existing measures each contain different facets of the supposed multidimensional construct.

Thus, the first aim of the dissertation was to develop a comprehensive measure of the context-specific construct ME assessing the most relevant facets currently discussed in the literature within one inventory. Such an inventory was in general terms believed to function as a mandatory first step in supporting the building of a more evidence-based framework of mechanisms in the evolving research of ME in the future. Regarding this particular thesis, such an inventory was presumed to be crucial for the following steps: Its comprehensive assessment of all important ME facets was intended to allow for testing different ME facets against each other to estimate their respective impact on maladaptive eating behaviors. Because an operational definition of ME was missing, it was furthermore aimed to derive an initial proposal from the identified factor structure to facilitate further research communication in the evolving field of applying mindfulness in the context of eating.

Hence, to answer this first research question, a comprehensive inventory assessing ME (*Mindful Eating Inventory*; MEI) was developed. The development was based on a multi-method approach using a variety of qualitative and quantitative techniques implemented in three subsequent studies (Study 1-3; see Table 1). The MEI was validated in two large and independent online samples to prove its assumed multidimensionality, estimate its psychometric properties, and derive an empirically based operational definition of ME.

Research Question II:

Does the context-specific construct of ME have an advantage over the generic concept in advancing the understanding of how mindfulness is related to maladaptive eating behaviors?

Research Question III:

Which ME facets are particularly useful in explaining maladaptive eating behaviors?

These research questions were answered in Paper 2.

Paper 2

Based on the results regarding the first aim to develop a comprehensive inventory to assess the multidimensional construct of ME (Paper 1), it was possible to approach two further aims of the dissertation.

The second aim of the dissertation was to investigate whether a context-specific assessment of mindfulness (i.e., ME measured by the MEI) is indeed superior to a generic one in explaining maladaptive eating behaviors. This had been assumed but not sufficiently tested before.

Building on this knowledge, the third aim was to go a step further and evaluate the distinct facets of ME (identified by the MEI) and their unique contributions to the prediction of specific maladaptive eating behaviors, thereby providing further evidence for the benefits of a multidimensional approach to the assessment of ME. This step was further intended to identify those ME facets that explain the largest amount of variance in maladaptive eating behaviors. Consequently, Paper 2 aimed to provide first indications of ME facets that are promising targets for further research on mechanisms of action in the application of mindfulness to maladaptive eating behaviors and the subsequent tailoring of interventions addressing these behaviors and associated eating and weight disorders.

To approach these aims, incremental validity of ME over and above generic mindfulness in relation to maladaptive eating behaviors was tested first by using hierarchical regression models on the online sample of Study 2 from the MEI validation studies. Regression analyses on MEI subscale level (i.e., ME facets) on maladaptive eating behavior followed this step using the same online sample.

Research Question IV:

Does training one particular ME facet impact maladaptive eating behaviors?

Research question IV was addressed in Paper 3.

Paper 3

After showing the advantage of using a context-specific approach and identifying particularly important ME facets by answering the second and third research questions, it was possible to approach the last aim of the dissertation: Investigating the particular influence of one of the previously identified ME facets (i.e., non-judgmental awareness of different motivations to eat; see Paper 2) on maladaptive eating behaviors in an attempt to explore one theoretically hypothesized mechanism of action of mindfulness in the context of eating.

To overcome the limitations of multi-component MBPs in deriving mindfulness-immanent effects, a training on a clearly delineated, isolated ME exercise was developed (based on one of those ME facets that was shown to be important for maladaptive eating behaviors; Paper 2). The particular exercise ('*9 Hunger'*) was extracted from the program *Mindful Eating – Conscious Living* (ME-CL; Bays & Wilkins, 2017), an eating-specific MBP of the MBSR-inspired family. Effects of this training on maladaptive eating behaviors and additional outcomes directly after the intervention and at a three-month follow-up were tested by comparing Latent Change Scores (LCS) of an intervention group (IG) and a waitlist control group (W-CG) in an online-sample using a RCT design.

Table 1

Summary of Research Questions and Methods ordered by Publication

#	Title of Publication	Research Question	Study No.	Method & Design	Sample: Type and Size	Analyses
1	Getting a Deeper Understanding of Mindfulness in the Context of Eating Behavior: Development and Validation of the Mindful Eating Inventory	**I: How can ME be measured comprehensively and in a reliable and valid way to advance understanding of how mindfulness works in the context of eating?**	1	1. Literature review	1. not applicable	Qualitative
				2. Expert ratings	2. Experts on eating behavior and/or mindfulness ($N = 15$)	
				3. Focus groups	3. Laypersons (3 groups; $N = 16$)	
				4. Think aloud protocols	4. Laypersons ($N = 10$)	
			2 (full sample)	Online-survey (cross-sectional, 1 measurement point)	Convenience-sample ($N = 828$)	Qualitative & quantitative (Item analyses; EFA; reliability & validity; group differences) (manifest & latent)
			3	Online-survey (cross-sectional, 2 measurement points; 2nd for retest-reliability)	Convenience-sample ($N = 612$)	Quantitative (CFA; measurement invariance; reliability & validity; group differences) (manifest & latent)
2	Taking a Closer Look at Mindful Eating: Incremental Validity and Importance of Subfacets	**II: Does the context-specific construct of ME have an advantage over the generic concept in advancing the understanding of how mindfulness is related to maladaptive eating behaviors?** **III: Which ME facets are particularly useful in explaining maladaptive eating behaviors?**	2 (subsample)	Online-survey (cross-sectional, 1 measurement point)	Convenience-sample ($n = 292$)	Hierarchical and multiple regression models (manifest)
3	What are you hungry for? Effects of a brief Mindful Eating Online Intervention: The 9 *Hunger* RCT-study	**IV: Does training one particular ME facet impact maladaptive eating behaviors?**	4	RCT (intervention group vs. waitlist control-group) Online-survey (longitudinal, 3 measurement points)	Convenience-sample ($N = 392$)	Latent change score (LCS) models (latent)

Note. CFA = Confirmatory Factor Analyses, EFA = Exploratory Factor Analyses, ME = Mindful Eating, RCT = Randomized Control Trial.

CHAPTER 3

GETTING A DEEPER UNDERSTANDING OF MINDFULNESS IN THE CONTEXT OF EATING BEHAVIOR: DEVELOPMENT AND VALIDATION OF THE MINDFUL EATING INVENTORY

This chapter presents the accepted research article in the manuscript version it was submitted.

Getting a Deeper Understanding of Mindfulness in the Context of Eating Behavior:

Development and Validation of the Mindful Eating Inventory

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1 **Abstract**

2 **Purpose:** Current research supports the effectiveness of mindfulness-based interventions for

3 maladaptive eating behaviors associated with obesity and eating disorders. To investigate

4 potential underlying mechanisms at work, reliable and valid instruments that allow for an

5 exhaustive assessment of the context-specific construct Mindful Eating (ME) are needed.

6 Therefore, the current work aimed to develop a comprehensive inventory reflecting a wide

7 range of ME attitudes and behaviors: The Mindful Eating Inventory (MEI). **Methods &**

8 **Results**: Study 1 describes the item pool development for an initial version of the MEI

9 comprising various steps (compilation of items, expert ratings, focus groups and think aloud

10 protocols by laypersons). Within Study 2, the factor structure of this initial version was explored

11 in an online sample of $N = 828$ participants and the item pool was shortened via a sequential

12 process based on statistical and content-related considerations. Exploratory factor analyses

13 yielded a seven-factor structure. This structure could be confirmed within Study 3 on an

14 independent online sample of $N = 612$ participants using confirmatory factor analysis. Criterion

15 validity was supported by hypotheses-confirming correlations with eating-specific and global

16 health-relevant outcomes. **Conclusion:** Our findings demonstrate that the MEI is a valid and

17 reliable (in terms of internal consistency and retest-reliability) tool, which allows for a

18 comprehensive assessment of various ME attitudes and behaviors within one parsimonious

19 inventory. It further enabled us to propose a so far missing, initial scientific operational

20 definition of this eating-specific construct, that may help to advance future research and clinical

21 application by clarifying mechanisms of action.

22

23 *Keywords*: Mindful Eating, Mindfulness, Assessment, Maladaptive Eating Behavior

Getting a Deeper Understanding of Mindfulness in the Context of Eating Behavior:

Development and Validation of the Mindful Eating Inventory

1   Though the Buddhist concept of mindfulness is increasingly used to modify

2   maladaptive eating behaviors, thereby supplementing current treatments of obesity and eating

3   disorders, the underlying mechanisms of action remain unclear. The current manuscript

4   presents the development and validation of a comprehensive instrument on eating-specific

5   mindfulness. This instrument integrates the main aspects of previous instruments in the field,

6   which assess partly different facets of mindful eating, and extends them by three hitherto

7   missing, but crucial, facets. The resulting comprehensive assessment should enable future

8   research to investigate which components of mindful eating may serve to modify maladaptive

9   eating behavior, and thereby aid closure of the current research gap regarding mechanisms of

10   action. Furthermore, a so far missing, preliminary operational definition of the construct was

11   derived to facilitate the scientific communication in this evolving field.

12   In recent years, the Buddhist construct of *mindfulness* got into the focus of research

13   and practice as a potential way to treat maladaptive eating behaviors such as eating in

14   response to emotions (so called *emotional eating*), eating in response to external clues (so

15   called *external eating*), eating in response to *food cravings*, overeating or *loss-of-control*

16   *eating* (O'Reilly, Cook, Spruijt-Metz, & Black, 2014). As a large body of research has shown

17   that these eating behaviors are associated with the development and maintenance of

18   overweight, obesity and eating disorders (Colles, Dixon, & O'Brien, 2008; Greeno, Wing, &

19   Shiffman, 2000; He, Cai, & Fan, 2017; Patel & Schlundt, 2001; Ricca et al., 2012; Tanofsky-

20   Kraff et al., 2011), mindfulness is increasingly used to supplement current state-of-the-art

21   treatments (Mantzios & Wilson, 2015; O'Reilly et al., 2014; Ouwens, Schiffer, Visser,

22   Raeijmaekers, & Nyklíček, 2015).

23

24

32

25 **Mindfulness**

26   According to Kabat-Zinn (2013) the generic construct of mindfulness can be defined

27 as deliberately paying attention to the present moment without judging. The term mindfulness

28 used in the scientific context subsumes different attitudes and behaviors, reflecting a whole

29 inner and outer stance to the present experience. Within the scientific discourse, it has

30 therefore mostly been conceptualized as a multifaceted construct (Bergomi, Tschacher, &

31 Kupper, 2013a). While there is agreement on the multifaceted nature of the construct, the

32 number of proclaimed facets varies considerably regarding different operationalizations from

33 at least two to five or even eight facets (for an overview see Bergomi et al., 2013a). For

34 example, Bishop (2004) conceptualized mindfulness with two facets: 1) the attention to and

35 awareness of the present moment as well as 2) a non-judging respectively accepting attitude

36 towards this experience. The current work is based on the most commonly used standard

37 operationalization of mindfulness following the Five Facets of Mindfulness Questionnaire

38 (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). Within a factor analysis

39 including the items of five established mindfulness questionnaires, Baer et al. (2006)

40 identified the following five facets of generic mindfulness: 1) 'observing/noticing' referring

41 to the awareness of experience; 2) 'describing' of experience; 3) 'acting with awareness'; 4)

42 'non-judging of experience' and; 5) 'non-reactivity to inner experience'.

43   Recent systematic reviews and meta-analyses found a positive influence of

44 mindfulness-based interventions on modifying maladaptive eating behaviors in individuals

45 with normal-weight, overweight and obesity (Rogers, Ferrari, Mosely, Lang, & Brennan,

46 2017; Warren, Smith, & Ashwell, 2017), as well as in sub-clinical (Katterman, Kleinman,

47 Hood, Nackers, & Corsica, 2014) and clinical samples with a full picture of eating disorders

48 (Wanden-Berghe, Sanz-Valero, & Wanden-Berghe, 2011), particularly Binge Eating Disorder

49 (Godfrey, Gallo, & Afari, 2015).

50

Eating-Specific Mindfulness

51

52   Despite the rising number of mindfulness-based intervention studies, there is growing

53 criticism regarding the lack of empirical investigation of the underlying mechanisms of action

54 (Olson & Emery, 2015; Rogers et al., 2017; Tapper, 2017). In order to investigate the various

55 theoretical assumptions on how mindfulness might be related to eating behaviors and weight

56 loss, the use of appropriate instruments is essential. Previous studies mostly used either no

57 mindfulness instrument or instruments assessing the generic form of mindfulness to evaluate

58 treatment outcomes (Olson & Emery, 2015). Yet there is limited evidence that mindfulness

59 skills can be generalized across different domains of life (Hulbert-Williams, Nicholls, Joy, &

60 Hulbert-Williams, 2014). Therefore, by using instruments of generic mindfulness, eating-

61 specific effects of the construct could not yet be investigated (e.g., if mindfulness enhances

62 awareness of satiety signals resulting in more pronounced eating in line with physiological

63 needs, less maladaptive eating and thus healthy weight regulation; Kristeller & Epel, 2014).

64 Following this line of thought, current results indicate that eating-specific forms of

65 mindfulness might indeed be more suitable to predict central eating- and weight-related

66 outcome criteria (Beshara, Hutchinson, & Wilson, 2013). In line with these findings,

67 expanding current research by focusing on the context-specific component of the core

68 construct, namely *Mindful Eating (ME)*, seems pivotal to gain a better understanding of

69 underlying specific effects of mindfulness-based interventions on maladaptive eating

70 behaviors associated with obesity and eating disorders like Binge Eating Disorder.

71   ME can be understood as a subdomain of generic mindfulness describing it

72 specifically in relation to the process of eating and associated feelings, thoughts and motives

73 (Framson et al., 2009). Though a uniform operationalization is lacking (Fung, Long, Hung, &

74 Cheung, 2016; Warren et al., 2017), ME seems, similar to generic mindfulness, to be

75 multifaceted and thus multidimensional as different attitudes and behaviors are assumed to

76 belong to the construct (Altman et al., 2013). Integrating the most common aspects mentioned

34

77   in the literature, ME is mainly characterized as follows: Being aware in the present moment

78   while eating; intentionally paying attention, nonjudgmentally, to the senses, including

79   physical and emotional sensations (Albers, 2009; Warren et al., 2017). The component of

80   non-judgment (or acceptance) implies that there is neither a positive nor a negative attachment

81   to this awareness, but just recognition of the feelings of hunger and satiety, of eating motives

82   as well as eating habits, and of the triggers which influence the initiation and stopping of

83   eating (Albers, 2009; Apolzan et al., 2016). ME is supposed to encourage conscious food

84   choices by fostering the use of physiological signals to determine what, when and how much

85   to eat (Altman et al., 2013; Miller, Kristeller, Headings, & Nagaraja, 2014). This ability is a

86   key component of the adaptive eating style called *intuitive eating* (Tylka & van Kroon Diest,

87   2013), which is in this way strongly connected to ME. Additionally, ME includes gratefulness

88   for, as well as the awareness of, the interconnectedness of all living beings and the earth,

89   which unfolds in the moment of eating (Altman et al., 2013; Fung et al., 2016).

90   So far, only a few studies based on non-clinical student or convenience samples

91   investigated the concept of ME directly with self-report measures, mainly using the Mindful

92   Eating Questionnaire (MEQ; Framson et al., 2009). Results suggest that higher ME scores

93   were associated with lower BMI, decreased maladaptive eating behaviors as well as increased

94   dietary quality (Bryan, Parasher, Cahil, & Pinto Zipp, 2013; Clementi, Casu, & Gremigni,

95   2017; Hutchinson, Charters, Prichard, Fletcher, & Wilson, 2017; Mantzios & Egan, 2018;

96   Mantzios, Egan, Bahia, Hussain, & Keyte, 2018; Mantzios, Egan, Hussain, Keyte, & Bahia,

97   2018; Moor, Scott, & McIntosh, 2013; Taylor, Daiss, & Krietsch, 2015). Furthermore, higher

98   ME scores were found to be related to greater general well-being (Khan & Zadeh, 2014) and

99   considered as a promising concept not only for individual health promotion but for

100   sustainable development in the interest of our planet (Fung et al., 2016). First empirical

101   evidence for the advantage of a context-specific measure assessing ME was shown by

102   Beshara et al.(2013): ME fully mediated the relationship between generic mindfulness and

103   self-reported serving size of energy dense food, which is associated with weight gain.

104   Furthermore, several recent studies showed that BMI was more highly negatively correlated

105   with ME than with generic mindfulness (Mantzios & Egan, 2018; Mantzios, Egan, Bahia, et

106   al., 2018; Mantzios, Egan, Hussain, et al., 2018) thereby emphasizing the need to assess and

107   investigate eating-specific mindfulness beyond the generic construct.

108   A uniform scientific operational definition of ME, which would allow the mapping of

109   a comprehensive picture of all important ME aspects, is currently not available, and is

110   therefore demanded by several authors (Fung et al., 2016). This operational definition is

111   pivotal to not only facilitate scientific communication, but to tailor and research current

112   treatment properly (Lofgren, 2014).

113   **The Need for a Comprehensive Inventory Measuring Eating-specific Mindfulness**

114   Considering an eating-specific mindfulness concept is important in understanding how

115   the concept works in modifying maladaptive eating behavior. So far, three instruments have

116   been developed to assess ME: The Mindful Eating Questionnaire (MEQ; Framson et al.,

117   2009); the Mindful Eating Scale (MES; Hulbert-Williams et al., 2014; Hulbert-Williams,

118   Nicholls, Flynn, & Hulbert-Williams, 2015); and the Mindful Eating Behavior Scale (MEBS;

119   Winkens et al., 2018). In line with the assumed multidimensionality of ME, all of them

120   contain partly different facets of ME. Table 1 gives an overview of central characteristics of

121   these instruments.

122   ------ Please insert Table 1 about here -----

123   Despite their unique contributions, there are several limitations that have been

124   frequently pointed out within the scientific discourse (e.g., Fung et al., 2016; Hart, Pierson,

125   Goto, & Giampaoli, 2018; Lofgren, 2014). These limitations refer, for example, to

126   characteristics of the validation samples (small sizes, limitations in representativeness), the

127   non-replication of factor structures or item formulation problems (see Table 1). Furthermore,

128   their focus is partly limited as they do not include crucial elements of ME programs (e.g.,

36

129   awareness of eating motives[1] or a felt sense of interconnectedness with all living beings and

130   the earth while eating; Bays & Wilkins, 2017). Regarding generic mindfulness, it has been

131   argued that defining the construct too narrowly without considering crucial empirical and

132   theoretical supposed facets endangers the content validity (e.g., discrimination between

133   mindfulness and general attention) of the operationalization and the derived measurement

134   (Bergomi et al., 2013a). Accordingly, an exhaustive, differentiated assessment of ME is

135   indispensable to not only theoretically, but empirically gauge the importance of specific ME

136   aspects, and thereby aid research in clarifying mechanisms at work in modifying maladaptive

137   eating behaviors which are associated to the development and maintenance of obesity and

138   eating disorders.

139   Therefore, the present work aims to develop a reliable, factor and content valid

140   comprehensive self-report measure to assess ME in the general population - the Mindful

141   Eating Inventory (MEI). This inventory should not only include all facets currently separated

142   in different questionnaires but complement them with so far missing aspects to enable a

143   holistic assessment of the various ME attitudes and behaviors. Along its development we

144   aimed to investigate the structure of ME to propose the so far missing, initial operational

145   definition (Fung et al., 2016; Lofgren, 2014) to facilitate scientific communication and

146   research in this evolving field.

147   **STUDY OVERVIEW**

148   The present work follows three large standard phases in scale construction (Loevinger,

149   1957), i.e., three separate studies: Study 1 describes the generation of an item pool to create

150   an initial version of the MEI (substantive component focused phase); Study 2 aims to explore

151   the structure of ME and to reduce the item pool from Study 1 to an economical final version

152   (structural component focused phase); Study 3 aims to replicate the factor structure of ME

153   found in Study 2 within an independent sample using confirmatory factor analysis (CFA) and

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[1]At least not in the recommended adjusted versions of the MEQ (Apolzan et al.,2016; Clementi et al., 2017).

154 explore the criterion validity of the final MEI (external component focused phase). Each study

155 was approved by the local ethics committee of the University of Potsdam (40/2015). An

156 overview of the various steps in developing and validating the MEI is depicted in Figure 1.

157   ------ Please insert Figure 1 about here -----

158   **STUDY 1: Development of an Initial MEI Version**

159   Study 1 aimed to create a large and comprehensive item pool for the MEI with the

160 following goals: Sufficient inclusion of all possible aspects of the concerning constructs

161 within the inventory to maximize content validity (even at the cost of including [initially]

162 irrelevant items; Schultze, 2017); assurance of this content validity as well as every-day

163 relevance and comprehensibility to allow unambiguous interpretation for persons of different

164 age, educational background and degree of meditation experience.

165   **Methods**

166   To reach these goals, the item pool was designed using a three-step approach (see

167 Figure 1; Step 1-3 for an overview). Study 1 took part from August 2015 to February 2016.

168 **Step 1: Generating an Initial Item Pool**

169   The first step served to compile an initial item pool based on adapted items from

170 existing questionnaires and newly developed items that addressed particularly

171 underrepresented or hitherto missing aspects. A particular focus was put on the semantical

172 clearness of items, the use of ordinary language and everyday relevance, which was checked

173 within various steps of qualitative examination (see also Step 2 and 3). Following the

174 argumentation of Hulbert-Williams et al. (2014), who emphasized the importance of

175 comparability of ME measures with those of generic mindfulness to investigate mechanisms

176 of action, we orientated the item compilation on the standard operationalization of Baer et al.

177 (2006) to cover core aspects of generic mindfulness within the eating-specific framework. In

178 line with the operationalization of generic mindfulness and the multidimensionality of former

179 ME questionnaires, ME was hypothesized as multidimensional.

180   As the exclusive use of negatively formulated items has been criticized (i.e.,

181 measuring the negation of mindful behavior; Grossman, 2011), we integrated both negatively

182 and positively worded items, which is also recommended as a standard practice in scale

183 construction (Kam & Meyer, 2015; Weems, Onwuegbuzie, Schreiber, & Eggers, 2003). To

184 facilitate the comparison with generic instruments, the scale format of the MEI follows the

185 format of the most common generic mindfulness questionnaires (cf., Bergomi, Tschacher, &

186 Kupper, 2014) with a 6-point scale ranging from *almost never* to *almost always* (coded 1-6).

187   All items of MES and MEQ were merged[2] to ensure capturing all currently assessable

188 ME aspects within one inventory (Schultze, 2017). Items were carefully screened,

189 reformulated (simplified or worded in positive direction) or, if necessary, deleted according to

190 the above mentioned construction guidelines. The resulting item pool was supplemented by

191 newly formulated items derived from an intense literature review (e.g., Hạnh & Cheung,

192 2010; Kristeller & Epel, 2014; Warren et al., 2017; see Figure 1 for details on item number).

193 **Step 2: Item Pool Refinement based on Expert Opinion**

194   Expert ratings on item redundancy and ideas for missing aspects were provided by

195 independent researchers, dietitians, and psychologists in the field of obesity and eating

196 disorders, as well as by experienced teachers of mindfulness and ME.

197 **Step 3: Item Pool Refinement based on Layperson Opinion**

198   **Focus groups.** The modified item pool was discussed in three different focus groups

199 consisting of 5-6 laypersons each. Focus groups differed in age (1: 14-17 years; 2: 28-31

200 years; 3: 35-59 years), meditation experience and educational background. As recommended

201 by Nassar-McMillan and Borders (2002), each focus group composition was rather

202 homogenous with respect to age, gender and educational background. Items that had been

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[2]MEBS was not published at the time of the item pool generation. Therefore, and as the MEBS represents a compilation of selected items from MEQ, MES and IES-2, it was not considered for the item construction process.

203   indicated to be ambiguous, unintelligible, or not related to personal daily life by more than

204   one person were discussed in the group and reformulated for a better applicability.

205   **Think aloud protocols.** As a last check for comprehensibility and fit of scale format,

206   the item pool was pretested with laypersons varying in age, gender, and educational

207   background with think aloud protocols (Haladyna & Rodriguez, 2013): Participants were

208   asked to fill in the inventory saying out loud what they understood regarding each single item

209   and why they chose a particular rating point. Items identified as ambiguous or unintelligible

210   based on the feedback of at least two participants were eliminated from the inventory.

211   **Results**

212   The preliminary item pool generated within Step 1 (see Figure 1 for details) consisted

213   of 98 items. Based on the expert evaluation, 19 items were refined, 3 were deleted due to

214   redundancy and 14 items regarding relevant practical application were added, resulting in a

215   modified item pool of 109 items. Of these items, 11 items were modified according to the

216   focus group discussions. A further 4 items were eliminated due to results on think aloud

217   protocols. The various steps of item pool development resulted in an initial version of the

218   MEI.

219   **STUDY 2: Generating a Final Version of the MEI**

220   The aim of Study 2 was to test this initial version of the MEI ($N = 105$ items) in a

221   large, diverse (in terms of age, weight status, gender, educational, occupational and spiritual

222   background) community sample and to explore its factor structure. Based on participants'

223   written feedback, item analyses and results of exploratory factor analyses (EFA), the item

224   pool was further reduced and refined to arrive at a parsimonious final version of the MEI.

225   Study 2 also served as a preliminary test of the instrument's criterion validity.

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229   **Methods**

230   **Procedure**

231   Participants provided written informed consent and completed online assessments via

232   the SoSci-Survey platform. Basic information was gathered (date of birth, height and weight)

233   before individuals filled out the MEI. Afterwards, participants were asked to rate the

234   comprehensibility of the MEI items on a 5-point scale and to indicate which ones were

235   ambiguous or unintelligible using an open answer format. The MEI was followed by

236   questions about meditation experience, an instrument on criterion validity, educational

237   background, and subjective social status (SSS; Hoebel, Muters, Kuntz, Lange, & Lampert,

238   2015). [3]

239   Inclusion criteria for further data analysis were a minimum age of 18 years, informed

240   consent, and completion of the MEI (to test its structure in full datasets). Participation was

241   voluntary. As an incentive, participants had the opportunity to download an information

242   booklet regarding ME and to participate in a lottery.

243   **Participants**

244   The initial sample of 837 individuals was recruited online between March and May

245   2016 via social media (e. g., facebook), internet panels, blogs, mail distributors and self-help

246   groups regarding eating and weight. Due to missing data on the MEI, nine respondents (~1 %)

247   were completely excluded from the study (Graham, 2009). Thus, $N = 828$ individuals were

248   available for statistical analysis of the MEI. From this final sample, $n = 795$ participants

249   continued the questionnaire battery and provided data for meditation experience and $n = 755$

250   respondents completed the whole questionnaire battery.

251   To address the limited diversity of the validation samples of former ME instruments

252   and to increase the comparability of the results with the general population, a quote scheme

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[3]After the assessment of ME-specific items, participants answered some questions on attitudes regarding experience of discontent with their eating behavior. Analyses regarding these questions are not included in this manuscript.

253   was used to collect a more diverse sample. The number of participants was aimed to be at

254   least 625, accomplishing a recommended minimum 5:1 subject to item ratio for EFA use

255   (Gorsuch, 1983; Hatcher & O'Rourke, 2014).

256   Participants were predominantly female (79 %) aged 18 to 77 years (M = 34.6, SD =

257   11.5). The average BMI, calculated from self-reported data (BMI = weight(kg)/ height(m)²;

258   World Health Organization, 2000) was 24.4 (SD = 5.7) and ranged from 17.5 to 64.6. The

259   sample included 5% individuals with underweight, 62% individuals with normal weight, 21%

260   individuals with overweight and 12% individuals with obesity. The participant's educational

261   background ranged from 10 school years or less (3%) up to university entrance qualification

262   (64%). The sample consisted of 9% students. The majority of the participants (70%) were in

263   employment. The SSS was assessed with the German version of the Mac Arthur Scale

264   (Hoebel et al., 2015), which is highly correlated with objective measures assessing

265   socioeconomic status like the Winkler Index, job position or educational background (Hoebel

266   et al., 2015). Using a pictured ladder ranging from 1 (*very low*) to 10 (*very high*), participants

267   reported their self-perceived status compared to their peers. The average score of 6.22 (SD =

268   1.65) reflects a middle-class socioeconomic status within the sample. Half of the sample (n =

269   427) reported experience with mindfulness practice. A total of 111 individuals indicated to

270   practice meditation on a regular basis (at least once per week).

271   **Instruments**

272   The following instruments were used in study 2: The initial version of the MEI with N

273   = 105 items; the Loss of Control over Eating Scale (LOCES; Latner, Mond, Kelly, Haynes, &

274   Hay, 2014) with N = 7 items. Specifically, ME was assessed with the initial MEI version

275   described in Study 1. To investigate preliminary evidence for criterion validity, loss-of-

276   control eating was measured using the short version of the LOCES in a German, by our study

277   group forward backward translated, version. The LOCES screens for subjective binge

278 episodes and needs to be responded to on a 5-point scale ranging from *never* to *always*.

279 Internal consistency in the current sample was α =.94.

280 **Procedure of item selection and factor exploration**

281 Following recommendations, and also common practice (Cladder-Micus et al., 2019;

282 Coste, Guillemin, Pouchot, & Fermanian, 1997; Smith, McCarthy, & Anderson, 2000), to

283 meet the different demands regarding the quality of a measurement instrument (e.g.,

284 heterogeneity of item content, economical application, reliability; Schultze, 2017), a

285 sequential item selection procedure following quantitative (statistical-driven) and qualitative

286 (content-related) techniques was applied. In the first step, we checked the written feedback of

287 participants for comments on intelligibility and redundancy to ensure the proper applicability

288 of the MEI. Items indicated by at least 2 respondents were excluded from the item pool or

289 were reworded. In the second step, item analyses were conducted: Every item was checked

290 using histograms for adequate item distribution with a focus on skewness, kurtosis and

291 bimodality. Furthermore, exploitation of scale format and psychometric item difficulty was

292 checked for each item. The latter was computed following the conventional formula ($P_i =$

293 $\frac{\overline{x}_i - \min(x_i)}{\max(x_i) - \min(x_i)}$); higher values indicate a higher tendency to agree to the item in the keyed

294 direction. Item difficulty aimed to lie between .2 to .8 to attain a range of various item

295 difficulties (Bühner; 2011). In the third step, factor analyses were conducted. As

296 recommended by Costello and Osborne (2005), EFA with maximum likelihood (ML)

297 estimation and oblique rotation (promax) was applied because ME was assumed to be a

298 multidimensional concept with interrelated factors. Determination of number of factors

299 followed the recommendations of O'Connor (2000) by using Velicer's minimum average

300 partial test (MAP; O'Connor, 2000; Zwick & Velicer, 1986) and parallel analysis (Horn,

301 1965). After factor extraction, items not fulfilling the following criteria were excluded: a) a

302 minimum loading of at least .40 on a primary factor; b) a clear assignment to this factor

303 (difference between primary factor loading and cross loading of at least .2). EFA was rerun

304   until criteria a) and b) were fulfilled for all the remaining items. To construct an economical

305   inventory with comparable item length per subscale, the item pool was finalized using

306   criterion c) low item redundancy (screening of the correlation matrix for interitem-

307   correlations above $r = .5$ within a factor and subsequent qualitative check for overlapping

308   content). Equalization of the MEI aimed to retain an item number of 3-5 items per facet (to

309   maintain a stable solution) with an internal consistency of at least .7 (Bühner, 2011). If

310   applicable, the positively worded item of a homogenous item pair was favored to ensure a

311   balanced item polarity within the inventory (see general considerations as described in Study

312   1). Otherwise, the item contributing most to heterogeneity in assessing the content of the facet

313   was retained. A final EFA was run to check the robustness of findings.

314   **Reliability and validity.** Cronbach's alpha (α) was used as a reliability estimator.

315   Mean interitem-correlations (*MIC*) were calculated as a measure for a balance between

316   homogeneity and heterogeneity of the scales. Pearson product-moment correlations were

317   computed to explore inter-correlations between subscales and associations with the LOCES

318   (interpretation of the strength of association was based on $r > .10$ small, $r > .30$ medium, $r > .50$

319   large effect size in accordance with Cohen, 1988). Group differences were determined by *t*-

320   tests and supplemented by calculation of Cohen's *d* to estimate effect sizes. Values of $d =$

321   0.20 reveal small, values of $d = 0.50$ indicate middle and values of $d = 0.80$ large effect sizes

322   (Cohen, 1988). All analyses were performed with SPSS 24.

323   **Results**

324   **Procedure of item selection and factor exploration**

325   The initial version of the MEI (*N*=105 items) was shortened by 75 items by various

326   steps, specifically: Following participants qualitative feedback on ambiguous items, 6 ME

327   items were excluded due to redundancy or unintelligibility and another 3 items were retained

328   but refined. Item analyses revealed that all the remaining 99 items met the criterion of item

329   difficulty and exploited the full range of the scale format. Due to inadequate item

      44

330   distributions, 14 ME items were excluded in this step. EFA with ML estimation was

331   conducted on the remaining 85 ME items. Both the MAP test and parallel analysis indicated a

332   nine-factor solution. 29 items were excluded due to primary factor loadings < .40 (criterion a)

333   and no clear assignment to one factor (criterion b). The ninth factor of this initial solution

334   could not be retained because of insufficient magnitude of factor loadings. Additionally, the

335   sixth factor of this solution comprised of 4 items that in their compilation described high

336   control over eating, comparable to so called *restraint eating*. This construct has shown to be

337   distinct from ME (Framson et al., 2009). Consultation of two independent international

338   experts in the field of ME confirmed the theoretical independence of ME from this factor.

339   Thus, the 4 ambiguous items which were loading on this factor, were excluded and as a

340   consequence the sixth factor of the initial solution was eliminated as well. On the remaining

341   52 items, MAP test and parallel analysis were re-examined. Both indicated a seven-factor

342   solution for EFA. Because of primary factor loadings < .40, another 2 ME items were

343   excluded (criterium a). Finalization of the item pool due to screening of the correlation matrix

344   for item redundancy within each factor (criterion c) following the described guidelines led to

345   the exclusion of further 20 items. Finally, a last EFA (see Table 2) showed the final seven-

346   factor solution with 30 items accounting for 58.6 % of the total variance. The factors were

347   named as follows: (1) '**A**ccepting and **N**on-attached **A**ttitude towards one's own eating

348   experience' (ANA), (2) '**A**wareness of **S**enses while **E**ating' (ASE), (3) '**E**ating in **R**esponse

349   to awareness of **F**ullness' (ERF), (4) '**A**wareness of eating **T**riggers and **M**otives' (ATM), (5)

350   'Inter**con**nectedness' (CON), (6) '**N**on-**R**eactive **S**tance' (NRS) and (7) **F**ocused **A**ttention on

351   **E**ating' (FAE). All factors were significantly correlated with each other (Table 3; Study 2

352   columns).

