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Mindful love:
The role of mindfulness in willingness to sacrifice in romantic relationships

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Abstract

Introduction: The well-being of romantic relationships often depends on the degree to which partners are able to sacrifice their own interests to meet each other's needs when necessary. While enacted sacrifices are not always beneficial, one's *willingness to sacrifice* (WTS) has been consistently linked to greater relationship satisfaction and personal well-being. One factor that may contribute to WTS is *mindfulness*, the non-reactive and non-judgmental attention to and awareness of present-moment experiences. Mindfulness is known to predict several positive relationship outcomes (e.g., relationship quality, forgiveness). Accordingly, mindfulness may promote WTS through lower relationship ambivalence (RA; the extent to which one holds simultaneously positive and negative attitudes towards one's partner/relationship) and higher commitment (the extent to which one intends to persist in one's relationship). Prior research has demonstrated that mindfulness is negatively correlated with general attitudinal ambivalence and positively correlated with relationship commitment. Commitment, while being negatively linked to ambivalence, is also a robust predictor of pro-relationship behaviours, including sacrifice. However, no prior study has systematically investigated the cross-sectional or longitudinal links between these variables in tandem.

Aim: Guided by the interdependence theory and theoretical models of mindfulness and relationships, this thesis investigates the link between mindfulness and WTS and examines whether RA and commitment uniquely or jointly mediate this link.

Method: Studies 1-2 used an exploratory-confirmatory approach to investigate whether RA and/or commitment may mediate the mindfulness-WTS association in response to hypothetical scenarios. Studies 3-6 tested whether experimentally enhanced mindfulness predicted greater hypothetical (Study 3, 6) and actual (Studies 4-5) WTS through RA and

commitment. Study 7 was a 5-week longitudinal study investigating the prospective effect of mindfulness on hypothetical WTS through RA and commitment.

Results: Studies 1-2 both revealed a significant indirect association between higher mindfulness and greater WTS, which occurred sequentially through lower RA and then higher commitment. This serial mediation model was replicated in Study 3, but not in Study 4-7. Although the links involving mindfulness and those involving WTS were more tenuous across studies, RA was consistently negatively linked to commitment in all studies.

Discussion: This research provides mixed evidence for the notion that mindfulness predicts WTS in relationships. The inconsistent findings across the experimental studies also illuminate the possibility that the factors that precede individuals' hypothetical versus actual WTS may be different. Results from the longitudinal study further suggest that the links between mindfulness, RA, commitment, and WTS may sometimes be overestimated from cross-sectional data. The consistent RA-commitment association introduces promising directions for future relationship studies. Taken together, these findings offer novel insight into interdependence theory and models of mindfulness and relationships by outlining and explaining the somewhat limited and inconsistent prospective influence of mindfulness on WTS.

Lay Summary

Being in love can be a tremendous source of joy, though at times it may also turn into a source of irritation when partners' preferences or needs do not meet. Partners encountering conflicts of this sort experience a number of negative relationship outcomes, such as higher negative emotions and stress, and lower relationship satisfaction; therefore, how they respond to such dilemmas are crucial for the functioning and longevity of the relationship. One solution to these conflicting situations that enables the romantic relationship to survive and thrive is for one or both parties in the relationship to sacrifice their own interests to fulfil their partners' needs or desires. While actual performed sacrifices are not necessarily beneficial to personal and relationship well-being, having the positive intentions to make sacrifices has been consistently linked to positive personal and relationship features in general, including greater relationship satisfaction and personal well-being.

One factor that may promote individuals' *willingness to sacrifice* (WTS) is mindfulness, the state of consciousness in which an individual is aware of and attentive to the present moment experiences, with a non-reactive and non-judgmental attitude. *Mindfulness* has been found to be linked to and predictive of several positive relationship features, such as greater relationship quality and forgiveness. According to relevant theories and models, mindfulness may contribute to WTS through lower *relationship ambivalence* (RA; the extent to which a person has simultaneous positive and negative evaluations towards a partner/relationship) and higher *commitment* (the extent to which a person is dedicated to a partner/relationship). Specifically, existing evidence has suggested that mindful people are less likely to experience mixed feelings (e.g., feeling torn or conflicted) towards an attitudinal object (e.g., certain issue or person), and they tend to have higher commitment to a romantic relationship. Commitment, while being negatively associated with ambivalence, is also

known as a strong predictor of pro-relationship behaviours, including sacrifices. However, no prior research has systematically examined the links between these factors.

Guided by relevant theories and models, this thesis fills in this gap by investigating whether mindful people may be more willing to make sacrifices, and whether it may be because they tend to have lower RA and/or greater commitment in the relationship. We examined these questions through single observations and over time in a series of seven studies using various sacrifice measures, and gained divergent results. In the initial three observations, mindful people indicated greater WTS in hypothetical scenarios as they sequentially experienced lower RA and higher commitment. However, this model was no longer observed when we repeatedly tested it at other points in time and over time, using various sacrifice measures. The inconsistent findings indicate that mindfulness may not necessarily promote WTS, and that having the positive intention to sacrifice in an imagined scenario may not be the same as being ready to make a real sacrifice in a given moment. Taken together, this thesis bridges the sciences of mindfulness and WTS in close relationships, and provides informative insights to researchers and practitioners by outlining the role mindfulness may or may not play in pro-relationship outcomes such as WTS.

Declaration

I declare that this thesis, presented for the qualification of Doctor of Philosophy, has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where states otherwise by reference or acknowledgment, the work presented is entirely my own.

Signed

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As Professor Albus Dumbledore once said, "It is not our abilities that show what we truly are, it is our choices." I am so glad with my choice of pursuing this PhD, which makes me a much stronger person in every sense of the word.

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Chapter 1: Overview of Thesis

The overall aim of this thesis is to investigate whether and how mindfulness may be positively associated with and/or promote individuals' willingness to sacrifice in romantic relationships. We addressed this research question through a series of seven studies. We started by exploring whether higher levels of mindfulness may be indirectly related to greater willingness to sacrifice through lower relationship ambivalence and higher commitment (Studies 1-2). We then investigated the causality between these factors with an experimental manipulation of mindfulness, and whether these patterns may be different when various types of sacrifice were assessed (Studies 3-6). We finished our investigation with a longitudinal study, which examined the potential prospective influence of mindfulness on WTS through relationship ambivalence and commitment (Study 7).

The aim of this chapter is to provide a brief preview for each chapter in the current thesis. The introduction chapter provides the essential background knowledge of the key topics covered in our studies. By introducing the concepts of mindfulness, willingness to sacrifice, relationship ambivalence and commitment, and how these constructs may potentially be linked to each other, we established the rationale of our research question. Chapter 3 is the first empirical chapter, which explores and confirms the potential link between mindfulness and individuals' willingness to sacrifice in hypothetical scenarios, and whether relationship ambivalence and commitment may uniquely or jointly explain such an association. The established model was then further investigated through the four experimental studies introduced in Chapter 4, in which a brief online experimental manipulation of mindfulness was implemented to examine the causality of the links in the established model. We also operationalized individuals' willingness to sacrifice using various measures in the experimental studies and investigated whether factors precede hypothetical and actual willingness to sacrifice may be different. The final empirical chapter, Chapter 5,

reconciles the mixed findings from the previous studies and further addresses how mindfulness may prospectively influence individuals' willingness to sacrifice through relationship ambivalence and commitment in a 5-week longitudinal study. Finally, Chapter 6 concludes this thesis by discussing the consistent and inconsistent findings across the seven studies, as well as the implications and promising directions for future mindfulness and relationship studies.

Chapter 2: Introduction

2.1 Mindfulness & Willingness to Sacrifice

2.1.1 Introducing Mindfulness

2.1.1.1 The Nature of Mindfulness

Originating from Buddhist and other contemplative traditions, *mindfulness* has attracted wide-ranging interests in contemporary psychology during the past two decades (Shapiro et al., 2006). Although some researchers argue that a universally accepted technical definition of "mindfulness" is yet to be established (Van Dam et al., 2018), when being referred to as a mental capacity in Western psychology,[1] mindfulness has consistently been described as moment-to-moment consciousness, cultivated by paying open-hearted, non-reactive and non-judgmental attention to and awareness of the present-moment experiences (Kabat-Zinn, 1990, 2011). To further interpret this conceptualization, it is important to note that mindfulness refers to a state of consciousness, which consists of awareness and attention (Brown & Ryan, 2003). Awareness, in the general sense, refers to the evidence-based knowledge derived from one's senses or intellect (Funk & Wagnalls, 1968; Yaure, 1973). Mindful awareness, on the other hand, significantly differs from our usual modes of awareness as it is characterized by an open-minded, non-analytic orientation of the present-moment experiences (Shankland et al., 2017). In other words, awareness in the context of mindfulness is sustained at a specific pitch, reflecting one's capacity of capturing the ongoing internal and external experiences with a curious and welcoming attitude, which usually demands gradual refinement through certain practices, e.g., mindfulness meditation

[1] Since the aim of this thesis is to investigate the possible role of mindfulness in fostering positive adjustment and psychological well-being of the general population, we will introduce the conceptualization of mindfulness within the context of modern psychology where interpretation of mindfulness is primarily developed from its clinical applications. An introduction in terms of the canonical conceptualization of mindfulness will be beyond the scope of this thesis and therefore will not be included (for a brief overview of the Buddhist understanding of mindfulness, see Quaglia et al., 2015).

(Grossman, 2011). An individual who is mindfully aware of the everchanging moment-to-moment experience fully acknowledges whatever is going on in the present-moment, does not attempt to avoid or suppress potentially negative experiences, and welcomes all experiences without judging them (Shankland et al., 2017). As a component of mindfulness, awareness serves as the background information detector that monitors the internal and external environment. Attention, the other subset of mindfulness, refers to the process where heightened awareness is directed to a specific range of stimuli/experiences, which are then "pulled" to the center of attention (Westen, 1999). An individual might be aware of but not attend to certain stimuli/experiences. For example, when having a meal, an individual may be aware of the smell and taste of the food as well as the gradually increasing feeling of fullness in the stomach, while his/her attention is primarily focused on the food but not the feeling of fullness. In other words, awareness and attention work complementarily in everyday life, with attention picking up targets from the background of awareness, "highlighting" them for varying lengths of time (Brown & Ryan, 2003).