353   ------ Please insert Table 2 about here -----

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Reliability and Validity

The majority (87 %) of the participants evaluated the initial version of the MEI as comprehensive or very comprehensive. Cronbach's alpha for the final version ranged from $\alpha = .73$ to $\alpha = .92$ across ME subscales, and the ME total score. All internal consistencies of the MEI as well as MICs, means and standard deviations can be seen in Table 3 (Study 2 columns). MEI total score approximated to a normal distribution (see Appendix A).

Men showed significantly higher MEI total scores (MEI_{men}: $M = 3.86$, $SD = .65$) than women (MEI_{women}: $M = 3.55$, $SD = .76$; $t_{(826)} = 4.868$, $p < .001$, $d = 0.42$).

Preliminary evidence for criterion validity could be shown by significant inverse correlations between all MEI facets and the LOCES (see Table 5). Furthermore, participants who meditate on a regular basis showed significant higher MEI total scores ($MEI_{meditators}$: $M = 4.09$, $SD = 0.75$) than non-meditators ($MEI_{non-meditators}$: $M = 3.51$, $SD = 0.72$; $t_{(793)} = 7.292$, $p < .001$, $d = 0.80$).

------ Please insert Table 3 about here -----

STUDY 3: Validation of the Final MEI

Study 3 aimed (1) to confirm the final MEI factor structure within a second, independent sample using CFA and test its multidimensionality (2) to examine criterion validity of the MEI using a wider range of conceptually related as well as more distant constructs, and (3) to investigate test-retest reliability. On an explorative basis, measurement invariance with respect to gender was examined. Regarding these aims, the following assumptions were made:

(1) As results on previous ME instruments suggesting a multidimensional structure of ME and due to the EFA results of our Study 2, we hypothesized a better fit of a seven-factor model compared to a one-factor model. Similar results could have been shown regarding generic mindfulness, where a multidimensional factor model fit the data best (Bergomi, Tschacher, & Kupper, 2013b).

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382   (2) To preliminary investigate the affiliation of ME to its generic structure, generic

383   mindfulness was assessed and assumed to correlate highly ($r \geq .5$) without completely

384   overlapping with ME. According to Study 2, meditators were expected to score higher on the

385   MEI than non-meditators. To integrate the concepts in the clinical and health psychological

386   frame, criterion validity regarding eating-specific and general health-related constructs was

387   tested. In line with former findings (e.g., O'Reilly et al., 2014) it was hypothesized that the

388   MEI would negatively correlate with maladaptive eating behaviors such as food cravings or

389   eating out of habit. Furthermore, MEI was assumed to positively correlate with other adaptive

390   (i.e., with healthy eating patterns) associated eating behaviors such as intuitive eating, eating

391   motives resulting from physiological need and hunger as well as health, and eating related

392   self-efficacy. Additionally, the MEI was expected to be positively associated with more

393   distant, general health-related constructs such as mental well-being and general gratefulness

394   (particularly with the ME facet 'Inter**con**nectedness') and negatively correlated with

395   psychological distress (e.g., Khan & Zadeh, 2014).

396   (3) As previous research has found that eating behavior is relatively stable over time

397   without intervention (e.g., Wertheim, Koerner, & Paxton, 2001), a high test-retest reliability

398   ($r \geq .5$) over a period of two weeks was expected.

399   **Methods**

400   **Procedure**

401   Participants took part in an online assessment at the SoSci-Survey platform. All

402   participants provided written informed consent and gave obligatory information about date of

403   birth, gender, height, and weight.

404   In order to include a wide range of indicators to test criterion validity and

405   simultaneously reduce the participants' burden, two sets of questionnaire batteries were

406   compiled (in the following termed Quest_A and Quest_B), each containing different measures

407   of mindfulness-based, eating-specific and general health-related constructs. After completion

408   of the MEI and a rating of its comprehensibility on a 5-point scale, the sample was randomly

409   assigned to one of the two questionnaire sets[3]. At the end of each set, information regarding

410   meditation practice, educational background and socioeconomic status according Winkler-

411   Index score (Winkler & Stolzenberg, 1999) were gathered and participants could choose an

412   incentive as in Study 2. Inclusion criteria were identical with Study 2 with two exceptions: 1)

413   Participants were asked whether they had participated in Study 2 and accordingly excluded to

414   not confound both study samples; 2) Only participants who completed the whole survey were

415   considered in the analyses. Test-retest reliability of the MEI was examined in a subsample of

416   participants who volunteered for a second assessment.

417   **Participants**

418   The initial sample consisted of 616 individuals who were recruited online between

419   November 2016 and February 2017 in a comparable manner to that in Study 2. Due to the

420   small number of missing data, listwise deletion ($n = 4$; ~1%) was conducted (Graham, 2009)

421   resulting in a final sample of $N = 612$ individuals for data use.

422   Participants were predominantly female (79 %). The age ranged from 18 to 75 years

423   ($M = 35.5$, $SD = 11.6$). Mean BMI was 25.8 ($SD = 7.5$) and ranged from 17.5 to 65.7.

424   According to WHO classification (World Health Organization, 2014), 4% of the sample were

425   classified as underweight, 55% as normal weight, 20% as overweight and 21% individuals as

426   obese based on self-reported weight and height data. The participant's educational

427   background ranged from ten school years or less (3%) up to university entrance qualification

428   (67%). Most of the participants (68%) were in employment, 14% were students. Based on

429   Winkler-Index score (Winkler & Stolzenberg, 1999), the majority of the participants belonged

430   to the middle class (66%) while 19% of the participants were assigned to the lower

431   socioeconomic class and 15% to the upper class. More than half of the sample ($n = 364$)

432   reported experience with mindfulness practice. Ninety participants reported practicing

433   meditation on a regular basis.

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434 The Quest_A set was filled out by $n = 303$ individuals, the Quest _B set by $n = 309$

435 participants. There were no significant differences between the subsamples regarding BMI

436 ($t_{(610)} = -1.42$; $p = .157$), gender ratio ($\chi^2_{(1)} = 1.91$; $p = .167$) and socioeconomic status ($\chi^2_{(2)} =$

437 1.66; $p = .436$). Only regarding age there was a small, but significant difference ($t_{(610)} = 2.63$;

438 $p = .009$; $d = .21$) indicating that participants in Quest_A ($M = 34.2$, $SD = 11.3$) were on

439 average younger than participants in Quest_B ($M = 36.7$, $SD = 11.7$).

440 Data for the retest-assessment were available for $n = 146$ participants. This subsample

441 did not differ from those of the total sample who did not participate in the retest in terms of

442 age ($t_{(610)} = 0.87$; $p = .387$), BMI ($t_{(610)} = 0.51$; $p = .614$) and gender distribution ($\chi^2_{(1)} = 2.17$;

443 $p = .141$), but comprised a higher socioeconomic status (lower class = 11%, middle class =

444 47%, upper class = 42%; $\chi^2_{(2)} = 54.84$; $p < .001$).

445 **Instruments**

446 ME was assessed with the final version of the MEI with seven factors distributed

447 among $N = 30$ items, which need to be answered on a 6-point scale ranging from *almost never*

448 (1) to *almost always* (6).

449 To evaluate criterion validity, the following nine instruments were used: The

450 Comprehensive Inventory of Mindfulness Experiences (CHIME; Bergomi et al., 2014) with N

451 $= 37$ items; the short version of the Food Craving Questionnaire Trait - reduced (FCQ-T-r;

452 Meule, Hermann, & Kübler, 2014) with $N = 15$ items; the German version of the Intuitive

453 Eating Scale 2 (IES-2; Ruzanska & Warschburger, 2017) with $N = 23$ items; the Norwegian

454 Weight Efficacy Life-Style Questionnaire Short Form (WEL-SF; Flølo, Andersen, Nielsen, &

455 Natvig, 2014) with $N = 8$ items; three subscales from the Eating Motivations Scale – brief

456 version (TEMS-b; Renner, Sproesser, Strohbach, & Schupp, 2012) including $n = 9$ items; the

457 German version of the General Health Questionnaire (GHQ-12; Linden et al., 1996) with $N =$

458 12 items; the German version of the WHO-5 Well-Being Index (WHO-5; Bech, 2004; Bech,

459 Olsen, Kjoller, & Rasmussen, 2003) with $N = 5$ items; the Gratitude Questionnaire-6 (GQ-6;

460   Mccullough, Emmons, & Tsang, 2002) with $N = 6$ items. In general, higher scores reflect

461   higher expressions on the measured variable. The allocation of instruments to the subsamples

462   is depicted in Table 5.

463   **Instrument regarding generic structure.**

464   *Mindfulness.* Generic mindfulness was assessed by the CHIME, which encompasses

465   eight subscales on a 6-point scale ranging from *almost never* to *almost always*. For this study,

466   a total score was computed. Internal consistency was $\alpha = .92$ in the current sample.

467   **Eating-specific instruments.**

468   *Food cravings.* The FCQ-T-r (Meule et al., 2014) was applied to assess food cravings.

469   On a 6-point scale (*never* to *always*) participants described how often they showed or

470   experienced certain food craving related characteristics. Internal consistency reached $\alpha = .96$

471   in the current sample.

472   *Intuitive eating.* To measure intuitive eating as an adaptive, with healthy eating

473   patterns associated, eating style, a German version of the IES-2 (Ruzanska & Warschburger,

474   2017) was used. Within four subscales ranging on a 5-point scale (*strongly disagree* to

475   *strongly agree*) the IES-2 measures key aspects of intuitive eating. Internal consistency for the

476   total score was $\alpha = .91$ in the current sample.

477   *Eating-related self-efficacy.* To measure a person's confidence in resisting eating-

478   related temptations, the WEL-SF (Flølo et al., 2014) was used. The WEL-SF assesses eating

479   related self-efficacy on a 10-point rating scale with a score of 0 indicating *not at all confident,*

480   and a score of 9 indicating *very confident*. The WEL-SF reached Cronbach's alpha $\alpha = .90$ in

481   the current sample.

482   *Motives for eating.* The TEMS-b(Renner et al., 2012) assesses the motivation to eat on

483   seven subscales. For this study, the following three subscales were used: 'need & hunger' and

484   'health' to measure adaptive, with healthy eating patterns related motives; and 'habit' to

485   assess an eating motive associated with external eating. Answers were given on a 7-point

50

486   scale from *never* to *always*. (Renner et al., 2012) In the current sample, Cronbach's alpha was

487   α = .60 for 'need & hunger', α = .76 for 'health' and α = .79 for 'habit'.

488   **General health-related instruments.**

489   *Psychological distress.* The German version of the GHQ-12 (Linden et al., 1996) was

490   applied to assess the presence resp. absence of mental health. The GHQ-12 focuses on the

491   severity of psychological complaints compared to the usual state of a person. Items were

492   answered on a 4-point response scale ranging from *not at all* to *much more than usual*.

493   Cronbach's alpha reached α = .89 in the current study.

494   *Mental well-being.* The German version of the WHO-5 (Bech et al., 2003; Bech,

495   2004) was administered to assess mental well-being. Participants rated the frequency of well-

496   being in the last two weeks on a 6-point scale ranging from *not at all* to *all the time*.

497   Cronbach's alpha was α = .88 in the current study.

498   *Gratitude.* To assess the degree of general gratitude in everyday life, the GQ-6

499   (Mccullough et al., 2002) was applied. Using a 7-point scale ranging from *strongly disagree*

500   to *strongly agree*, participants had to evaluate different statements on experiencing gratitude.

501   In the current sample, Cronbach's alpha was α = .89.

502   **Analyses**

503   **CFA.** To confirm the factor structure of the MEI, CFA was performed using Mplus 7.

504   Models were based on the results of Study 2. Since the chi-square (χ^2) value is highly

505   affected by the size of the sample (Bühner, 2011), the standardized root mean square residual

506   (SRMR), the root mean square error of approximation (RMSEA) and the comparative fit

507   index (CFI) were used to judge model fit. RMSEA ≤ .08, SRMR ≤ .10 and CFI ≥ .90 were

508   taken as cut-offs for an acceptable fit while RMSEA ≤ .06, SRMR ≤ .08 and CFI ≥ .95

509   indicated a good fit for the model (Browne & Cudeck, 1993; Hooper, Coughlan, & Mullen,

510   2008; Schermelleh-Engel, Moosbrugger, & Müller, 2003). Additionally, a one-factor model

511   and the correlational seven-factor model found in Study 2 were compared via Akaike-

512   information-criterion (AIC) values to decide, which model explains the factor structure better.

513   We abstained from computing a G-factor model (e.g., a hierarchical G-factor or bifactor

514   model) to compare it with the correlational seven-factor model as recent research has shown

515   that such models require that domains of a measurement instrument are interchangeable rather

516   than structurally different (for details see Eid, Geiser, Koch, & Heene, 2017; Eid & Koch,

517   2014). This requirement was not fulfilled by the MEI (i.e., domains of ME are structurally

518   different and not interchangeable).

519   **Measurement invariance across gender.** We exploratively investigated measurement

520   invariance of the MEI between males and females. Therefore, three nested models were

521   specified and compared, each representing a different level of invariance identified by using

522   the reference group method (Schroeders & Gnambs, 2018). First, configural measurement

523   invariance was determined. In this model, all model parameters are freely estimated (except

524   those necessary for model identification). Second, metric invariance was tested by setting all

525   factor loadings to equality across both groups. Third, scalar invariance was tested by setting

526   all factor loadings as well as all item intercepts to equality across both genders. Due to the

527   sensitivity of chi-square difference test to sample size, we focused on alternative fit indices to

528   investigate measurement invariance (Putnick & Bornstein, 2016). Specifically, nested models

529   were compared based on the difference in RMSEA, SRMR and CFI. The following

530   differences were considered as acceptable: Δ RMSEA $\leq$ .015, Δ CFI $\leq$ .010 and Δ SRMR $\leq$

531   .030 from configural to metric invariance and Δ RMSEA $\leq$ .015, Δ CFI $\leq$ .010 and Δ SRMR $\leq$

532   .015 from metric to scalar invariance (Chen, 2007).

533   **Reliability and validity.** Cronbach's alpha was computed as a reliability estimator.

534   Pearson's product-moment correlations were used to calculate 1) inter-correlations between

535   the subscales of the MEI as well as 2) their correlations with other instruments regarding

536   criterion validity and 3) their test-retest reliability between two timepoints. Group differences

537   were determined by t-tests and effect sizes were computed by using Cohen's d. Effect sizes

538   were interpreted as described in Study 2. These analyses were calculated using SPSS statistics

539   24.

Results

Factor Structure of the MEI.

542   The factor structure of the MEI could be confirmed by CFA. The multiple-factor

543   model with seven correlated factors fitted the data best by showing acceptable (CFI) to good

544   (RMSEA & SRMR) fit. The one-factor model did not reach acceptable fit. Lower AIC values

545   further emphasized the superiority of the seven-factor model over the one-factor model. All fit

546   indices are depicted in Table 4.

547   ------ Please insert Table 4 about here -----

Measurement invariance across gender.

549   Both, the configural ($\chi^2_{(768)}$= 1728.243, RMSEA = .064, SRMR = .066; CFI = .898)

550   and the metric invariance model showed acceptable ($\chi^2_{(791)}$= 1745.572, RMSEA = .063,

551   SRMR = .068; CFI = .898) and comparable fit indices (Δ RMSEA = .001, Δ SRMR = .002

552   and Δ CFI = .000), indicating invariance of loadings. The scalar invariance model showed

553   acceptable fit regarding two fit indices ($\chi^2_{(814)}$= 1844.846, RMSEA = .064, SRMR = .070).

554   Although the CFI value (CFI = .890) was below the suggested cut-off, change in fit indices

555   between the scalar invariance model and the metric invariance model met the applied cut-offs

556   (Δ RMSEA = .001, Δ SRMR = .002 and Δ CFI = .008) for invariant intercepts.

Reliability and Validity.

558   Acceptance of the MEI was high: 81% of the participants rated the MEI as either very

559   comprehensive or comprehensive. Cronbach's alpha ranged from α = .75 to α = .91 across

560   MEI subscales and the MEI total score. Internal consistencies, MICs, means and standard

561   deviations as well as inter-correlations between the subscales and results on test-retest

562   reliability are summarized in Table 3 (Study 3 columns). Scale format was again exploited for

563   all items and the total score approximated a normal distribution (see Appendix A).

564   To assure the comparability with Study 2, gender differences were also calculated for

565   Study 3: Men showed significantly higher MEI total scores (MEI$_{men}$: $M = 3.91$, $SD = .62$)

566   than women (MEI$_{women}$: $M = 3.63$, $SD = .73$; $t_{(610)} = 3.874$, $p < .001$, $d = .40$).

567   With respect to criterion validity, all correlations showed in the expected directions.

568   Though most MEI facets were significantly associated, the extent of the correlations differed

569   depending on the respective outcome. Details are depicted in Table 5 and briefly summarized

570   hereafter.

571   Regarding its relation to generic mindfulness, MEI total score was highly correlated

572   with generic mindfulness. In accordance with Study 2, meditators showed significantly higher

573   ME total scores (MEI$_{meditators}$: $M = 4.01$, $SD = 0.72$) than non-meditators (MEI$_{non-meditators}$: $M =$

574   3.63, $SD = .70$; $t_{(610)} = 4.699$, $p < .001$, $d = .54$).

575   With respect to criterion validity regarding eating-specific instruments, the MEI total

576   score was highly negatively associated with food craving. There were small, but significant

577   negative correlations between the MEI total score and the eating motive 'habit'. MEI total

578   score was highly positively correlated with intuitive eating, moderately positively with weight

579   related self-efficacy and small to moderately associated with the eating motives 'need and

580   hunger' and 'health'.

581   Regarding more distant, general health-related outcomes, correlation analyses revealed

582   moderate negative correlations between MEI total score and psychological distress as well as

583   moderate positive correlations between MEI total score and mental well-being.

584   ------ Please insert Table 5 about here -----

585   **Discussion**

586   The objective of the present work was to develop a reliable and valid instrument to

587   assess Mindful Eating (ME) as a context-specific form of mindfulness in a comprehensive

588   and differentiated way. Psychometric properties of the MEI regarding factorial validity,

589   internal consistency, retest-reliability and observed criterion validity using a wide range of

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590   eating-specific and general health-related outcomes provided evidence that the MEI is a sound

591   instrument to measure ME. Acceptance of the MEI was supported by qualitative data,

592   quantitative ratings and a low level of missing data in both studies. Descriptively, comparable

593   means and standard deviations as well as similar internal consistencies in two independent

594   samples indicate a high stability of the inventory's psychometric characteristics.

595   **Facets and Operational Definition**

596   The presented studies provide evidence that eating-specific mindfulness should be

597   considered as a multidimensional construct as it has already been shown in the context of

598   generic mindfulness (Baer, Smith, & Allen, 2004; Bergomi et al., 2013b). Specifically, factor

599   analyses indicated that ME comprises seven correlated facets that cover a variety of eating-

600   specific mindful attitudes and behaviors. The ME facets were significantly correlated with

601   conceptually relevant external criteria, whereby the magnitude of the correlations differed

602   depending on the respective outcome. These correlation patterns emphasize the importance of

603   a differentiated assessment of ME and the value of considering different facets of the

604   construct.

605   Measurement invariance tests suggested that factor loadings and intercepts for the

606   MEI can be considered invariant for men and women. Nevertheless, one out of three applied

607   indices regarding the scalar invariant model marginally did not met acceptable fit statistics.

608   Furthermore, results on measurement invariance should be considered as explorative due the

609   small number of men ($n = 122$) and need to be replicated in future research.

610   In the following paragraphs, each of the ME facets will be discussed in more detail. As

611   the current work is based on cross-sectional data, all assumptions should be considered as

612   preliminary and need to be investigated more deeply in future empirical studies.

613   An '**A**ccepting and **N**on-attached **A**ttitude towards one's own eating experience'

614   (ANA) enables a person to be aware of the present moment; allowing to be what is there, both

615   the pleasant and the unpleasant experience. It represents the eating-specific correspondence of

the generic mindfulness subfacet 'non-judging of experience', also called 'acceptance'. In

contrast to the MES acceptance facet, the ANA facet of the MEI further integrates aspects of

non-attachment. Through reduced automatic negative self-judgments, the attitude captured by

ANA is free from resistance towards the actual experience (e.g., in relation to how, what and

how much is eaten) and might thus function as a buffer to consecutive emotional reactions

such as guilt or shame, which in turn often may result in compensatory maladaptive behaviors

(Haedt-Matt & Keel, 2011; Kristeller & Epel, 2014). This assumption fits well with our

results as this ME facet showed strong negative correlations with loss-of-control eating and

food cravings.

'**A**wareness of **S**enses while **E**ating' (ASE; contently identical with 'awareness' facet

in the MES/MEQ and 'focused eating' in the MEBS) represents the context-specific part of

present moment awareness, also called 'observing/noticing' within the framework of generic

mindfulness. Including all senses in the process of eating is considered the only possibility to

actually experience the look, smell, taste, sound and haptic of a meal moment by moment

(Bays, 2009). Findings on the awareness component of ME showing an association with

healthy maternal dietary choices in line with physiological needs (Hutchinson et al., 2017)

map well with the strong correlations between ASE and intuitive eating found in our work.

'**F**ocused **A**ttention on **E**ating' (FAE) reflects deliberately paying attention (Kabat-

Zinn, 2013) or the generic mindfulness subfacet 'acting with awareness' with respect to

eating. It is comparable in this stressed content with the 'distraction' subscale of MEQ, the

'act with awareness' subscale of MES as well as the 'eating with awareness' and 'eating

without distraction' subscales of the MEBS. This ability to consistently refocus on the process

of eating when distracted by cognitive or behavioral aspects is a central presumption for any

form of present moment awareness. The strong inter-correlation of ASE and FAE supports

this assumption. Eating when distracted is known to support unconscious, automatic behavior

such as loss-of-control eating and is associated with higher food intake (Robinson et al.,

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2013). FAE as a conscious eating attitude might function as a counterpart to this behavior. This assumption was supported by the negative correlation with loss-of-control eating found in our data.

'**E**ating in **R**esponse to awareness of **F**ullness' (ERF) describes both, the awareness or 'observing/noticing' component of ME regarding internal satiety signals as well as the subsequent, conscious eating behavior. ERF partly represents the counterpart of the 'disinhibition' subscale of the MEQ and 'hunger and satiety cues' of the MEBS as originated from the IES-2. The awareness component is supposed to be a presumption of experiencing body related signals as cues to eating intuitively. The terms ME and intuitive eating are often used interchangeably (Mathieu, 2009) but might indeed describe two different constructs both encompassing a wider range of attitudes and behaviors, that overlap in ERF. This view is supported by the strong positive correlation between the IES-2 and the ERF facet observed in our data. In line with results on intuitive eating (Schaefer & Magnuson, 2014) enhancing ERF through interventions may support individuals with obesity and eating disorders in abstaining from unconscious maladaptive eating behaviors such as overeating and loss-of-control eating. Our data preliminarily support this assumption as ERF was strongly negatively correlated with loss-of-control eating and food cravings. Moreover, the ability of ERF might be related to increased trust in one`s self-regulation abilities, shown by positive correlations with eating-related self-efficacy in our data.

'**A**wareness of eating **T**riggers and **M**otives' (ATM) describes the awareness or 'observing/noticing' of eating decisions and the ability to distinguish between different needs. This requires insight in emotional and physical sensations as well as external cues and personal eating habits in the present moment. Thus, assessing ATM allows assessing these aspects indirectly at the same time. The assessment of this important ME facet was in large part neglected in the former assessment of ME[1]. Only the factorial not replicable MEQ subscale 'external cues' allowed for the assessment of the awareness of external triggers.

668   Formulation of MEQ items regarding 'emotional response' rather reflect emotional eating

669   than the awareness of emotional triggers itself. Gaining awareness of personal eating motives

670   and triggers might explain findings on generic mindfulness and healthier food choices

671   (Jordan, Wang, Donatoni, & Meier, 2014; Tak et al., 2015) as it is supposed to increase the

672   chance to rather consciously decide starting to eat in line with physiological needs instead of

673   loosing control (Albers, 2009). In line with this view, ATM was strongly positively correlated

674   with intuitive eating and strongly negatively correlated with loss-of-control eating.

675   '**N**on-**R**eactive **S**tance' (NRS) describes an observant, non-impulsive attitude when

676   facing external eating triggers (e.g., watching others eating) as well as inner signals (e.g.,

677   emotions or food cravings), without instantly reacting to them. It represents the eating-

678   specific 'non-reactivity to inner experience' component of generic mindfulness. The NRS

679   facet within the MEI extends the exclusive scope of the MES 'non-reactivity' subscale on

680   feelings of hunger by adding content regarding other external and internal clues to overcome

681   recent critique on its content validity (Winkens et al., 2018). The focus of NRS is less the

682   performed behavior (e.g., emotional eating) but the awareness of what is going on and the

683   eventually resulting conscious, self-determined regulation of behavior. In line with the

684   observed effects of generic mindfulness on healthier food decisions (Jordan et al., 2014; Tak

685   et al., 2015), NRS might enhance the scope of eating-related decision-making. This

686   assumption is underlined by strong negative correlations with loss-of-control eating and food

687   cravings in our data.

688   A felt sense of gratitude for and 'Inter**con**nectedness' (CON) with all living beings and

689   natural elements that are involved in the origin and manufacturing of food reflects the broader

690   awareness of the world around us within the ME concept. This facet represents the roots of

691   mindfulness in Buddhist culture. Therefore, it plays an important role in practicing ME and

692   addresses the broader impact of food choices (Hạnh & Cheung, 2010), although it was not

693   assessable with existing ME measurements. As this facet focuses on another part of ME,

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694   beyond processes within the person itself or its direct environment, correlations with other

695   subscales were comparatively low except for the ASE subscale (eating-specific present

696   moment awareness). Our results are comparable to findings highlighting that particularly

697   generic present moment awareness positively predicts generic gratitude (Ahrens, Breetz, &

698   Forbes, 2011). Experiencing food with all senses might concordantly facilitate gratefulness

699   for this food. Future research should examine, if CON might play a role in recently proposed

700   models for ME for health promotion and sustainability (Fung et al., 2016), e.g., by mindful

701   food choices in the interest of our planet.

702   ***Operational definition of ME.*** In sum, following the structure of MEI, ME can be

703   described as bringing an accepting and non-attached attitude (ANA) to the experience of

704   eating while deliberately paying attention (FAE) to the present moment with all senses (ASE),

705   being aware of not only motives and needs which trigger eating (ATM) without directly

706   reacting to them (NRS) but also integrating this knowledge with the awareness of

707   physiological hunger and satiety signals to guide one's own eating behavior consciously

708   (ERF). Additionally, ME includes the awareness of connectedness between the earth and all

709   living beings setting the process of eating in a broader picture (CON).

710   As no consensual and professionally recognized definition of ME existed so far

711   (Warren et al., 2017), this comprehensive operational definition can be seen as a first attempt

712   to structure the evolving field of ME research and to facilitate communication as well as

713   treatment implementations.

714   **ME in the Broader Context: Criterion Validity of the MEI**

715   Our studies provide first evidence for the criterion validity of the MEI. With the help

716   of these results, the still relatively newly researched concept of ME should be integrated in the

717   broader theoretical framework.

718   The expected strong positive association between the MEI and generic mindfulness

719   provides first implication of the relationship to this Buddhist concept. In line with our

720   assumptions, meditators who are supposed to regularly practice mindfulness, scored higher on

721   the MEI than non-meditators.

722   With respect to the relevance of ME in the eating-related context, the hypothesized

723   high positive correlation to intuitive eating as an adaptive, with healthy eating patterns

724   associated eating style, emphasize the conceptual closeness (Mathieu, 2009). In addition, the

725   small to moderate correlations with the eating motives 'health' and 'need and hunger'

726   preliminary confirm associations observed between generic mindfulness and healthier food

727   decisions, which were guided by a better interoceptive awareness of physiological hunger and

728   satiety cues (Jordan et al., 2014; Tak et al., 2015). Moderate correlations to eating-related self-

729   efficacy were in line with previous research on associations between self-efficacy and generic

730   mindfulness (St. Charles, 2010). In sum, our findings map well with the positive effects of

731   mindfulness found in intervention studies (Godfrey et al., 2015), providing further evidence

732   that ME describes as well an adaptive eating style contributing to healthy eating patterns.

733   Negative associations with loss-of-control eating, habitual eating and food cravings indicate

734   that ME might further function as a counterpart of maladaptive eating behavior.

735   With respect to the relevance of ME in the more general health-related context, the

736   eating-specific construct was moderately associated with lower levels of psychological

737   distress and higher levels of well-being. These results are in line with findings on positive

738   associations between psychological health, well-being and generic mindfulness (Brown &

739   Ryan, 2003). Furthermore, the findings replicate prior reports about the positive correlation

740   between ME and mental well-being (Khan & Zadeh, 2014), providing further evidence that an

741   eating-specific construct like ME might have a broader impact in promoting general health. In

742   this context, Khan and Zadeh (2014) hypothesize that ME may serve as a promoter of more

743   satisfaction in everyday-life. This may in turn increase overall well-being and thus general

744   health without changing a whole personal lifestyle. As ME is an eating skill that can be taught

745   easily (Bays, 2009), it might be an economical way to support not only current treatment of

746   maladaptive eating behavior but to contribute to the sustainment of broader general health.

747   **Limitations and Strengths**

748   Although both samples were carefully recruited via a quote scheme to address

749   common critiques on the validation samples of former ME questionnaires and thereby to

750   ensure a comparability of the results with the general population in terms of age, weight

751   status, gender, educational and occupational background, this goal was not achieved regarding

752   gender distribution. As common in studies concerning eating behavior (O'Reilly et al., 2014;

753   Ouwens et al., 2015; Rogers et al., 2017), we were not able to recruit more than 20% male

754   participants. Due to the limited number of men in our sample, measurement invariance could

755   only be examined in an exploratory manner and results need to be interpreted with caution.

756   Furthermore, our samples were more highly educated (32% university entrance degree)

757   compared to the general German population (Statistisches Bundesamt, 2018) which could

758   limit the generalizability of our results with respect to means and standard deviations.

759   Additionally, participants in the retest-assessment possessed a higher socioeconomic status.

760   The seven-factor solution for the MEI allows for a differentiated assessment of

761   important ME facets within one inventory, which was one major aim of the current work.

762   However, this assessment requires the fitting of more complex models, longer assessment as

763   well as more complex calculation and interpretation of participants scores. As we did not

764   examine the incremental validity of each facet, future research must prove the value of such a

765   nuanced inventory.

766   In accordance with common practice (Cladder-Micus et al., 2019; Coste et al., 1997;

767   Smith et al., 2000), the scale shortening process was based on an sequential procedure using a

768   variety of statistical and content-related considerations. Meanwhile, algorithmic approaches

769   for scale shortening have been presented and implemented in statistical software packages

770   (e.g., ant colony optimization as realized in the R statistics package "stuart"; Schultze, 2017).

771   These algorithms improve the traceability of the procedure and are preferable to the approach

772   used in our study.

773   Finally, initial assumptions, particularly on the MEI facet level, must be considered as

774   preliminary due to the cross-sectional design of studies that do not allow for causal

775   interpretation. Other research designs such as longitudinal studies or randomized controlled

776   trials are needed to address this limitation in future research.

777   Apart from these limitations, there are several strengths to be mentioned: The MEI

778   was developed within various steps that combined qualitative and quantitative procedures.

779   Ecological validity was tested prudently with expert opinions and focus groups. Acceptance

780   of the MEI was checked carefully within each study. Not only does the MEI allow for the

781   simultaneous assessment of important ME facets within one inventory to investigate

782   underlying mechanisms of eating-specific effects of mindfulness, it also enables researchers

783   and practitioners to assess crucial aspects that were either neglected or excluded by

784   abbreviated versions of previous instruments: '**A**wareness of eating **T**riggers and **M**otives

785   (ATM)', 'Inter**con**nectedness (CON)' and '**N**on-**R**eactive **S**tance (NRS)' (as an extension of non-

786   reactivity for physiological hunger related triggers). Since these facets represent crucial parts of

787   common ME programs, their assessment is pivotal to investigate them in a sufficient way, and

788   thus to aid research in clarifying mechanisms at work in modifying maladaptive eating

789   behaviors which are associated with the development and maintenance of obesity and eating

790   disorders. We were able to recruit two independent, large and diverse samples for

791   investigating factor and criterion validity, which extends previous research (Framson et al.,

792   2009; Hulbert-Williams et al., 2014; Winkens et al., 2018). Our samples comprised

793   participants of a wide range of age (18-76 years) and were comparable to the German

794   population (Statistisches Bundesamt, 2018) in terms of employment rate (68% in German

795   population) as well as weight status (26.0 in German population). Moreover, the BMI

796   distribution in both studies roughly corresponds to the one of the German population (2%

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797   underweight, 45% normal weight, 36% overweight, 17% obesity; Statistisches Bundesamt,

798   2018).

799   **Future Directions: Working on and with the MEI**

800   The MEI was designed as a comprehensive instrument to assess a wide range of

801   different attitudes and behaviors, offering multiple starting points for future research to

802   achieve a deeper understanding of ME. According to our initial assumptions on the ME facet

803   level, future studies with longitudinal or experimental designs could investigate if certain ME

804   facets are more relevant in predicting and modifying maladaptive eating behaviors than

805   others. This would allow for the gauging of importance of a certain ME facet not only from a

806   theoretical point of view but based on empirical evidence. Nevertheless, future studies on

807   incremental validity are warranted to further support the additional value of an eating-specific

808   measure over a generic one in this context.

809   Furthermore, the MEI with its differentiated facets offers the opportunity to nuancedly

810   evaluate multicomponent mindfulness-based interventions on obesity and eating disorders in

811   order to clarify potential mechanisms at work in the future. To do so, it is important to

812   investigate measurement invariance for different groups affected by maladaptive eating

813   behavior in future validation work of the MEI to assure its suitability for this purpose.

814   Moreover, future validation on the MEI within prospective intervention data should assess its

815   change sensitivity.

816   Beyond researching ME in the context of eating behavior (e.g., its association to other

817   adaptive eating styles as intuitive eating) our promising findings invite researchers to

818   investigate the value of this adaptive eating style in research and practice regarding other

819   relevant scopes (e.g., broader mental and physical health)

820   As our work is based on community samples, future studies might explore the

821   usefulness of the MEI in clinical samples with eating disorders as well as samples with co-

822   occurring mental (e.g., depression) or physical (e.g., cardiovascular diseases) conditions. To

823   this end, besides self-reported data, additional methods (e.g., peer reports, objectively

824   measured health status or assessment of mental disorders via structured clinical interviews)

825   should be considered. Further, a validation for adolescents is important: This group is widely

826   known for its vulnerability to the development of eating disorders and weight problems

827   (Golden, 1997) and might therefore benefit from ME-based intervention.