Mindfulness has been considered an enhanced state of consciousness where open and undivided awareness and attention are present (Brown & Ryan, 2003; Deikman, 1982; Martin, 1997). For example, when communicating with one's partner, a mindful individual can be highly attentive to the conversation and sensitively aware of the subtle fluctuations of the partner's facial expressions or tone in the voice, without being distracted by internal (e.g., his or her own emotions or thoughts) or external (e.g., environmental noise) factors. This is to be contrasted with mindlessness, denoted as the absence of mindfulness, where blunted or restricted consciousness may lead to ruminative or lingering feelings or thoughts about the past, or anxieties and fantasies about the future (Brown & Ryan, 2003). When being referred to in the same context and situation, mindfulness and mindlessness are the opposites on the same scale (e.g., being mindless towards a partner's emotional needs on certain days is

equivalent to not being mindful towards a partner's emotional needs on certain days). However, when being referred to in different contexts or situations, mindfulness and mindlessness, while being highly negatively correlated, should be regarded as two independent constructs (Daks et al., 2021). That is to say, an individual may be mindful in one context (e.g., being mindful towards a partner's sexual needs) or situation (e.g., being mindful towards a partner's sexual needs on certain days), but mindless in another context (e.g., being mindless towards a partner's emotional needs) or situation (e.g., being mindless towards a partner's sexual needs on other days) (Daks et al., 2021). Mindlessness may be reflected in automatic behaviours (i.e., acting on "auto-pilot") (Deci & Ryan, 1980; Smalley & Winston, 2010), and in defensive reactions when one is reluctant to recognize or attend to certain feelings, thoughts or bodily sensations (Schultz & Ryan, 2015). Awareness and attention may also be divided when one is occupied with various tasks simultaneously or preoccupied with thoughts that may hinder mindful engagement to the current moment (Kahneman, 1973). The aforementioned types of "impaired" consciousness are therefore considered counterpoints to mindfulness that detract one's awareness and attention from what is occurring at the present moment (Brown & Ryan, 2003).

Mindfulness is regarded as a pre-reflexive state of consciousness that operates perceptually on the contents of consciousness (e.g., thoughts, emotions, feelings, etc.) without generating evaluations on them (Brown & Ryan, 2003). Therefore, mindfulness can be distinguished from various forms of reflexive consciousness, an umbrella term for self-consciousness encompassing cognitive operations that generate mental accounts of the self (Baumeister, 1999; Bermudez, 1998). For example, private self-consciousness (i.e., a disposition to be highly attentive to and reflexive on one's inner state) and public self-consciousness (i.e., a disposition to be highly attentive to and reflexive on the self as it is viewed by other people (Fenigstein et al., 1975)), are two reflexive constructs that have

received considerable interest during the past three decades. These constructs appear to be related to mindfulness at first blush but are different in important ways. Private self-consciousness encompasses both internal state awareness and self-reflectiveness (Cramer, 2000; Trapnell & Campbell, 1999), meaning that individuals with high private self-consciousness may be preoccupied with reflections on one's internal state or self-image (e.g., constantly scrutinize one's behaviour or ruminate on one's thoughts), which is regarded as a sign of divided attention and awareness that may compromise mindfulness (Brown & Ryan, 2003). Public self-consciousness differs from mindfulness even more clearly by its external locus of attention on how the self is evaluated by others (Karremans et al., 2017). Most importantly, mindfulness can be distinguished from these constructs by its pure focus on the quality of consciousness itself; that is, the ability to offer bare attention to what is presently occurring, without becoming overly absorbed in the actual content (Brown & Ryan, 2003).

The attentive and pre-reflexive nature of mindfulness has also been addressed by Bishop et al.'s (2004) two-component model, which proposed an operational definition of mindfulness. The first component refers to the self-regulation of attention, the cognitive process in which attention is sustained, directed and limited to current experiences, thereby allowing high sensitivity to moment-to-moment mental processes. From this perspective, mindfulness can be regarded as a metacognitive process (thinking about one's thinking; Flavell, 1979), which encompasses the process of monitoring one's consciousness and controlling cognitive processes (e.g., directing one's attention to the present moment),[2] and thereafter leads to the second component of the model. The second component, summarized

[2] It should be noted that mindfulness involves controlling the direction of attention (i.e., being attentive to the present moment as opposed to the past or future), rather than controlling the content of attention (i.e., what behaviours, thoughts, or feelings are being attentive to), or reflecting on either the direction or content of the attention (e.g., distinguishes from private self-consciousness as mindfulness does not involve any reflections on the content of one's experiences, although both mindfulness and private self-consciousness involve monitoring and directing one's attention to one's experiences).

by Bishop et al (2014) as the orientation to experience, involves adopting a curious, open, and accepting stance towards each moment of a given experience. An acceptance stance involves being consciously and experientially open to one's true present-moment experiences, without attempting to produce any state or experience that is not in line with the current reality (e.g., trying to suppress the tension when feeling anxious) (Hayes et al., 1999; Roemer & Orsillo, 2002). Therefore, when acting mindfully, one is instructed to simply notice and observe any feelings, thoughts, and bodily sensations that arise, without being over-absorbed in or trying to alter them.

Mindfulness can be trained and cultivated, usually through meditation sessions where one can increase his or her capacity for daily mindfulness processes by repeatedly evoking the state of being mindful (Davidson, 2010; Garland et al., 2010; Karremans et al., 2017; Vago & Silbersweig, 2012). While various forms of meditation practices have been established (for an overview, see Sedlmeier et al., 2012), what they have in common is that meditators are instructed to focus their attention on either a meditation object (e.g., one's breath that comes in and out), or on any internal (e.g., feelings, thoughts, or sensations) or external stimuli (e.g., sounds) that arises from moment to moment. The aim of such meditation practices is to train an individual's attention regulation skills, so that one may be able to direct attention to momentary experiences more easily and habitually in everyday life (Lutz et al., 2008). The non-judgmental and open attitude can also be cultivated through meditation practices (Shapiro et al., 2006). Meditators are instructed to adopt an open and accepting stance when they notice their attention to the breathing, or other stimuli was distracted (e.g., just acknowledge that the mind wanders for a moment without judging it), and then gently bring the attention back to where it was originally focused on. The non-judgmental and non-reactive attitude cultivated repeatedly through meditation practices could be generalized to everyday life where individuals may become more aware and accepting

towards their moment-to-moment experiences during daily routines and interpersonal communications (Shapiro et al., 2006).

2.1.1.2 Trait and State Mindfulness

Mindfulness can be characterized as either a trait or a state. Trait-level mindfulness is considered as one's general tendency or predisposition to be mindful, and sometimes is also referred to as dispositional mindfulness (Baer et al., 2006; Lau et al., 2006). Representing an individual's long-term behavioural pattern, trait mindfulness reflects the between-person variability in the capacity for and engagement in mindfulness processes (Brown & Ryan, 2003; Medvedev et al., 2017). Elements of both nature and nurture may explain the individual differences in trait mindfulness. Firstly, some researchers have suggested that trait mindfulness can be considered as an inherent, relatively innate human capacity that varies naturally between people, possibly because of genetic or social factors (Baer, 2015; Brown et al., 2011). Secondly, abundant evidence has demonstrated that trait mindfulness can be cultivated through long-term and intensive training in mindfulness techniques, such as frequent meditation (Grossman & Van Dam, 2011). As a result, although it is assumed to be relatively stable over time in the absence of intervention, trait mindfulness can still change longitudinally as a result of life experiences, or repeated mindfulness meditation (Nyklíček et al., 2013; Shapiro et al., 2011; Tang et al., 2016).

Mindfulness facets can also be characterized by state-level, within-person differences (Medvedev et al., 2017). State mindfulness represents one's tendency to be mindful at any particular moment or within a narrow time window (e.g., the past 10 minutes). Because state mindfulness reflects one's unique adaptation to that time and occasion, it may be more prone to fluctuate under different conditions (e.g., with intervention) and across time (Baer, 2015; Bravo et al., 2018; Brown et al., 2011; Eisenlohr-Moul et al., 2016). In studies where mindfulness practices are implemented, state mindfulness is usually assessed before and after

the session to evaluate whether participant's post-intervention state mindfulness differs significantly from pre-intervention state mindfulness (Carmody et al., 2008; Lau et al., 2006). It is a particularly convenient way of monitoring temporary change in mindfulness for researchers who would like to investigate the causal relationship between mindfulness and relevant psychological processes (e.g., whether change in mindfulness would lead to change in the downstream variables) but do not have sufficient time or budget to assess changes in trait mindfulness.

2.1.1.3 Operationalizing Mindfulness

To appropriately study the role of mindfulness in relevant psychological processes (e.g., whether enhanced mindfulness leads to more positive psychological outcomes in certain context), researchers must be able to rigorously describe and assess mindfulness as a construct. To date various scales have been developed to measure mindfulness at both state and trait level. Although researchers recently started to investigate possible behavioural measures of mindfulness (e.g., the Meditation Breath Attention Scores Task employing real-time experience sampling of awareness of certain current-moment experiential object during mindfulness exercises; for a review, see Hadash & Bernstein, 2019), most existing mindfulness measures take the form of self-reported questionnaires. Quaglia et al. (2015) suggested that diversity of the scales, particularly differences in terms of factor structures, can be accounted for primarily by the scale's conceptual origin and intended use. Table 1 briefly summarizes the six commonly used trait mindfulness scales (Park et al., 2013) and the two commonly used state mindfulness scales (Quaglia et al., 2015).

Table 1

Psychometric Characteristics of Self-Report Mindfulness Scales

Scale	Number of items	Factor(s)	Conceptual Origin	Applicable Population
Scales measuring trait mindfulness				
Cognitive and Affective Mindfulness Scale – Revised (CAMS-R; Feldman et al., 2007)	12	Attention, Present focus, Awareness, Acceptance	Modern psychology	General/Unexperienced meditators
Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003)	15	Attention/Awarene ss	Traditional Buddhism, modern psychology	General/Unexperienced mediators, experienced mediators, clinical
Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006)	39	Observe, Describe, Act with awareness, Non-judge, Nonreact	Modern psychology	General/Unexperienced mediators, experienced mediators, clinical
Kentucky Inventory of Mindfulness Skills (KIMS; Baer et al., 2004)	39	Observe, Describe, Act with awareness, Act without judgment	Modern psychology	General/Unexperienced meditators, clinical
Freiburg Mindfulness Inventory (FMI; Walach et al., 2006)	30	Mindfulness	Traditional Buddhism, modern psychology	Experienced mediators, clinical
Philadelphia Mindfulness Scale (PHLMS; Cardaciotto et al., 2008)	20	Awareness, Acceptance	Modern psychology	General/Unexperienced mediators, experienced mediators, clinical
Scales measuring state mindfulness				
State Mindfulness Attention Awareness Scale (State-MAAS; Brown & Ryan, 2003)	5	See MAAS above	See MAAS above	See MAAS above
State Mindfulness Scale (SMS; Tanay & Bernstein, 2013)	21	State mindfulness of mind, state mindfulness of body	Traditional Buddhism, modern psychology	General/Unexperienced mediators, experienced mediators, clinical

The majority of the existing mindfulness scales are conceptually based on the canonical definition of mindfulness established by Buddhist scholarship or well-known Buddhist writings, the Western conceptualization of mindfulness established through clinical settings, or a combination of both (Quaglia et al., 2015). Although all of the commonly used mindfulness measures have addressed the quality of awareness and attention as a central factor, some mindfulness measures also include other features (e.g., acceptance, nonjudgement) because of the various conceptual origins (i.e., originated from canonical definition, or Western conceptualization, or a combination of both), leading to differences in factor structures (Quaglia et al., 2015). For example, the Mindfulness Attention Awareness Scale (MAAS; Brown & Ryan, 2003) and Freiburg Mindfulness Inventory (FMI; Walach et al., 2006) were primarily based on a combination of the canonical and Western clinical understanding of the concept of mindfulness and were designed to operationalize mindfulness as a one-factor construct that reflects the quality of one's naturally occurring present-centered *awareness* and *attention* (Park et al., 2013; Quaglia et al., 2015). The MAAS is designed to assess the intra- and interpersonal differences in how frequently an individual is, or is not, aware of and attentive to the current-moment experiences in everyday life, including variations in awareness of and attention to feelings, thoughts, behaviours, physical states, and interpersonal communications (Brown & Ryan, 2003). As a one-dimensional scale, the MAAS is distinguished by its only focus on the frequency of awareness of (i.e., being constantly conscious of the ongoing experience; Rapgay & Bystrisky, 2009) and attention to (i.e., flexibility focusing attention to the ever-changing internal and external experience; Rapgay & Bystrisky, 2009) the present-moment experiences, and does not address attitudinal factors (e.g., acceptance), motivational intent (i.e., why an individual is aware of and attentive to the current-moment experiences), or potential outcomes of mindfulness (e.g., calmness) (Brown & Ryan, 2003). On the other hand, the Kentucky Inventory of Mindfulness Skills

(KIMS; Baer et al., 2004) and Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) are two multi-factor scales that share similar structures. Both the KIMS and FFMQ were established from the model of Dialectical Behaviour Therapy (DBT; Linehan, 1993) aiming at enhancing one's mindfulness skills (i.e., the capacity to observe, describe, act with awareness, and be non-judgmental and non-reactive towards internal experiences), which were reflected in the factors being assessed by the KIMS and FFMQ (Quaglia et al., 2015). The FFMQ is considered to be the most comprehensive mindfulness scale as it consists of all the five aforementioned factors extracted from DBT (Sauer-Zavala et al., 2013), and is distinguished from the KIMS, which consists of four of the five components derived from DBT (Baer et al., 2004). Specifically, *observing* refers to being aware and attentive to one's internal and external experiences, e.g., feelings and thoughts. *Describing* refers to the tendency or capacity to put one's internal experiences into words. *Acting with awareness* is defined as acting with full and undivided attention as opposed to acting automatically. *Non-judgment of inner experience* means holding a non-analytic stance toward one's internal experiences such as sensations, thoughts, and emotions. Finally, *non-reactivity to inner experience* is defined as experiencing thoughts and emotions without being caught up in or dwelling on them (i.e., over-engagement with internal experiences) (Aguado et al., 2015). In addition, the Cognitive and Affective Mindfulness Scale - Revised (CAMS-R; Feldman et al., 2007) and Philadelphia Mindfulness Scale (PHLMS; Cardaciotto et al., 2008) are multi-factor mindfulness measures based on Kabat-Zinn's (2003, 2011) definition of mindfulness as the tendency of being highly aware of the present-moment experiences openly and non-judgmentally, with the CAMS-R incorporating additional factors on *attention* (i.e., the ability to regulate attention) and *present-focus* (i.e., the ability to be oriented to the current-moment experiences) compared to the PHLMS, which just encompasses two factors - *awareness* and *acceptance* (Feldman et al., 2007). The diversity of state mindfulness scales can be similarly

explained by the differences in factor structures due to various conceptual origins. The State Mindfulness Scale (SMS; Tanay & Bernstein, 2013), a commonly used scale measuring state mindfulness in addition to the State-Mindfulness Attention Awareness Scale (State-MAAS; Brown & Ryan, 2003), was based on a combination of the traditional Buddhist scholarship conceptualization and Bishop et al. (2004)'s two-component definition of mindfulness.

Scale diversity can also be explained by various intended uses, most notably the population of application (Quaglia et al., 2015). For example, the MAAS and CAMS-R were two comparatively short and jargon-free scales designed to assess mindfulness in a brief and accessible manner. These two scales were also designed to be applied to the general population regardless of past experiences in meditation (Park et al., 2013). On the contrary, the Trait Toronto Mindfulness Scale (TMS; Davis et al., 2009) and FMI were designed to assess mindfulness in the context of mindfulness meditation training, to be applied to more experienced meditators specifically (Quaglia et al., 2015). The KIMS and its descendant, the FFMQ, can be used in both experienced and inexperienced meditator samples. That being said, the FFMQ has been validated as a four-facet construct for the general population, and a five-facet construct for experienced meditators (with Observing as the fifth factor), and there has been mixed evidence regarding the influence of meditation experiences on the FFMQ assessment (Park et al., 2013). For instance, Van Dam et al. (2009) found that the FFMQ scores of meditators were higher than non-meditating students, and meditators' total scores of the FFMQ were related to meditation history. However, Baer et al. (2011) suggested there has been little to no evidence for differential item functioning (DIF)[3] of the FFMQ between same-age experienced and novice meditators. Taking these together, it is recommended that

[3] Differential item functioning is defined as the tendency to which a particular item on a multi-item scale may be measuring different abilities for people from different subgroups (e.g., in terms of gender, age, ethnicity, or education level etc.) (Osterlind & Everson, 2009).

studies employing the FFMQ as the measure of mindfulness should control for meditation experiences to minimize the interference of possible confounding factors.

The scales introduced above offer unique advantages as well as limitations in terms of the conceptual coverage of the elements of mindfulness, the item content, and the length of the scales. For example, the CAMS-R is a jargon-free measure that can be applied to the general population regardless of their meditation experiences, and is the shortest holistic mindfulness scale (i.e., containing 12 items) available in the current literature (Park et al., 2013). Therefore the CAMS-R has the advantage of allowing researchers to measure mindfulness in a short time. However, the CAMS-R, which highlights the cognitive flexibility in most of its items, has been criticized by some researchers for its emphasis on assessing individuals' ability (e.g., CAMS-R1: "It is easy for me to concentrate on what I am doing") and willingness (e.g., CAMS-R8: "It is easy for me to keep track of my thoughts and feelings") to be mindful as opposed to the extent to which mindfulness experience is realized throughout the day, which raised certain concerns regarding its content validity (Bergomi, 2013).

Similar to the CAMS-R, the MAAS is also designed to assess mindfulness in the general population within a comparatively short time (i.e., it is the second shortest mindfulness scale containing 15 items), and is currently the most popular mindfulness measure (i.e., with over 5000 citations from Google Scholar, see Van Dam et al., 2018). However, researchers have raised concerns regarding the one-factor structure of the MAAS (Bergomi et al., 2013; Shankland et al., 2017). The MAAS initially consisted of both a *presence* (i.e., awareness/attention of the present moment) and *acceptance* (i.e., acknowledging an open and non-judgmental stance toward the present moment) component. The acceptance component was later removed from the measure as the authors argued that it did not offer any further explanatory advantage over and above the awareness/attention

component (Brown & Ryan, 2004). Brown and Ryan (2004) suggested that the acceptance of the ongoing experience is already incorporated in individuals' ability of being fully aware and flexibly attentive to the current moment, and therefore would be a functionally redundant component if included in the scale. However, this claim has later been challenged as researchers have found the acceptance component of mindfulness is significantly correlated with indicators of well-being (e.g., rumination, thought suppression; Cardaciotto et al., 2008) which are not associated with the awareness component, indicating a potential unique explanatory power of the acceptance component (Bergomi et al., 2013). In addition, the MAAS and the State – MAAS have also been criticized for their item content. The items of the two scales were developed to capture the absence of attention and awareness in everyday modes of experiences, as opposed to the attention and awareness of one's physical and mental experiences to the current moment, or a specific moment during certain activities, such as mindfulness meditation. Furthermore, since all items of the MAAS and the state-MAAS are negatively worded, researchers have argued that the scales assess the lack of awareness and attention (Grossman, 2008), or day-to-day lapse of awareness and attention (Carriere et al., 2008), rather than individuals' realization of mindfulness to everyday experiences. As a result, the MAAS and the State-MAAS have been challenged regarding whether they may capture the entire spectrum of individuals' mindfulness experiences.

2.1.1.4 How Mindfulness May Promote Pro-Relationship Behaviours

Mindfulness has been consistently found to be positively associated with romantic relationship processes and outcomes (Karremans et al., 2017). According to Karremans et al (2017), higher levels of mindfulness can be beneficial to romantic relationship functioning from a) the cognitive perspectives, involving enhanced awareness and attention (Bishop et al., 2004), executive control (Chiesa et al., 2011), and relationship-specific motives such as commitment (Barnes et al., 2007); and b) the emotional perspectives, involving enhanced

affective experiences (Cameron & Fredrickson, 2015) and emotion regulation (Arch & Craske, 2006; Hill & Updegraff, 2012). In this section, we will introduce how mindfulness may promote pro-relationship behaviours, a specific positive relationship outcome, from cognitive and emotional perspectives. Our arguments are primarily inspired and theoretically based on Karremans et al.'s (2017) seminal article in which the authors proposed a theoretical model of how mindfulness may influence close relationship processes and outcomes. It should be noted that some arguments are presented for the purpose of establishing an initial understanding on the association between mindfulness and pro-relationship behaviours in general before proceeding to the topic on sacrifice, a specific type of pro-relationship behaviour that the current thesis focuses on. Therefore, some supporting arguments mentioned in this section will not be directly addressed or tested in our studies.