828   Due to the good psychometric properties, the use of single MEI subscales

829   independently from the MEI total score can be considered in research and practice. However,

830   future work will have to investigate whether the exclusive assessment of single MEI subscales

831   is applicable and instructive.

832   **Conclusion**

833   Our aim was to develop a reliable, valid and comprehensive assessment tool for

834   research and practice to measure eating-specific mindfulness. Besides its sound psychometric

835   properties, the MEI was well accepted by the participants. The MEI enables a detailed

836   assessment of ME on a differentiated facet level, which may help a) to explore mechanisms of

837   action regarding the broader concepts of mindfulness in modifying maladaptive eating

838   behavior in clinical or non-clinical groups and b) to tailor pre- and intervention in this field

839   more precisely in the future. For example, the MEI could be used (1) before an intervention as

840   an assessment tool to identify specific problem areas on facet level and adapt the intervention

841   on these specific needs and (2) after treatment, to assess which progress regarding awareness

842   of eating behavior was made and whether there is a need for further support. Furthermore, the

843   MEI might contribute to investigate the beneficial use of this eating-specific construct not

844   only in the context of eating behavior but also in terms of general health. Through its

845   comprehensiveness, the MEI allowed us to provide a preliminary, empirically based

846   operational definition of ME, which was missing so far and might enrich scientific

847   communication as well as provide a stable basis on which researchers in this emerging field

848   can build on.

64

Declarations of Interest: none

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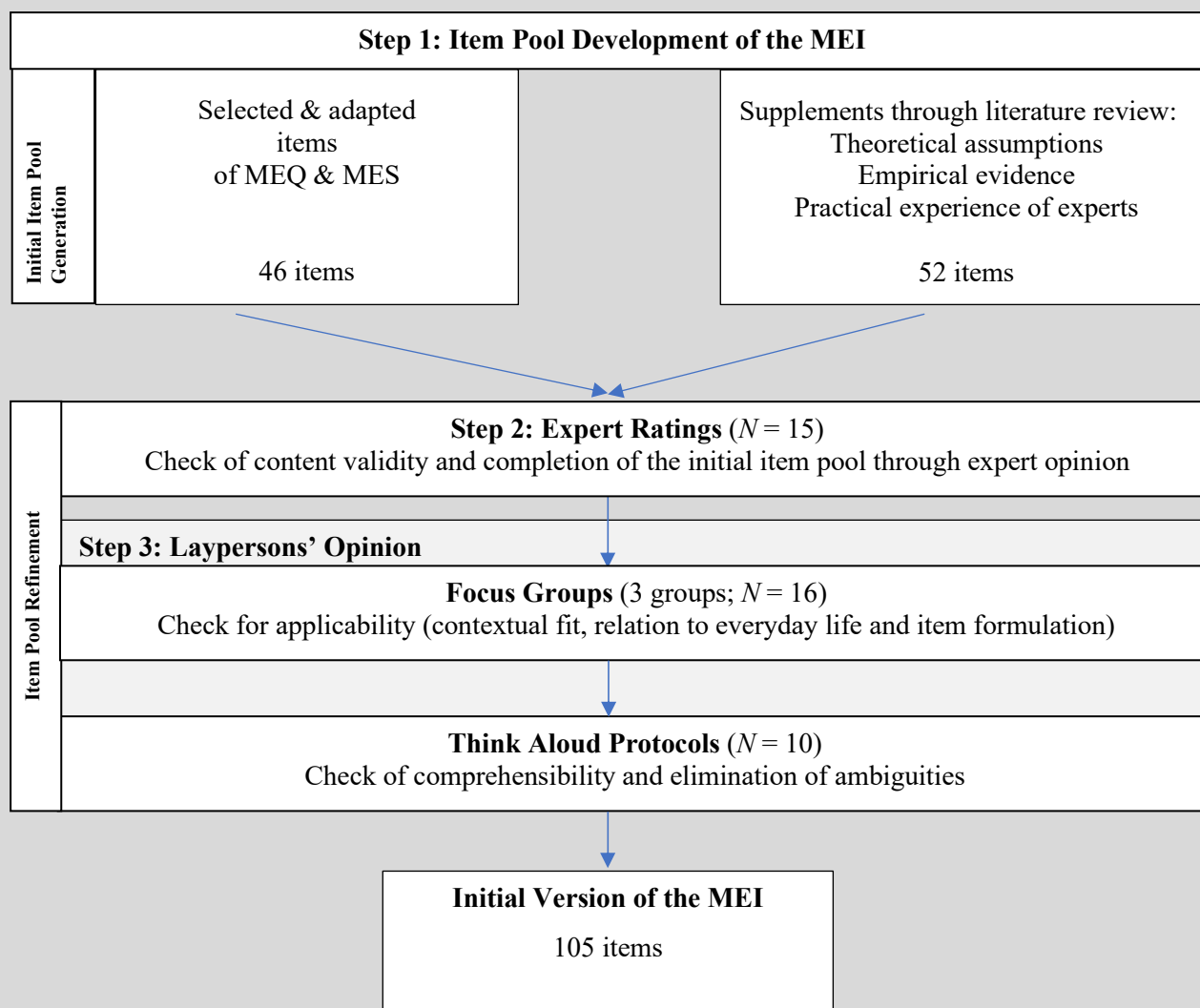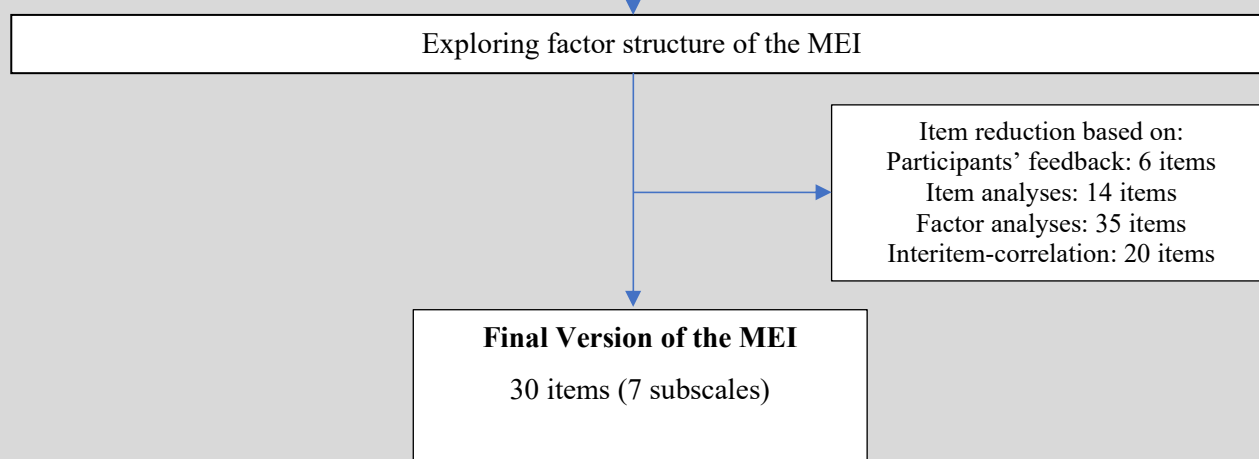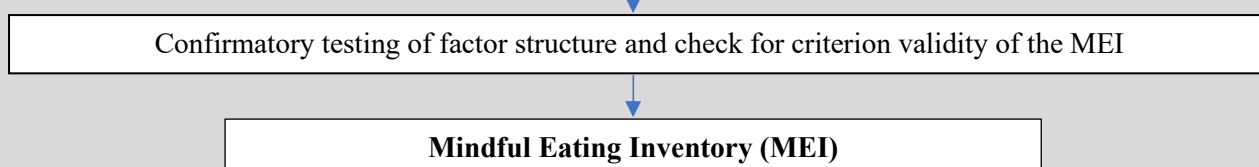
Figure 1: Development of the MEI

MEQ = Mindful Eating Questionnaire, MES = Mindful Eating Scale.

Table 1
Characteristics of available Mindful Eating Measurements

	MEQ (Framson et al., 2009)	**MES** (Hulbert-Williams et al., 2014)	**MEBS** (Winkens et al., 2018)
Original Validation Sample	$N = 303$ Age $M = 42.0$ years BMI $M = 24.2$ Convenience sample	$N = 127$ Age $M = 25.7$ years BMI $M = 23.6$ Convenience sample	$N = 1227$ Age $M = 68.8$ years BMI $M = 27.2$ Representative sample of adults aged 55 and older
Aim & Characteristics	First attempt to measure ME Most frequently used ME questionnaire	Parsimonious scale corresponding to standard operationalization & factor structure of generic mindfulness (FFMQ; Baer et al., 2006) incl. acceptance and non-reactivity	Exclusive assessment of ME attention element (no items on emotional or external eating triggers [resp. eating motives] nor acceptance)
Development	Selected items of questionnaires on generic mindfulness and maladaptive eating behavior	Applied selected items of questionnaires on generic mindfulness to eating-related behaviors, which were reviewed by experts	Selected items from MES, MEQ & IES-2
Number of Items & Original Subfacets	[28 items] 1 'awareness' 2 'emotional response' 3 'external cues' 4 'disinhibition' 5 'distraction'	[28 items] 1 'acceptance' 2 'awareness' 3 'act with awareness' 4 'non-reactivity' 5 'routine' 6 'unstructured eating'	[17 items] 1 'focused eating' 2 'hunger and satiety cues' 3 'eating with awareness' 4 'eating without distraction'
Abbreviated Versions	Apolzan et al. (2016): 4 subfacets (exclusion of 'external cues') Clementi et al. (2017): 2 subfacets 'awareness', 'recognition of hunger and satiety'	Hulbert-Williams et al. (2015): 5 subfacets (exclusion of 'unstructured eating')	None: original factor structure could be replicated using CFA within the same study (Winkens et al., 2018)
Limitations	- size and representativeness of original validation sample (overrepresentation of participants from yoga and weight loss centers; Winkens et al., 2018; Lofgren, 2014) - original factor structure not replicable (Apolzan et al., 2016; Clementi et al., 2017) - exclusion of important content in abbreviated versions such as awareness of eating motives (reflected by 'emotional response' and 'external clues')	- size and representativeness of original validation sample (only students; Hart et al., 2018) - non-reactivity component regards only to drive to eat neglecting other relevant eating triggers; rather reflects behaviors resulting from ME practice than construct immanent aspects (Winkens et al., 2018) - items predominantly negatively formulated	- narrow focus on attention element obstructs from an exhaustive assessment of the so far less researched construct of ME - correlations with theoretically important criteria were relatively low (-.32 to .19; Winkens et al., 2018, p. 11)

Note. MEQ = Mindful Eating Questionnaire, MES = Mindful Eating Scale, MEBS = Mindful Eating Behavior Scale, IES-2 = Intuitive Eating Scale-2.

Table 2

MEI: Final Factor Structure of Mindful Eating regarding EFA (Study 2)

Factors & Items		ANA	ASE	ERF	ATM	CON	NRS	FAE
Accepting and Non-attached Attitude towards one's own eating experience (ANA)								
#15	I feel guilty after eating something "unhealthy", "forbidden" or "high-caloric."*	.916						
#9	If I have eaten more than my body actually needed (e.g., on holidays or with my favorite meal), I can't let go of thoughts about it.*	.893						
#30	I tell myself I shouldn't be eating what I eat.*	.732						
#23	I criticize myself for the way I eat.*	.725						
#4	I accept my eating behavior as it is right now.	.635						
Awareness of Senses while Eating (ASE)								
#19	I'm fully aware of the smells and aromas of my food.		.825					
#8	While I eat, I'm fully aware of the food in my mouth (e.g., temperature, texture, etc.).		.824					
#27	I taste every bite of food that I eat.		.774					
#14	While I eat, I look at the colors and shapes of the food closely.		.645					
#1	Before I start eating, I take a moment to appreciate the appearance and smell of my food.		.529					
Eating in Response to awareness of Fullness (ERF)								
#3	I stop eating when I'm full, even if my plate is not empty yet.			.896				
#22	If there are leftovers, I take a second helping even though I'm already full.*			.793				
#18	I pay attention to my body telling me when I'm full.			.723				
#10	If it tastes good to me, I don't recognize when I am full.*			.633				
#24	It's hard for me to find the point when I'm full but not uncomfortably stuffed.*			.498				
Awareness of eating Triggers and Motives (ATM)								
#28	I'm able to notice if I'm physically hungry or if I want to eat for other reasons (e.g., boredom, habit, availability, etc.).				.888			
#13	I can distinguish if my body needs food or if I want to eat because I don't feel emotionally well (e.g., stress, frustration, sadness, tension, etc.).				.885			
#20	I can distinguish if my body needs food or if I want to eat because others around me are eating.				.679			
#7	I am aware of the triggers leading me to eat without my body actually needing food (resp. is not physically hungry).				.606			
Connectedness (CON)								
#16	While I'm eating, I make myself aware of who and what were part of the origin and the production of this food (e.g., rain, sun, living beings, harvest, etc.).					.954		
#26	When I'm eating, I thank all living beings that were involved in the production of this food.					.771		
#6	When I'm eating, I bring to mind where my food comes from and how it came to me.					.648		
Non-Reactive Stance (NRS)								
#12	When I see or smell something tasty, I have to eat it.*						.801	
#25	When I'm keen on eating a special food, I have to follow that urge right away.*						.705	
#5	When others eat, I have to eat, too.*						.541	
#17	When I am hungry, I can't think of anything else.*						.484	
Focused Attention on Eating (FAE)								
#29	While I eat, I keep my whole attention focused on my food.							.822
#11	When I eat, I do something else on the side (e.g., read, watch TV, drive, work, be on the phone).*							.721
#2	While I eat, I focus all my attention on the food.							.621
#21	While I eat, my thoughts tend to drift off (e.g., plan what I am going to do next; think about the past, etc.).*							.564

Note. $N = 828$. Table shows translated items of the German questionnaire; order regarding the reduced item pool of $n = 30$ ME items.

* = inverted items.

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Table 3
MEI: Means, Reliabilities and Intercorrelations of Study 2 (N = 828) & Study 3 (N = 612)

Study	MEI_{total}		ANA		ASE		ERF		ATM		CON		NRS		FAE	
	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3
ME_{total}	-	-														
ANA	.77*	.65*	-	-												
ASE	.73*	.74*	.38*	.30*	-	-										
ERF	.76*	.74*	.56*	.39*	.36*	.39*	-	-								
ATM	.73*	.64*	.47*	.30*	.49*	.45*	.54*	.42*	-	-						
CON	.51*	.54*	.21*	.10*	.54*	.51*	.18*	.24*	.27*	.28*	-	-				
NRS	.54*	.59*	.39*	.35*	.15*	.24*	.45*	.43*	.34*	.34*	.10*	.14*	-	-		
FAE	.67*	.65*	.42*	.29*	.55*	.52*	.38*	.39*	.35*	.21*	.32*	.34*	.25*	.29*	-	-
M	3.61	3.69	3.88	4.05	3.65	3.75	3.67	3.69	4.39	4.48	2.53	2.52	3.72	3.89	3.11	3.07
SD	.75	.72	1.33	1.21	1.04	1.03	1.09	1.13	1.03	1.02	1.25	1.27	1.03	0.94	0.93	1.03
Cronbach's Alpha	.92	.91	.90	.87	.86	.86	.85	.86	.84	.83	.84	.84	.73	.75	.79	.82
MIC	.28	.26	.65	.57	.56	.55	.54	.56	.57	.55	.64	.64	.41	.43	.48	.54
r^{tt}	.91[a]		.88[a]		.79[a]		.90[a]		.70[a]		.81[a]		.89[a]		.81[a]	

Note. [a] n = 146. MIC = Mean interitem-correlation. r^{tt} = Test-Retest Reliability over 2 weeks. MEI_{total} = Mindful Eating total score, ANA = Accepting and Non-attached Attitude towards one's own Eating Experience, ASE = Awareness of Senses while Eating, ERF = Eating in Response to Awareness of Fullness, ATM = Awareness of Eating Triggers and Motives, CON = Interconnectedness, NRS = Non-Reactive Stance, FAE = Focused Attention on Eating. * *p* < .001

Table 4
MEI: Model Fit and Model Comparison regarding CFA (Study 3)

Model	$X^2_{(df)}$	RMSEA (90%CI)	CFI	SRMR	AIC
One-factor model	$5139.44_{(405)}$*	.14 (.13 - .14)	.48	.12	58336.95
Seven-factor model	$1244.71_{(384)}$*	.06 (.05 - .06)	.91	.06	54388.47

Note. $N = 612$. CFA = Confirmatory Factor Analysis. χ^2 = chi-square, RMSEA = root mean square error of approximation, 90% CI = 90% confidence interval, CFI = comparative fit index, SRMR = standardized root mean square residual, AIC = Akaike-information-criterion. * $p < .001$.

THE MINDFUL EATING INVENTORY

Table 5
Relationships between MEI and Related Constructs regarding Criterion Validity

Instrument & Construct	MEI$_{total}$	ANA	ASE	ERF	ATM	CON	NRS	FAE
Mindfulness-related								
CHIME[a] (generic mindfulness)	.60*	.40*	.42*	.38*	.52*	.28*	.40*	.36*
Eating-specific								
LOCES[2] (LOC)	-.76*	-.78*	-.37*	-.67*	-.54*	-.20*	-.51*	-.40*
FCQ-T-r[b] (craving)	-.70*	-.65*	-.38*	-.60*	-.41*	-.19*	-.60*	-.32*
IES-2[b] (intuitive eating)	.72*	.66*	.48*	.60*	.48*	.25*	.37*	.34*
WEL-SF[b] (eating related self-efficacy)	.45*	.36*	.30*	.39*	.38*	.09	.29*	.23*
TEMS-b – Need & Hunger[a] (motive)	.29*	.20*	.22*	.24*	.32*	.21*	.04	.07
TEMS-b – Health[a] (motive)	.28*	.04	.20*	.24*	.30*	.29*	.13	.13*
TEMS-b – Habit[a] (motive)	-.27*	-.11	-.25*	-.23*	-.12	-.10	-.22*	-.19*
Global health-related								
GHQ-12[b] (psychological distress)	-.33*	-.36*	-.23*	-.22*	-.17*	-.10	-.15*	-.22*
WHO-5[a] (wellbeing)	.35*	.24*	.27*	.25*	.23*	.20*	.15	.29*
GQ[a] (gratefulness)	.25*	.11	.20*	.15*	.29*	.26*	.11	.12

Note. [a] Contained in Questionnaire A. Study 3. [b] Contained in Questionnaire B. Study 3. [2] Contained in Study 2. CHIME = Comprehensive Inventory of Mindfulness Experiences, LOCES = Loss of Control over Eating Scale, FCQ-T-r = Food Craving Questionnaire-Trait-reduced, IES-2 = Intuitive Eating Scale-2, WEL-SF = Weight Efficacy Life-Style Questionnaire-Short Form, TEMS-b –Need & Hunger = The Eating Motivation Survey – brief version, subscale 'need and hunger', TEMS-b – Health = The Eating Motivation Survey – brief version, subscale 'health', TEMS-b – Habit = The Eating Motivation Survey – brief version, subscale 'habit', GHQ-12 = General Health Questionnaire, WHO-5 = WHO-5 Well-Being Index, GQ = Gratitude Questionnaire. MEI$_{total}$ = Mindful Eating total score, ANA = Accepting and Non-attached Attitude towards one's own Eating Experience, ASE = Awareness of Senses while Eating, ERF = Eating in Response to Awareness of Fullness, ATM = Awareness of Eating Triggers and Motives, CON = Interconnectedness, NRS = Non-Reactive Stance, FAE = Focused Attention on Eating. * p < .001.

Supplementary material

The following supplementary material related to this article is available:

Appendix A. Histograms showing the distribution of the ME total score in Study 2 and Study 3

Histogram Study 2
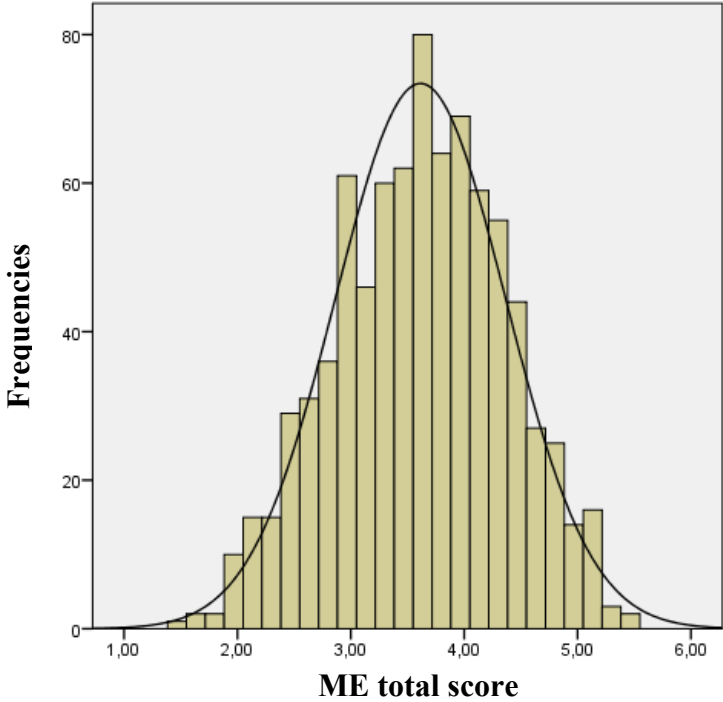
Histogram Study 3

CHAPTER 4

TAKING A CLOSER LOOK AT MINDFUL EATING: INCREMENTAL VALIDITY AND IMPORTANCE OF SUBFACETS

This chapter presents the research article in its published form and format.

ORIGINAL ARTICLE

Taking a closer look at mindful eating: incremental validity and importance of subfacets

Diana Peitz[1] · Petra Warschburger[1]

Abstract

Purpose Mindful eating (ME) seems a promising approach to clarify the underlying mechanisms of mindfulness-based interventions for eating and weight-related issues. The current study aimed to investigate the incremental validity of this eating-specific approach beyond a generic conception of mindfulness and explore preliminary indication which subfacets of the multidimensional construct ME might be of particular importance in order to study them more precisely and tailor mindfulness-based interventions for eating and weight-related issues more properly.

Methods Self-report data ($N = 292$) were collected online. Hierarchical regression analyses were used to explore the incremental validity of ME beyond generic mindfulness, predicting maladaptive eating (emotional and uncontrolled eating) and consumption of energy-dense food. Multiple regressions were used to examine the impact of the seven different ME subfacets on the very same outcomes.

Results Findings demonstrated the incremental validity of ME on all outcomes. Generic mindfulness no longer predicted emotional eating, uncontrolled eating, or the consumption of energy-dense food when entering ME. The subfacet '*non-reactive stance*' predicted all three outcomes significantly. For emotional and uncontrolled eating, the subfacets '*accepting and non-attached attitude toward one's own eating experience*', '*eating in response to awareness of fullness*', *and the '*awareness of eating triggers and motives*' additionally showed a significant influence.

Conclusion ME seems a valuable approach in clarifying how mindfulness might impact eating and weight-related issues. Beyond that, it might be beneficial for upcoming interventions to strengthen specific ME subfacets, depending on the focused outcomes.

Level of evidence Level V, descriptive cross-sectional study.

Keywords Mindful eating · Mindfulness · Maladaptive eating · Incremental validity · Subfacet

Introduction

Maladaptive or non-homeostatic eating (i.e., eating for reasons other than hunger) has shown to be associated with the development and maintenance of obesity and eating disorders (ED) [1–5]. Mindfulness-based interventions have demonstrated to reduce maladaptive eating behaviors (such as emotional eating or uncontrolled overeating) in persons across different weight groups [6, 7] and among subclinical and clinical ED samples [8, 9]. Thus, mindfulness became

popular in research and practice to enrich the treatment of obesity and ED [10, 11].

Despite its popularity, the underlying mechanisms of mindfulness (resp. paying attention to the present moment without judging; [12]) in the context of eating seem so far largely unknown [6, 11, 13]. Some approaches focus on the attentive component of mindfulness by reducing the amount of food eaten while being with all senses with the food [14] or suppose that mindfulness might disrupt habit loops of maladaptive eating (or what the authors called "reward-related eating") and facilitate rewiring eating-related learning processes [15]. Moreover, further preliminary attempts assume that mindfulness may operate through increased awareness of physical hunger and satiety cues as well as increased awareness of and reduced responsiveness to external and emotional cues [7]. Other assumed mechanisms refer

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to the mindfulness-immanent quality to be aware of the experience in the present moment (*present moment awareness*), the non-judgment or *acceptance* of this experience, and a *non-reactive stance toward this experience*, so called decentering [13]. However, none of these mechanisms have been sufficiently investigated to date. Regarding the increasing number of intervention studies, exploring the underlying mechanisms is crucial to tailor treatments properly in future research and practice [11].

Hitherto, it is unknown if mindfulness skills can be generalized to different domains of life [16]. There is even evidence that non-eating-specific mindfulness interventions did not affect maladaptive eating [17]. Thus, applying an eating-specific approach seems beneficial to utilize mindfulness in the context of eating behavior and study underlying mechanism in this evolving field [16, 18, 19]. This is one reason why recent research has focused on the context-specific *Mindful Eating* (ME) approach.

In line with generic mindfulness [20], ME is conceptualized as a multidimensional construct [7, 21]. Using comprehensive factor analyses, Peitz and colleagues. [18] identified seven subfacets and consecutively operationalized ME as "bringing an accepting and non-attached attitude to the experience of eating (1) while deliberately paying attention (2) to the present moment with all senses (3), being aware of not only motives and needs which trigger eating (4) without directly reacting to them (5) but also integrating this knowledge with the awareness of physiological hunger and satiety signals to guide one's own eating behavior consciously (6). Additionally, ME includes the awareness of connectedness between the earth and all living beings setting the process of eating in a broader picture (7)" ([18], p. 12).

Several correlational studies have shown significant negative associations between higher ME and both maladaptive eating behaviors and less healthy nutrition behavior (e.g., [16, 22–25]). However, only one study investigated the assumed incremental validity of ME over generic mindfulness: Beshara and colleagues [26] (using hierarchical regression analyses on cross-sectional data) showed ME to fully mediate the relationship between the generic construct and the self-reported serving size of energy-dense food, which is associated with weight gain and binge eating episodes.

Moreover, there is preliminary evidence that certain ME subfacets are more strongly associated with particular eating behaviors than others [27–29]. Thus, they might be of particular interest in preventing and treating eating and weight-related issues. To approach the mechanism of action, it is crucial to identify those subfacets of a multidimensional construct that in fact have predictive power (and distinguish them from those with non-predictive power); otherwise, the effect of the overall construct on the outcome to be addressed may be under- or overestimated [30]. Previous studies used different instruments to assess ME, sharing some subfacets but differing in others. To compare all subfacets, empirically gauging their specific importance, the use of a comprehensive measure assessing all subfacets of ME seems pivotal.

Aims of the current study:

1. ME seems a promising approach to study the underlying effects of mindfulness on eating behaviors that are associated with the development and maintenance of obesity and ED. However, the incremental validity of ME over generic mindfulness in this context has not been sufficiently investigated. Thus, the current study aims to explore if ME explains variance in eating behaviors associated with obesity and ED, i.e., maladaptive eating (emotional eating, uncontrolled eating) and, consumption of energy-dense food, beyond the generic construct.

2. ME has shown to be a multidimensional construct. In approaching the mechanism of action, it seems essential to explore whether and which subfacets of ME have the most impact on the previously mentioned variables and thus seem of particular interest in treating eating and weight-related issues.

Methods

Procedure and participants

Data were gathered online within the validation of the final version of the Mindful Eating Inventory (MEI) [18]. The convenience sample was recruited mainly via social media and specific websites and mail distributors regarding eating behavior. Participation was voluntary, and participants received an incentive (ME information booklet; opportunity to take part in a lottery). After providing obligatory demographic information (e.g., date of birth, height, and weight), individuals answered questions on eating behavior and socioeconomic status.

Individuals were included in the study if they were at least 18 years of age, provided informed consent, and completed the survey. The full sample consisted of 292 individuals (81% female) with a mean *Body Mass Index* (BMI = weight(kg)/height(m)^2; 31) of $M = 25.7$ ($SD = 6.7$, range 18.5–59.4). Age ranged from 18.3 to 65.8 years ($M = 34.7$, $SD = 11.4$). According to Winkler Index [32], 18% could be assigned to a lower socioeconomic class, 63% to a middle and 19% to the upper class.

Measures

ME was assessed with the *Mindful Eating Inventory* (MEI) [18]. The MEI is a comprehensive instrument that unites the different ME subfacets detected in previously published scales within one inventory. It assesses the

multidimensional construct of ME with seven subfacets (internal consistency in brackets): (1) '*A*ccepting and *N*on-attached *A*ttitude toward one's own eating experience' (ANA; $\alpha = 0.87$) with five items (e.g., "I accept my eating behavior as it is right now."), (2) '*A*wareness of *S*enses while *E*ating' (ASE; $\alpha = 0.86$) with five items (e.g., "I taste every bite of food that I eat"), (3) *E*ating in *R*esponse to awareness of *F*ullness (ERF; $\alpha = 0.86$) with five items (e.g., "I stop eating when I'm full, even if my plate is not empty yet."), (4) '*A*wareness of Eating *T*riggers and *M*otives'(ATM; $\alpha = 0.83$) with four items (e.g., "I'm able to notice if I'm physically hungry or if I want to eat for other reasons (e.g., boredom, habit, availability, etc.)."), (5) 'Inter*con*nectedness' (CON; $\alpha = 0.82$) with three items (e.g., "When I'm eating, I bring to mind where my food comes from and how it came to me."), (6) '*N*on-*R*eactive *S*tance' (NRS; $\alpha = 0.76$) with our items (e.g., "While I eat, I focus all my attention on the food.", reversed), and (7) *F*ocused *A*ttention on *E*ating' (FAE; $\alpha = 0.81$) with four items (e.g., "While I eat, I focus all my attention on the food."). The 30 items were rated on a six-point scale ranging from *almost never* to *almost always.* Internal consistency of the total score was $\alpha = 0.92$ in the current sample.

The *Comprehensive Inventory of Mindfulness Experiences* (CHIME) [33] was applied to assess *generic mindfulness*. The 37 items (8 subscales) of the CHIME are assessed on a six-point scale ranging from *almost never* to *almost always*. For this study, the total score was used (internal consistency in current sample: $\alpha = 0.92$).

Emotional eating and *uncontrolled eating* were measured by an 18-item version of the *Three Factor of Eating Questionnaire* (TFEQ-R18V2) [34]. Items were taken from the *Fragebogen zum Essverhalten (FEV)* [35], the German equivalent of the TFEQ. The TFEQ-R18V2 measures three domains of eating behaviors—together with cognitive restraint—on a four-point scale with alternating scale point descriptions. In the current sample, Cronbach's alpha reached $\alpha = 0.94$ for emotional eating and $\alpha = 0.90$ for uncontrolled eating.

In accordance with Beshara and colleagues [26], we assessed the *frequency of consuming energy-dense food.* Participants were asked how often they consumed (1) 'fast food (such as burger, pommes, kebab, hot dogs) or instant meals (such as lasagna, pizza)' and (2) 'sweets or snacks (e.g., chocolate, potato chips, ice cream, cake, pudding)'. Answers ranged on a six-point rating scale ('never/seldom', '1–3 times a month', '1–2 times a week', 'several times a week', 'daily', 'several times a day').

Analyses

First, Pearson's product moment correlations were computed between ME, generic mindfulness, and the three outcomes

Table 1 Correlation between Generic Mindfulness, Mindful Eating and Maladaptive Eating and Nutrition Behaviors

	Emotional Eating	Uncontrolled Eating	Energy-dense food consumption
CHIME	−0.45*	−0.45*	−0.21*
ME$_{total}$	−0.67*	−0.75*	−0.36*
ANA	−0.58*	−0.50*	−0.18
ASE	−0.33*	−0.36*	−0.27*
ERF	−0.50*	−0.68*	−0.27*
ATM	−0.44*	−0.48*	−0.20*
CON	−0.18	−0.24*	−0.17
NRS	−0.59*	−0.70*	−0.34*
FAE	−0.38*	−0.41*	−0.24*

Note. CHIME = Comprehensive inventory of mindfulnes experience, *MEI$_{total}$* = Mindful Eating total score, *ANA* = Accepting and Non-attached Attitude toward one's own eating experience, *ASE* = Awareness of Senses while Eating, *ERF* = Eating in Response to awareness of Fullness, *ATM* = Awareness of eating Triggers and Motives, *CON* = Interconnectedness, *NRS* = Non-Reactive Stance, *FAE* = Focused Attention on eating. *$p < 0.001$

emotional eating, uncontrolled eating, and consumption of energy-dense food to prove their associations for further analyses.

Second, hierarchical multiple regressions were computed. Generic mindfulness was entered first (first model), while ME was entered second (second model) to investigate incremental validity of ME above and beyond generic mindfulness.

Third, multiple regression analyses were used to investigate possible impact of the single ME subfacets (entered simultaneously) over and above each other regarding emotional eating, uncontrolled eating, and consumption of energy-dense food and to identify predictive facets for these outcomes.

All analyses were performed with SPSS 26. There were no missing data regarding the investigated variables.

Results

ME and generic mindfulness were correlated significantly positively ($r = 0.61$; $p < 0.001$). Correlations showed significant negative associations between the ME total score, emotional eating, uncontrolled eating, and consumption of energy-dense food. Generic mindfulness was significantly negatively associated with emotional eating, uncontrolled eating, and consumption of energy-dense food, but to a lesser degree. Detailed correlation values can be found in Table 1.

Hierarchical regression analyses showed that generic mindfulness significantly predicted emotional eating (β

-0.447; $p < 0.001$). This first model explained 20% of the variance. The inclusion of ME ($\beta - 0.631$; $p < 0.001$) enhanced the explained variance to 45%, indicating incremental validity. When entering ME, generic mindfulness no longer predicted emotional eating ($\beta - 0.066$; $p = 0.234$).

Regarding uncontrolled eating, generic mindfulness explained 20% of the first model and significantly predicted the construct ($\beta - 0.449$; $p < 0.001$). When entering ME ($\beta - 0.751$; $p < 0.001$) in the second model, the explained variance increased to 56%. Generic mindfulness did no longer predict uncontrolled eating ($\beta - 0.006$; $p = 0.911$) in this model.