First, by paying undivided and non-judgmental attention to one's internal and external experiences in the current relationship, mindful individuals are more likely to detect their own automatic impulses that may otherwise be inaccessible to conscious awareness (Brown & Ryan, 2003; Carlson, 2013; Papies et al., 2012). Specifically, higher levels of mindfulness allow individuals to discern the automatically generated self-interested impulses that may lead to relationship-undermining behaviours (e.g., "I just want it my way and I don't care about the rest!") and split the direct and automatic link between the implicit impulses and subsequent responses (Papies et al., 2015). Mindful individuals may therefore be more inclined to engage in pro-relationship behaviours that may contradict their own implicit interests but in line with the interest of the partner (Karremans et al., 2017). Furthermore, being in a mindful state allows individuals to become more aware and attentive to a partner's interests and needs (Donald et al., 2019), and therefore increases the likelihood for an individual to perform pro-relationship behaviours to fulfill such needs. The capacity to discern one's self-interests and a partner's interests is crucial in initiating certain pro-

relationship behaviours, such as sacrificial behaviours, which is of particular relevance to the current thesis. We will incorporate this argument into the specific context of sacrifice in section 2.1.3 after introducing the psychological processes precede sacrificial behaviours in romantic relationship in section 2.1.2.

In addition to the enhanced awareness and attention to one's own interests and a partner's interests, mindfulness may further promote individuals' *ability* to perform pro-relationship behaviours by enhancing one's capacity to down-regulate the automatic self-interested impulses (Karremans et al., 2017). Specifically, researchers have suggested that the cultivation of a mindful state is related to enhanced self-regulatory capacity and executive control (Chiesa et al., 2011). Executive control comprises a number of cognitive functions including cognitive flexibility and inhibitory control. Cognitive flexibility refers to the capacity to adjust one's mental set to present-moment needs (e.g., attend to and respond appropriately to relevant stimuli; Diamond, 2013). Inhibitory control refers to the capacity to control one's attention, emotion, thoughts and/or behaviours so that an individual becomes capable of inhibiting inappropriate responses guided by internal predispositions or external temptations (Cásedas et al., 2019; Miyake et al., 2000). The cultivation of mindful awareness promotes an individual's cognitive flexibility through enhanced vigilance to mind-wandering (which has been found to occupy one's available attentional and executive resources; see Thomson et al., 2015). The cultivation of open and non-judgmental attitude promotes an individual's inhibitory control through enhanced capacity for disengaging from mind-wandering, increasing one's disposable attentional and executive control resources, which can in turn be more efficiently used to enhance one's performance monitoring and control (Teper & Inzlicht, 2013). In particular, during mindfulness meditation, meditators are asked to consistently monitor whether their attention is focused on current-moment experiences, and are instructed to gently bring the attention back to where it was originally focused on if

distraction occurs (Karremans et al., 2017). This practice of focusing and refocusing one's attention in turn provides a training basis for cultivating executive control (Teper & Inzlicht, 2013). In support of this, mindfulness-based interventions have been consistently found to promote executive control through enhanced executive attention and inhibitory control (Chiesa et al., 2011; Gallant, 2016), and cognitive flexibility (Lao et al., 2016) in adult samples. Vekety et al. (2021) also found positive effects of mindfulness-based interventions on overall impulse control of children aged from 3 to 12. Of conceptual relevance to the present research, a study by Pronk & Karremans (2014) provided more direct evidence by demonstrating a positive association between executive control and an individual's sacrificial behaviours in romantic relationships.

Third, mindfulness has also been found to positively influence individuals' affective experiences through increased positive emotions (e.g., love/closeness, joy, and moral elevation) and decreased negative emotions (e.g., disgust, stress, and guilt), which in turn influence people's pro-relationship behaviours respectively (Donald et al., 2019). In particular, individuals with higher present-focused attention experienced greater positive emotions that are associated with greater self-reported helping behaviours. In contrast, individuals with greater non-judgmental acceptance of experiences reported decreased negative emotions that are associated with less self-reported helping behaviours (Cameron & Fredrickson, 2015). As a result, mindfulness may promote an individual's motivation to respond to a partner's need through more positive affective experiences

Finally, mindfulness may promote an individual's capacity of performing pro-relationship behaviours through decreased inhibition of compassionate reactions (Teper & Inzlicht, 2013). Mindful people, who can attend to their emotions quickly and accurately, are more attuned to their emotions and therefore hold a more accepting stance towards their emotional states (Teasdale et al., 2002; Niemiec et al., 2010). By observing and experiencing feelings and

thoughts come and go, one is more likely to accept the existence of negative emotions without identifying too much with them and therefore less likely to be caught up in feeling negatively (Farb et al., 2010; Teper & Inzlichi, 2013). A number of studies have provided supporting evidence that mindfulness is associated with enhanced emotion regulation and less emotion reactivity (Arch & Craske, 2006; Creswell et al., 2007; Goldin & Gross, 2010; Hill & Updegraff, 2012; Ortner et al., 2007). As a result, more mindful individuals are less likely to inhibit compassionate reactions and more likely to behave in a more cognitively flexible manner even when experiencing negative emotions (Condon, 2017; Donald et al., 2016), which may in turn increase their capacity of performing pro-relationship behaviours such as sacrifice.

2.1.2 Introducing Willingness to Sacrifice

2.1.2.1 Understanding Willingness to Sacrifice in Romantic Relationships

Imagine the following scenario: Mary has been quite satisfied with her personal life over the last few months because she thinks she finally found the perfect partner, Matthew. She is particularly looking forward to the upcoming party at her favourite pub this Sunday, where she plans to introduce Matthew to her friends. However, Matthew feels less excited about the party as he has just returned from his long-distance business trip and would rather rest at home for the entire weekend. Now Mary and Matthew are facing a difficult situation where one of them would have to change their plans for the sake of their partner. Will Matthew give up the snacks and cozy sofa and go to the party with Mary, or will Mary postpone the party and spend the weekend at home with Matthew?

Being in love can be a tremendous source of joy, while at times it may also turn into a source of irritation when partners' preferences or interests are not compatible, as in the above case with Mary and Matthew. Partners encountering conflicts of interests tend to experience increased negative affect, stress, and decreased relationship satisfaction (Righetti et al.,

2016); therefore, how they respond to such dilemmas are crucial for the quality and stability of the relationship. One solution to these conflicting situations that enables the romantic relationship to survive and thrive is for one or both parties in the relationship to sacrifice their own interests for their partners' needs. In our hypothetical scenario, it means that either Mary or Matthew would have to forego their original plans for the sake of their partner's happiness.

In the context of romantic relationships, *sacrifice* has been defined as giving up one's immediate self-centered interest to promote the partner's preferences and needs (Van Lange et al., 1997). Sacrifice can be classified as either active sacrifice (i.e., engaging in undesirable activities for one's partner) or passive sacrifice (i.e., giving up desirable activities for the close other; Righetti et al., 2013). For example, Mary would be performing a passive sacrifice if she chose to cancel the party and stay at home with Matthew, while Matthew would be performing an active sacrifice if he chose to go to the party with Mary. Romantically-involved individuals may make fairly routine sacrifices for their partner, such as deciding what to eat for dinner, changing weekend plans, or doing small favours for their loved ones (Impett et al., 2005), while at other times people may need to make more significant sacrifices for their partner, such as giving up a favourite hobby that one's partner does not like, lending a large amount of money to solve a partner's financial problem, or moving to another city to support a partner's professional development (Gere & Impett, 2018; Righetti & Impett, 2017). In psychology research, sacrifice is commonly assessed either as an intention, referred to as *willingness to sacrifice* (WTS; Van Lange et al., 1997), or an actual behaviour performed in the relationship (Impett et al., 2012; Impett et al., 2005; Righetti et al., 2015). It remains controversial whether actual performed sacrifice is beneficial to relationship well-being. While some researchers found enacted sacrifice to be positively linked to relationship satisfaction (Chen & Li., 2007; Lan et al., 2017; Ruppel & Curran, 2012; Zhang & Li, 2015; Zhu et al., 2020), other researchers found no such association

(Righetti et al., 2016; Totenhagen et al., 2013). Some previous studies even found enacted sacrifices to be negatively associated with implicit partner evaluations (Righetti et al., 2020) and relationship satisfaction (Totenhagen & Curran, 2011; Whitton et al., 2007; Curran et al., 2016). In particular, Righetti et al (2020) suggested that individuals who performed sacrifices in general exhibited greater negative mood, frustration, and feelings of being exploited. By contrast, individuals' WTS has been consistently found to be positively linked to relationship well-being, as it builds a "climate" of trust between the two romantically involved individuals (Righetti & Impett, 2017; Van Lange et al., 1997). Therefore, the studies to be introduced in this thesis are primarily focused on investigating the relationship between mindfulness and WTS in close relationships.

2.1.2.2 Understanding Transformation of Motivation through the Interdependence Theory

The interaction between two people is shaped by both intra- and interpersonal psychological processes. From a social psychological point of view, these interactions can be regarded as the integrated result of each person's needs, thoughts, and motives in relation to one another under certain social situations where the interaction takes place. In terms of sacrifice, people's response to the specific situation where their own needs and preferences are not compatible with that of their partner depends on and is shaped by the interpretation and evaluation of one's own preferences, cognitions oriented towards understanding a partner's preferences, and motivation to act in a moral and benevolent manner. In other words, sacrifice in romantic relationships can be considered as the result of a transformation of motivation, which refers to the process of transforming one's own immediate self-interested impulses into a response or action that is more compatible with the interests of their partner and the relationship (Kelley & Thibaut, 1978; Rusbult & Van Lange, 2003).