Generic mindfulness significantly predicted the consumption of energy-dense food ($\beta - 0.211$; $p < 0.001$) and explained 4% of its variance. When entering ME ($\beta - 0.369$; $p < 0.001$), the explained variance increased to 12%. Consumption of energy-dense food was no longer predicted by generic mindfulness in this second model ($\beta\ 0.013$; $p = 0.855$).

Multiple regression analyses revealed that entering all seven ME subscales together explained 53% of the variance in emotional eating, 69% of the variance in uncontrolled eating, and 14% of the variance in the consumption of energy-dense food. ANA, ERF, ATM and NRS significantly predicted both emotional eating and uncontrolled eating, NRS significantly predicted the consumption of energy-dense food (see Table 2).

Discussion

In our study, a multidimensional eating-specific mindfulness approach (ME), showed incremental value beyond generic mindfulness regarding maladaptive eating behaviors and the consumption of energy-dense food. Furthermore, the single ME subfacets contribute to a different extent to these outcomes. This observation might be of particular interest in tailoring mindfulness-based interventions for eating- and weight-related issues.

Maladaptive eating behaviors

Both generic mindfulness and ME were significantly negatively correlated with maladaptive eating behaviors. However, entering ME as a predictor not only improved the explained variance, but also the significant prediction of generic mindfulness on both emotional and uncontrolled eating faded. ME remained the only significant predictor. Our results indicate the incremental validity of ME above and beyond generic mindfulness in the context of maladaptive eating behaviors. Furthermore, they give preliminary evidence that ME might work as a mediator between those constructs. Consequently, future research with longitudinal data must show if ME (and its subfacets) is one missing piece in clarifying the mechanism of action regarding mindfulness-based interventions in the context of eating and weight-related issues.

Within a second step, all seven subfacets were simultaneously entered in a multiple linear regression model. They explained more than 50% of the variance in emotional eating and almost 70% of the variance in uncontrolled eating. As both of these eating patterns are assumed to foster the development and maintenance of ED [1, 5], results give initial evidence that targeting them with ME-based interventions might be beneficial. In this context, the following four ME subscales explained the significant amount of variance in both maladaptive eating behaviors and should therefore be focused on while targeting these behaviors in pre- and intervention: *accepting and non-attached attitude toward one's own eating experience* (*ANA*), *eating in response to awareness of fullness* (*ERF*), *the awareness of eating triggers and motives* (*ATM*), and a *non-reactive stance* (*NRS, i.e., meaning an observing, non-impulsive attitude toward eating triggers*).

Table 2 Multiple Regression Analyses of ME Subfacets

	Criterion: Emotional Eating		Criterion: Uncontrolled Eating		Criterion: Energy-dense food consumption	
	β	p	β	p	β	p
ANA	-0.323	< 0.001	-0.151	< 0.001	.009	0.890
ASE	-0.008	0.889	0.016	0.722	-0.147	0.055
ERF	-0.150	0.003	-0.369	< 0.001	-0.073	0.284
ATM	-0.132	0.008	-0.110	0.006	.009	0.895
CON	-0.008	0.869	-0.046	0.235	-0.024	0.702
NRS	-0.315	< 0.001	-0.415	< 0.001	-0.260	< 0.001
FAE	-0.095	0.057	-0.057	0.155	-0.057	0.397

Note: ANA accepting and non-attached attitude toward one's own eating experience, *ASE* awareness of senses while eating, *ERF* eating in response to awareness of fullness, *ATM* awareness of eating triggers and motives, *CON* interconnectedness, *NRS* non-reactive stance, *FAE* focused attention on eating, $\beta =$ standardized β weights, $p = p$ values (corrected for multiple testing)

In explaining uncontrolled eating, particularly NRS and ERF seemed important, as they depict counterparts of this behavior. Instead of losing control over one's own eating behavior, which often leads to overeating [5], NRS and ERF describe self-regulated eating skills in line with physiological needs. Emphasizing particularly these ME skills in interventions might contribute to the enhancement of a conscious, self-determinant regulation of eating behavior. As potential mediators, NRS and ERF might explain the positive influence of generic mindfulness on maladaptive eating behaviors found in intervention studies [7, 10]. Regarding emotional eating, again, NRS explained a high amount of variance. This result seems reasonable, as NRS describes a conscious way of handling triggers like emotional cues instead of simply reacting to them (e.g., with eating; [18]).

Also, ATM explains a significant amount of variance in emotional as well as uncontrolled eating. This finding indicates that being aware of triggers might facilitate eating according to physiological needs (ERF, third important subfacet) and it is in line with assumptions on reducing reward-related eating through mindfulness by the working group of Brewer and colleagues [15]: The authors argue that the awareness of eating triggers is the first step in changing habitual maladaptive eating patterns. The particular importance of ATM in predicting uncontrolled and emotional eating behaviors in our study could possibly also explain the paradoxical findings regarding the moderating effects of ME on the relationship between emotional functioning and eating styles in overweight and obese women in a recently published study [36], as this subfacet was not sufficiently captured by the ME instrument used by the working group.

However, our results showed that particularly ANA seems of special impact in explaining maladaptive eating. These findings might explain the assumption that a non-judgmental stance toward one's own eating experience may interrupt dysfunctional eating circles associated with overeating [37]. More specifically, by accepting the emotional or uncontrolled eating behavior, ANA may buffer the effects of high self-criticism endangering dysfunctional circles that lead to more overeating [38, 39].

Regarding the importance of certain ME subfacets in the context of prevention and treatment of eating and weight-related issues, our findings are in line with the aforementioned theoretical assumptions [7, 13] and results: the ME acceptance subdomain (equivalent to ANA) and the ME non-reactivity subdomain (equivalent to NRS) were found to be particularly strongly correlated with maladaptive eating behaviors [23, 29]. Also, *intuitive eating* (i.e., eating in line with physiological needs), an adaptive eating style that can be considered as equivalent to ERF within the ME framework [18], was associated with healthy eating habits comparable to ME [40].

Consumption of energy-dense food

In line with the results of Beshara and colleagues [26], who first showed incremental validity of ME beyond generic mindfulness in the context of eating and according to whom we chose to assess a food consumption outcome to facilitate comparability, ME not solely showed an increase in the explained variance of the consumption of energy-dense food; this outcome was no longer predicted by generic mindfulness when ME was added. Our findings align well with former results on higher ME and healthier food choices from correlational studies [22, 27, 41] and experiments [42, 43], and indicate that ME might support that "unhealthy foods" become less attractive [44].

In comparison to maladaptive eating behaviors, ME explained less variance in consumption of energy-dense food. Future prospective studies should investigate more deeply if our results indicate that eating-specific mindfulness may have a greater impact on *how* rather than *what* to eat. In our study, only one subfacet (NRS) proved to be a significant predictor of the consumption of energy-dense food. Hutchinson and colleagues [27] found the awareness component of ME to be the most important subfacet in predicting maternal dietary choices. A meta-analysis [14] showed comparable effects of eating attentively with all senses on the amount of food eaten. In our study, the equivalent ASE (being there with all senses whilst eating) was next to NRS the second important predictor, but yielded no significance. This might be due to our only focus on so-called "unhealthy foods". Our findings should be further investigated in upcoming studies using different assessments.

Strengths and limitations

Our sample contained a wide range of age, socioeconomic status and especially BMI, representative of the German population [45]. However, the sample comprised mainly females. Further studies should stress the inclusion of more males to generate more generalizable results in terms of this issue.

Our study enables the comparability with the only other result of ME's incremental validity provided by Beshara and colleagues [26]. Though, particularly with respect to this result, one should consider that we only used two questions on the consumption of energy-dense food, reflecting only a narrow but also an essential part of our food intake. Future studies should use more elaborate food frequency questionnaires to investigate the influence of mindfulness on nutrition behavior more deeply.

We used a comprehensive ME measure that was able to compare the impact of different subfacets. Based on our cross-sectional design, causal conclusions can only be hypothesized.

Prospective and experimental studies are warranted to broaden our knowledge on ME, especially regarding the predictive power and potential mediating effects of the different ME subfacets and their significance in treating obesity and ED.

Preliminary clinical suggestions

In line with other findings [17], our results give a preliminary implication that maladaptive eating and nutrition behaviors might be addressed more beneficially by mindfulness exercises or interventions with a specific focus on eating, such as MB-EAT [46] or *Mindful Eating - Conscious Living* (ME-CL) [47]. Thus, these context-specific interventions should be more focused on clinical practice and more extensively studied in research than to date [13, 48].

Moreover, findings on the subscale level indicate that exercises regarding the enhancement of a non-reactive stance toward eating (NRS; resp. solely being aware of eating triggers without reacting to them), might be beneficial. So-called "mini meditations" [46] before starting to eat may decrease maladaptive eating behavior as well as "unhealthy" nutrition behavior, since NRS showed significant predictions of both behaviors.

For maladaptive eating, such as emotional eating and/or uncontrolled eating, there seems to be more mechanisms at play, and, thus, they should be addressed in interventions via different exercises. For instance, the ME-CL core exercise '*9 HUNGER*' [47] aims to enhance the ability to become aware of and distinguish between different eating triggers and motives (ATM subfacet) in order to decide if the body needs food or one wants to eat, e.g., for emotional reasons. This aims to facilitate a conscious decision on food intake and caring of emotional needs in other ways than food. Especially for clinical groups with elevated emotional and/or uncontrolled eating, this exercise might be particularly helpful. However, these and other assumptions need to be researched in future intervention studies and experiments.

Conclusion

In sum, ME seems a valuable approach to approximate the underlying mechanisms of mindfulness-based interventions on obesity and ED, as it possesses incremental validity beyond the generic construct on maladaptive eating and the consumption of energy-dense food, both of which have been shown to be associated with the development and maintenance of these clinical pictures. Furthermore, our findings indicate that different subfacets might be important for the treatment of eating and weight-related issues, depending on the primary goal of the intervention. Further longitudinal studies with clinical samples are needed to find out more about the potential of ME and its subfacets

in explaining the underlying mechanisms of mindfulness-based interventions to target them more precisely.

What is already known on this subject?

- Mindful Eating (ME) is suggested as one mechanism to explain the effects of mindfulness-based interventions on eating and weight-related issues.
- Hitherto, evidence for its incremental validity on maladaptive eating and nutrition behaviors beyond generic mindfulness and the impact of certain ME subfacets on these behaviors is mainly missing.

What this study adds?

- This study provides initial evidence that ME might be helpful to study the underlying mechanisms of mindfulness in the context of eating. It explained significantly more variance in maladaptive eating behaviors and the consumption of energy-dense food than the generic construct.
- Depending on the outcomes, particular ME facets seem of interest for tailoring mindfulness-based interventions for obesity and eating disorders properly.

Declarations

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CHAPTER 5

WHAT ARE YOU HUNGRY FOR?
THE 9 HUNGER MINDFUL EATING ONLINE RANDOMIZED CONTROLLED TRIAL

This chapter presents the research article in its published form and format.

ORIGINAL PAPER

What Are You Hungry for? The 9 Hunger Mindful Eating Online Randomized Controlled Trial

Diana Peitz[1] · Petra Warschburger[1]

Abstract

Objectives Mindful eating (ME) has been receiving increased attention in the treatment of eating and weight disorders. In this context, the ME approach is assumed to help modify maladaptive eating behaviors. This work investigated the effects of a brief ME intervention that focused on the non-judgmental awareness of different motivations to eat in order to study this mechanism.

Method Using a randomized controlled trial design, participants were allocated to an intervention group (IG; $n = 87$) or waitlist control group (W-CG; $n = 137$). For a 2-week training phase, participants of the IG were instructed to take a mindful moment to rate their different motivations to eat once per day. Self-report data on emotional eating, external eating, and loss of control eating (primary outcomes) and intuitive eating, ME, mental well-being, and self-compassion (secondary outcomes) were gathered online pre, post, and 3 months after the training. Latent change score (LCS) models were used to estimate shorter and longer term effects of the intervention.

Results LCS revealed significant shorter and longer term effects of the training when comparing data of the IG with those of the W-CG regarding all primary ($d = 0.38–0.61$) and most secondary outcomes ($d = 0.29–1.16$).

Conclusions The positive and sustainable effects of practicing this clearly outlined ME skill over a short period support the idea that ME might be a promising approach to enrich the current treatment of eating and weight disorders and aid in expanding our understanding of the underlying mechanisms on its application in the field.

Preregistration This study was preregistered at the German Clinical Trials Register (DRKS00012351).

Eating is driven not only by the physiological need to eat but by several motives and triggers (Renner et al., 2012). Next to internal processes such as hunger and satiety, a variety of other cues trigger the initiation and termination of food intake. Therefore, the response to these cues is also assumed to influence the development of non-homeostatic eating (i.e., eating for other than physiological reasons), such as *emotional eating* (eating in response to emotions), *external eating* (eating in response to external cues), *loss of control eating* (LOC), or *binge eating* (Brewer et al., 2018). Since these eating behaviors can be considered non-adaptive in relation

to physiological needs, they are often called *maladaptive eating behaviors*, especially when used extensively. These maladaptive eating behaviors were found to be involved in the development and maintenance of eating- and weight-related problems (Colles et al., 2008; Greeno et al., 2000; He et al., 2017; Patel & Schlundt, 2001; Ricca et al., 2012; Tanofsky-Kraff et al., 2011), revealing a promising starting point for their prevention and treatment.

The application of mindfulness (non-judgmentally paying attention to the present moment; Kabat-Zinn, 2013), i.e., mindfulness-based interventions (MBIs), has been found to improve maladaptive eating behaviors across persons with and without eating and weight disorders (Warren et al., 2017). For example, mindful awareness was found to be associated with lower craving (Sala et al., 2021). However, though several underlying mechanisms are assumed (e.g., self-regulation, emotion regulation), empirical research on

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their direct investigation is scarce (Barney et al., 2019; Rogers et al., 2017; Tapper, 2017). Moreover, their investigation is hampered by the fact that mostly the effects of multi-component interventions are studied, making it difficult to clearly determine the specific effects of certain elements, such as mindfulness-immanent qualities and their unique importance relative to other components (Tapper, 2022).

One RCT provided first evidence that effects of a mindfulness-enhanced diet and exercise intervention might be mediated by the context-specific skill of *mindful eating* in terms of eating sweet foods and fasting glucose in adults with obesity (Mason et al., 2016). Another cross-sectional study showed that the relationship between generic mindfulness and the self-reported serving size of energy-dense food could be explained by mindful eating (Beshara et al., 2013). These recent findings show the context-specific approach of mindful eating as a potential pathway in explaining the effects of underlying mechanisms of mindfulness on modifying eating behavior. Like generic mindfulness (Baer et al., 2019), mindful eating comprises a set of different skills containing attention elements (so-called *what* of mindfulness) and attitude elements (so-called *how* of mindfulness) (Carrière et al., 2022; Mantzios, 2021). A seven-facet comprehensive operationalization of mindful eating describes the multidimensional construct as.

> … bringing an accepting and non-attached attitude to the experience of eating (1) while deliberately paying attention (2) to the present moment with all senses (3), being aware of not only motives and needs which trigger eating (4) without directly reacting to them (5) but also integrating this knowledge with the awareness of physiological hunger and satiety signals to guide one's own eating behavior consciously (6). Additionally, mindful eating includes the awareness of connectedness between the earth and all living beings setting the process of eating in a broader picture (7) (Peitz et al., 2021, p. 12).

Mindful eating has shown to be associated with reduced maladaptive eating behaviors such as emotional and external eating (Kerin et al., 2019), food preoccupation (Taylor et al., 2015), and grazing (Mantzios et al., 2018) in various correlational studies (with mostly moderate effect sizes) and experiments (Allirot et al., 2018; Arch et al., 2016). Positive associations with mindful eating were found for dietary quality such as the consumption of fruit and vegetables (Hutchinson et al., 2017; Keeler, 2014), reduced fat and/or sugar consumption (Mantzios, Egan, Hussain, et al., 2018a, 2018b), and reduced self-reported serving size of energy-dense food (Beshara et al., 2013) as well as with higher mental well-being (Khan & Zadeh, 2014; Peitz et al., 2021) and enhanced *self-compassion* (Mantzios & Egan, 2018; Taylor et al., 2015), another Buddhist concept describing an attitude

of mindful kindness towards oneself in the face of difficulties (Neff, 2003).

Explicit mindful eating–specific MBIs such as those based on the program "Mindfulness-Based Eating Awareness Training" (MB-EAT; Kristeller, et al., 2013) have shown positive effects on maladaptive eating behaviors and related outcomes in a series of NIH-funded RCTs (e.g., most recent: Hooker et al., 2022) as well. Positive effects have also been found in different subgroups, such as in persons with diabetes (Miller et al., 2014), and low-income overweight women in primary health care (Salvo et al., 2022). However, studies on specific mindful eating–specific MBIs are still scarce (only one direct intervention study published in *Mindfulness* between 2022 and 2023; Hooker et al., 2022).

In approaching mechanisms of action regarding MBIs on maladaptive eating behaviors, there is preliminary evidence that certain facets of mindful eating differ in their relevance depending on the intervention goal or the considered outcome (Hutchinson et al., 2017; Mantzios et al., 2018; Moor et al., 2013). Consequently, these facets should be stressed in particular when treating maladaptive eating behaviors as significant characteristics in the development and maintenance of eating- and weight-related problems. In a recent study, Peitz and Warschburger (2022) identified four facets of mindful eating possessing predictive power to explain variance in both emotional and uncontrolled eating (i.e., LOC). One of these facets or mindful eating skills was the *awareness of eating triggers and motives* (ATM). ATM describes the ability to non-judgmentally notice and identify different needs which influence the initiation and termination of food intake and to distinguish them accordingly (i.e., distinguishing emotional triggers and external cues from physiological body needs). This requires awareness of emotional and physical sensations as well as external cues and personal eating habits in the present moment.

Teaching the mindful eating skill of ATM displays an important part in mindful eating–based interventions (Bays & Wilkins, 2017; Kristeller et al., 2014). In particular, the key "9 Hunger" exercise of the program "Mindful Eating – Conscious Living" (ME-CL) trains the awareness of so-called different *kinds* or *experiences of hunger* by pausing before a meal and mindfully asking "Who in there is hungry?" Then, nine kinds or aspects of hunger (Table 1) related to different eating triggers and motives should be non-judgmentally assessed on a 10-point scale (Bays, 2017; Bays & Wilkins, 2017).

Since different eating motives or needs come with similar experiences in the body (e.g., stomach growling as a sign of both physiological hunger and anxiety), they are difficult to distinguish, increasing the probability of non-homeostatic maladaptive eating (Bays, 2017; Brewer et al., 2018). Training ATM, i.e., practicing non-judgmental awareness of these different kinds of hunger or needs before and/or after a meal,

Table 1 Illustration of the nine different kinds of hunger (adapted from Bays, 2017)

Kind of hunger	Illustration
Eye hunger	What do I **see**? How much (more) of this food do my eyes want me to eat?
	Eyes' need for individual beauty/aesthetics (related to colors, shapes, surface textures, etc.); relates to delicious looking or just available food
Nose hunger	What do I **smell**? How much (more) of this food does my nose want me to eat?
	Need of the nose for individually fragrant impressions, smells, and aromas; strong effect on subconscious: smells activate memories and associated ideas
Mouth hunger	What can **I perceive in the mouth**? How much (more) of this food does my mouth want me to eat?
	The mouth's need for diverse and varied experiences and sensations (e.g., tastes, consistencies, and temperatures), so-called sensation seeker: looking for ever new, exciting sensations and experiences; endangers inattentive eating and rapid change related to consistency and taste
Ear hunger	What can **I hear**? How much (more) of this food do my ears want me to eat?
	Related to sounds or others' descriptions of food; strong effect on subconscious: sounds activate memories and associated ideas
Touch hunger	What do I **feel on my skin**? How much (more) of this food does my sense of touch want me to eat?
	Related to (surface) structures, temperature, changes in structures; making contact while shopping as well as preparing and eating food (e.g., finger food)
Mind hunger	What does my **mind say**? How much (more) of this food does my mind want me to eat?
	Interplay of all voices within that have something to say about the topic of food; arises through information from the outside, e.g., social environment and media; often anxious, critical (e.g., should/shouldn't); contains important information as well that can be used wisely in combination with information coming from the body
Heart hunger	What **emotion** do I associate with the food? Does it trigger memories, preferences or expectations in me? How much (more of) this food does my heart want me to eat?
	Describes feelings/memories associated with food (e.g., favorite childhood food); hope and expectation that the food will make me feel better (e.g., comfort, reassurance); mostly subconscious
Cell hunger	What does my **body need** right now? How interested are my cells in having this food come to them?
	"Intuitive eating" within the ME approach = perceiving instead of thinking what the body needs (listening to the body); recognizing intuitive bodily signals (compare thirst; reactions during illness): buried quality that can be relearned step by step
Stomach hunger	How much food does my **stomach need** right now? How much of this food does my stomach want?
	Perceiving instead of thinking (how does my stomach communicate with me through e.g., growling, rumbling, emptiness, something completely different?); fullness level of the stomach (volume receptors); confusion with other types of hunger (needs) endangers risk of overeating

is assumed to facilitate untangling these various experiences of perceived hunger and might consequently support regaining interoceptive awareness of hunger and satiety signals as well as their differentiation from other cues (such as emotional triggers and external cues). In the long run, gaining awareness of one's own eating motives and triggers (i.e., mindful eating skill ATM) is supposed to increase conscious and informed decision-making about when and what to eat in line with physiological needs, thus reducing maladaptive eating behaviors (Bays, 2017). Moreover, it should enable a person to respond to those needs not directly related to nutrition uptake (e.g., emotional needs) in a more appropriate and wholesome way (Kristeller & Epel, 2014). In this way, ATM exercises, as well as mindful eating–based interventions in general, not only possess the potential to modify maladaptive eating but may also increase adaptive eating (Kristeller & Wolever, 2011; Warren et al., 2017), such as *intuitive eating*. Intuitive eating describes another well-studied approach relating to an adaptive eating style, which mainly involves eating more in line with physiological hunger and satiety cues, but also includes body-congruent food choices

and an attitude of rejecting the diet mentality (Ruzanska & Warschburger, 2017; Tribole & Resch, 2020). Following a model of Brewer et al. (2018), ATM can be seen as the first step in disrupting neuronal habit loops of maladaptive or reward-related eating to establish more pronounced adaptive eating patterns.

The objective of the current study was to examine a clearly outlined mindful eating skill, which stems from a multi-component MBI (ME-CL), to approach the underlying mechanisms of mindfulness in the context of eating and weight disorders more closely. The mindful eating skill of *awareness of eating triggers and motives* (ATM) has been shown to be relevant in predicting maladaptive eating behavior in a recent study (Peitz & Warschburger, 2021).

Consequently, the current RCT aimed to explore if a short intervention, that was carried out online and in which the participants were asked to tune in and become non-judgmentally aware of their nine different kinds of hunger once a day before and after a self-chosen meal for 2 weeks, had short- and long-term effects on the reduction of maladaptive eating behaviors (emotional eating, external eating, and

LOC). Maladaptive eating behaviors serve as the primary outcomes since the overall evidence on the effectiveness of mindful eating was strongest and thus offers a reliable starting point to explore underlying mechanisms at a deeper level. Since the evidence on the following constructs was not as strong as on maladaptive eating behaviors, we investigated on an exploratory level (secondary outcomes) if the training had an effect on enhancing adaptive eating behaviors (intuitive eating and mindful eating) and more distant outcomes associated with mindful eating (self-compassion and mental well-being).

Method

Participants

In total, $n = 762$ participants requested the study link. Of those, $n = 392$ completed the first questionnaire battery (T0) and were therefore included in the intention-to-treat analyses (ITT). This initial sample consisted predominantly of females (92%) aged 18 to 82 years ($M = 37.04$, $SD = 13.82$; 23% between 18 and 24 years, 40% between 25 and 39 years, 24% between 40 and 54 years, 12% between 55 and 69 years, and 1% above 70 years). The average BMI (calculated from self-reported weight (kg) / height (m)^2; World Health Organization, 2000) was 25.21 ($SD = 5.43$) and ranged from 17.54 to 64.64. Following WHOs classification (World Health Organization, 2014), the initial sample included 3% individuals with underweight, 56% individuals with normal weight, 25% individuals with overweight, and 16% individuals with obesity. According to the Winkler Index score (Winkler & Stolzenberg, 1999), most of the participants belonged to the middle class (62%), 6% of the participants to the lower socioeconomic class, and 32% to the upper class. Sixty-eight percent had some experience with any form of mindfulness.

Data for post-measurement (T2) were provided by $n = 162$ participants of the waitlist control group (W-CG) and $n = 94$ members of the intervention group (IG). Reasons for drop out can be seen in the flow chart (Fig. 1). It can be assumed that most of the participants in the IG had not even started with the intervention. In total, $n = 87$ participants of the W-CG and $n = 137$ participants of the IG completed T2 and were therefore included in the completer analyses (per-protocol analyses, PPA). Due to a technical error, half of the follow-up results (T2) of the IG on the secondary outcomes (adaptive eating and broader health concepts) needed to be retraced, resulting in only $n = 53/87$ in the IG for completer analyses (PPA). The technical error did not concern the main outcomes on maladaptive eating behaviors.

Participants who dropped out between (a) T0 and T1 and (b) T1 and T2 did not differ from completers in terms of age (a: $t_{(392)} = 1.16$, $p = 0.246$; b: $t_{(262)} = 1.48$, $p = 0.140$), BMI (a: $t_{(392)} = 0.27$, $p = 0.786$; b: $t_{(262)} = 0.33$, $p = 0.740$), socioeconomic status (a: $t_{(392)} = 0.52$, $p = 0.603$; b: $t_{(392)} = 0.26$, $p = 0.796$), and gender distribution (a: $\chi^2_{(1)} = 3.69$, $p = 0.060$; b: $\chi^2_{(1)} = 0.48$, $p = 0.487$).

Procedure

The study utilized a randomized control design using a W-CG to compare their results on defined outcomes with an IG on three measurement points (before the intervention [T0], after the training [T1], and 3-month follow-up [T2]).

Participants were recruited online (social media, internet panels, blogs, mail distributors) and offline via flyers. A landing page informed participants about the broader scope of the training as well as its procedure and contained the informed consent. After providing their e-mail address, participants received an online link to the baseline survey (T0). Completion of this survey was mandatory for study inclusion. After its completion, participants were automatically randomized to one respective group by the used questionnaire platform (SoSci Survey) and informed whether they were allocated to the IG or W-CG. While the W-CG was informed that they would receive another questionnaire battery 2 weeks later, the IG received the study material for download.

The study material contained a 50-min training video. This video introduced ME and the nine kinds of hunger, led the participants through the exercise, and explained the procedure of the upcoming 2-week training (for content, see Supplementary Table 3). Participants were asked to pause mindfully to immerse into their experience and rate their nine kinds of hunger in a non-judgmental way once per day before and after a self-selected meal or snack. In the delivery, special attention was paid to introduce not only the *what* of mindfulness (i.e., paying attention) but also the *how* (i.e., getting aware of the "9 Hunger" in a non-judgmental way). Moreover, participants were instructed to pause and take a few mindful breaths before rating the "9 Hunger."

Additionally, two audio versions of the "9 Hunger" exercise (a 10-min version for the beginning and a 2-min short version for the time they would get used to it), a protocol sheet for the self-monitoring task, and a short explanation of the different kinds of hunger were provided.

During the 2-week training period, participants received three mails, which should remind them to adopt a self-compassionate attitude when performing the training task. Two weeks after the baseline survey as well as 3 months afterwards, participants of both the IG and the W-CG received a mail with a link to the post-survey (T1) and 3-month follow-up survey (T2). After the completion of the third questionnaire battery, participants of the W-CG received the link to the intervention materials. Both groups were offered an

Fig. 1 Flowchart in accordance with CONSORT guidelines. IG intervention group, W-CG waitlist control group, ITT intention-to-treat analysis, PPA per-protocol analysis
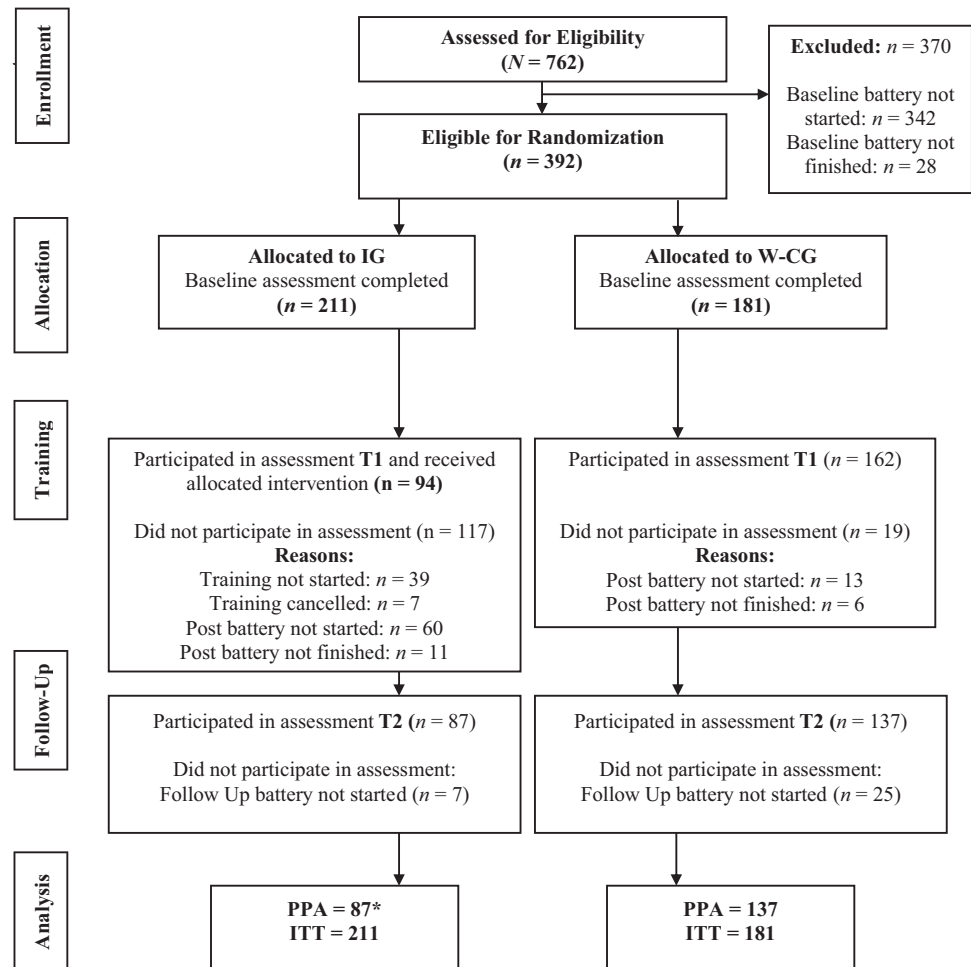
*Due to a technical error in the follow-up battery, the questionnaire of the secondary outcomes was not forwarded to part of the IG; thus, only a reduced data set of $n = 53$ is available for these secondary outcomes at T2

incentive (information booklet on mindful eating or an evaluation of their mindful eating behavior).

Criteria for study inclusion were a minimum age of 18 years, informed consent, and completion of the baseline survey. Participation was voluntary.

Measures

To explore whether a training on the mindful eating exercise "9 Hunger" had an impact on maladaptive eating behaviors (primary outcomes) and additional secondary outcomes, these study outcomes were operationalized by the following measurement instruments, which have shown to be reliable and valid in various validation studies.

Primary Outcomes

Maladaptive eating behaviors (emotional eating, external eating, and LOC) served as primary outcomes of this study.

Emotional eating and *external eating* were measured by an adapted and established German version of the *Dutch Eating Behavior Questionnaire* (DEBQ; Grunert, 1989). The DEBQ measures—together with cognitive restraint—three domains of eating behaviors on a 4-point scale with alternating scale point descriptions. In the current sample, the averaged Cronbach alpha of all three measurement points reached $\alpha = 0.95$ for emotional eating (McDonald's omega $\omega = 0.95$) and $\alpha = 0.89$ for external eating ($\omega = 0.89$). Those were comparable with a representative German validation (emotional eating: $\alpha = 0.94$; external eating: $\alpha = 0.89$; Nagl et al., 2016). An example item for emotional eating is "I

want to eat when I am disappointed," and for external eating "I tend to eat more than usual when I see others eating."

The short version of the *Loss of Control over Eating Scale* (*LOCES*; Latner et al., 2014) with 7 items was used to assess *loss of control eating* (*LOC*). It screens for subjective binge episodes on a 5-point scale ranging from *never* to *always*. Averaged internal consistency in the current sample was $\alpha = 0.93$ ($\omega = 0.93$) which was comparable with the original validation ($\alpha = 0.93$; Latner et al., 2014). An example item is: "I felt helpless about controlling my eating."

Secondary Outcomes

Adaptive eating behaviors such as mindful eating and intuitive eating, as well as self-compassion and mental well-being, served as secondary outcomes for this study.

Mindful eating was assessed with the *Mindful Eating Inventory* (MEI; Peitz et al., 2021). It assesses the multidimensional construct of mindful eating with 30 items (e.g., "I taste every bite of food that I eat.") assigned to seven subfacets, which were answered on a 6-point scale ranging from *almost never* to *almost always.* For this study, the total score was used. Averaged internal consistency regarding this total score ranged from $\alpha = 0.92$ to $\alpha = 0.94$ ($\omega = 0.91$ to $\omega = 0.94$); comparable values were reported in the original validation ($\alpha = 0.91$; Peitz et al., 2021).

Intuitive eating as another adaptive eating style was captured by a German version of the *Intuitive Eating Scale-2* (IES-2; Ruzanska & Warschburger, 2017). The 23 items (e.g., "Most of the time, I desire to eat nutritious foods.") are assigned to four subscales ranging on a 5-point scale (*strongly disagree* to *strongly agree*). Averaged internal consistency for the total score was $\alpha = 0.86$ ($\omega = 0.83$) in the current sample and $\alpha = 0.89$ in the original validation (Ruzanska & Warschburger, 2017).

Mental well-being was assessed by the 5 items (e.g., "I have felt calm and relaxed.") of the German *Well-Being Index* (WHO-5; Bech, 2004; Bech et al., 2003) on a 6-point scale ranging from *not at all* to *all the time*. Averaged Cronbach's alpha was $\alpha = 0.86$ ($\omega = 0.90$) in the current study (original validation: $\alpha = 0.92$; Bech, 2004).

Self-compassion was measured with the German version of the 12 items *Self-Compassion Scale – Short Form* (SCS; Hupfeld & Ruffieux, 2011; Raes et al., 2011). On a 5-point rating scale (1 = *almost never* to 5 = *almost always*), participants rate how often they behave self-compassionately to themselves (e.g., "I try to see my failings as part of the human condition."). Averaged Cronbach's alpha for the total score was $\alpha = 0.91$ ($\omega = 0.88$) in the current sample (original validation: $\alpha = 0.87$; Raes et al., 2011).

Data Analyses

To examine intervention effects, we calculated latent change score (LCS) models using M*Plus*. In this approach, change scores between two measurement points are computed on the level of latent variables. Using LCS to evaluate interventions is preferable to the computing of classical (manifest) repeated-measures multivariate analysis of variance (MANOVA) for several reasons: They do not contain their strict and frequently unfulfilled prerequisites (e.g., homogeneity of variances), account for measurement error in the repeated measurements, consider interindividual differences, and have a higher statistical power, which increases the chance of detecting a treatment effect that is actually present (Mun et al., 2009). Significant deviations of mean differences in the change scores between IG and W-CG were interpreted as short-term effects of the intervention (difference between T1 and T0) and long-term effects of the intervention (difference between T2 and T0). Saturated models with freely estimated change scores for both groups were compared to two models that restricted the change scores for IG and W-CG to equality (the short-term and the long-term effect, respectively). Cohen's *d* was used as an effect size estimator for the intervention effect ($d = 0.20$ small, $d = 0.50$ moderate, $d = 0.80$ large effect sizes) (Cohen, 1988). Analyses were run for each outcome variable separately.

Missing data were handled with full information maximum likelihood (FIML) to include all available data (Schafer & Graham, 2002), even those of persons who just intended to take part in the intervention but dropped out later (intention-to-treat analyses, ITT). All analyses were run again without FIML to compare the result of this per-protocol analyses (PPA; main analyses) as a completer analysis with those of ITT (secondary analyses).

Results

Use of the Training

Most of those attending the IG practiced the "9 Hunger" exercise every day (modus value). However, on average participants trained tuning in and assessing the nine different kinds of hunger 4–5 times per week during the training period (8–10 times/2 weeks).

Effects of the Training

In studying short- und long-term effects of the 9 Hunger intervention in modifying maladaptive eating behaviors (primary outcomes) and further associated secondary outcomes,

the findings showed improvements regarding all focused outcomes.

Primary Outcomes

Regarding emotional eating and loss of control eating (LOC), LCS indicate significant changes in both groups between T0 and T1 and between T1 and T2. These changes were significantly higher in the IG compared to the W-CG for both measurement points, indicating both short- and long-term effects of the "9 Hunger" intervention on reduced emotional eating and LOC with moderate sizes.

Regarding external eating, significant LCS were observed for both groups between T0 and T1, but only for the IG between T1 and T2. Again, changes for both measurement points were higher in the IG, suggesting moderate short- and long-term effects of the "9 Hunger" intervention on reduced external eating with moderate sizes.

Secondary Outcomes

Regarding mindful eating, LCS revealed significant changes in both groups, but they were significantly higher in the IG compared to the W-CG for both measurement periods, indicating both short- and long-term effects of the "9 Hunger" intervention on enhanced mindful eating with high effect size.

Concerning intuitive eating, only the IG showed significant LCS between T0 and T1 and T0 and T2. Thus, although test of differences revealed higher LCS for the IG for both measurement periods, they were only significant for the post-measurement point, indicating moderate-sized short-term but no long-term effects of the "9 Hunger" intervention on enhanced intuitive eating.

Looking at the effect on mindful eating–related but more distant constructs, LCS analysis showed significant changes in both groups regarding self-compassion between T0 and T1 and between T1 and T2. In the IG, this change was significantly higher compared to the W-CG for the post and the follow-up measurement points, indicating large-sized short-term and moderate long-term effects of the "9 Hunger" intervention on enhanced self-compassion.

Considering well-being, only the IG showed a significant change between T0 and T1, but not between T1 and T2. The change between T0 and T1 was significantly higher compared to the W-CG suggesting a moderate-sized short-term effect of the "9 Hunger" intervention on general mental well-being.

PPA (Table 2; main analyses) and ITT analyses (Supplementary Table 4) led to similar results with a tendency to stronger effects for the IG in the PPA.

Discussion

The objective of the present work was to test the effects of a short 2-week mindful eating intervention, which focused on the differentiation of several motivations to eat, on eating behaviors, and on related but more distant constructs (generic self-compassion and mental well-being). Findings suggest both short- and long-term effects of the "9 Hunger" intervention on all of the addressed outcomes, particularly on eating behaviors. Moreover, participants' adherence to training the "9 Hunger" exercise almost every day showed a high acceptance of the training.

In line with findings of meta-analyses and systematic reviews on the effects of MBI on maladaptive eating (Grohmann & Laws, 2021; Mercado et al., 2021), the results of this study showed moderate effect sizes for the "9 Hunger" intervention on decreased maladaptive eating behaviors (emotional eating, external eating, and loss of control eating [LOC]) directly after and yet at the 3-month follow-up. In approaching mechanisms of action regarding MBIs on eating- and weight-related issues, our findings suggest that repeatedly training an isolated and clearly outlined ME skill ("*awareness of eating triggers and motives*"; ATM), in particular the non-judgmental awareness of several motivations to eat and their differentiation (i.e., distinguishing emotional triggers and external cues from physiological body needs), has the potential to influence maladaptive eating behaviors in the short and longer term.

Furthermore, ME techniques not only intend to decrease maladaptive eating behaviors (via awareness of different eating motivations) but develop more adaptive ways of eating (Kristeller & Epel, 2014). Compared to the strong findings on the effects of ME on maladaptive eating behaviors, there are fewer studies on the influence of ME on increasing adaptive eating behaviors. Findings of our study indicate that the "9 Hunger" exercise is suitable for this goal by showing more pronounced intuitive eating and ME in the IG compared to the W-CG directly after the training. At the 3-month follow-up, changes reached only significance for mindful eating but not for intuitive eating and should be considered preliminary due to the limited data. As it could be assumed, training a specific single ME skill had a particular high impact on the overall construct of mindful eating: Regarding this outcome, we found the highest effect sizes.

Lastly, the "9 Hunger" training showed even effects on more distant outcomes, which were in line with results on the positive relationship of ME with those constructs, namely mental well-being (Khan & Zadeh, 2014; Peitz et al., 2021) and self-compassion (Mantzios & Egan, 2018; Taylor et al., 2015): In comparison to the W-CG, the IG showed significantly increased self-compassion directly and 3 months after the training. Again, longer term effects should be interpreted

Table 2 Per-protocol analysis: primary outcomes/secondary outcomes

	T0	T1	Post (short-term effects) (change T1–T0)		T2	Follow-up (long-term effects) (change T2–T0)	
	M (SD)	M	Within-group	Between-group	M	Within-group	Between-group
Primary outcomes							
Emotional eating (DEBQ)							
IG[1]	3.22 (1.22)	2.46	−0.76 (0.98) $p<0.001$*	−0.43 $p<0.001$* $d=0.47$	2.68	−0.54 (0.76) $p<0.001$*	−0.39 $p<0.001$* $d=0.53$
W-CG[2]	3.24 (1.06)	3.00	−0.33 (0.82) $p<0.001$*		3.17	−0.15 (0.70) $p=0.011$	
External eating (DEBQ)							
IG[1]	3.41 (0.75)	2.67	−0.73 (0.77) $p<0.001$*	−0.42 $p<0.001$* $d=0.58$	2.94	−0.43 (0.57) $p<0.001$*	−0.36 $p<0.001$* $d=0.60$
W-CG[2]	3.63 (0.74)	3.32	−0.32 (0.67) $p<0.001$*		3.53	−0.10 (0.64) $p=0.065$	
Loss of control eating (LOCES)							
IG[1]	2.45 (0.93)	1.89	−0.56 (0.73) $p<0.001$*	−0.43 $p<0.001$* $d=0.63$	1.99	−0.46 (.73) $p<0.001$*	−0.27 $p=0.005$* $d=0.38$
W-CG[2]	2.67 (0.90)	2.54	−0.13 (0.61) $p=0.002$*		2.49	−0.18 (.70) $p=0.002$*	
Secondary outcomes							
Mindful eating (MEI)							
IG[1]	3.23 (0.72)	3.91	0.68 (0.64) $p<0.001$*	−0.62 $p<0.001$ $d=1.19$	3.71	0.48 (0.57) $p<0.001$*	−0.33 $p<0.001$ $d=0.66$
W-CG[3]	3.20 (0.73)	3.25	0.05 (0.37) $p=0.087$		3.34	0.15 (0.43) $p<0.001$*	
Intuitive eating (IES-2)							
IG[1]	3.28 (0.62)	3.53	0.25 (0.49) $p<0.001$*	−0.25 $p<0.001$ $d=0.57$	3.48	0.20 (0.45) $p<0.001$*	−0.11 $p=0.483$ **$d=0.11$**
W-CG[3]	3.17 (0.61)	3.17	0.00 (.41) $p=0.654$		3.23	0.08 (0.40) $p=0.014$	
Mental well-being (WHO-5)							
IG[1]	3.50 (1.06)	3.81	0.31 (0.74) $p<0.001$*	−0.31 $p=0.011$* $d=0.42$	3.74	0.24 (0.97) $p=0.069$	−0.06 $p=0.656$ **$d=0.07$**
W-CG[3]	3.46 (1.02)	3.46	0.00 (0.78) $p=1.000$		3.59	0.13 (0.97) $p=.118$	
Self-compassion (SCS)							

Table 2 (continued)

	T0	T1	Post (short-term effects) (change T1–T0)		T2	Follow-up (long-term effects) (change T2–T0)	
	M (SD)	M	Within-group	Between-group	M	Within-group	Between-group
IG[1]	2.98 (0.75)	3.64	0.67 (0.69) $p<.001$*	−0.51 $p<0.001$* $d=0.92$	3.31	0.34 (0.49) $p<0.001$*	−0.23 $p=0.002$* $d=0.47$
W-CG[3]	3.06 (0.83)	3.21	0.15 (0.45) $p<.001$*		3.17	0.11 (0.47) $p<0.001$*	

[1] $n=137$. [2] $n=87$. [3] $n=53$. *IG* intervention group, *W-CG* waitlist control group, *M* mean, *SD* standard deviation, *p* p-values, *d* Cohen's d effect size (in bold for non-significant results)

with caution. PPA revealed significant results here, which can be interpreted as a preliminary indication for possible sustainable effects. Moreover, since participants were reminded to do the training compassionately, this could have also had an effect on the increased self-compassion scores. Regarding mental well-being, results provide first indications that training mindful eating for 2 weeks might lead to a more general feeling of comfort. This effect did not sustain until the 3-month follow-up. Due to the missing data on this outcome, findings should be considered preliminary and need to be replicated in future studies.

According to a recent literature review by Tapper (2022), it was noted that comprehensive and labor-intense MBIs such as *Mindfulness-Based Stress Reduction* (MBSR) or ME-CL might lead to greater benefits but could promote health inequalities because of restricted physical and psychological resources of those with greater health needs. Briefer, low-threshold applications of mindfulness might be suitable to reach larger numbers of people and thus might have the potential to achieve benefits for health and well-being at population level (Tapper, 2022). Findings of the current study support the idea that it might not always need a comprehensive intervention program to reach sustainable effects. Moreover, our study gives a preliminary indication that these effects can even be reached by brief but context-specific interventions. Results showed that, on average, a 5-min training per day for around eight–ten times during a 2-week period might be sufficient to effect this change. The "9 Hunger" exercise displays an informal mindfulness practice. It can be applied without introducing the theory of Buddhism or a broader spiritual background and be integrated in a time-saving economical manner as a cost-effective self-help intervention as well as a tool in therapy. Using it in these settings, the exercise might help to investigate and establish other ways to nourish different kinds of hunger. Following scientific research on different eating triggers and motives, Bays (2017) suggests that we do not always hunger for food but for various other reasons such as comfort and social interaction. Bringing awareness to one's own true needs might thus not only facilitate our ability to distinguish between them, resulting in pronounced eating in line with physiological needs. Moreover, it might help to respond to one's own true needs in a more appropriate and wholesome way.

Lastly, in our self-selected study sample with an interest in eating behavior, we found increases in almost all outcomes in the W-CG as well, though smaller and less stable than in the IG. This suggests that even filling in questionnaires related to the topic of eating behaviors, explicitly mindful eating, might evoke first reflections leading to initial behavior changes. This side result might be beneficial to further investigation and even development of an own

intervention in treating eating- and weight-related problems to support improvements of eating habits.

Limitations and Future Research

When interpreting the results of the current study, its limitations and strengths should be considered to arrive at suggestions for future research. Several limitations concern the following:

First, as often found in studies on eating behavior, particularly on mindful eating (O'Reilly et al., 2014; Ouwens et al., 2015; Rogers et al., 2017), our study included mainly females. This, as well as the overrepresentation of participants in the middle class, hampers the transferability of the results to the general population. Future studies should find ways to include more men and participants from lower socioeconomic classes to improve research on mindful eating regarding its generalizability. Furthermore, a next step in researching effects of mindful eating might be the inclusion of not only self-selected samples but of samples in broader health settings to test the approach's feasibility for universal prevention of eating and weight disorders.

Second, our study suffers from the well-known problem of high dropout in self-guided web-based interventions (Karyotaki et al., 2015). Although we retrospectively tried to assess reasons for dropout via mail, we were not able to fully explain this phenomenon. Future studies might address this problem by including an assessment of treatment fidelity or investigating the "9 Hunger" exercise or other mindful eating interventions via apps, which are able to assess if the training has even been started (e.g., via protocols). Moreover, targeted recruiting and/or advertising might be a promising way to address dropout in online interventions as well as guidance within a structured program or self-help (Zagorscak et al., 2019).

Third, due to a technical error, follow-up results (T2) on adaptive eating and broader health concepts (secondary outcomes) need to be interpreted with caution. Half of the IG sample needed to be retraced regarding these outcomes, so that only 60% of participants who finished the training offered data for T2. However, the results of the primary outcomes (maladaptive eating behaviors) were not affected by this problem.

Fourth, we did not intentionally include clinical groups with eating and weight disorders since this study served as a first step in approaching the influence of ATM on maladaptive eating behaviors directly. In a next step, future studies using online and face-to-face designs should include clinical samples in particular to investigate the effect of the "9 Hunger" exercise in these groups more closely. In addition to persons with a range of different eating disorders, this step should also include persons with obesity in weight loss programs who actually perceive health detriments because of

their weight, ideally in comparison with *treatment as usual* (TAU) with and without the "9 Hunger" exercise (i.e., dismantling studies). To evaluate such interventions, questionnaire data should be supplemented with observation of direct behavior and the assessment of possible health detriments (e.g., high blood pressure).

Besides these limitations, there are different strengths to be mentioned. Firstly, isolating a single exercise of a multicomponent intervention allows for a targeted evaluation of mechanisms of action. The lack of research in this area in relation to the simultaneously increased use of MBIs in the field of eating- and weight-related issues has been criticized intensively (Tapper, 2017, 2022). Evaluating multi-component interventions as a whole may hamper statements about whether and which of the mindfulness-immanent qualities have an influence on a particular outcome. Instead, our approach allows for the first implication that promoting *awareness of eating triggers and motives* (ATM) might be one direct pathway in explaining the effects of MBIs on changing eating habits reported in systematic reviews and meta-analyses (Grohmann & Laws, 2021; Mercado et al., 2021; Tapper, 2022). Secondly, both the calculation of LCS and the additional use of an ITT evaluation strategy allowed for the inclusion of all possible data (Graham, 2009). Similar results of ITT and PPA support the use of the chosen methodology. Findings are additionally supported by the high number of participants who could be included. Finally, it is the first study showing change sensitivity of the MEI, a comprehensive and multifaceted mindful eating questionnaire, which was missing so far (Peitz et al., 2021; Tapper, 2022).

In sum, an economical 2-week mindful eating intervention with solely 5 min of training per day revealed not only short-term effects in decreasing maladaptive eating behaviors that foster the development and maintenance of eating- and weight-related disorders. Furthermore, it seems to hold the potential to change these behaviors in the longer term, as shown by effects 3 months after the short training period.

In approaching the mechanism of action, the results of the current study facilitate our understanding of mindfulness in the context of eating: By isolating a single exercise from a multi-component mindful eating intervention (ME-CL) and focusing solely on its specific effects, a first indication can be deduced that the mindful eating facet *awareness of eating triggers and motives* (ATM) leads to a change in eating patterns. Thus, training this particular skill might aid the current treatment of eating- and weight-related disorders.

setting up the intervention as well as Theresa Zickert for helping with the manuscript's language.

Data Availability The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflicts of interest/competing interest The authors have no relevant financial or non-financial interests to disclose.

Ethics Approval This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the local Ethic Committee of the University of Potsdam (88/2016). This study was preregistered at the German Clinical Trials Register (DRKS00012351).

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Consent for Publication Participants signed informed consent regarding publishing their data on mean level.

Use of Artificial Intelligence Statement AI was not used.

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CHAPTER 6

GENERAL DISCUSSION

1 Summary of Findings

During the last decade, more than 20 reviews on mindfulness in the context of eating have been published, showing the growing interest in applying the concept to eating- and weight-related issues. However, research on the mechanism of action is scarce and limited by methodological shortcomings.

The dissertation at hand aimed to contribute to our current understanding of how mindfulness, more specifically its context-specific form of ME, works in changing maladaptive eating behaviors and thus, how it could be used appropriately in the future to enrich and improve existing interventions (prevention and treatment) for maladaptive eating behaviors and associated eating and weight disorders.

To attain this overarching aim, in the first step of this dissertation (Paper 1), a reliable and valid inventory comprehensively including the most important facets of the multidimensional construct ME was developed and validated: The *Mindful Eating Inventory* (MEI). Having the MEI at hand, allowed to go a step further and to show that a context-specific assessment of mindfulness (i.e., ME assessed with the MEI) possessed incremental validity over assessing the generic concept of mindfulness in explaining maladaptive eating behaviors. Moreover, four ME facets were identified as having particular predictive power in explaining these behaviors. Thus, findings from Paper 2 suggest that a multidimensional assessment of ME might indeed be promising for investigating the underlying mechanisms of how mindfulness and MBPs impact eating behavior. The identified ME facets provided a first indication which ME skills should be focused when targeting maladaptive eating behaviors in general or in the prevention and treatment of eating and weight disorders and also which skills might be worth investigating in future research on the associated mechanisms of action. The prior analyses on ME facet-level were used to develop an online intervention based on one of the ME facets which had shown to be important for maladaptive eating behaviors: The non-judgmental awareness of eating triggers and motives. Findings from Paper 3 revealed that training this particular ME skill via the '9 Hunger' exercise (extracted from the eating-specific MBP ME-CL) was associated with reductions in maladaptive eating behaviors directly after the intervention and at three-month follow up. This association had previously been hypothesized on theoretical grounds as one possible pathway by which mindfulness and MBPs might affect changes in maladaptive eating behaviors and associated eating and weight disorders. The results represent preliminary evidence for these possible mechanisms of action.

Table 2 provides an overview of the different aims of this thesis and summarizes the main findings of the three included scientific manuscripts as well as the derived conclusions for

the overarching research questions. Following the order of Paper 1-3, findings are explained and discussed in more detail in the three upcoming sections of this chapter. Thereafter, suggestions for prevention and treatment of maladaptive eating behaviors and associated eating and weight disorders based of the integrated findings are presented. Finally, strengths and methodological limitations will be outlined to arrive at possibilities for future research on mindfulness in the context of eating and to draw an overall conclusion of the dissertation at hand.

Table 1

Summary of Aims, Findings and Conclusions ordered by Publication

#	Aims	Findings	Conclusions
1	To develop a reliable and valid instrument to assess ME as a context-specific form of mindfulness in a comprehensive and differentiated way. To test the assumed multidimensionality of ME. To derive an initial operationalization of ME from the identified factor structure.	7 Mindful Eating facets were empirically identified: (1) **A**ccepting and **N**on-attached **A**ttitude towards one's own eating experience (ANA) (2) **A**wareness of **S**enses while **E**ating' (ASE) (3) **E**ating in **R**esponse to awareness of **F**ullness (ERF) (4) **A**wareness of eating **T**riggers and **M**otives' (ATM) (5) Inter**con**nectedness (CON) (6) **N**on-**R**eactive **S**tance (NRS) (7) **F**ocused **A**ttention on **E**ating (FAE) Superiority of a 7-correlated factor model over a unidimensional model proved the assumed multidimensionality. Psychometric properties of the instrument, regarding factorial validity, internal consistency, retest-reliability, and criterion validity, as well as measurement invariance in terms of gender, indicated that the Mindful Eating Inventory is a sound instrument to assess ME in a reliable, valid, and comprehensive way.	The *Mindful Eating Inventory* (MEI) allows for a comprehensive assessment of the context-specific construct ME by including the most relevant facets currently described in the literature within one inventory. The comprehensive assessment with the MEI makes it possible to test the ME facets of the multidimensional concept ME against each other to appropriately investigate underlying mechanisms of action of MBPs for maladaptive eating behaviors and associated eating and weight disorders in the future. The empirically derived proposal of an operational definition has the potential to facilitate communication in the evolving research field of mindfulness in the context of eating.
2	To determine if the multidimensional assessment of a context-specific form of mindfulness (i.e., ME via MEI) actually adds value to assessing the generic form of mindfulness in the context of eating (to identify mechanisms of action in the longer term). To investigate which ME facets of the multidimensional construct of ME clarify the most variance in selected maladaptive eating behaviors.	ME showed incremental value beyond generic mindfulness regarding maladaptive eating (emotional eating and uncontrolled eating) and maladaptive nutrition (consumption of energy-dense food) behaviors. The four ME subscales ANE, ERF, ATM and NRS explained the significant amount of variance in maladaptive eating behaviors.	ME seems a promising approach for investigating the underlying mechanisms of how mindfulness impacts eating and weight disorders as it possesses incremental validity beyond the generic construct in explaining maladaptive eating behaviors (which are known to be involved in the development and maintenance of these conditions). The identified four ME facets - can inform future research which ME skills to further investigate when exploring potential underlying mechanisms of action in the application of mindfulness to maladaptive eating behaviors and associated disorders. - give a first orientation which ME skills to focus on when targeting maladaptive eating behaviors in general or in the prevention and treatment of eating and weight disorders.
3	To explore one theoretically hypothesized mechanism of action by investigating if a short training on the particular ME facet ATM (identified as an important facet in #2) has short- and longer-term effects on the reduction of maladaptive eating behaviors.	RCT results showed moderate effects following an isolated training on the ME skill ATM via the '9 Hunger' exercise on maladaptive eating behaviors (emotional eating, external eating, and LOC) directly after the intervention and at the 3-month follow-up.	Repeatedly training the ME skill ATM shows potential to influence maladaptive eating behaviors in the short and longer term. These preliminary findings on the effectiveness of ATM can inform future research about its potential to indeed be one underlying mechanism of action of MBPs for maladaptive eating behaviors and associated eating and weight disorders.

Note. ME = Mindful Eating, MPBs = mindfulness-based intervention programs, LOC = loss-of-control eating, RCT = Randomized Controlled Trial.

2 Making the ME Concept Assessable in a Suitable Way:
The Mindful Eating Inventory (MEI)

The following research question was addressed:

I: *How can ME be measured comprehensively and in a reliable and valid way to advance understanding of how mindfulness works in the context of eating?*

The point of departure was the circumstance that facets in ME questionnaires available at the time of construction partly overlapped and partly differed between the questionnaires. This indicated ME to be a multidimensional construct. However, this assumption had not previously been tested using CFA before (i.e., multiple-factor model needs to show superiority against a single-factor model). Moreover, the fragmented assessment of the individual facets and the accompanying lack of specifically needed ME skills, which were crucial in the existing eating-specific MBPs, also obstructed from a comparative evaluation of ME-related qualities. In order to explore underlying mechanisms of action and hereby to advance the understanding of the importance of individual ME facets for prevention and treatment of eating and weight disorders, it was indispensable to develop a more comprehensive measure that helps represent the broad subject area of ME.

Given the lack of a comprehensive inventory of the multidimensional construct ME, the development and validation of such an instrument represented the first step of the dissertation (Paper 1). To ensure that all central ME facets as reported in the literature were included, items from existing ME scales were supplemented with contents derived from a broad literature search. Qualitative methods were used to arrive at an initial item pool which comprised an exhaustive range of various ME-related attitudes and skills (Study 1).

This item pool was analyzed and shortened using an online sample (Study 2) to arrive at a final version. The Mindful Eating Inventory (MEI) is a 30 items self-report instrument referring to the frequency of ME-related skills and attitudes in the last four weeks using a 6 point-scale ranging from (1) '*almost never'* to (6) '*almost always*'. The validated German version as well as the published English versions of the MEI can be found in the Appendix. Seven ME facets were empirically identified using EFA and confirmed in an independent sample (Study 3) using CFA to describe ME. Those ME facets were named as follows: (1) '**A**ccepting and **N**on-attached **A**ttitude towards one's own eating experience' (ANA), (2) '**A**wareness of **S**enses while **E**ating' (ASE), (3) '**E**ating in **R**esponse to awareness of **F**ullness' (ERF), (4) '**A**wareness of eating **T**riggers and **M**otives' (ATM), (5) 'Inter**con**nectedness' (CON), (6) '**N**on-**R**eactive **S**tance' (NRS) and (7) **F**ocused **A**ttention on **E**ating' (FAE). A detailed description of the single ME facets can be found in chapter 3. The results on factor

structure and criterion validity preliminarily confirmed the theoretical assumptions of the multidimensionality of the construct and a beneficial use of a multidimensional assessment.

Answering research question 1, the psychometric properties of the instrument regarding factorial validity, internal consistency, retest-reliability and criterion validity as well as measurement invariance in terms of gender indicated the MEI to be a sound instrument to assess the multidimensional context-specific construct of ME in a reliable, valid, and comprehensive way. The MEI can be used to further identify mechanisms of action regarding the application of mindfulness in the field of eating- and weight-related issues. Additionally, with the help of the first paper, it was possible to provide first statistical evidence for the multidimensionality of ME: The correlational seven-factor model was shown to be superior to a single-factor model. This verification of ME's multidimensionality, which had previously only been assumed on theoretical grounds, was a necessary precondition for testing the possibility of different associations between the different ME facets and various outcomes. Construct validity preliminary supported this assumption in Paper 1: The magnitude of the correlations with the external criteria such as LOC differed between the ME facets.

Due to the problems of replicating the factor structure of the previous questionnaires (specifically of the most common MEQ) and criticism of the composition of the underlying validation samples and their understanding of mindfulness, particular attention was given to the broad comprehensibility of the items in designing the MEI. There is an ongoing debate on the assessment of mindfulness (Grossman, 2011; Grossman & van Dam, 2011): Crucial critique refers to the different understanding of items regarding participants with different age and meditation experience, which led to divergent interpretation and therefore biased response (Belzer et al., 2013; Baer et al., 2007). Following the recommendation of Bergomi et al. (2013) to avoid such an interpretation bias, focus on the MEI item construction lied on semantical clarity and every-day relevance as well as a check for unambiguity. This was addressed with the help of various steps of qualitative examination through participants differing in age and familiarity with mindfulness and meditation. Such a procedure had not been undertaken in the construction of the MES, MEQ and MEBS. The merged items from MES, MEQ and MEBS were tested in line with the mentioned guidelines. Following the study results of Apolzan et al. (2016), the MEQ items regarding external cues were reformulated. Notably, not the presence of external eating behavior itself was intended to be measured with these items but the awareness of the external eating motivation within the ME framework (e.g., "I notice when I'm eating from a dish of candy just because it's there"; MEQ item #24). However, the qualitative analyses of these MEQ items revealed that participants referred to the behavior itself when

answering these items and found the question structure confusing (Apolzan et al., 2016). To avoid such ambiguity in response behavior and misleading the scoring procedure in the MEI, aspects of these questions were clearly reworded in this dissertations' study, focusing on the ability to distinguish eating motives and triggers (e.g., "I can distinguish whether I want to eat because I am physically hungry or eat because something is just there."; MEI item removed during scale shortening process). As mentioned before, this important ME skill (Bays & Wilkins, 2017; Brewer et al., 2018; Kristeller & Epel, 2014) could not be captured anymore by the adapted versions of the MEQ or the other existing instruments. The MEI facet '*awareness of eating triggers and motives*' (ATM) presupposes the awareness of interoceptive perceptions such as hunger signals as well as emotions but also external cues (which promote emotional and external eating, respectively). Thus, this subscale does not only assess the ability to distinguish different eating motives but also indirectly the awareness of emotional and physiological sensations as well as external eating triggers without the previous interpretation ambiguities reported for the MEQ items. Focus groups within the construction of the MEI served as a source of confirmation since no ambiguities were fed back. The careful construction of these items and the belonging subscale (ME facets) has been shown to be crucial in the course of the studies belonging to this thesis, since the ME facet of ATM could be identified as being particularly important for addressing eating behavior (Paper 2 and Paper 3).

The MEI reflects the facets of ME most often described in the literature (see Tapper, 2022): Following the approach of Baer et al. (2006) regarding generic mindfulness, an evidence-based operational definition of the construct could thus be derived. In sum, following the factor structure of the MEI (numbers in brackets indicate the respective ME facet), ME can be operationalized as

> … bringing an accepting and non-attached attitude to the experience of eating (1) while deliberately paying attention (7) to the present moment with all senses (2), being aware of not only motives and needs which trigger eating (4) without directly reacting to them (6) but also integrating this knowledge with the awareness of physiological hunger and satiety signals to guide one's own eating behavior consciously (3). Additionally, ME includes the awareness of connectedness between the earth and all living beings setting the process of eating in a broader picture (5) (Peitz, Schulze, & Warschburger, 2021, p.12).

Since a common definition of ME was lacking and thus hampering consensus on used practices, the provided one was intended to facilitate future research on the construct as well as the discussion about it in research and practice. The proposed definition is in line with the definition of mindfulness by comprising the *what* and the *how* elements and enables a distinguishment of *mindful eating behavior* itself as well as *decision making for mindful eating* (via the ME facets ETR and ATM), which is outlined as important in newer research on ME (Mantzios, 2021). As extensively discussed regarding the overall topic of mindfulness (van Dam et al., 2018), it is pivotal for future research on ME to state which ME operationalization and ME facets is referred to and what exactly it is, that is being taught, practiced and studied. This is often neglected in current ME studies - particularly regarding informal practices – and obstructs interpretations of study results (Carrière et al., 2022; Mantzios, 2021).

Another ME questionnaire was published in the end of the dissertation period and was therefore not considered in the setup up of the conducted studies. As it seems, the authors generated an own initial item pool without regard to the ones that had been developed before and thereby developed the 29-item *Four Facet Mindful Eating Scale* (FFaMES; Carrière et al., 2022) with the help of four independent samples using EFA and CFA. Four factors could be identified: 'non-reactance', 'non-judgement', 'external awareness', and 'internal awareness'. Unfortunately, even though thoroughly validated, the awareness (*what*) domains of the FFaMES ('external awareness', 'internal awareness') showed moderate negative correlations with those reflecting the acceptance (*how*) domain ('non-reactance', 'non-judgement'). This impedes a meaningful use of a total score and raises questions about the usability of the scale in future research. Moreover, the lack of important ME facets restricts the investigation of the relatively new research field of ME (Bergomi et al., 2013a; see chapter 3 for arguments against defining mindfulness too narrowly in exploring newer fields of research).

Owing to its broad content, its careful development and validation as well as its convincing psychometric properties, the MEI improves existing instruments and can presently be recommended as the instrument of choice in researching ME based on several criteria. The relevance of the inventory is further underlined by the fact that multiple international research groups have requested the MEI for translation and/or use in their respective countries (Obesity Management Service, Canberra Health Service, ACT Government/Australia; Nutritional Epidemiology Research Unit, Université Sorbonne Paris Nord/France; Department of Psychology, Ethiraj college/India; Department of Psychology, Azad University of Shiraz/Iran; School of Humanities, University of Akureyri/Iceland; Faculty Health Sciences, University of Primorska/Slovenia; Faculty of Health Sciences, Department of Nutrition and Dietetics, Ankara

University/Turkey; Faculty of Health Sciences, Department of Nutrition and Dietetics, Erzurum University/Turkey; Faculty of Health Sciences, Department of Nutrition and Dietetics, Gazi University/Turkey; Department of Experimental Psychology, University of Bristol/United Kingdom; Department of Psychological Science, Health Psychology, University of North Carolina at Charlotte/United States of America; Human Nutrition and Hospitality Management, University of Alabama/United States of America). To date, the MEI has been translated into Persian, Slovenian, Turkish, Icelandic, Chinese, Japanese, Indian and French. First studies using the MEI in the United Kingdom and China have recently been published (Hinton, Zhang, Parfitt, Zou, & Ferriday, 2022). Moreover, through its comprehensiveness the MEI builds a solid basis for future extensions. Following more and more elaborated research in the upcoming field of ME, important ME facets - which might have not been identified yet - could be added and integrated. Building on already established work seems more suitable in bundling expertise than reinventing new measures with slightly different operationalization over and over again, as this hampers unambiguous communication and the comparability of study results. I am pleased to be able to mention my current collaboration with scientists from the Sorbonne University in France as a good example of cross-linked, economically profitable research efforts: They are currently testing the MEI with additional items to find out more about important facets that had not been empirically investigated before and which might provide valuable new insights and help to expand our knowledge about ME.

Currently, we are preparing a publication on the MEI for adolescents, including data from a weight management clinic. The youth validation is so far only available in the form of an unpublished master thesis giving preliminary evidence for a good model fit in this age group and sound psychometric properties. Data were simultaneously assessed with the development and validation of the MEI for adults. Moreover, a study on a youth version based on one Turkish validation is currently in progress (Sürmeli Akçadağ et al., in prep).

In conclusion: With the MEI, this dissertation provides a comprehensive tool to assess ME that is already widely used and offers the possibility of future extensions and modification in different samples. In combination with the operationalization provided, it has not only the potential to facilitate upcoming research communication in the field. It might furthermore help to advance our understanding of how mindfulness impacts maladaptive eating behaviors in different groups of the eating and weight disorder spectrum in upcoming studies. Thus, it might support the development of a more evidence-based framework of underlying mechanisms in the evolving research of ME in the future.