The interdependence theory (Rusbult & Van Lange, 2003) provides a conceptual framework of understanding this transformation process by demonstrating how intra- and interpersonal processes are shaped by various social situations. According to the interdependence theory, a given social interaction is characterized by a unique situation structure that delineates the nature of the interpersonal reality. Rusbult and Van Lange (2003) introduced that situation structure encompasses six dimensions. The first dimension is *level of dependence*, the extent to which one is dependent on his or her partner such that one's outcomes are affected by a partner's act. High levels of dependence may potentially activate partner-focused and partner-oriented emotion, attention and cognitive activities and reinforce persistence in a romantic relationship (Arriaga & Rusbult, 1998; Bui et al., 1996; Drigotas & Rusbult, 1992; Fiske, 1993). The second dimension is *mutuality of dependence*, the extent to which one and his or her partner equally rely on each other. Unbalanced dependence may yield unbalanced power, leaving one person being comparatively vulnerable and the other person being comparatively powerful in the relationship. As a result, the less powerful person is more likely to behave benevolently while the more powerful partner is more likely to act exploitatively when the couple's interests do not meet (Baumeister et al., 1993; Fiske, 1993; Drigotas et al., 1999). The third dimension considers the *nature of dependence*, depicting the pattern by which romantically involved individuals influence one another's outcome. A person's outcome can be primarily influenced by the partner alone, yielding partner control, or by the joint actions of both parties in the relationship, yielding joint control (Buss & Craik, 1980; Clark & Mills, 1993; Fiske, 1992). The fourth dimension refers to the *covariation of dependence*, the extent to which two people's outcomes correspond, or whether what is best for one person is also what is best for his/her partner. Covariation ranges from perfectly compatible situations, where partners' needs correspond perfectly and there is zero divergence, to perfectly incompatible circumstances, where partners experience the most

extreme conflicts of interests such that their needs do not converge at all (Holmes & Murray, 1996; Insko & Schopler, 1998; Van Lange, 2000).

The fifth dimension refers to the *temporal nature* of social situations, addressing the dynamic nature of interactions and relationships (i.e., these situations typically change and evolve over time). As a result, interpersonal processes should be interpreted not only in terms of the partners' immediate outcomes, but also in terms of potential future outcomes that become possible (vs. impossible) as a result of the interactions (Kelley et al., 2002). This dynamic nature can be reflected explicitly in situation selection, which refers to the movement (vs. decision against movement) from the current situation to a new situation that is different from the former one in terms of behavioural options, outcomes, or both (Rusbult & Van Lange, 2003). The last dimension is the *availability of information* one holds in terms of a partner's goals, motives, and outcomes as consequences of own or joint behaviour. Lack of information may lead to confusion or misunderstanding, hindering the course of interaction (Holmes, 1981; Kelley et al., 2003).

Social situations can be distinguished by their unique structure dimensions. For instance, a situation that can potentially yield sacrifice intentions or behaviours must be characterized by low covariation of interests between partners (Rusbult & Van Lange, 2003). A sacrifice situation may also be characterized by high and/or non-mutual dependence, non-mutual partner-control or mutual joint control, high possibility for situation selection, and adequate level of information between partners (Rusbult & Van Lange, 2003). Understanding situation structure is important as it helps us to obtain a clearer perspective on the nature of interpersonal reality, and in what direction we should direct research rationale. For instance, situations including conflicts of interests are typically characterized by concerns with self-centered interests and collective interests (Rusbult & Van Lange, 2003); therefore, if researchers would like to investigate individual's response in such situations and what factors

may possibly influence one's response, it is theoretically and logically plausible to investigate the affective processes and cognitive activities that may be directly or indirectly related to one's a) self-centered interests and b) motivation and capacity to consider and fulfill the interests of one's significant other.

According to the interdependence theory, partners in situations characterized by low covariation of interests and a high possibility for situation selection are initially in a *given situation*, where individuals' behavioural choices are regarded as the consequences of direct and immediate self-centered interests, ignoring other broader concerns such as partner's interests and the long-term well-being of the relationship (Rusbult & Van Lange, 2003). This is the case where individuals behave in a way that maximizes the immediate, "given" outcomes, and is particularly common among children or people who are less inclined or capable to take the "broader picture." Sometimes people may also make behavioural choices at "gut level" under conditions of heavy cognitive load (Lattimore & Maxwell, 2004).[4]

However, in reality one's initial behavioural preferences are often shaped by a number of other broader considerations, such as long-term goals, the desire to promote a partner's outcome or to yield positive symbolic outcomes on behalf of one's partner (Kelley, 1979). For instance, if Mary decides to cancel the party and stay at home with Matthew, Matthew's physical needs will be satisfied as he will be able to have a good rest at home. Meanwhile, the fact that Mary prioritizes Matthew's preference and need has symbolic meaning for Matthew, promoting his positive affect as Mary has shown that she cares and is responsive to Matthew's well-being. This interpersonal process also has symbolic meaning for Mary, promoting her positive affect as she has expressed her love and concern for Matthew, and demonstrated that she is a caring and nice person. Behaviour choices based on

[4] Cognitive load is defined as the amount of information that can be held by working memory at one time (Sweller, 2011).

these broader concerns yield a *transformation* (situation selection) from a given situation to an *effective situation*, where individual behaviours are guided by reconceptualized, effective preferences including strategic concerns and long-term goals that benefit the interests of one's partner or relationship (Rusbult & Van Lange, 2003). In summary, transformation of motivation is initiated when individuals become capable and motivated to engage in interpersonal processes yielding pro-relationship outcomes, which in turn contributes to the shift from a given situation to an effective situation. The natural next question, then, is what factors may promote this process of transformation of motivation.

2.1.3 Integrating Mindfulness and Willingness to Sacrifice

Mindfulness may be positively associated with pro-relationship behaviours from cognitive and emotional perspectives (Karremans et al., 2017). As the intention to perform a specific pro-relationship behaviour, WTS can be considered as the result of a transformation of motivation, which is characterized by individuals' capacity and motivation to sacrifice own immediate self-interest for the purpose of fulfilling a partner's needs (Rusbult & Van Lange, 2003). By cultivating heightened and non-judgmental mindful awareness and attention to one's internal and external experiences, mindfulness supposedly promotes individuals' capacity to sacrifice by promoting their capacity to attend to their own and partner's interests (Karremans et al., 2017). The cultivation of a mindful state may also help individuals to down-regulate the automatic self-interested impulses through enhanced executive control (Karremans et al., 2015, 2017), further enhancing their capacity of performing pro-relationship behaviours.

In this section, we will propose a conceptual model of how mindfulness may influence individuals' WTS in romantic relationships (see Figure 1). We will first revisit some arguments in section 2.1.1.4 on how greater mindfulness may contribute to individuals' capacity and motivation to perform pro-relationship behaviours. This time, we will

incorporate these arguments in the context of sacrifice and offer more context-specific explanation on how mindfulness may promote the process of transformation of motivation. By doing so, we aim to carry forward our earlier arguments on mindfulness and pro-relationship behaviours and extend it to the link between mindfulness and WTS when we have introduced the process of transformation of motivation to our reader. Our arguments are primarily inspired and theoretically based on the interdependence theory (Rusbult & Van Lange, 2003) and Karremans et al.'s (2017) seminal article. According to the interdependence theory, cognitions and emotions play critical roles in stimulating and guiding the process of transformation of motivation (Rusbult & Van Lange, 2003). We will illustrate how certain cognitive and emotional benefits yielded by mindfulness may shape relationship-specific outcomes in a way that the outcomes can eventually contribute to greater willingness to perform pro-relationship behaviours, such as sacrifice. This illustration covers relationship-specific outcomes involved in the given situation and transformation process – the two stages of transformation of motivation that are directly related to WTS. In addition, we will expand our question to include the possible relationship-specific factors that may account for the potential positive link between mindfulness and WTS. We will briefly introduce our reasons for including these factors in our studies and address each factor with more details in the following sections.

Mindfulness May Contribute to Sacrifice Capacity through Enhanced Awareness

Mindfulness contributes to a better interpretation of a given situation through greater awareness and monitoring of otherwise implicit and automatic self-centered impulses in situations involving conflicts of interests (Karremans et al., 2017). According to the interdependence theory, stimulation of transformation of motivation requires an individual's ability to recognize and identify the nature of the given situation they are in (Rusbult & Van Lange, 2003). A given situation is construed by one's automatic behavioural choices

reflecting the automatic self-centered interests and motives, and the direct given outcomes as a result of these behaviours. When acting mindlessly, an individual may repeatedly go through a fixed behavioural pattern in all given situations, where one acts automatically to maximize one's own immediate and direct outcomes (Rusbult & Van Lange, 2003). To initiate the transformation process, an individual needs to be consciously aware of such fixed behavioural pattern and be capable of capturing the automatic self-interested impulses. Individuals with low levels of mindfulness are less likely to detect such automatic impulses and therefore are more inclined to act on "auto-pilot," meaning that they may repeatedly adopt the behavioural pattern prioritizing their own preferences without realizing the nature of or the reason for their behaviours (Karremans et al., 2017). In contrast, when acting mindfully, individuals are more likely to discern such urges and feelings at an earlier stage, which may in turn disrupt the direct and automatic link between the implicit impulses and responses (Papies et al., 2015), and encourage pro-relationship behaviours that embodies broader concerns for the well-being of the partner and the relationship such as sacrifices (Karremans et al., 2017). For example, if Mary is a mindful person, she is likely to be aware that her preference for the party (vs. letting Matthew rest at home) is guided (or at least partly guided) by the self-centeredness that she wants to show her friends her happiness, or even show off her shiny new boyfriend in front of people. Such awareness essentially frees Mary's behavioural choices from control by the direct self-centered impulses, allowing her to be responsive to broader concerns (e.g., Matthew's comfort and well-being), which may eventually lead her to cancel the party.

Existing studies offered supporting evidence that mindfulness leads to greater awareness of automatically generated impulses. Papies et al. (2012) found that participants in a mindful attention condition, compared to those in the control condition, exhibited greater awareness of impulsive cravings for tempting but unhealthy food. In terms of interpersonal

relationships, Cox et al. (2012) demonstrated that mindfulness may promote an individual's ability to be aware of automatic prejudiced feelings and impulses so that such impulses may not necessarily guide one's consequential reactions or behaviours. Similarly, Lueke and Gibson (2015) found that participants with increased state mindfulness following a 10-min mindfulness exercise became more aware of the automatic activation of negative associations to outgroup members, and consequently exhibited less implicit outgroup bias than participants in the control condition.