3 Examining the Utility of the ME Concept:
Incremental Validity of ME & Initial Analysis of its Facets

The following research questions were addressed:

II: *Does the context-specific construct of ME have an advantage over the generic concept in advancing the understanding of how mindfulness is related to maladaptive eating behaviors?*

III: *Which ME facets are particularly useful in explaining maladaptive eating behaviors?*

The starting point was the circumstance that the application of mindfulness and MBPs in the context of eating- and weight-related issues has a tradition of primarily being top-down, i.e., theory-driven. For example, Kristeller and colleagues developed a theoretical framework which provided the basis for designing one of the first eating-specific MBPs for patients with BED, called MB-EAT (Kristeller et al., 2014; Kristeller & Wolever, 2011). The assumption that an eating-specific approach (i.e., ME) might be beneficial in identifying underlying pathways on how mindfulness impacts maladaptive eating behaviors and associated eating and weight disorders is reasonable - but so far mostly a theoretical assumption. However, the incremental value of ME over generic mindfulness had not been sufficiently studied. There are isolated correlational findings that the associations between ME and individual eating- and weight-related outcomes are higher than those with the generic construct (Mantzios & Egan, 2018; Mantzios, Egan, Bahia, et al., 2018; Mantzios, Egan, Hussain, et al., 2018). However, these results are based on highly selective and small samples. One RCT provided first evidence that effects of a mindfulness-enhanced diet and exercise intervention (orientated on MB-EAT) might be mediated by ME in terms of eating sweet foods and fasting glucose in adults with obesity (Mason, Epel, Kristeller, et al., 2016). Another cross-sectional study showed that the relationship between generic mindfulness and the self-reported serving size of energy-dense food could be explained by ME (Beshara et al., 2013). Unfortunately, all of these conducted studies were undertaken with the previously developed ME instruments (MEQ, MES), which - next to psychometric shortcomings – do not cover important ME facets. Thus, in investigating the concept of ME in more depth, it was pivotal to first examine if the multidimensional assessment of a context-specific form of mindfulness (i.e., ME with the comprehensive MEI) actually possesses added value over assessing the generic form of mindfulness in the context of eating, and whether it is preferable since different ME facets account for different amounts of these outcomes.

Because evidence on the impact of mindfulness on modifying (disinhibited) maladaptive eating behaviors was strongest and most consistent in the scientific research on mindfulness in the field of eating- and weight-related issues (Sala, Rochefort, Lui, & Baldwin,

2020; Yu et al., 2020), these behaviors were chosen as appropriate outcomes to answer these questions in the dissertation at hand. This decision could be justified within the data presented in Paper 2, since all seven ME facets explained a high amount of variance in the chosen maladaptive eating behaviors (50% in emotional eating and 70% in uncontrolled eating, which was chosen as equivalent to LOC, but named differently in the applied inventory *Three-Factor Eating Questionnaire*; Cappelleri et al., 2009). Study findings emphasize the strong association between these eating behaviors and ME which supports their utility as an outcome when exploring how mindfulness works in eating- and weight-related issues.

Answering research question 2, results on the incremental validity of ME over and above generic mindfulness reported in Paper 2 serve as preliminary evidence for the beneficial use of this context-specific form of mindfulness in a) researching effects of MBPs on maladaptive eating behaviors and associated eating and weight disorders and, b) approaching its underlying mechanism in the field: ME explained more variance in the chosen maladaptive eating behaviors than the generic concept. Moreover, analyses on subscale level showed that the different ME facets contribute to varying degrees of the prediction of maladaptive eating behaviors. Similar findings were obtained regarding nutrition behavior (see chapter 4) but will not be discussed further here since they were not the primary focus of the dissertation at hand. In accordance with the supporting results regarding the hitherto only theoretically assumed multidimensionality of ME in Paper 1, findings in Paper 2 served as a further confirmation that ME should be assessed within a multidimensional framework. This regards not only the scientific investigation but also the clinical use.

To successively investigate mechanisms of action in general, it is pivotal to first identify the subdimensions or facets of a multidimensional construct (such as ME here) that have verifiable predictive power for a chosen outcome (which has previously shown to be affected by the construct such as here maladaptive eating behaviors). This knowledge is important to distinguish them from subdimensions or facets with non-predictive power. Omitting this step bears the risk of under- or overestimating the effects of the overall construct on the addressed outcome (Smith, McCarthy, & Anderson, 2000). This in turn might hamper or bias the subsequent selection of those isolated mechanisms, which should be investigated in more depth, as well as the subsequent interpretation of results. *Answering research question 3*, four ME facets were identified as beneficial to be further processed in investigating mechanisms of action: They explained significantly more variance in maladaptive eating behaviors when compared to the others and might thus possess particular importance in predicting or influencing those outcomes. These ME facets were *Accepting and Non-attached Attitude*

towards one`s own eating experience (ANA), Eating in Response to awareness of Fullness (ERF), Awareness of eating Triggers and Motives (ATM), and a *Non-Reactive Stance (NRS,* i.e., an observing, non-impulsive attitude towards eating triggers).

Results on the particular importance of ERF and ATM are in line with one of the main mechanisms assumed to explain how applying mindfulness and MBPs might impact maladaptive eating behaviors and associated eating and weight disorders through the modification of eating behaviors (see Figure 1 in chapter 1; Brewer et al., 2018; Kristeller & Epel, 2014): An increased awareness through mindfulness practices is supposed to enhance the ability to become aware of and distinguish between different eating motives and triggers (i.e., ATM) and thus homeostatic and non-homeostatic eating processes to facilitate eating in line with physiological needs (i.e., ERF). Findings from Paper 2 suggest that a training to enhance ATM might be a promising way in exploring one of the assumed mechanisms of action directly (see Paper 3).

Moreover, the ME facets identified as being important in Paper 2 fit well with meta-analytic findings on the relations found between facets of generic mindfulness and eating disorder symptoms (Sala, Rochefort, et al., 2020): The facet 'non-judging', which is the generic counterpart of ANA, showed the strongest associations. Also, the 'non-reactivity' facet (generic equivalent to NRS) yielded significant results. Both facets (ANA, NRS) are considered to reflect the *how* of mindfulness. Particularly this *how* or attitude aspect of mindfulness is currently discussed as being particularly important when applying ME to eating- and weight-related issues and to distinguish it from other attentional processes, which rather reflect 'attentive eating' than ME (Mantzios, 2021). Practices regarding solely 'observing' (generic mindfulness) or 'awareness of senses while eating' (AWA; eating-specific mindfulness) seem not to be sufficient in modifying eating- and weight-related issues: They omit the non-evaluative part of mindfulness and are therefore not in line with the definition of ME. Moreover, applying an overemphasized focus on the *what* resp. attention element of mindfulness is thought to have detrimental effects; for example the increased 'noticing' of internal and/or external experience in an evaluative way is hypothesized to lead to increased impulsive reactions like overeating (Carrière et al., 2022). Consequently, the authors warn about such "false" deliveries of mindfulness and propose that these might explain previous inconclusive results of MBPs for weight management.

In conclusion, with showing that the MEI possessed incremental validity over and above generic mindfulness in explaining maladaptive eating behaviors, the dissertation at hand informs future research to focus on an eating-specific approaches when addressing these

behaviors. Findings on ME facet-level can inform upcoming research which ME skills to further investigate when exploring potential underlying mechanisms of action in this field. Moreover, they give a first orientation that ANA, ERF, AMT and NRS might be of particular importance when targeting maladaptive eating behaviors in general or in the prevention and treatment of eating and weight disorders.

4 Approaching one Potential Mechanism of Action by Using the ME Concept:
Investigating Intervention Effects of an Isolated ME Skill ('9 Hunger' RCT-Study)

The following research question was addressed:

IV*: Does training one particular ME facet impact maladaptive eating behaviors?*

The design of Study 4 presented in Paper 3 addressed the second major short-coming of the current body of research regarding underlying mechanisms of mindfulness for eating- and weight-related issues: Delivering mindfulness in multi-component MBPs or broader mindfulness-inspired interventions containing other non-mindfulness related components. In general, multi-component interventions are known to be more effective than the use of isolated exercises and might therefore be beneficial to the aim of treating multifactorial conditions such as eating and weight disorders (National Institute for Health and Care Excellence; NICE, 2006). However, research on such isolated exercises is assumed to be beneficial in identifying the potential underlying mechanisms of action, which in turn can be used to inform and tailor broader interventions in the future (Tapper, 2022). This line of thought was followed in the dissertation at hand. By isolating a single ME-skill and building an intervention on it, it was intended to explore one specific theoretically hypothesized mechanism of action directly. Furthermore, the use of a waitlist-control group (W-CG) responded to the common critique about the delivery of mindfulness in uncontrolled interventions and addressed the call for more rigorous methodology and robust trials (Tapper, 2022; Turgon et al., 2019): The RCT-design allowed for an attribution of the effects on the exercise itself.

The '9 Hunger' RCT-study was built on one of the ME facets that have been identified as important for maladaptive eating behaviors in Paper 2, the nonjudgmental *awareness of eating triggers and motives* (ATM). The '9 Hunger' exercise had been extracted from the eating-specific MBP called ME-CL (Bays & Wilkins, 2017), since it was originally developed to train this particular ME skill within ME-CL. The so called '9 Hunger' represent 9 different motivations to eat referring to both homeostatic and non-homeostatic signals (see Table 1 in chapter 3 for more details). After randomization, participants of the intervention group (IG) received a video, which introduced the basic concepts (i.e., mindfulness, ME, '9 Hunger'), led

participants through the exercise and explained the procedure of the upcoming two-week training. Participants were asked to check in with their bodies and to rate their different motivations to eat ('9 Hunger') non-judgmentally once per day before and after a self-chosen meal or snack. Additional study materials contained two audio versions of the '9 Hunger' exercise (a 10-minute introductory version and a 2-minute short version for the time when they would be familiar with the content), a protocol sheet for the self-monitoring task as well as a short explanation of the different kinds of hunger (see Appendix).

Answering research question 4, comparing LCS between IG and W-CG showed that training the ME facet ATM was associated with reductions on maladaptive eating behaviors directly after the training (*short term effects*) and at a three-month follow up (named *longer term effects* in the belonging Paper 3 and in this thesis). Thus, results indicated the modification of emotional eating, external eating and LOC through mindfulness-based mechanisms in the short and in the longer term. These findings represent the preliminary confirmation of the so far mainly theoretical assumption that mindfulness impact maladaptive eating behaviors through learning to distinguish between different motivations to eat and thus to differentiate homeostatic from non-homeostatic cues (Brewer et al., 2018; Kristeller & Epel, 2014). Results indicate that learning to become aware of various inner and outer eating signals (here practiced via the '9 Hunger' exercise) might support individuals in reducing the reactivity to internal cues other than hunger and satiety such as emotions (so called *heart hunger*), and external cues such as food availability (e.g., represented by so called *eye hunger* or *mouth hunger*). Consequently, emotional eating resp. external eating scores decreased.

Results on Publication 3 are remarkable since they suggest that 5 minutes of training per day for around 8-10 times during a two-week period seems to be an effective method for changing firmly established, habitual eating patterns, at least three months after the training period. These results are compatible with the introduced model (Figure 1 in chapter 1) of Brewer et al. (2018) on how habitually learned maladaptive eating behaviors can be modified through the application of mindfulness. Brewer et al. (2018) suggest that (re)learning to become aware of and distinguish between different motivations to eat (i.e., ATM) serves as a first step in disrupting the neuronal habit loops of unconscious, automatic maladaptive eating. Regaining the ability to differentiate between homeostatic processes (perception of physiological hunger and satiety signals via training the awareness of so called *stomach hunger* and *cell hunger*) and non-homeostatic cues (represented by the other seven hungers) might help to regulate our eating behavior to make more conscious decision about when, what and how much we eat as well as to foster more pronounced adaptive eating patterns. This could be shown through the increase

of ME and intuitive eating (another well studied eating style describing eating in line with physiological hunger and satiety cues; Ruzanska & Warschburger, 2017) following the training. However, these results must be considered as preliminary due to the restricted cases included in the analysis.

Previous evidence on applying mindfulness and MBPs to the spectrum of eating- and weight-related issues showed strongest and most stable effects for the modification of maladaptive eating behaviors (Grohmann & Laws, 2021; Mercado et al., 2021; Sala, Shankar Ram, et al., 2020; Tapper, 2022). That is one reason why these behaviors were chosen as the main outcome in this thesis. The results presented in Paper 3 offer one possible explanation of how the previous effects for maladaptive eating behaviors might have occurred. Enhancing a non-judgmental awareness of different motivations to eat (i.e., the ME facet ATM) is part of most eating-specific MBPs even though the ME facet and the respective exercise is sometimes named differently. This was also shown by one of the rare scoping reviews which solely included eating-specific MBPs dealing with obesity management: 16 out of 19 studies contained exercises concerning the awareness of eating triggers (Carrière et al., 2022). For example, the eating-specific MBP ME-CL trains this skill with the exercise '9 Hunger' explicitly researched in the dissertation at hand (Bays & Wilkins, 2017). In the most popular eating-specific MBP MB-EAT, this awareness is addressed by so called 'hunger meditations' to introduce sensory-specific satiety by a 'taste satisfaction meter' among other methods Kristeller et al., 2014). In other interventions, a wider interoceptive awareness is taught which is assumed to enhance the interoceptive awareness of hunger and satiety signals and combining it with eating-specific exercises. In accordance, this procedure should facilitate distinguishing homeostatic eating cues from non-homeostatic ones to facilitate eating in line with physiological needs as well (Smart, Chisum, Robertson-Pfeffer, & Tsong, 2015; Timmerman & Brown, 2012).

In conclusion: Integrating the results of Paper 3 with the fact that ATM has been incorporated into several of the multicomponent MBPs which - summarized in meta-analyses and systematic reviews - were found to impact the decrease of maladaptive eating behaviors (Carrière et al., 2018; Godfrey et al., 2015; Katterman et al., 2014; Rogers et al., 2017; Ruffault et al., 2017; Turgon et al., 2019; Wanden-Berghe et al., 2011; Yu et al., 2020), lead to the preliminary assumption that ATM might have contributed to these effects. More specifically, the results of the present thesis provide the first empirical support for this mechanism of action, which has so far only been assumed theoretically (Brewer et al., 2018; Kristeller & Epel, 2014). In doing so, the dissertation at hand not only contributes to our current understanding of how

mindfulness, and more specifically its eating-specific form of ME, might affect maladaptive eating behaviors through its particular skill ATM. Results might help to explain the general effects of MBPs on eating and weight disorders. Findings leads to various potential implications on how to address maladaptive eating behaviors in general and in future prevention and treatment of associated eating and weight disorders. Suggestions will be presented and discussed in more depth within the next paragraph.

5 Suggestions for Prevention and Treatment based on the Integrated Findings

Findings of the dissertation at hand offer several suggestions on how mindfulness can address and impact maladaptive eating behaviors. Since maladaptive eating behaviors are widespread in the general population and associated with adverse health outcomes such as depression, lower psychological well-being, and higher blood pressure (Brytek-Matera, 2021; Ouwens et al., 2009; van Strien et al., 2016; Wade et al., 2017), results might be used to inspire different kinds of future interventions addressing maladaptive eating behaviors to improve health in general.

Moreover, since maladaptive eating behaviors are associated with the whole spectrum of eating and weight disorders, the results of the present dissertation can also be used to enrich the existing prevention approaches for these conditions in healthy populations and/or the general population (primary prevention/universal prevention), in populations at risk or with a sub-threshold manifestation (secondary prevention/indicated prevention), and the treatment of populations with a full clinical manifestation as well as the corresponding scientific progress. Nonetheless, it should be noted again, that the use of ME in specific clinical groups was not the scope of this thesis. On the contrary, this thesis followed the calls of several authors in the field (Carrière et al., 2022; Mantzios, 2021; Tapper, 2022) to provide much needed evidence-based fundamental research on the core of eating-specific mindfulness (e.g., measure ME suitably, unify practice on and definition of ME). The results of this thesis have the potential to inform upcoming research with representative community samples and specific clinical and non-clinical groups in order to gain a clearer understanding of what exactly works for whom, and under which circumstances. This knowledge is pivotal for the proper development of broader prevention and treatment of eating and weight disorders in the future and to help avoiding inappropriate or harmful use of mindfulness in this field.

5.1 Benefits of an Eating-Specific Approach

Particularly the results of Paper 2 (incremental validity) and Paper 3 (investigating effects of an eating-specific mechanism of action) lead to the preliminary implication for future research and also for the practical use to regard an eating-specific approach as superior to applying unspecific generic MBPs. More specifically, the findings of the dissertation at hand suggest that eating-specific mindfulness (i.e., ME) seems more suitable than generic mindfulness in addressing maladaptive eating behaviors, which are widespread in the general population, accounting for adverse health outcomes and the development and maintenance of eating and weight disorders. Thus, researchers and practitioners might benefit from focusing on eating-specific MBPs such as MB-EAT and ME-CL as a whole or with single exercises in the attempt to examine and address maladaptive eating behaviors in the prevention and treatment of these conditions.

Results of Paper 2 emphasize the importance of including the _how_-elements of mindfulness (ANA & NRS) in the delivery of ME. Thus, when applying an eating-specific approach it seems pivotal to solely apply ME exercises that include both, the attentional (_what_) and the attitude (_how_) elements of mindfulness, to be in line with common definitions and ethical recommendations on the application of mindfulness in general (Baer et al., 2019) and for the context of eating- and weight-related issues in particular (Carrière et al., 2022; Mantzios, 2021). This can also prevent from applying exercises for attentive eating, which are assumed to have a detrimental effect on eating and weight disorders (see arguments in chapter 6, section 3).

5.2 Potential for Diagnostic Assessment & Tailoring Interventions

Given its broad scope, the MEI can be used as a diagnostic tool to identify individual difficulties on ME facet level and to tailor eating-specific mindfulness interventions accordingly. By doing so, certain ME skills can be focused on in a timely manner and integrated in the overall treatment approach instead of applying an entire MBP. During the treatment process, the MEI could serve to help adjust interventions precisely. After the treatment, therapy success could be evaluated in a differentiated way by showing progress on MEI facet level and detecting persistent difficulties, which can be discussed with the participant to give further suggestions.

One could argue that the MEI is relatively large and the burden of filling in completely might be too high in the context of a larger diagnostic battery. Thus, it should be taken into account that completing the MEI might by itself be beneficial to initiate important awareness

processes regarding eating: the qualitative feedback from participants within the retest assessment (Study 3) consistently pointed towards a higher awareness of the eating process itself and the choice of food. Due to journal-specific page limitations, these results on unsystematic qualitative participants' feedback were not reported in Paper 1. Nonetheless, these findings can be seen as a preliminary clue for a favorable use of the MEI in the prevention and treatment of eating and weight-related issues to raise awareness of problematic eating habits in order to transform them into more adaptive eating habits. Further support of this initial assumption comes from findings on the W-CG (Study 4): ME values increased within the measurement points without attaining the '9 Hunger' intervention, though smaller and less stable than in the IG. These preliminary findings are in accordance with observations in the development of another diagnostic instrument, the CHIME (Bergomi et al., 2014), a measure of generic mindfulness. In the construction process of the MEI the CHIME gave helpful orientation in terms of comprehensiveness, procedure, and further aspects such as scaling. The authors of the CHIME indicate the favorable effects of assessing mindfulness via self-report such as reminding individuals of their purpose to cultivate mindfulness during daily life and revealing the barriers to sustainably developing this attitude (Bergomi et al., 2013b). However, such assumptions on the potential benefits of using the MEI should explicitly be explored in further application-based research.

Furthermore, results on Paper 2 showed that the ME skills ANA, ERF, ATM and NRS might be of particular interest when addressing maladaptive eating behaviors with mindfulness. Especially ATM and ERF might have the potential to be strengthened with particular exercises such as the '9 Hunger' training, which has been shown to be beneficial in Paper 3 in the short and longer term. Other practices include so called 'mini-meditations' before eating (Kristeller et al., 2014) which might help a person to become mindfully aware of their current thoughts, emotions, and body signals to promote NRS through non-judgmental awareness and might support more conscious eating decisions in line with physiological needs or, in other words, homeostatic signals.

Moreover, results on Paper 2 emphasize that the _how_ elements of ME, namely a kind, non-judgmental (ANA) and non-reactive (NRS) attitude towards the eating process, seems to be important when applying mindfulness to maladaptive eating behaviors and seems worthwhile to be considered when tailoring interventions. Next to formal meditation practice, this attitude needs to be promoted within the delivery of mindfulness techniques (regardless of whether the delivery is face-to-face or implemented online for self-study). This is one reason why teachers of longer and more intense general MBPs (such as MBSR) and eating-specific

MBPs (such as ME-CL) are encouraged to practice mindfulness and mindful meditation themselves to truly transport an attitude of non-attachment, decentering and non-judgement in the face-to-face delivery (Bays & Wilkins, 2017; Kabat-Zinn, 2013). The same should be considered by researchers who set up interventions in the field and who are in charge of the correct delivery of mindfulness practices to comply with ethical intentions.

5.3 Potential for Integrated Prevention & Treatment (Weight-Inclusive Approach)

The presented findings, particularly the results of Paper 3, showed that implementing ME skills seems to be a promising way to modify maladaptive eating behaviors in the short and longer term. Since these behaviors display a shared risk factor of both eating disorders and obesity, findings could be used to inform an integrated prevention and treatment approach for eating and weight disorders. Integrated forms are recommended by current research to avoid the adverse effects patients could be exposed to through separated interventions (Neumark-Sztainer, 2009; Rancourt & McCullough, 2015; Sánchez-Carracedo, Neumark-Sztainer, & López-Guimerà, 2012; Stabouli et al., 2021). One example of the adverse effects is weight-related stigmatization due to a strong focus on losing weight in conservative weight management programs (so called *weight normative approach*, see below). Moreover, an overemphasized focus on weight reduction bears the risk of developing body dissatisfaction, unhealthy dietary behaviors and maladaptive eating, which in turn are assured risk factors for weight gain but also eating disorders (Leme et al., 2018; Tylka et al., 2014).

ME is a *weight-inclusive*, also called *weight-neutral, approach*, which is particularly suitable for circumventing such adverse effects within the framework of integrated prevention and treatment. Weight-inclusive approaches are developed as an answer to the well-studied, adverse effects of unsustainable weight-loss following dieting and/or weight loss programs and the accompanying weight cycling as well as weight stigmatization and the internalization of the thin body ideal which negatively affect the overall physical health and psychological wellbeing, including the development and maintenance of eating and weight disorders (see Tylka et al., 2014 for a broad overview). Instead of overemphasizing weight-loss, weight-inclusive approaches such as *Health At Every Size* (HAES; Bacon & Aphramor, 2011) support the health of people across the weight continuum, e.g., by shifting the attention to the promotion of behaviors that make one feel better, emotionally and physically. By that, they aim to create healthful, individualized practices, that are sustainable and thus capable of promoting overall health and well-being in the long term, regardless of BMI (which is not seen as the main problem per se in contrast to weight cycling, which is associated with higher burden such as

mortality; Lissner et al., 1991; Rzehak et al., 2007). A summary of several RCTs testing weight-inclusive approaches against standard weight-focused approaches showed no harm but proved statistically and clinically significant improvements of weight-inclusive approaches regarding physiological (e.g., blood pressure), psychological (e.g., decreased depressive symptoms), and behavioral (e.g., decreased maladaptive eating) outcomes even though the body weight remained relatively stable (Bacon & Aphramor, 2011). A newer meta-analysis found greater improvement in bulimic symptoms due to applying weight-neutral approaches (Dugmore, Winten, Niven, & Bauer, 2020).

According to the weight-inclusive focus, the '9 Hunger' training developed in this thesis was explicitly not carried out in order to reach any weight-related goals but to promote listening non-judgmentally to the body. Moreover, setting up the training followed ethical recommendations on the application of ME by the biggest respective international association of practitioners and scientists: *The Center of Mindful Eating* (TCME). According to TMCE one should have in mind that "co-opting mindful eating in a way that sustains weight bias and feeds the dieting mind is a betrayal of the ethics of mindfulness." (The Center for Mindful Eating, 2019; p. 4).

Unfortunately, most of the reviews on the use of mindfulness in the context of eating do focus on BMI, weight reduction or obesity management. Even if understandable, since obesity represents a global health challenge (Blüher, 2019), this emphasis does not reflect the idea of ME, and fosters a weight-normative approach which has been shown to exacerbate adverse effects accounting for the development and maintenance of eating and weight disorders (Tylka et al., 2014). Interventions based on the principles of mindfulness and ME are not designed and intended to serve the purpose of losing weight. The disregard for this principle may be one reason for the inconsistent findings regarding effects of mindfulness and MBPs on weight reduction (Katterman et al., 2014; Warren et al., 2017) and the lack of overall associations between self-reported ME and BMI (Anderson et al., 2016; Goodwin et al., 2017; Taylor et al., 2015; Winkens et al., 2018).

ME as representing a weight-inclusive approach understands obesity as a multifactorial disorder which is influenced by a complex interplay of genetic, metabolic, physiological, cultural, social, and behavioral determinants (Blüher, 2019). Energy intake or other factors that can be modified by the individual display only one component in their genesis and maintenance (Tylka et al., 2014). Maladaptive eating behaviors have been shown to be such a modifiable component (also reflected by results of this thesis). It is possible that increased decision spaces acquired through the '9 Hunger' training on what, when and how much the individual eats

might lead to more eating in line with homeostatic signals and might thus eventually contribute to weight reduction in the long term. However, the primary goal of the '9 Hunger' intervention was to promote a non-evaluative awareness (of different eating motives) and an accompanying enhancement of freedom to take care of needs other than eating. Consequently, it aimed to facilitate the establishment of healthful and sustainable eating habits to promote overall health and well-being in the long term, regardless of BMI. This seems to be in line with the recommended ethical way of how ME interventions should be delivered and integrated in the overall prevention and treatment of eating and weight disorders. Accordingly, it has to be kept in mind: Although the results of this thesis are encouraging, mindfulness should not be seen as a panacea and hence should not be used as such in clinical practice. The spectrum of eating and weight disorders circumscribes diverse clinical manifestations with a complex multifactorial etiology. Therefore, their prevention and treatment also need to be consistently multimodal. Mindfulness in general and ME in particular appear to be promising components in this broader multimodal framework which might help to modify maladaptive eating behaviors (as shown by the results of the dissertation at hand). Specifically, ME and associated eating-specific MBPs do not attempt to function as a first-line intervention which can replace psychotherapy (Bays & Wilkins, 2017) or other established treatment approaches, but are best applied as integral add-on to inspire and enrich current approaches to prevent and treat eating and weight disorders.

5.4 Potential of ME for Public Health Measures

Despite the fact that eating-specific MBPs include formal practice to promote ME, ME itself can be considered as an informal practice and thus as a nontraditional contemplative approach (Carrière et al., 2022). Informal practices apply the non-evaluative form of attention called mindfulness to the daily practice of eating. Herewith, ME skills such as the '9 Hunger' exercise are informal practices which do not make a broader spiritual background mandatory in order to function effectively. In line with this argumentation, results from Paper 3 indicate that around 10 times of a 5-minute daily practice during a two-week training-period might contribute to modifying habitual maladaptive eating behaviors - which account for the development and maintenance of eating and weight disorders - in the short and longer term. These results are promising, particularly from a public health perspective: Maladaptive eating behaviors are widespread in the general population (Wilfley, Vannucci, & White, 2010). Thus, addressing them early in form of primary or universal prevention on population level or in populations at risk (i.e., secondary or indicated prevention) might contribute to the prevention of fully developed manifestations of eating and weight disorders. Especially obesity is

associated with lower economical and personal resources (Blüher, 2019; Schienkiewitz et al., 2022) which suggests that offering brief and low-threshold interventions could be particularly important. ME skills such as the '9 Hunger' exercise can be applied without introducing a broader spiritual background which in turn could potentially be off-putting for many people (Mantzios & Wilson, 2014). In a time saving and cost-effective manner, ME skills can not only be integrated as a tool in therapy but in self-help intervention processes for a broader audience. However, particularly in these forms of delivery it must be ensured that the _how_ elements of mindfulness are sufficiently conveyed (see above). Once this is ensured, trainings on particular ME skills offer a promising way to address a larger number of people and consequently might have the potential to achieve benefits for health and well-being at population level. Nevertheless, this potential use and the respective cost-benefit ratio needs to be investigated in future studies (see below).

6 Strengths

The following strengths of the dissertation at hand should be mentioned.

The *first* one regards the methodological rigor and the successive bottom-up design. In its relatively short history, mindfulness research in the context of eating can be merely described as top-down. Studies have mainly focused on the effects of MBPs in different non-clinical and clinical groups across the spectrum of eating- and weight-related issues. Various mechanisms of action are theoretically assumed but empirical research is scarce. Instead of conducting further reviews based on the existing studies with their known limitations, it is pivotal at this point to (mindfully) pause and undertake method-specific fundamental research on the core construct. Acknowledging this need and catering to it, is essential for upcoming research that should investigate what works for whom, under what circumstances, and to tailor future interventions – either on population level or in clinical groups - properly.

Consequently, this thesis started at the foundations, and each conducted research step successively built on the evidence provided from the previous one. Beginning with the development of an appropriate measurement instrument first. Then testing the multidimensionality of the concept and deriving an operationalization. Building on this, testing the incremental validity of the concept before continuing to work with this (unaudited) assumption. Thereupon diving deeper by investigating which facets of the construct are important in an empirical and not mainly theoretical way. Finally, closing with the selection of one of these important facets and investigating it further to advance the understanding of one potential direct mechanism of action. Given the current body of research recommendations

(Sala, Shankar Ram, et al., 2020; Warren et al., 2017) and for the purpose of keeping the methodology as clear as possible, this dissertation solely focused on MEBs as the main outcome. Hence, this dissertation contributes to the field overall by methodological specificity, testing assumptions successively and therewith supporting the development of a more evidence-based framework in researching ME in the future (e.g., by providing the MEI, the operational definition, identification of important ME facets).

The *second* strength concerns the high methodological diversity: The dissertation at hand combines qualitative and quantitative techniques (e.g., in designing the MEI; Study 1) to investigate the construct ME. Study 4 expanded on the results from cross-sectional Studies 2 and 3 by applying a longitudinal design with three measurement points, resulting in statistical analyses including models with latent variables that could be applied in this thesis (CFA, measurement invariance, LCS models).

Third, the RCT-design of Study 4 with almost 400 participants on an isolated ME skill enriches the current research on MBPs in the field of eating, which had so far mostly been based on uncontrolled studies with pre-post design, studies with low power, and interventions which include mindfulness techniques as one part among others (Tapper, 2022).

This leads to the *fourth* strength: The number of participants with a diverse background regarding age, education, socioeconomical status, and BMI (together more than $N = 1800$) included in the single studies increased the theoretical and practical impact of the derived results.

Fifth, even though mindfulness has become part of mainstream research, the concept roots in Buddhism and its link to spirituality still evokes suspicion (Mantzios & Wilson, 2015b). Therefore, it is even more important that the associated research follows clear scientific standards, methodological rigor, and ethical guidelines. Next to providing comprehensible methodological descriptions of study designs and methods, all studies have been approved by the Ethics Commission of the University of Potsdam (40/2015; 88/2016) and are in line with the declaration of Helsinki. Moreover, Study 4 was preregistered at the German Clinical Trials Register (DRKS00012351) and datasets are available upon reasonable request to support open science in the field. Providing data and material has been identified as a common problem in ME research which hampers transparency and progress within the field (Turgon et al., 2019).

Lastly, because the dissertation was conducted in consideration of the current state of research and the generally recognized foundations, it can be seen as a worthy source of information and the results can be used directly in future ME practice and research. The English version of the developed questionnaire is contained in Publication 1 for free use. The German

version of the MEI can be downloaded on the following website: https://www.uni-potsdam.de/de/beratungspsychologie/forschung/psychologische-messinstrumente/mindful-eating-inventar-mei-deutsche-version. The high practical benefit of the results is shown by the MEI application in different national and international groups (see chapter 6, section 2). The training on the '9 Hungers' can also be used for application and further scientific investigation. Training materials such as the introduction video and the audio files are available upon request (see Appendix). The provided transparency regarding data and study materials applied in this thesis aims to contribute to the progress in the field.

7 Limitations and Future Research

The results of the dissertation at hand need to be interpreted in consideration of their methodological limitations. These will be described in the following section. Coming from these constraints, needs and possibilities for upcoming research are presented.

First, methodological limitations relate to the used samples: Though including high numbers of participants representing a wide range of age and BMI in all studies, the representativity of the results is limited due to the small number of men included. This phenomenon is common in research on eating behavior and specifically ME (84% female across 74 independent samples; Sala, Shankar Ram, et al., 2020). However, men suffer from severe forms of obesity in particular (Schienkiewitz et al., 2022) and therefore seem to have a more pronounced need for low-threshold interventions. Future research needs innovative ideas in order to include more men. In this context, a recent study from Zagorscak, Bohn, Heinrich, Kampisiou, and Knaevelsrud (2019) showed that stronger, more direct targeting might facilitate the inclusion of underserved individuals (e.g., less educated, older age, male) into clinical trials in higher numbers, rather than relying on self-selection. Furthermore, outsourcing recruitment at least for non-intervention-related studies to market and social research institutes, which use their own panels and are experienced in the collection of balanced samples, could be another strategy.

A *second* problem regards the education level (32% university entrance degree; Study 2 & 3) and socioeconomic status (overrepresentation of the middle class; Study 4) of the used samples. While all types of eating disorders are present across a wide range of socioeconomic backgrounds (Huryk, Drury, & Loeb, 2021), obesity has been shown to be overrepresented in persons with lower educational and socioeconomic backgrounds (Schienkiewitz et al., 2022). Thus, these persons need to be explicitly targeted in future studies on ME to enhance the representability of results and to find out whether these groups benefit more from ME in

particular or, conversely, less or not at all. One of the rare studies on ME in a low-income population was a correlational one (Goodwin et al., 2017). Findings from this study suggest that parents and their children share comparable ME behaviors. Participants were recruited from public housing and the authors suggest including measures of food insecurity as a potential mediator. Their work can serve as a guideline for future research in recruiting and setting up studies to include more persons with lower educational and socioeconomic backgrounds.

Third, all data included in the dissertation at hand is based on self-selected convenience samples (see Table 1). This means that the samples were not drawn at random but are the result of self-selection by the participants themselves as they voluntarily participated in the MEI development (Study 1-3) and the intervention study (Study 4). This means that results might have been biased by high motivation or general study interest (Kennedy-Martin, Curtis, Faries, Robinson, & Johnston, 2015; Mantzios & Wilson, 2015b). Though justifiable in developing questionnaires and the preliminary exploration of underlying mechanisms of action, these characteristics restrict the representativity of the results, particularly the effects of the '9 Hunger' intervention. However, MBPs are thought to be most effective when individuals are interested and voluntarily decide to participate (Walach, Schmidt, & Esch, 2014). Therefore, the use of the '9 Hunger' in this self-selected sample can be considered as an ecologically valid standard practice. Nevertheless, for a regular use of ME on public health level and particularly the aim to optimize the broader prevention of eating and weight disorders, its benefit has to be demonstrated in representative samples first, e.g., drawn from regular health care. Future research should cooperate with broader (mental) health organizations or community care institutions such as counseling offices (e.g. dick and duenn e.v., Berlin) to investigate whether ME might be mostly suitable for individuals with high change motivation and/or interest in mindfulness, eating behavior, self-reflection, etc. or applicable in forms of a universal or indicated public health interventions. Mantzios and Wilson (2014), coming from their research on the effects of ME and self-compassion in military surroundings, provide some suggestions in applying mindfulness and particularly ME to the general public, including renaming some practices and making the attendance affordable to everyone.

The dissertation at hand can be seen as an attempt to directly investigate one potential theoretically hypothesized mechanisms of mindfulness in the context of eating. Although all studies from this thesis contained BMI distributions representative of the German population (Statistisches Bundesamt, 2022) indicating transferability of results to different weight groups, a *fourth* limitation results from the fact that the study participants were not explicitly drawn from clinical settings (e.g., inpatient or outpatient psychiatric care). While some participants in

the data sets screened positive for eating disorders (unpublished results) with the SCOFF (Richter, Strauss, Braehler, Adametz, & Berger, 2016), no structured clinical interviews were administered. Thus, participants could not be validly categorized into distinct disorder categories. Future studies should explicitly include subgroups with different kinds of eating disorders such as AN, BN, BED and subthreshold eating disorders, ideally identified with an established diagnostic interview measure. Regarding the MEI, measurement invariance for these groups should also be explored in upcoming research. Moreover, the estimation of MEI norms in these groups could facilitate research and clinical practice. In building up respective norms for the DEBQ, maladaptive eating behaviors such as the ones investigated in this thesis have shown to be present in all types of eating disorders (Wardle, 1987); therefore, effects of the '9 Hunger exercise' on these behaviors could be assumed as well. However, only direct investigations of the impact of the '9 Hunger' or other ME skills in these clinical groups can reveal whether the effects are stronger, smaller or if some adjustment in their delivery might be necessary. This knowledge can inform the proper tailoring of prevention and intervention measures in the future.

A *fifth* limitations regards the duration of the follow-up period in Study 4*:* To explore one theoretically hypothesized mechanism, the '9 Hunger' study was conceptualized as a longitudinal study with three measurement points. Effects of the three-month follow-up serve as preliminary promising evidence that applying ME might have a sustainable impact on the modification of eating behaviors in the longer term. However, even though three measurement points were sufficient to reveal a general association between ATM and the reduction of maladaptive eating behaviors in order to investigate one particular mechanism of action, extended follow-up periods are needed to create reliable findings for sustainable effects of ME on highly automated eating habits as well as broader eating disorder pathology. Future studies should therefore include several further measurement points, ideally extending follow-ups over one year and longer. Replication studies of the '9 Hunger' training with longer catamnestic periods are also necessary to reproduce and thus validate the empirical findings reported in Paper 3 (comp. 'replication crises'; Open Science Collaboration, 2012).

Sixth, Paper 3 only reports the effects of the quantitative data. However, qualitative data was assessed in Study 4 as well to find out more about the underlying mechanisms of action. This assessed qualitative data is still being processed, therefore the results are not part of this thesis. Upcoming studies on the underlying effects of mindfulness in the context of eating need to integrate more qualitative research, since this kind of data could give insights into a) what works for whom, under what circumstances and b) unidentified mechanisms to this point,

thereby inspiring future quantitative research. This could be shown by one of the rare mixed-method evaluations of mindfulness as a suitable amendment to cognitive behavioral therapy. Correspondingly, it contributed to first empirical examinations of underlying mechanisms of action in the treatment of BED (Woolhouse, Knowles, & Crafti, 2012). Accordingly, in future research in this context, quantitative-orientated reviews could be enriched by so called *mixed methods reviews* such as *realist reviews* (Rycroft-Malone et al., 2012). This kind of review integrates evidence from theory-driven studies and other types of publications to identify potential underlying mechanisms to help answer the question "What works for whom, under what circumstances, how, and why?". In particular, realist reviews analyze the context in which the resources that were provided in the interventions can be used to reach a positive health outcome (Wong, Greenhalgh, Westhorp, Buckingham, & Pawson, 2013). This knowledge seems particularly suitable for tailoring ME interventions properly, also in order to avoid potential harm such as so called *opportunity costs*. Opportunity costs describe money and time spent on an intervention that has little to no therapeutic advantage in relation to potential resources that could have been spent in an intervention more likely to generate improvements (Lilienfeld, Lynn, & Lohr, 2004). Opportunity costs are discussed as a potential danger of the "hype" around the concept of mindfulness in research and practice (van Dam et al., 2018) and need to be focused on in upcoming ME research in particular.

Seventh, all results on the dissertation at hand are based on self-report data. This might have caused biases, e.g., regarding the underestimation of the BMI in each study (McAdams, van Dam, & Hu, 2007) or actual behavior change (Dang, King, & Inzlicht, 2020). Moreover, the assessment of mindfulness and related qualities via self-report is not uncontroversial either (e.g., suspicion on construct validity due to different item understanding as mentioned above, introspection ability, general inattentiveness in answering questionnaires, etc.; see van Dam et al., 2018 for an overview). Though the subjective report of specific behaviors under which ME can be subsumed seems less problematic in terms of construct validity (Levinson, Stoll, Kindy, Merry, & Davidson, 2014), the use of a multimodal approach combining first-person self-report data and third-person assessments (i.e., behavioral, neurobiological, significant other-report) is recommended in future studies. These additions could, for example, enrich questionnaires with objectively measured data such as BMI, interoceptive awareness (e.g., water load test-II; van Dyck et al., 2016) and the assessment of actual eating behavior (e.g., laboratory food intake by bogus task test; Robinson et al., 2017).

Eighth, four important ME facets were identified as important in predicting maladaptive eating behaviors in Paper 2. However, only one ME facet was chosen to investigate its

mechanism in this thesis. Additional research is warranted on the other ME facets identified as important as well as on further hypothesized mechanisms of action such as emotion regulation (see Mercado et al., 2021 for first suggestions on this topic). These could be investigated with the help of longitudinal studies to identify moderating and mediation effects or with laboratory experiments addressing exercises on the identified ME facets. However, a well-known problem of such experiments is their limit in ecological validity. Therefore, designing more interventions with isolated ME skills as presented in Paper 3, which successively add further intervention components and investigate their incremental value step by step (ideally in a changing, randomized design), would allow for clearer derivations. These studies should not only combine qualitative and quantitative data but use a broader multimodal approach as mentioned above.

Moreover, in exploring the impact of different ME facets, other important outcomes for eating and weight issues should be investigated in more depth. For example, apart from maladaptive eating behaviors, meta-analytic results have also identified body dissatisfaction as an important construct in the relation between mindfulness and broader eating disorder pathology (Sala, Shankar Ram, et al., 2020). Therefore, body dissatisfaction seems worthwhile to be investigated further in research on mechanisms of action in the field of mindfulness and eating.

Mindfulness and specifically ME approaches do not attempt to function as first-line interventions for eating and weight disorders but as parts of a multidimensional framework to facilitate current prevention and treatment efforts. In line with the design of Study 4, upcoming studies should indispensably be realized within a RCT-design implementing a passive or active control group as well. However, from a clinical perspective it remains questionable if the scientific use of a treatment condition as usual (TAU) to test it as a direct comparison to ME interventions is adequate. Eating-specific MBPs are aware of the multifactorial geneses of eating and weight disorders and do not aim to fully replace TAU (Bays & Wilkins, 2017) but to enrich them (Woolhouse et al., 2012). Therefore, adding ME to TAU and testing it against TAU without ME, like it has been done before (Mason, Epel, Aschbacher, et al., 2016; Mason, Epel, Kristeller, et al., 2016), seems the recommended way to investigate effects of ME in line with clinical recommendations. Notably, so far MBPs were not found to outperform cognitive behavioral therapies for eating and weight disorders, although the factor of treatment duration should be taken into account when interpreting these findings (Linardon, Fairburn, Fitzsimmons-Craft, Wilfley, & Brennan, 2017; Turgon et al., 2019).

Ninth, data is limited to adult samples. In tailoring eating-specific MBPs to specific groups, one should consider that childhood and youth is a widely known period of vulnerability

for developing eating and weight issues (Blüher, 2019; Golden, 1997; Stabouli et al., 2021). Therefore, intervening in this age group seems particularly promising to prevent the manifestation of maladaptive behaviors such as habitual eating habits. However, research on ME interventions for children and adolescents is scarce. Future research should address these age groups, particularly in light of promising preliminary findings (Hoare, Lister, Garnett, Baur, & Jebeile, 2022; Lara Perez & Delgado-Rios, 2022). To do so, appropriate measurement to assess treatment success is needed. There are validations for children of the MEQ (Hart et al., 2018; Kocaadam-Bozkurt, Köksal, & Özalp Ateş, 2022). However, due to the mentioned methodological problems of the MEQ, it seems preferable to adapt a more comprehensive measure, such as the MEI (see chapter 6, section 2).

Lastly, and following the growing research on the effects of mindfulness in modifying maladaptive eating behaviors (O'Reilly et al., 2014), another Buddhist construct became the focus of recent research and practice as a potential way to supplement treatment of eating and weight disorders (Braun et al., 2016), called *self-compassion.* While mindfulness describes a particular attitude of attention without judgment concerning ANY FORM of moment-to-moment-experience (positive, negative, neutral; Kabat-Zinn, 2013), self-compassion addresses the relationship with oneself in the face of difficulties (Bluth & Blanton, 2014). Though evolving, research on self-compassion in the context of eating is still in its infancy (Pinto-Gouveia et al., 2017). At this stage, the development of appropriate measures seems crucial to facilitate upcoming research. Analogous to mindfulness, measuring self-compassion in a context-specific way might yield more precise and sensitive results in investigating effects on eating behaviors as well. Therefore, a measurement on *self-compassionate eating*, a new construct that we define as a kind and mindful *attitude* towards oneself when struggling with one's own eating behavior rather than the *behavior* itself (Neff, 2003), together with an accompanied manuscript, has been developed during the period of this dissertation as well. To not confound findings with those regarding ME and to avoid the dilution of clear conclusions, this manuscript was not included in the current thesis. However, previous findings showed that the combination of mindfulness and self-compassion in the context of eating seems to be more beneficial than mindfulness alone (Mantzios & Wilson, 2014; Mantzios & Wilson, 2015a). Moreover, a preliminary supportive effect of a self-compassionate attitude on ME skills has been found (Webb, Jafari, Schoenefeld, & Hardin, 2013). Hence, upcoming research on ME should consider self-compassion and more specifically, self-compassionate eating, in order to investigate, if and how the incipient integrated application of those concepts (Pinto-Gouveia et

al., 2017; Rahimi-Ardabili, Reynolds, Vartanian, McLeod, & Zwar, 2017) might indeed facilitate prevention and treatment of eating and weight disorders.

8 Conclusion

There is hardly a research topic that has attracted as much attention in the past two decades as the construct of mindfulness. As shown by over 20 reviews mentioned in this thesis, the application of mindfulness in the context of eating has been of great interest as well. Given this level of enthusiasm, it seems all the more important to apply a rigorous methodology in examining the construct and its effects to provide evidence for the development of tailored interventions and to avoid potential harm when addressing maladaptive eating behaviors and associated eating and weight disorders. Mindfulness does not represent a panacea. It represents a particular way of directing attention in a non-judgmental way that can be used to raise awareness of habitual eating behaviors, which - in their dysfunctional form - often underlie eating and weight disorders. Therefore, its application in their prevention and treatment seems appealing. However, a solid understanding of how previous promising effects have occurred should precede a widespread implementation. Research on the reliable assessment of an eating-specific form of mindfulness (ME), agreement on the use of a common operationalization, and studies building on both to address underlying mechanisms of action are crucial first steps. This dissertation set out to address these fundamentals.

The presented findings provide evidence that ME and presumably some of its particular facets impact maladaptive eating behaviors, which account for the development and maintenance of eating and weight disorders. Based on the results provided in this thesis, research in the area of mindfulness and eating can continue on a more evidence-based foundation. By investigating the preliminary explored mechanisms more closely (e.g., nonjudgmental awareness of eating triggers and motives; ATM) with an appropriate measurement (i.e., the MEI), and in representative community samples and specific clinical groups across the eating and weight disorder spectrum, future research can shed light on the question what works for whom, under what circumstances and to make necessary adjustments to future prevention and treatment accordingly.

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(References for each paper listed separately in chapters 3-5)

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APPENDIX

Complete list of publications

*Peitz, D., & Warschburger, P. (under review). What are you hungry for? Effects of a brief mindful eating online intervention: The 9 Hunger RCT-study. *Mindfulness*.

Peitz, D., Schulze, J., & Warschburger, P. (submitted). The self-compassionate eating scale. *Appetite*.

Mauz, E., Walther, L., Junker, S., Kersjes, C., Damerow, S., Eicher, S., Hölling, H., Müters, S., **Peitz, D.**, Schnitzer, S., & Thom, J. (accepted). Time trends of mental health indicators in the German adult population before and during the COVID-19 pandemic. *Frontiers in Public Health*.

Thom, J., Walther, L, Eicher, S., Hölling, H., Junker, Stephan, **Peitz, D**., Wilhelm, J., & Mauz, E. (accepted). Mental Health Surveillance am Robert Koch-Institut – Strategien zur Beobachtung der psychischen Gesundheit der Bevölkerung. *Bundesgesundheitsblatt - Gesundheitsforschung – Gesundheitsschutz.*

Barnes, B., Buchmann, M., Mumm, R., Nowossadeck, E., **Peitz, D**., Prütz, F., Wachtler, B., & Wienecke, A. (2022). Evidenzsynthesen in Public Health: ein Überblick [Evidence syntheses in public health: An overview]. *Zeitschrift fuer Evidenz, Fortbildung und Qualitaet im Gesundheitswesen*, S1865-9217(22)00170-2. https://doi.org/10.1016/j.zefq.2022.09.003

*Peitz, D., & Warschburger, P. (2022). Taking a closer look at mindful eating: Incremental validity and importance of subfacets. *Eating and Weight Disorders -Studies on Anorexia, Bulimia and Obesity,* 27, 2507-2514. https://doi.org/10.1007/s40519-022-01383-w

Mauz, E., Eicher, S., **Peitz, D.**, Junker, S., Hölling, H., & Thom, J. (2021). Mental health of the adult population in Germany during the COVID-19 pandemic. Rapid Review. *Journal of Health Monitoring*, *6*(Suppl 7), 2–63. https://doi.org/10.25646/9537

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*Peitz, D., Schulze, J., & Warschburger, P. (2021). Getting a deeper understanding of mindfulness in the context of eating behavior: Development and validation of the Mindful Eating Inventory. *Appetite*, *159*, 105039. https://doi.org/10.1016/j.appet.2020.105039

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Thom, J., Mauz, E., **Peitz, D**., Kersjes, C., Aichberger, M., Baumeister, H., . . . Hölling, H. (2021). Establishing a Mental Health Surveillance in Germany: Development of a framework concept and indicator set. *Journal of Health Monitoring*, *6*(4), 34–63. https://doi.org/10.25646/8861

Thom, J., **Peitz, D**., Kersjes, C., & et al. (2020). Proceedings of the International Workshop 'Integration of International Expertise in the Development of a Mental Health Surveillance System in Germany'. *BMC Proceedings*, *14*(S4). https://doi.org/10.1186/s12919-020-00186-0

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* Article is part of this thesis.

Das Mindful Eating Inventar (MEI) – Deutsche Originalversion (Peitz et al., 2021)

Der MEI ist ein Selbstauskunftsfragebogen, der verschiedene Facetten des Achtsamen Essens misst.
Er umfasst 30 Items, die 7 Facetten zugeordnet sind.

Kodierung:

fast nie (1)   selten (2)   eher selten (3)   eher häufig (4)   häufig (5)   fast immer (6)

Mindful Eating-Facetten:

1) *Akzeptierende, nicht-anhaftende Haltung ggü. der eigenen Esserfahrung*: 4, 9*,15*,23*, 30*
2) *Gewahrsein der Sinneserfahrung während des Essens*: 1, 8, 14, 19, 27
3) *Essen in Abhängigkeit zum Gewahrsein der Magenfülle*: 3, 10*, 18, 22*, 24*
4) *Gewahrsein von Essmotiven- und -triggern*: 7, 13, 20, 28
5) *Verbundenheit:* 6, 16, 26
6) *Nicht-reaktive Haltung:* 5*, 12*, 17*, 25*
7) *Auf das Essen fokussierte Aufmerksamkeit:* 2, 11*, 21*, 29

* invertiertes Item (sollte bei der Auswertung umgepolt werden)

Quelle:
Peitz, D., Schulze, J., & Warschburger, P. (2021). Getting a deeper understanding of mindfulness in the context of eating behavior: Development and validation of the Mindful Eating Inventory. *Appetite*, *159*, 105039. https://doi.org/10.1016/j.appet.2020.105039

Das Mindful Eating Inventar (MEI) – Deutsche Originalversion (Peitz et al., 2021)

<u>**Instruktion:**</u>

Bitte lesen Sie sich die folgenden Aussagen zum Essverhalten sorgfältig durch. Wir möchten von Ihnen wissen, wie häufig die einzelnen Aussagen in den **letzten 4 Wochen** auf Sie zugetroffen haben. Wählen Sie immer die Möglichkeit, die am ehesten auf Sie zutrifft.

Sie werden merken, dass sich einige Aussagen sehr ähnlich sind. Lassen Sie sich davon nicht irritieren und versuchen Sie, jede Aussage für sich gestellt zu beantworten - unabhängig davon, was Sie zuvor beantwortet haben. Es gibt keine „richtigen" oder „falschen" Antworten. Ihre persönliche Wahrnehmung ist uns wichtig. Versuchen Sie deshalb, nicht zu lange über die Fragen nachzudenken, sondern diese ehrlich und spontan zu beantworten.

1	Bevor ich mit dem Essen beginne, nehme ich mir einen Moment Zeit, um das Aussehen und den Geruch meines Essens wertzuschätzen.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
2	Während ich esse, richte ich meine ganze Aufmerksamkeit auf das Essen.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
3	Ich höre auf zu essen, wenn ich satt bin, auch wenn mein Teller noch nicht leer ist.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
4	Ich akzeptiere mein Essverhalten so, wie es gerade ist.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
5	Wenn andere essen, muss ich auch essen.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
6	Wenn ich esse, vergegenwärtige ich mir, wo mein Essen herkommt und wie es zu mir gekommen ist.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
7	Ich bin mir der Auslöser bewusst, die dazu führen, dass ich esse, obwohl mein Körper gerade keine Nahrung braucht (bzw. nicht körperlich hungrig ist).	fast nie	selten	eher selten	eher häufig	häufig	fast immer
8	Während ich esse, nehme ich die Nahrung im Mund bewusst wahr (z.B. Temperatur, Konsistenz etc.).	fast nie	selten	eher selten	eher häufig	häufig	fast immer
9	Wenn ich mal mehr gegessen habe, als mein Körper eigentlich brauchte (z.B. an Feiertagen oder bei einer Lieblingsspeise), kann ich die Gedanken daran nicht loslassen.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
10	Wenn es mir gut schmeckt, bemerke ich gar nicht, wann ich satt bin.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
11	Während ich esse, mache ich irgendetwas nebenbei (z.B. lesen, fernsehen, fahren, arbeiten, telefonieren etc.).	fast nie	selten	eher selten	eher häufig	häufig	fast immer
12	Wenn ich etwas Leckeres sehe oder rieche, muss ich es essen.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
13	Ich kann unterscheiden, ob mein Körper Nahrung braucht oder ich essen möchte, weil es mir nicht gut geht (z.B. Stress, Frust, Traurigkeit, Nervosität etc.).	fast nie	selten	eher selten	eher häufig	häufig	fast immer
14	Beim Essen betrachte ich Farben und Formen der Lebensmittel genau.	fast nie	selten	eher selten	eher häufig	häufig	fast immer

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15	Ich fühle mich schuldig, wenn ich etwas „Ungesundes", „Verbotenes" oder „Hochkalorisches" gegessen habe.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
16	Während ich esse, mache ich mir bewusst, wer und was an der Entstehung und Herstellung dieser Nahrung beteiligt war (z.B. Regen, Sonne, Lebewesen, Ernte, etc.).	fast nie	selten	eher selten	eher häufig	häufig	fast immer
17	Wenn ich hungrig bin, kann ich an nichts anderes mehr denken.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
18	Ich achte darauf, wann mein Körper mir zeigt, dass ich satt bin.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
19	Ich nehme Gerüche und Aromen von Nahrungsmitteln bewusst wahr.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
20	Ich kann unterscheiden, ob mein Körper Nahrung braucht oder ich essen möchte, weil andere gerade auch essen.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
21	Während ich esse, schweifen meine Gedanken ab (z.B. plane ich, was ich als nächstes tue; denke ich an Vergangenes, etc.).	fast nie	selten	eher selten	eher häufig	häufig	fast immer
22	Wenn noch Essen übrig ist, nehme ich nochmal nach, auch wenn ich schon satt bin.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
23	Ich kritisiere mich für die Art und Weise, wie ich esse.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
24	Es fällt mir schwer den Punkt zu finden, an dem ich satt und nicht unangenehm voll bin.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
25	Wenn ich Lust auf ein bestimmtes Nahrungsmittel habe, muss ich dem sofort nachgehen.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
26	Wenn ich esse, danke ich allen Lebewesen, die an der Herstellung dieser Nahrung beteiligt waren.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
27	Ich schmecke jeden Bissen, den ich zu mir nehme.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
28	Ich kann wahrnehmen, ob ich körperlich hungrig bin oder aus anderen Gründen essen möchte (z.B. Langeweile, Gewohnheit, Verfügbarkeit, etc.).	fast nie	selten	eher selten	eher häufig	häufig	fast immer
29	Während ich esse, bleibe ich mit meiner ganzen Aufmerksamkeit beim Essen.	fast nie	selten	eher selten	eher häufig	häufig	fast immer
30	Ich sage mir selbst, dass ich nicht das essen sollte, was ich esse.	fast nie	selten	eher selten	eher häufig	häufig	fast immer

The Mindful Eating Inventory (MEI) – English Translation

The MEI is a self-report questionnaire measuring different facets of mindful eating.
It includes 30 items that are assigned to 7 facets.

Coding:

almost never (1)   infrequently (2)   somewhat infrequently (3)   somewhat frequently (4)   frequently (5)   almost always (6)

<u>Mindful Eating Facets:</u>

1) *Accepting and Non-attached Attitude towards one's own Eating Experience (ANA)*: 4, 9*,15*,23*, 30*
2) *Awareness of Senses while Eating (ASE)*: 1, 8, 14, 19, 27
3) *Eating in Response to Awareness of Fullness (ERF)*: 3, 10*, 18, 22*, 24*
4) *Awareness of Eating Triggers and Motives (ATM)*: 7, 13, 20, 28
5) *Interconnectedness (CON):* 6, 16, 26
6) *Non-Reactive Stance (NRS):* 5*, 12*, 17*, 25*
7) *Focused Attention on Eating* (FAE)*:* 2, 11*, 21*, 29

* = inverted item (should be reversed before scoring)

Please note that the questionnaire below contains translated items of the validated German questionnaire.

Reference:

Peitz, D., Schulze, J., & Warschburger, P. (2021). Getting a deeper understanding of mindfulness in the context of eating behavior: Development and validation of the Mindful Eating Inventory. *Appetite*, *159*, 105039. https://doi.org/10.1016/j.appet.2020.105039

The Mindful Eating Inventory (MEI) – English Translation

Instruction:

Please read the following statements about eating behavior carefully. We would like you to tell us how frequent the individual statements have applied to you in the **last 4 weeks**. Always choose the option that most closely applies to you.

You will notice that some statements are very similar. Don't get confused by this and try to answer each statement on its own - regardless of what you answered before. There are no "right" or "wrong" answers. Your personal perception is important to us. Therefore, try not to think about the questions for too long, but to answer them honestly and spontaneously.

1	Before I start eating, I take a moment to appreciate the appearance and smell of my food.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
2	While I eat, I focus all my attention on the food.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
3	I stop eating when I'm full, even if my plate is not empty yet.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
4	I accept my eating behavior as it is right now.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
5	When others eat, I have to eat, too.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
6	When I'm eating, I bring to mind where my food comes from and how it came to me.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
7	I am aware of the triggers leading me to eat without my body actually needing food (resp. is not physically hungry).	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
8	While I eat, I'm fully aware of the food in my mouth (e.g., temperature, texture, etc.).	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
9	If I have eaten more than my body actually needed (e.g., on holidays or with my favorite meal), I can't let go of thoughts about it.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
10	If it tastes good to me, I don't recognize when I am full.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
11	When I eat, I do something else on the side (e.g., read, watch TV, drive, work, be on the phone).	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
12	When I see or smell something tasty, I have to eat it.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
13	I can distinguish if my body needs food or if I want to eat because I don't feel emotionally well (e.g., stress, frustration, sadness, tension, etc.).	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
14	While I eat, I look at the colors and shapes of the food closely.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
15	I feel guilty after eating something "unhealthy", "forbidden" or "high-caloric.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always

#	Statement						
16	While I'm eating, I make myself aware of who and what were part of the origin and the production of this food (e.g., rain, sun, living beings, harvest, etc.).	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
17	When I am hungry, I can't think of anything else.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
18	I pay attention to my body telling me when I'm full.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
19	I'm fully aware of the smells and aromas of my food.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
20	I can distinguish if my body needs food or if I want to eat because others around me are eating.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
21	While I eat, my thoughts tend to drift off (e.g., plan what I am going to do next; think about the past, etc.).	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
22	If there are leftovers, I take a second helping even though I'm already full.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
23	I criticize myself for the way I eat.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
24	It's hard for me to find the point when I'm full but not uncomfortably stuffed.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
25	When I'm keen on eating a special food, I have to follow that urge right away.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
26	When I'm eating, I thank all living beings that were involved in the production of this food.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
27	I taste every bite of food that I eat.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
28	I'm able to notice if I'm physically hungry or if I want to eat for other reasons (e.g., boredom, habit, availability, etc.).	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
29	While I eat, I keep my whole attention focused on my food.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always
30	I tell myself I shouldn't be eating what I eat.	almost never	infrequently	somewhat infrequently	somewhat frequently	frequently	almost always

9 Hunger
TRAINING MATERIALS

- Power Point Slides (Basis of Introduction Video)
- Participant's Protocol Sheet
- Participant's Script (Exercise Description)
- Participant's Overview of the 9 Hunger

Ein onlinegestütztes Training zu Achtsamkeit beim Essen

Die Befriedigung verschiedener Bedürfnisse bei der Nahrungsaufnahme

→ Anmerkung: Dieser Foliensatz bildete die Grundlage für ein 50-minütiges Einführungsvideo, für welches die einzelnen Folien mit Hilfe von Audiospuren besprochen wurden

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Forschungsteam

- M. Sc. Psych. Diana Peitz
  - Wissenschaftliche Mitarbeiterin in der Abteilung für Beratungspsychologie (Frau Prof. Dr. Petra Warschburger)
  - Promotion zu Achtsamkeit und Selbstmitgefühl beim Essen an der Universität Potsdam
  - leitet Kurse zu Achtsamkeit beim Essen (Grundlage *Mindful Eating – Conscious Living*)
- Technischer Support
  - B. Sc. Psych. Magdalena Fuchs
  - Psych. cand. Hannah Micklitz

Inhalt

- Theoretische Grundlagen
- Die 9 Hunger-Übung
- Instruktionen für die Trainingsdurchführung & Trainingsmaterial
- Wie geht es weiter?
- Kontakt
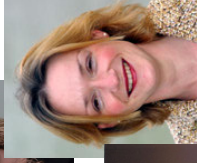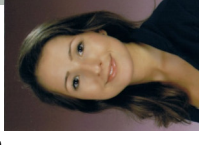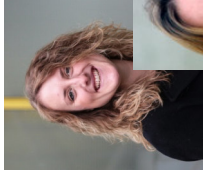
Theoretische Grundlagen

WAS IST ACHTSAMKEIT BEIM ESSEN?
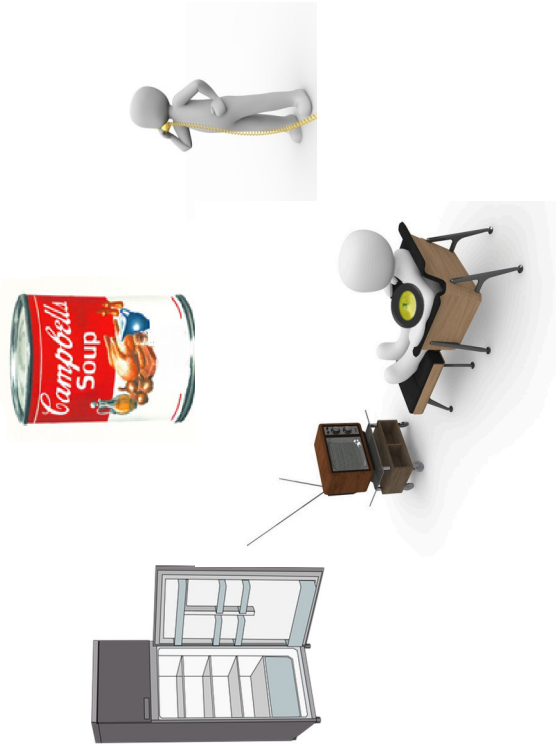
Was ist achtsames Essen?

Was ist achtsames Essen?

Paket Hunger

Was bewegt uns zum Essen?

Was ist Hunger? Wie fühlt sich dieser an?

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Achtsamkeit

Körper

Gefühle

Gedanken
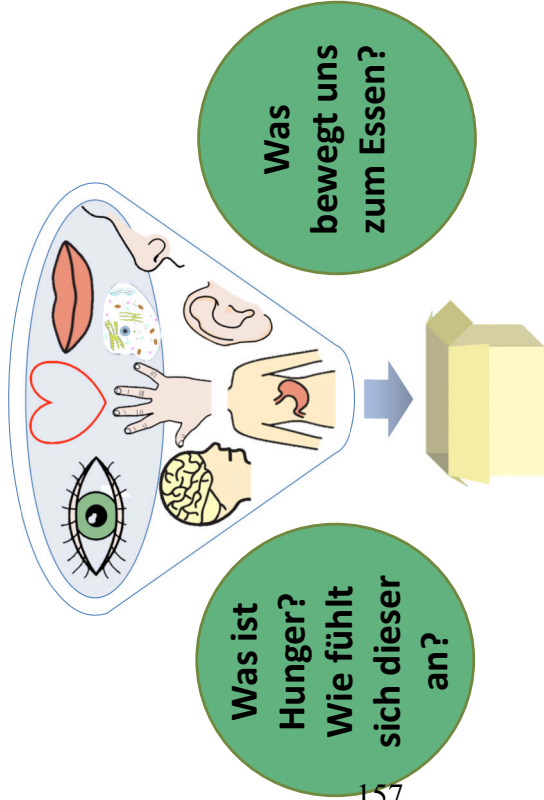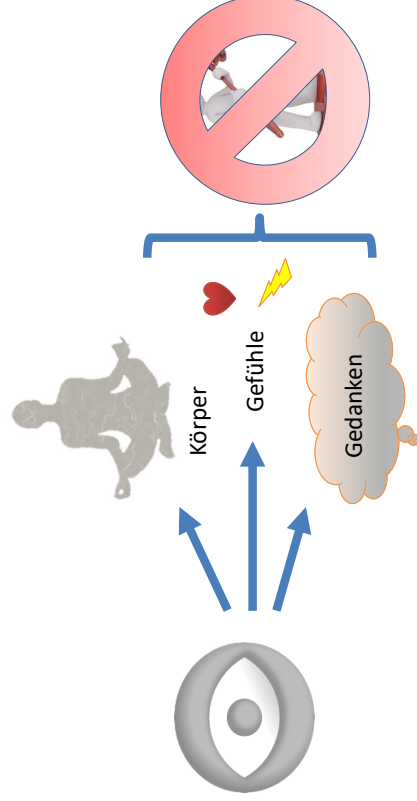
AUFMERKSAM WAHRNEHMEN

&

NICHT WERTEN

Achtsamkeit

NICHT WERTEN

&

AUFMERKSAM WAHRNEHMEN

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Neugier, Freundlichkeit und Anfängergeist

Neugier, Freundlichkeit und Anfängergeist

Selbstmitgefühl
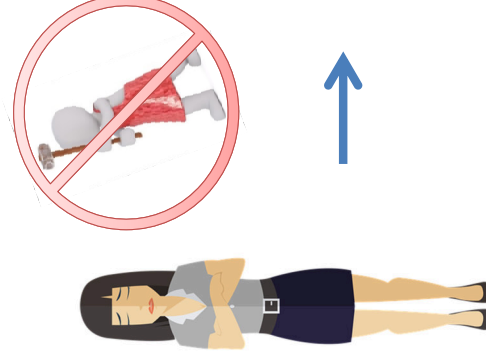
Programme zu Achtsamkeit beim Essen

Grundlagen | Übung | 9 Hunger | Hinweise | Kontakt

Ziel: Freudvolle Beziehung zum Essen (wieder-)herzustellen

Mindful Eating CONSCIOUS LIVING

dt. Achtsam Essen – Bewusst Leben

13

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9 Hunger

JETZT WIRD'S PRAKTISCH!

14

Anleitung

Grundlagen | Übung | 9 Hunger | Hinweise | Kontakt

- Nehmen Sie sich einen Moment Zeit und sorgen Sie dafür, dass Sie während dieser Zeit nicht gestört werden
- Papier und Stift
- Nehmen Sie nun Ihr vorbereitetes Lebensmittel (am besten eine Rosine)
- Sind Sie bereit?