The beneficial effect of mindfulness on the interpretation of a given situation is also reflected in one's enhanced awareness of and attention to a partner's needs. Since mindfulness is characterized by open and undivided awareness and attention, mindful people are usually less preoccupied with existing thoughts or stereotypes (Bishop et al., 2004), and can be more attentive to the communication with a partner without being distracted by his or her own emotions or thoughts. For example, if Mary is a mindful person, she may be sensitively aware of the subtle fluctuations in Matthew's facial expressions and voice tone ("He sounds a bit upset, did my request make him unhappy?") without being distracted by her own excitement about the coming party. She may also be less preoccupied with pre-existing impressions that may not correspond to her partner's current need ("Matthew has always been energetic, so there's no reason that he wouldn't want to go to the party"). Indeed, existing evidence has suggested that mindfulness-based interventions contribute to the cultivation of interoceptive awareness (e.g., through enhanced activity in insula; Farb et al., 2007), which is known as the ability to recognize, access, understand, and properly respond to one's internal bodily state (Craig, 2015). More importantly, enhanced interoceptive awareness is also associated with greater capacity for processing others' emotional experiences (Singer et al., 2009) and greater awareness of other people's needs in a social context (Donald et al., 2019). As a result, mindful attention may help individuals to become

more aware of not only their own feelings and thoughts, but also the needs of their partners, which sets the foundation for individuals to perform sacrifices to fulfil their partner's needs.

Mindfulness May Contribute to Sacrifice Motivation through Relationship Specific Motive

Mindfulness may also promote individuals' motivation to perform pro-relationship behaviours through enhanced affective experiences. As introduced in section 2.1.1.4, the cultivation of present-moment attention promotes positive emotions that are associated with greater helping-behaviours, while the cultivation of non-judgmental acceptance is linked to lower negative emotions that are associated with less helping behaviours (Cameron & Fredrickson, 2015; Donald et al., 2019). When it comes to WTS, the intention to perform a specific type of pro-relationship behaviour, the beneficial influence of mindfulness on overall affective experiences may be reflected in individuals' greater relationship quality. Existing evidence has demonstrated that more mindful individuals tend to report higher relationship quality (Burpee & Langer, 2005; Kozlowski, 2013; McGill et al., 2016; McGill & Adler-Baeder, 2020), and that individuals with higher self-reported relationship quality exhibited greater willingness to forego self-interests (Etcheverry & Le, 2005; Monk et al., 2014; Van Lange et al., 1997; Wieselquist et al., 1999). According to the interdependence theory, relationship quality[5] should be regarded as multidimensional, which incorporates factors reflecting how the relationship is experienced as stable (e.g., relationship stability) and fulfilling (e.g., relationship satisfaction, closeness, and commitment) by the romantically involved individuals (Kelley, 1979; Sabatelli & Shehan, 1993; Totenhagen et al., 2013). The interdependence theory further suggests that commitment serves as a central relationship specific motive that helps to promote the process of transformation of motivation and

[5] It should be noted that the relationship quality presented here refers to the umbrella term of a variety of factors representing relationship well-being (e.g., relationship satisfaction, relationship stability, and commitment). This is to be distinguished from the relationship quality mentioned in the next paragraph, which stands alone as a psychological construct.

subsequent pro-relationship outcomes, including WTS (Rusbult & Van Lange, 2003). Indeed, previous studies have offered supportive evidence that higher levels of commitment are associated with greater WTS (Etcheverry & Le, 2005; Powell & Van Vugt, 2003; Van Lange et al., 1997; Wieselquist, et al., 1999). We therefore believe it is theoretically plausible to include commitment in our main research question and investigate its role in the potential link between mindfulness and WTS.[6]

Understanding the Mindfulness-WTS Link from a Novel Perspective on Relationship Quality

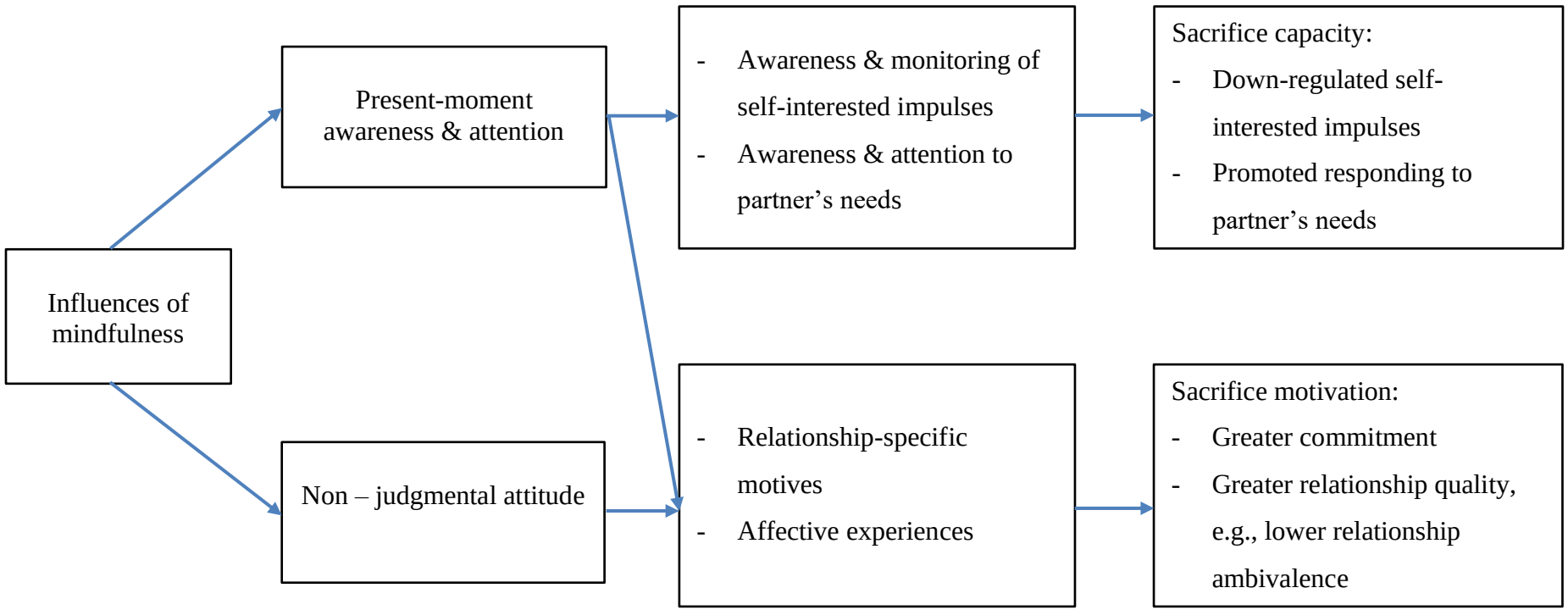
While greater relationship quality has been consistently found to be linked to more positive relationship outcomes (for a review, see Kiecolt-Glaser & Newton, 2001), few study considers the complexity of relationship quality as a psychological construct, and the possibility that individuals may experience positive and negative relationship quality simultaneously (Reblin et al., 2020). However, researchers have demonstrated that ambivalent relationships, which are characterized by simultaneous high positivity and high negativity, has unique influence on a number of psychological outcomes, including stress, depression, and anxiety (Vaughn et al., 2016), and physical outcomes, including cardiovascular functioning (Birmingham et al., 2009; Holt-Lunstad et al., 2007) and telomere length (Uchino et al., 2012). Researchers further suggest that models incorporating multiple dimensions of relationship quality (i.e., independently measures the extent to which individuals experience positivity and negativity in a relationship) provide better prediction over and above models incorporating unidimensional measure of relationship quality (i.e., measures purely the extent to which individuals experience positivity, or negativity in a relationship) (Herr et al., 2019; Holt-Lunstad et al., 2010). We therefore treat relationship

[6] We will offer more in-depth introduction on the concept of commitment and how it may be related to mindfulness in section 1.2.2.

quality as a two-dimensional construct in our studies and aim to investigate how experiences of simultaneous high positivity and high negativity in a romantic relationship may account for the potential link between mindfulness and WTS.

Figure 1

A Conceptual Model of How Mindfulness May Influence Willingness to Sacrifice



2.2 Relationship Ambivalence and Commitment

2.2.1 Understanding Relationship Ambivalence in Romantic Relationships

Romantically-involved individuals routinely experience mixed feelings towards their partner and the relationship - they may be extremely satisfied with a partner's wonderful qualities ("My partner is such a funny person with great sense of humor"), but may at the same time be frustrated by the negativity experienced in the relationship ("But he/she socializes way more than I expected, and I can't help but wonder whether our relationship is as strong as I want it to be"). Indeed, individuals' experiences in romantic relationships are not uniformly positive or negative, or to put it in other words, "positivity and negativity are not opposites on the same scale" (Uchino et al., 2014, p. 1); rather, romantic relationships can be a source of *ambivalence,* where positive and negative experiences towards a partner and/or relationship can co-occur (Haddock et al., 2017). It is common for individuals to experience ambivalent attitudes and evaluations towards a partner or the current relationship (Joel et al., 2018; Righetti et al., 2020; Zayas & Shoda, 2015). However, existing evidence suggests that experiencing high levels of positivity and negativity simultaneously in romantic relationships can have negative consequences for personal well-being (e.g., higher blood pressure, coronary artery calcification, and inflammation; Birmingham et al., 2015; Uchino et al., 2013; Uchino et al., 2014).

Studies investigating ambivalence commonly distinguish between two approaches in terms of how ambivalence is conceptualized and operationalized. Subjective ambivalence, sometimes also referred to as attitudinal ambivalence, is characterized by the extent an individual subjectively experiences conflicting feelings towards an attitude object, including feelings of confusion, indecision, and conflict, and is often assessed by asking participants to indicate explicitly how torn they felt towards certain attitude object (e.g., "To what extent do you feel indecisive/conflicted/confused about euthanasia?") (Dummel, 2018). On the other

hand, objective ambivalence reflects people's integrated positive and negative experiences towards an attitude object. To assess objective ambivalence, researchers need to measure participants' positive and negative feelings or responses towards an attitude object respectively (e.g., using two sets of questions about the same attitude object), and then mathematically combine the positive and negative scores using specific formulas (Haddock et al., 2017; Thompson et al., 1995).