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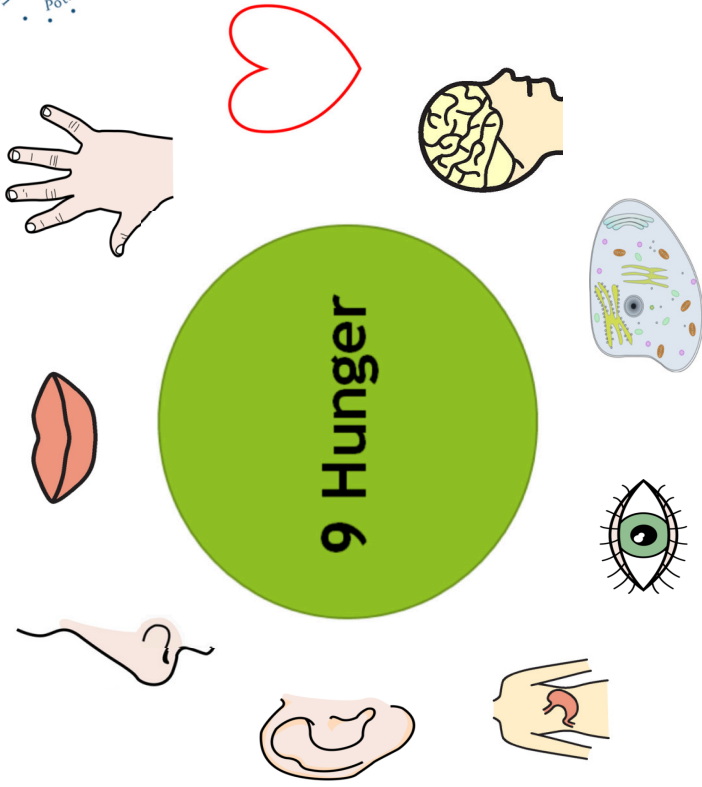
15

16

Slide 17

9 Hunger

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Slide 18

Was haben Sie beobachtet?
5 Sinne

Es fühlte sich gut an, das zu essen ...

Es schmeckte würzig / wie ...

Ich mag keine Rosinen

Ich mochte den Geruch nicht

Slide 19

Was haben Sie beobachtet?
5 Sinne

Zurückkehren: Was können Sie mit Ihren Sinnen wahrnehmen?

Es fühlte sich gut an, das zu essen ...

mag keine Rosinen

Ich mochte de... Geruch nicht

Slide 20
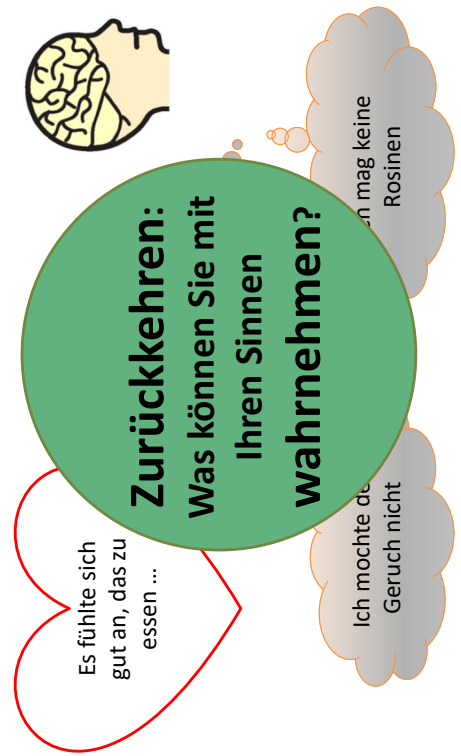
Was haben Sie beobachtet?
Magenhunger
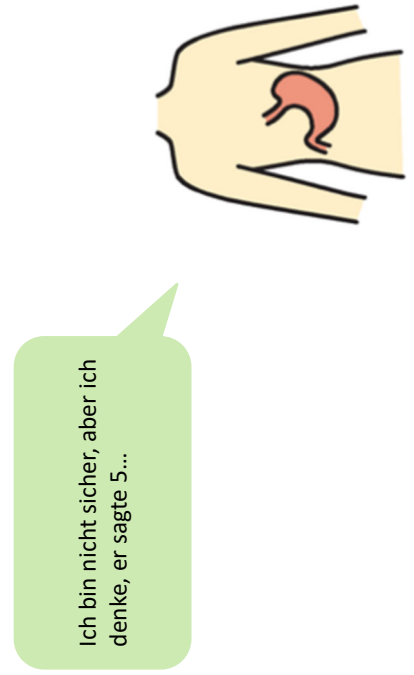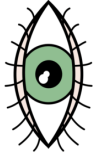
Ich bin nicht sicher, aber ich denke, er sagte 5...

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9 Hunger

Augenhunger

„Das sieht wirklich gut aus! Also eigentlich bin ich schon satt, AAAABER davon könnte ich noch etwas essen!"

➢ Bedürfnis unser Augen nach (individueller) Schönheit und Abwechslung von Farben & Formen

➢ bezieht sich häufig auf lecker aussehendes oder einfach nur verfügbares Essen

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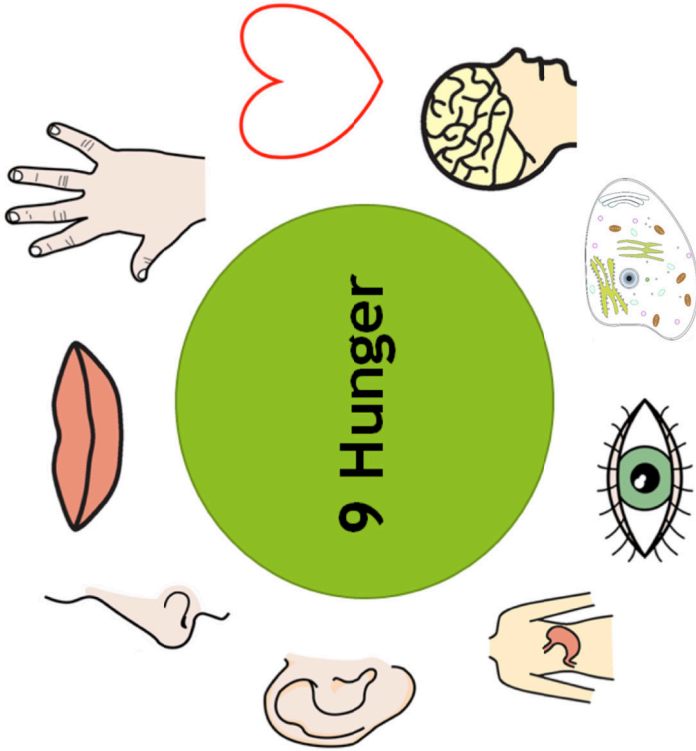
Nasenhunger

„Mmh, ich rieche Pizza! Lass uns Pizza essen!"

➢ Bedürfnis unserer Nase nach (individuell) wohlriechenden Eindrücken

  ➢ Aroma als Grundlage für Geschmack
  ➢ Intensive & starke Wirkung auf das Unterbewusstsein (Erinnerungen)

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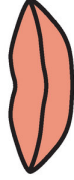
Mundhunger

„Ich will MEHR Erfahrungen & UNTERSCHIEDLICHE Empfindungen! Hauptsache lecker! Hauptsache interessant!"

➢ Verlangen des Mundes nach angenehmen Empfindungen

  ➢ Mund als „Sensation Seeker"
  ➢ Lechzt nach unterschiedlichen Geschmäckern, Konsistenzen, Temperaturen: will Vielfalt und Abwechslung

Mundhunger
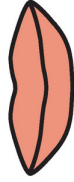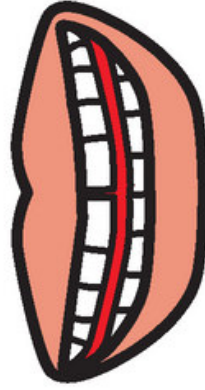
Ohrenhunger

„Oh, höre ich da nicht jemanden Chips knuspern? Ich will auch Chips"

➤ Geräusche aktivieren Erinnerungen & Vorstellungen

➤ Auch: Beschreibungen anderer von leckerem Essen
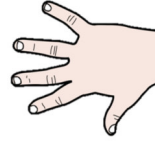
Tasthunger

➤ Bezieht sich auf (Oberflächen)struktur, Temperatur, Veränderung (assoziiert mit Vorstellungen)

➤ Einkaufen, Kochen, Essen

→ Finger Food

Herzhunger

Gefühl und Erinnerung, die wir mit einem Lebensmittel oder einer Speise verbinden

➤ Hoffnung oder Erwartung, dass Essen mich besser fühlen lässt

   ➤ z.B. aufheitert oder beruhigt etc.

➤ häufig nicht direkt zugänglich

➤ „Verwandlungskünstler"
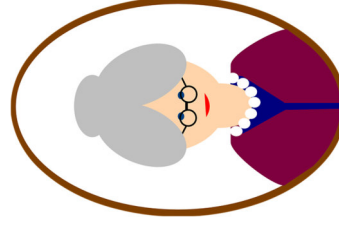
Herzhunger
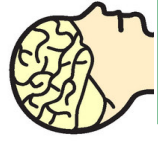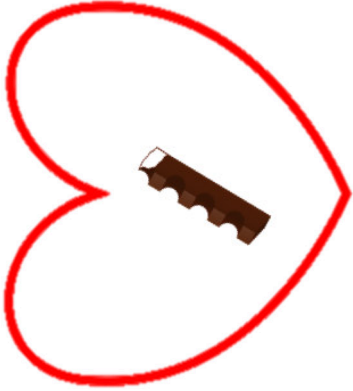
Geisteshunger

„Das solltest du nicht essen. Es ist ungesund/schlecht/zu fettig."

„Das war zu viel!"

„Du solltest mehr Obst und Gemüse essen!"

- Zusammenspiel aller Stimmen in uns, die etwas über das Thema Essen zu sagen haben
- entstanden durch Informationen von außen wie soziales Umfeld & Medien
- Häufig ängstlich, kritisch: z.B. „Du solltest...!"/"Du solltest nicht...!"

Haltung

Neugier
Kritik

Geisteshunger

Zellhunger

„Ich bin krank. Gib mir eine warme Suppe!"

„Ich habe Durst."

➢ Fähigkeit ist wiedererlernbar
➢ Wie stark sind meine Zellen daran interessiert, dass dieses Lebensmittel zu mir kommt?
➢ Wahrnehmen statt Denken

Magenmeter

Zentrale Frage: Wie leer bzw. voll ist mein Magen?

1/2 · 3/4 · 1/4 · leer · „könnte mehr essen" · „voll" · „übervoll" · „am Verhungern"

Angelehnt an Wansinck, B. (2008). *Essen ohne Sinn und Verstand. Wie die Lebensmittelindustrie uns manipuliert.* Campus: Frankfurt / New York.
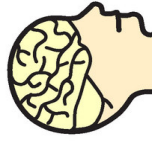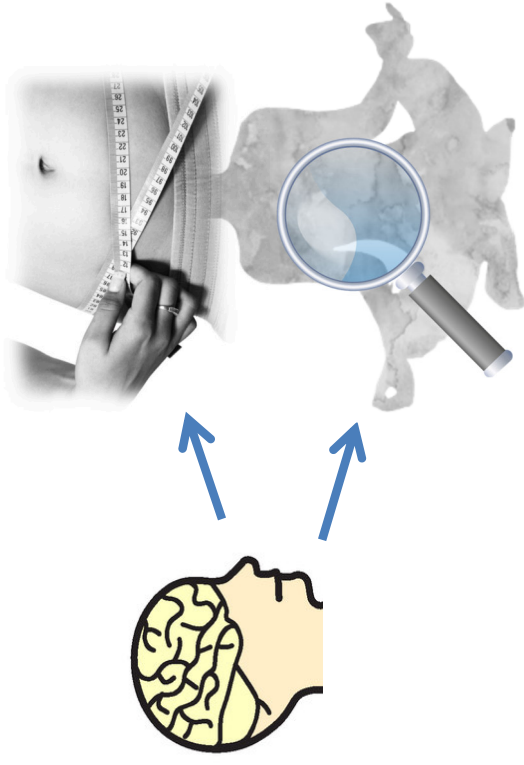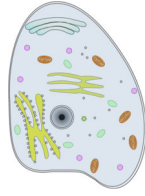
Zellhunger

➢ Weisheit des Körpers nutzen: Signale erkennen
➢ Was braucht mein Körper gerade?
➢ „Intuitives Essen"
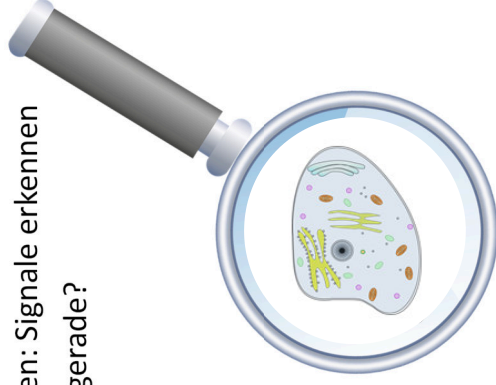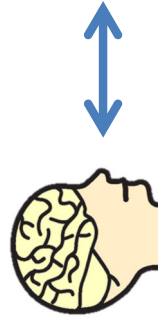
"Es wird gegessen, was auf den Tisch kommt!"

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Magenhunger

„Wieviel brauchst du, lieber Magen?"

➢ Verwechslungsgefahr mit anderen Hungerarten (Bedürfnissen): Gefahr des Überessens
➢ keine Geschmackrezeptoren: beschäftigt sich nur mit Volumen (Füllstand)
➢ **Befragung des Magens essentiell!**
➢ *Was nehme ich im Magen wahr?*
  • Knurren? Rumoren? Leere? Völle? Zusammengeschnürt?

Haltung

9 Hunger

Wer da drin ist hungrig?

1. Innehalten
   - Autopilotenmodus verlassen
2. 9 Hunger einzeln bestimmen
   - Bewusstsein: Was bewegt mich zum Essen?
   - Freiere, bewusstere Entscheidung, ob, was und wieviel ich esse (anstatt automatisch Gewohnheiten zu folgen)
   - Bewusstheit schafft Wahlmöglichkeiten

Bewusstheit → Wahlmöglichkeit
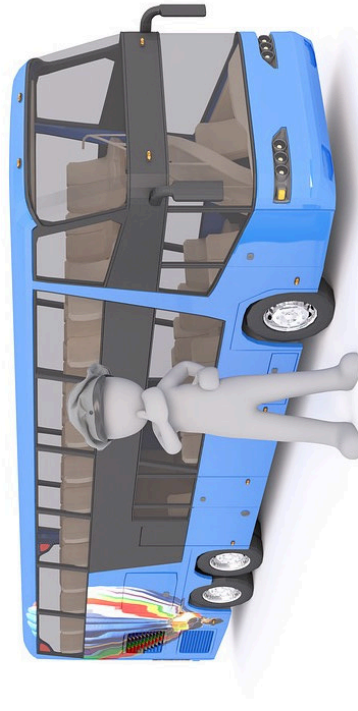
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Bewusstheit → Wahlmöglichkeit

| Grundlagen | Übung | **9 Hunger** | Hinweise | Kontakt |

Bewusstheit → Wahlmöglichkeit

| Grundlagen | Übung | **9 Hunger** | Hinweise | Kontakt |

Bewusstheit → Wahlmöglichkeit

| Grundlagen | Übung | **9 Hunger** | Hinweise | Kontakt |

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Bewusstheit → Wahlmöglichkeit

| Grundlagen | Übung | **9 Hunger** | Hinweise | Kontakt |

Brauche ich gerade Essen oder etwas anderes?

Wieviel brauche ich?

Wer in mir ist hungrig?

Kann diese Speise meine aktuellen Bedürfnisse befriedigen?
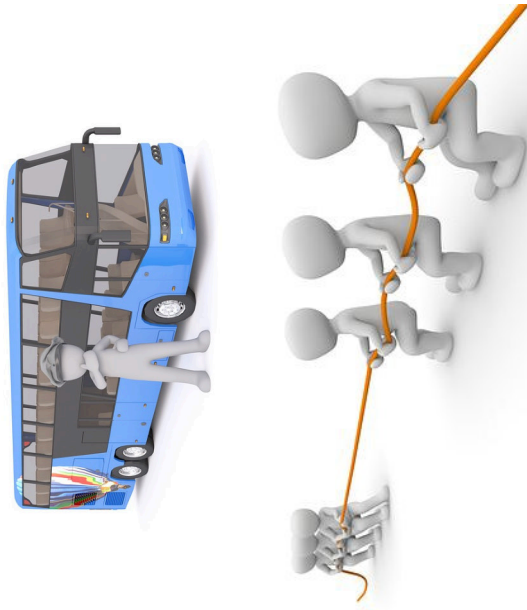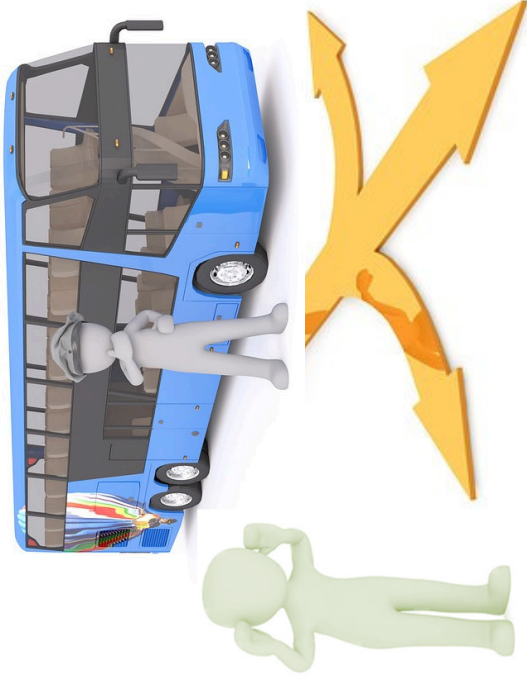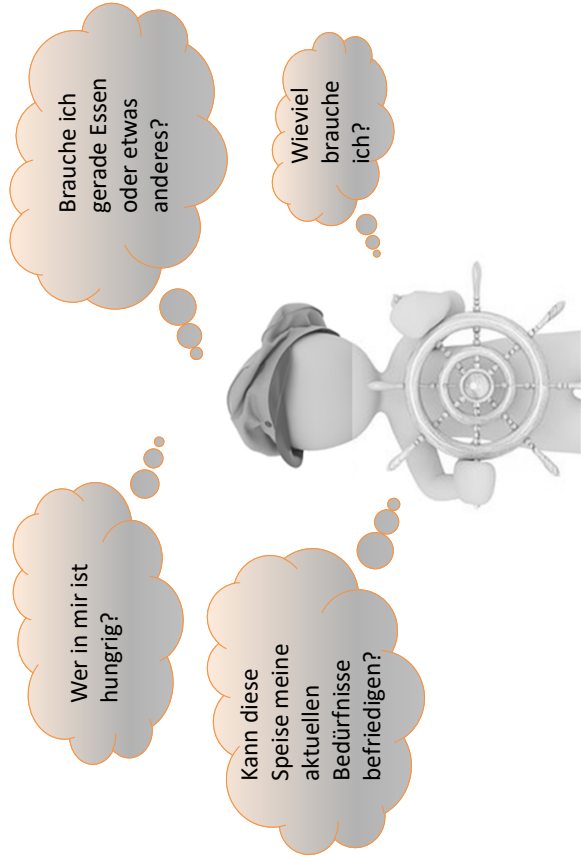
Bewusstheit → Wahlmöglichkeit
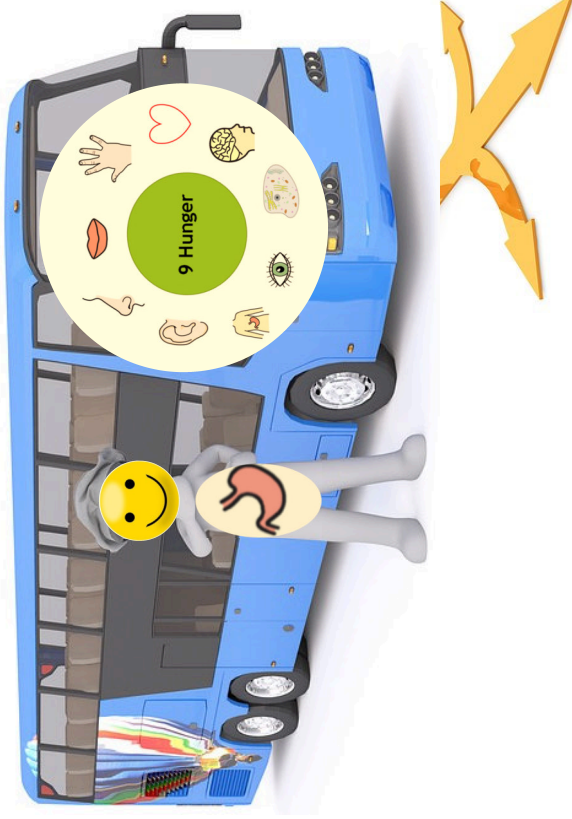
Grundlagen	Übung	**9 Hunger**	Hinweise	Kontakt

Hinweise für

DAS TRAINING

Ablauf Training

Grundlagen	Übung	9 Hunger	**Hinweise**	Kontakt

Trainingsphase (2 Wochen):

➢ jeden Tag **VOR** und **NACH** einer selbst bestimmten Mahlzeit (kann auch ein Snack sein) die **verschiedenen „Hungerarten"** getrennt voneinander bestimmen und mit Hilfe des Protokollbogens dokumentieren

➢ Wie hoch ist mein ... Hunger auf einer Skala von 0-10?

0 1 2 3 4 5 6 7 8 9 10

➢ **Nehmen Sie die einzelnen Bedürfnisse einfach nur wahr und bewerten Sie sie nicht**

Ihre Trainingszeit pro Tag: ca. 5 Minuten

Hilfsmittel

Grundlagen	Übung	9 Hunger	**Hinweise**	Kontakt

- Audiodatei
  - Langversion
  - Kurzversion
- Skript 9 Hunger
- Protokollbogen
- Übersicht 9 Hunger

Protokollbogen

- Zu Beginn des Trainings das angehangene PDF-Dokument ausdrucken
- **Vor** und **nach** jeder Mahlzeit den Protokollbogen ausfüllen
- Datum, Wochentag & Uhrzeit auf dem Protokollbogen sowie die ausgewählte Speise notieren

WICHTIG:

- **Zuerst** in den Körper hineinspüren und ihn befragen
- **Dann erst**: Wert notieren

Übersicht

Audiodatei

168

- Langversion (10 Min)
- Kurzversion (3 Min)
- Für Handy oder Mp3-Player

Skript

Praktisch – auch zum Mitnehmen:
Eine Zusammenfassung der wichtigsten Schritte

Slide 53

9 Hunger

Slide 54 — Wie geht es weiter

Wie geht es weiter

- Starten Sie **direkt morgen** mit Ihrer ersten Trainingseinheit
- **3 Erinnerungsmails,** um Sie an Ihr tägliches Training zu erinnern
- In **2 Wochen** wenden wir uns per Mail erneut an Sie, um das Training mit Ihnen gemeinsam näher zu beleuchten

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Slide 55 — Kontakt

Bei weiteren

FRAGEN:

DIPEITZ@UNI-POTSDAM.DE

Slide 56 — Nicht vergessen:

Nicht vergessen:

- Konzentration auf Wahrnehmung und Körper – weniger Denken und Kopf
- Mittelpunkt: Aktuelle Erfahrung statt Konzepte & Voreinstellungen
- Aktuelle Erfahrung & Hungerarten nicht bewerten
- Neugier & „Anfängergeist"
  - Immer wieder neu auf's Essen schauen!
  - Experimentieren & Erforschen!
- Selbstmitgefühl

➢ Jede Erfahrung ist wertvoll und informativ!

Viel Freude!

Protokollbogen

Tag 1

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
👁		
✋		
👃		
👂		
👄		
🧠		
🧠		
♡		
🧍 *		

Tag 2

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
👁		
✋		
👃		
👂		
👄		
🧠		
🧠		
♡		
🧍 *		

Tag 3

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
👁		
✋		
👃		
👂		
👄		
🧠		
🧠		
♡		
🧍 *		

Tag 4

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
👁		
✋		
👃		
👂		
👄		
🧠		
🧠		
♡		
🧍 *		

*

1/2

1/4   3/4

"könnte mehr essen"

"am Verhungern"   "voll"

leer   "übervoll"

171

Protokollbogen

Tag 5

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
👁		
✋		
👃		
👂		
👄		
🫀		
🧠		
♡		
🫃 *		

Tag 6

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
👁		
✋		
👃		
👂		
👄		
🫀		
🧠		
♡		
🫃 *		

Tag 7

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
👁		
✋		
👃		
👂		
👄		
🫀		
🧠		
♡		
🫃 *		

Tag 8

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
👁		
✋		
👃		
👂		
👄		
🫀		
🧠		
♡		
🫃 *		

*
1/2
1/4   3/4
"könnte mehr essen"
"am Verhungern"   "voll"
leer
"übervoll"

172

Protokollbogen

Tag 9

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
(Auge)		
(Hand)		
(Nase)		
(Ohr)		
(Mund)		
(Zunge)		
(Gehirn)		
(Herz)		
(Magen) *		

Tag 10

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
(Auge)		
(Hand)		
(Nase)		
(Ohr)		
(Mund)		
(Zunge)		
(Gehirn)		
(Herz)		
(Magen) *		

Tag 11

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
(Auge)		
(Hand)		
(Nase)		
(Ohr)		
(Mund)		
(Zunge)		
(Gehirn)		
(Herz)		
(Magen) *		

Tag 12

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
(Auge)		
(Hand)		
(Nase)		
(Ohr)		
(Mund)		
(Zunge)		
(Gehirn)		
(Herz)		
(Magen) *		

*

1/2
1/4   3/4
"könnte mehr essen"
"am Verhungern"   "voll"
leer
"übervoll"

173

Protokollbogen

<table>
<tr><td colspan="3" align="center">Tag 13</td><td colspan="3" align="center">Tag 14</td></tr>
</table>

Tag 13

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
👁		
✋		
👃		
👂		
👄		
(Magen)		
(Gehirn)		
♡		
(Bauch) *		

Tag 14

Datum & Wochentag:

Speise & Uhrzeit:

9 Hunger (Skala 0-10)	Vor der Mahlzeit	Nach der Mahlzeit
👁		
✋		
👃		
👂		
👄		
(Magen)		
(Gehirn)		
♡		
(Bauch) *		

*

1/2

1/4   3/4

"könnte mehr essen"

"am Verhungern"   "voll"

leer

"übervoll"

Danken Sie sich nun selbst für 14 Tage Achtsamkeit beim Essen!

Skript 9 Hunger: Die wichtigsten Schritte

- ➤ Nehmen Sie sich 5 Minuten Zeit, bevor Sie mit dem Essen beginnen.
- ➤ Notieren Sie Datum, Wochentag & Uhrzeit auf dem Protokollbogen sowie die ausgewählte Speise.
- ➤ Halten Sie bewusst inne und richten die volle Aufmerksamkeit auf die Speise vor Ihnen.
- ➤ Fragen Sie sich dann:

Auf einer Skala von 0 (gar kein Hunger) bis 10 (stärkster Hunger)…

1. Wie hoch ist mein Augenhunger?

Wie sehr möchten meine Augen, dass ich (mehr) von dieser Speise esse?
Basierend auf dem, was ich sehe, wie groß ist mein Bedürfnis zu essen?

2. Wie hoch ist mein Tasthunger?

Wie sehr möchte mein Tastsinn, dass ich (mehr) von dieser Speise esse?
Basierend auf dem, was ich spüre, wie groß ist mein Bedürfnis zu essen?

3. Wie hoch ist mein Nasenhunger?

Wie sehr möchte meine Nase, dass ich (mehr) von dieser Speise esse?
Basierend auf dem, was ich rieche, wie groß ist mein Bedürfnis zu essen?

4. Wie hoch ist mein Ohrhunger?

Wie sehr möchten meine Ohren, dass ich (mehr) von dieser Speise esse?
Basierend auf dem, was ich höre, wie groß ist mein Bedürfnis zu essen?

5. Wie hoch ist mein Mundhunger?

Wie sehr möchte mein Mund, dass ich (mehr) von dieser Speise esse?
Basierend auf dem, was ich im Mund wahrnehme, wie groß ist mein Bedürfnis zu essen?

6. Wie hoch ist mein Zellhunger?

Wie sehr brauchen / wollen meine Zellen diese Speise?
Basierend auf dem, was meine Zellen rückmelden, wie groß ist mein Bedürfnis zu essen?

7. Wie hoch ist mein Geisteshunger?

Was sagt mein Geist zu dieser Speise?
Basierend auf dem, was mein Geist sagt, wie groß ist mein Bedürfnis zu essen?

8. Wie hoch ist mein Herzhunger?

Wie sehr wünscht sich mein Herz, dass ich (mehr) von dieser Speise esse?
Basierend auf dem, was mein Herz fühlt, wie groß ist mein Bedürfnis zu essen?

9. Wie hoch ist mein Magenhunger?

Wie viel möchte mein Magen von dieser Speise?

➔ Hierzu können Sie Ihren Magen befragen, wie voll er aktuell ist:
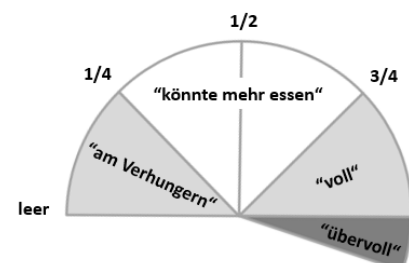
- Notieren Sie sich die Werte auf dem Protokollbogen.
- Beginnen Sie nun zu essen.

- Nach dem Essen, befragen Sie Ihren Körper erneut: Wie hoch sind die unterschiedlichen Hungerarten jetzt ausgeprägt? Notieren Sie dann die Werte in der zweiten Spalte.
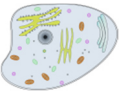
VIEL FREUDE!

Training Achtsamkeit beim Essen
Überblick 9 Hunger

Hungerart (Bedürfnis)	Erläuterung
Augenhunger „Das sieht wirklich gut aus! Also eigentlich bin ich schon satt, AAAABER davon könnte ich noch etwas essen."	*Was sehe ich?* Wie sehr möchten meine Augen, dass ich (mehr) von dieser Speise esse? ➢ Bedürfnis der Augen nach individueller Schönheit / Ästhetik (bezogen auf Farben, Formen, Oberflächenstrukturen etc.) • Bezieht sich auf lecker aussehendes oder einfach nur verfügbares Essen
Nasenhunger „Mmh, ich rieche Pizza! Lass uns Pizza essen!"	*Was rieche ich?* Wie sehr möchte meine Nase, dass ich (mehr) von dieser Speise esse? ➢ Bedürfnis der Nase nach individuell wohlriechenden Eindrücken, Gerüchen und Aromen • Starke Wirkung auf Unterbewusstsein: Gerüche aktivieren Erinnerungen und damit verbundene Vorstellungen
Mundhunger „Ich will mehr Erfahrungen & unterschiedliche Empfindungen!" „Es ist so lecker, ich kann nicht aufhören!"	*Was kann ich im Mundraum wahrnehmen?* Wie sehr möchte mein Mund, dass ich (mehr) von dieser Speise esse? ➢ Bedürfnis des Mundes nach vielfältigen und abwechslungsreichen Erfahrungen und Empfindungen (z.B. Geschmäckern, Konsistenzen und Temperaturen) • Mund als „Sensations-Suchender": Auf der Suche nach immer neuen, spannenden Empfindungen und Erfahrungen • Probleme hierbei: unaufmerksames Essen & schnelle Veränderung bezogen auf Konsistenz & Geschmack
Ohrenhunger „Das hört sich lecker an!"	*Was kann ich hören?* Wie sehr möchten meine Ohren, dass ich (mehr) von dieser Speise esse? ➢ Bezogen auf Geräusche oder Beschreibungen anderer von Essen • Starke Wirkung auf Unterbewusstsein: Geräusche aktivieren Erinnerungen und damit verbundene Vorstellungen
Tasthunger „Das fühlt sich lecker an!"	*Was spüre ich auf der Haut?* Wie sehr möchte mein Tastsinn, dass ich (mehr) von dieser Speise esse? ➢ Bezogen auf (Oberflächen-)strukturen, Temperatur, Veränderungen von Strukturen • Kontaktaufnahme beim Einkaufen sowie Zubereitung und Essen von Nahrungsmitteln (Finger Food)

Angelehnt an
Mindful Eating CONSCIOUS LIVING

Hungerart (Bedürfnis)	Erläuterung
Herzhunger „Es fühlt sich im Herzen gut an, das zu essen." „Nachdem ich das gegessen habe, werde ich mich besser fühlen."	*Welches Gefühl verbinde ich mit dem Essen?* *Löst es bei mir Erinnerungen, Vorlieben oder Erwartungen aus?* Wie sehr wünscht sich mein Herz, dass ich (mehr) von dieser Speise esse? ➢ Beschreibt Gefühle / Erinnerungen, die ich mit einem Lebensmittel verbinde (z.B. Lieblingsspeise aus der Kindheit) • Hoffnung und Erwartung, dass das Essen mich besser fühlen lässt (z.B. Trost, Beruhigung) • Meist unterbewusst; Verwandlungskünstler (leicht verwechselbar)
Geisteshunger „Das solltest du nicht essen. Es ist ungesund!" „Du hättest nicht so viel essen sollen!"	*Was sagt mein Geist?* Wie sehr möchte mein Geist, dass ich (mehr) von dieser Speise esse? ➢ Zusammenspiel aller Stimmen in uns, die etwas über das Thema Essen zu sagen haben • Entsteht durch Infos von außen z.B. soziales Umfeld & Medien • Häufig ängstlich, kritisch: z.B. Sollte / Sollte nicht, Hätte / Hätte nicht • Enthält auch wichtige Informationen, die klug genutzt und mit Informationen des Körpers kombiniert werden können
Zellhunger „Ich bin krank. Gib mir Orangen!" „Ich habe Durst."	*Was braucht mein Körper gerade?* Wie stark sind meine Zellen daran interessiert, dass diese Speise zu ihnen kommt? ➢ „Intuitives Essen" • Wahrnehmen statt denken, was der Körper braucht (→ in den Körper hineinhorchen) • Intuitive körperliche Signale erkennen (vergl. Durst; Reaktionen bei Krankheit): verschüttete Eigenschaft, die Schritt für Schritt wiedererlernt werden kann
Magenhunger „Gib mir etwas, womit ich arbeiten kann, aber nicht zu viel!" (mitfühlender Umgang)	*Wieviel Nahrung braucht mein Magen gerade?* Wie viel möchte mein Magen von dieser Speise? ➢ Wahrnehmen statt Denken • Füllstand des Magens berücksichtigen (Volumenrezeptoren) • Verwechslungsgefahr mit anderen Hungerarten (Bedürfnissen) →Gefahr des Überessens • Intelligenz des Magens nutzen: Was nehme ich im Magen wahr? Wie kommuniziert mein Magen mit mir? Knurren? Rumoren? Leere? Zusammengeschnürt? Etwas ganz anderes?

Bewusstheit → Wahlmöglichkeiten

Eidesstattliche Erklärung

Hiermit versichere ich, dass ich die vorgelegte Arbeit selbstständig verfasst und keine anderen als die angegebenen Hilfsmittel verwendet habe.
Die Arbeit ist in keinem früheren Promotionsverfahren angenommen oder abgelehnt worden.

Berlin, den 06.02.2023

Diana Peitz