Relationship ambivalence (RA) can be assessed as either subjective or objective ambivalence, much depends on the research question and what other scales are used alongside. When being assessed as subjective ambivalence, RA is measured by directly asking participants how ambivalent or conflicted they felt towards their partner and/or relationship (e.g., "To what extent do you feel conflicted towards your partner/relationship?", "Did you have mixed feelings about your partner?"; see Priester & Petty, 1996). This kind of self-reported assessment reflects an individual's meta-cognitive ambivalence, which refers to the conflicted and torn feelings that an individual can consciously be aware of and attend to (Haddock et al., 2017). Researchers have suggested that holding strong and simultaneous positive and negative feelings towards an attitude object, or objective ambivalence, may not always lead to the conscious and direct experience of conflicted feelings, or subjective ambivalence (Weng & Demarree, 2019). To translate it to topics in the context of romantic relationships, it means that individuals who hold both strong positive and negative evaluations towards a partner may not always be consciously aware of such conflicted evaluations. Therefore, objective ambivalence assessment, which is not constrained by participants' capacity for meta-cognition, may be more suitable for studies aiming at understanding individuals' "objective" experiences as opposed to "perceived" or "evaluative" experiences in romantic relationships. A second reason objective ambivalence is prudent to study is that subjective ambivalence assessment may overlap with other constructs that also

involve a meta-cognition dimension, such as mindfulness. As described in section 2.1.1.1, the self-regulatory process of monitoring one's consciousness is essentially a meta-cognitive process (Bishop et al., 2004). As a result, the association between mindfulness and RA may be overestimated when RA is measured as subjective ambivalence than when it is measured as objective ambivalence, as individuals' capacity for meta-cognition may account for part of the association. Thus, in the present research we measured objective ambivalence rather than subjective ambivalence.

Although few studies have investigated how mindfulness might be related to RA in the specific context of romantic relationships, previous studies have consistently demonstrated a link between trait mindfulness and ambivalence towards non-relational attitude objects, with greater mindfulness being related to lower levels of subjective (Dummel, 2018; Haddock et al., 2017) and objective ambivalence (Haddock et al., 2017). We suggest that, based on existing theories and evidence, this negative association between mindfulness and general ambivalence may be extended to the context of romantic relationships for two main reasons. First, mindful individuals may hold less ambivalent evaluations towards a partner because they are more accepting of their partner in general. As introduced earlier, one of the key steps in cultivating mindfulness involves being highly aware and attentive to one's current-moment experiences (Bishop et al., 2004). In the context of romantic relationships, more mindful individuals are more aware and attentive to their reactions to a partner's shortcomings (e.g., annoyance, desire for an "ideal" partner), and therefore are more likely to recognize that it may usually be their own negative reactions to the shortcomings, but not necessarily the actual shortcomings, that lead to frustration or distress (Karremans et al., 2017). This capability to distinguish the source of distress may motivate romantically-involved individuals to cultivate a more accepting attitude towards the partner and relationship (Karremans et al., 2017). Indeed, researchers have found that trait

mindfulness is positively related to partner acceptance (Kappen et al., 2018), which may eventually contribute to decreased actual-ideal partner discrepancy (i.e., the extent to which individuals perceive their partners as closely matching their ideal standards; Campbell et al., 2013), which has been found to be negatively related to ambivalence (DeMarree et al., 2014).[7] Second, because mindful people recognize their emotions without identifying too much with them, they are less likely to be "caught up" with negative emotions, and experience lower levels of negative affect in general (Kiken & Shook, 2011), which may in turn contribute to less ambivalence (Haddock et al., 2017).

2.2.2 Understanding Commitment in Romantic Relationships

In addition to RA, certain relationship-specific motives also have significant influence on individuals' pro-relationship act and intention (Rusbult & Van Lange, 2003). Romantically-involved individuals' behaviours can, to a large extent, be directed and shaped by relationship-specific motives, which refer to one's tendency to respond to certain situations in a specific way with a specific partner (Rusbult & Van Lange, 2003). Commitment is considered to be one of the most important relationship-specific motives, as it refers to the extent to which one feels psychologically attached to and intends to persist in a specific relationship (Rusbult, 1983; Rusbult et al., 1994). Commitment has been found to be the second strongest predictor of nonmarital romantic relationship longevity (Le et al., 2010), and consistently linked to positive relationship outcomes, including enhanced relationship satisfaction (Frank & Brandstätter, 2002; Givertz & Segrin, 2005) and pro-relationship behaviours (Wieselquist et al., 1999).

The positive association between mindfulness and commitment can be theorized based on at least two reasons. First, mindfulness is positively related to an individual's

[7] It is important to note that the purpose of bringing in partner acceptance and actual-ideal partner discrepancy is to simply help us develop a better understanding on how and why mindfulness may be negatively related to RA - this thesis does not aim to investigate the role of partner acceptance or actual-ideal partner discrepancy in interpersonal dilemmas.

feeling of closeness with others (Brown et al., 2007), which has in turn been positively related to commitment (Park et al., 2019; Rusbult et al., 1998; Wieselquist et al., 1999). By being mindful towards one's own responses or experiences under certain circumstances, it also helps an individual to cultivate an understanding of how others' acts may be affected and shaped by external factors (Block-Lerner et al., 2007). Indeed, existing evidence has shown that mindfulness can enhance feelings of empathy and understanding towards other people's behaviours (Birnie et al., 2010; Block-Lerner et al., 2007; Hutcherson et al., 2008). Such an understanding can in turn facilitate feelings of closeness and commitment in a romantic relationship (Karremans et al., 2017). Second, in a mindful state, people tend to be more aware of any lingering feelings or retaliatory thoughts in the aftermath of conflicts. When acting mindlessly, such feelings or thoughts may automatically guide subsequent detrimental behaviours or decisions (Karremans, 2017). As a result, mindful individuals are less likely to be caught up in the negative feelings or thoughts of the unpleasantness that happened in the past and may be more capable of incorporating long-term goals when making future decisions. This cognitive benefit of mindfulness overlaps with the long-term orientation dimension of commitment (Rusbult & Van Lange, 2003). In other words, an individual who is mindful may as well be a committed person in a romantic relationship because s/he tends to be more capable of behaving in a way that promotes the long-term interests of the relationship.

In support of this theoretical explanation, previous studies have indeed demonstrated a positive link between mindfulness and commitment in the context of romantic relationships. For instance, Barnes et al. (2007) found that state mindfulness mediates the link between dispositional mindfulness and the positive change in love/commitment after a relationship conflict discussion. A more recent study by Knowles et al. (2015) suggested that mindful ability to describe, a subscale of mindfulness characterized by the capacity to define and label

present moment experiences into words, positively predicted commitment in romantic relationships.

2.2.3 Integrating Relationship Ambivalence and Commitment

Commitment and RA are both known as constructs representing relationship quality, with commitment reflecting certain "desirable" aspects of a relationship, and RA reflecting certain "undesirable" aspects of a relationship. Committed people are long-term oriented and exhibit high levels of satisfaction and closeness in the relationship (Johnson & Rusbult, 1989; Rusbult & Van Lange, 2003). By contrast, individuals with high RA tend to exhibit low relationship satisfaction and closeness and may be conflicted about whether they should be long-term oriented towards the current relationship (Campbell et al., 2005; Joel et al., 2018; Joel et al., 2021; Mikulincer et al., 2010). Therefore, it seems logical to propose that RA may be negatively related to commitment. Due to the lack of explicit empirical evidence on the association between RA and commitment, we will draw our theoretical arguments from studies investigating a) attachment insecurities, and b) stay/leave ambivalence, being ambivalent towards whether to continue staying in an intimate relationship. While stay/leave ambivalence is not exactly the same as ambivalence in terms of positive and negative relationship qualities, they are similar in some ways. We will not expand our discussion on the similarity and difference between the two constructs in the thesis as this is not our focus. Therefore, it is important to note that the purpose of bringing in attachment insecurities and stay/leave ambivalence is to simply help us develop a better understanding on how and why ambivalence in romantic relationships may be related to commitment - this thesis does not aim to investigate the role of attachment insecurities or stay/leave ambivalence in interpersonal dilemmas.

While little research has explicitly investigated the link between RA and commitment, existing evidence has found attachment anxiety and avoidance, the two

dimensions of attachment orientations, to be positively related to RA (MacDonald et al., 2013; Mikulincer et al., 2010) and negatively related to commitment in romantic relationships (DeWall et al., 2011; Etcheverry et al., 2013; Keelan et al., 1994). Anxiously attached individuals, who suffer from hyperactivating attachment systems (Cassidy & Kobak, 1988), fear about being rejected or abandoned by a partner, and therefore are excessively vigilant and may sometimes exaggerate a partner's disengagement from the relationship (Feeney, 2004; Mikulincer & Shaver, 2003; 2007). In particular, people with higher levels of attachment anxiety tend to exhibit greater distress and hold more negative appraisals on a partner's response during conflicts, and perceive the influences of such conflicts on their relationships more negatively, even when their partners reported more positive and propitiatory responses to them during conflicts (Campbell et al., 2005). As a result of the increased negative affect and negative evaluations on a partner and/or relationship, anxiously attached individuals tend to experience greater ambivalence in their relationship. Indeed, Mikulincer et al. (2010) found that anxiously attached people showed greater attitudinal ambivalence toward their partners. MacDonald et al. (2013) found that attachment anxiety led to increased reward-threat ambivalence as a result of amplified social threat perceptions (e.g. rejection, negative evaluation) in intimate relationships.[8] Besides, anxiously attached individuals exhibit lower levels of trust to their partners' long-term benevolence (Holmes & Rempel, 1989) and less closeness (on days involving conflicts; see Campbell et al., 2005), which may in turn lead to decreased dependence and commitment in romantic relationships. Indeed, previous studies have consistently demonstrated a negative association between attachment anxiety and relationship commitment (Etcheverry et al., 2013; Keelan et al., 1994).

[8] Ambivalence in terms of reward/threat perceptions is not exactly the same as ambivalence in terms of positive and negative relationship experience, but they share/bear a significant proportion of similarity. We will not expand on this in the thesis as this is not the focus - we just list it as a supporting evidence for our account of the potential link between RA and commitment.

Avoidantly attached individuals, who suffer from deactivating attachment systems (Cassidy & Kobak, 1988), tend to be self-reliant and independent in a relationship (Fraley & Shaver, 2000; Mikulincer & Shaver, 2007), and avoid proximity as they don't feel comfortable to be psychologically intimate and close with a significant other (Bowlby, 1973; Brennan et al., 1998; DeWall et al., 2011). As a result, individuals with high levels of attachment avoidance exhibit less closeness to their partners (Mikulincer & Shaver, 2003), which may lead them to be less committed to a relationship. Indeed, previous studies have consistently demonstrated a negative association between attachment avoidance and relationship commitment (DeWall et al., 2011; Etcheverry et al., 2013; Keelan et al., 1994). Besides, avoidants are also inclined to be distrustful of a partner's benevolent intentions and view a partner as consistently unresponsive (Collins & Read, 1990; Feeney & Noller, 1990; Simposon, 1990; Mikulincer et al., 2010). As a result, avoidantly attached people may appraise their partners and/or relationship more negatively, which may in turn lead to greater RA. In support of this, MacDonald et al. (2013) found that attachment avoidance led to increased reward-threat ambivalence as a result of inhibited social reward perceptions (e.g. thoughts about gaining emotional reward from a partner; see Aron et al., 2000) in intimate relationships.

Studies on stay/leave ambivalence have been primarily inspired by the investment model (Rusbult, 1983), which suggests that individuals are likely to exhibit higher level of dependence and commitment to a relationship if they have high relationship satisfaction, perceive lower quality of alternatives, and have high investment in the relationship. Joel et al (2018) proposed that, beyond its predictive power, the investment model provides promising insights into individuals' ambivalent experiences on whether to stay in or leave a relationship, as individuals are supposed to make careful trade-offs between the potential losses and gains before deriving an evaluation of the overall relationship quality. This process of weighing

various aspects of the relationship illuminates the possibility that individuals may have conflicting experiences during the decision-making process, which is not necessarily reflected in the global investment model constructs (Joel et al., 2018).

Supporting the aforementioned argument, Joel et al. (2018) found that for individuals experiencing stay/leave ambivalence, commitment was linked to stronger endorsement of many of their stay reasons (e.g., long-term orientation, general satisfaction, and emotion intimacy) and weaker endorsement of many of their leave reasons (e.g., lack of enjoyment, romantic alternatives, and loss of attraction). The authors suggest that these findings indicate that positive and negative relationship experiences jointly contribute to the global ratings on psychological constructs of relationship quality, such as commitment. In a more recent study, Joel and colleagues (2021) further demonstrated that people who experienced greater level of stay/leave ambivalence exhibited more intense fluctuations in commitment and thoughts about breaking up in everyday life compared to less ambivalent people. The authors also found that ambivalent individuals' stay/leave intentions were more strongly influenced by their daily experiences, such that they exhibited stronger intentions to stay on days with higher positive relationship experiences and exhibited stronger intentions to leave on days with higher negative relationship experiences. These findings further highlight the possibility that the association between stay/leave ambivalence and commitment may be generalized to the link between individuals' overall ambivalent experiences in a relationship (i.e., RA) and commitment. In other words, an individual in an ambivalent relationship (i.e., relationship characterized by simultaneous high positive and high negative relationship quality) are more likely to experience higher level of stay/leave ambivalence due to the fluctuating daily experiences. According to Joel et al.'s (2021) findings, this greater stay/leave ambivalence may, in turn, be associated with individuals' greater daily fluctuations in relationship commitment. Although in the current thesis we aim to focus on commitment itself rather than

fluctuations in commitment, we believe that it is theoretically plausible to hypothesize that individuals' overall ambivalent experiences in a relationship (i.e., RA) may be negatively associated with commitment.

2.2.4 Integrating Mindfulness, Relationship Ambivalence, Commitment and Willingness to Sacrifice

Although little empirical work has considered mindfulness, RA, commitment and WTS simultaneously, we suggest that based on the theories and evidence introduced earlier, RA and commitment may uniquely or jointly explain the positive association between mindfulness and WTS. In this section, we will first briefly introduce how RA and commitment may respectively be related to WTS. Based on these evidence and our previous description on how mindfulness may be respectively related to RA and commitment, we will propose a theoretically plausible parallel mediation model with ambivalence and commitment as two competing mediators. Since previous evidence also suggest that ambivalence in romantic relationships may be negatively associated with commitment (Joel et al., 2018; 2021), we will propose a theoretically plausible serial mediation model in which RA and commitment may jointly explain the link between mindfulness and WTS.

According to the interdependence theory (Rusbult & Van Lange, 2003), commitment serves as a central relationship-specific motive that stimulates and directs transformation of motivation and prompts pro-relationship behaviours, including sacrifice, accommodation, and forgiveness (Finkel et al., 2002; Rusbult et al., 1991, Van Lange et al., 1997). Researchers theorized the positive association between commitment and WTS based on four lines of reasoning. First, according to the investment model (Rusbult, 1983), highly committed individuals usually have higher satisfaction and investment in the relationship and perceive lower quality of alternatives (Johnson & Rusbult, 1989; Rusbult & Van Lange, 2003), and therefore tend to be more willing to sacrifice self-interests to maintain the relationship

(Wieselquist et al., 1999). Second, committed individuals are long-term oriented and more inclined to reciprocal pro-relationship behaviours that may benefit long-term self-interest (Axelrod, 1984). For example, if Mary is long-term oriented towards her relationship with Matthew, she may be more inclined to take care of Matthew's needs and cancel the party as she knows that, may be some time in the future, she may also need Matthew to take care of her needs as well. However, if Mary is not long-term oriented towards the relationship, she may not take her future needs and Matthew's future behaviours into consideration and just make her decisions based on what's best for her at the short run. Third, committed individuals are more psychologically attached to their partner, and exhibit greater feelings of closeness to a partner, or self-other connectedness (Park et al., 2019; Rusbult et al., 1998; Wieselquist et al., 1999). Therefore, a sacrifice may not be perceived as a personal cost but instead as something that would eventually bring joy to the sacrificer as it brings joy to their partner (Van Lange et al., 1997). Fourth, commitment may involve collective communal orientation, which motivates individuals to respond unconditionally to their partner's needs and may therefore lead to sacrifice (Agnew et al., 1998). Indeed, previous studies have found commitment to be a robust predictor of WTS (Etcheverry & Le, 2005; Powell & Van Vugt, 2003; Van Lange et al., 1997; Wieselquist, et al., 1999). In particular, Wieselquist et al. (1999) conducted two longitudinal studies, in which the researchers measured participants' level of dependence, commitment, and WTS, which was assessed by asking participants to list four "most important activities in your life, other than your relationship," and then indicate to what extent they would consider giving up the activities to maintain their relationships on a 9-point Likert scale. The researchers found that individuals who were more dependent on a relationship exhibited greater commitment to the relationship, which in turn predicted their WTS.

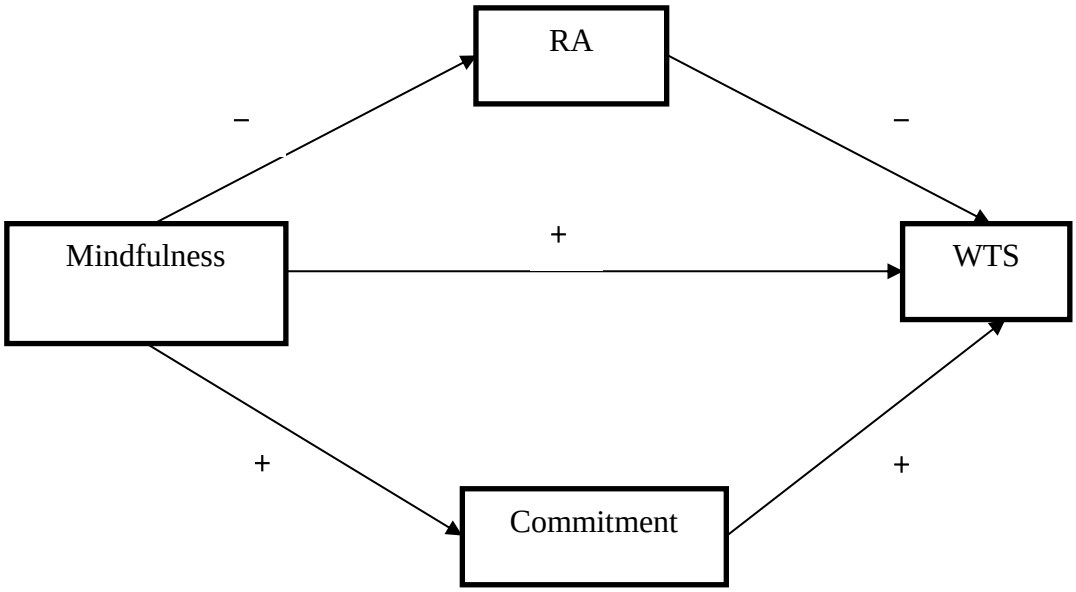
Although little research has explicitly investigated how RA may be related with WTS, existing evidence has consistently demonstrated a negative link between ambivalence and positive relationship outcomes. RA has been related to less relationship satisfaction (Lavner et al., 2012), increased conflict (Thompson & Holmes, 1996), decision to end a relationship (Joel et al., 2018), and dissolution of a relationship (Le et al., 2010). Work on general attitudinal ambivalence has also shown that ambivalent individuals are more indecisive and vacillating (Sincoff, 1990), exhibit greater procrastination in decision-making (Rothman et al., 2017) and are less able to decide and act (Pratt & Pradies, 2011; Weick, 1998). Emmons & King (1988) further suggested that ambivalent individuals exhibited greater inhibition of behaviour and rumination as they spent more time contemplating on a potential behavioural decision. Taken together, it seems that having higher levels of ambivalence may exert more resistance for individuals to make behavioural decisions, which may have negative influence on their capacity of performing certain behaviours. According to these literatures, we believe it is reasonable to expect that holding conflicting evaluations towards one's partner and/or relationship may exert negative influences on individuals' willingness to engage in pro-relationship behaviours such as sacrifice.

In sections 2.2.1 and 2.2.2, we have introduced respectively why and how mindfulness may be associated with RA and commitment. Specifically, by cultivating a non-judgmental and accepting attitude towards one's internal and external experiences, mindful individuals may have less discrepant experiences in a relationship (Kappen et al., 2018), and experience lower negative affect in general (Kiken & Shook, 2011). Therefore, we proposed mindfulness may be negatively associated with RA. Besides, mindfulness is positively associated with individuals' feelings of closeness with others (Brown et al., 2007), which has in turn been positively associated with commitment (Park et al., 2019; Rusbult et al., 1998; Wieselquist et al., 1999). Integrating these arguments with our arguments on how RA and

commitment may be independently related to WTS in the previous paragraphs, we believe it is theoretically plausible to propose a parallel mediation model in which RA and commitment may uniquely mediate the link between mindfulness and WTS (see Figure 1).

Figure 1

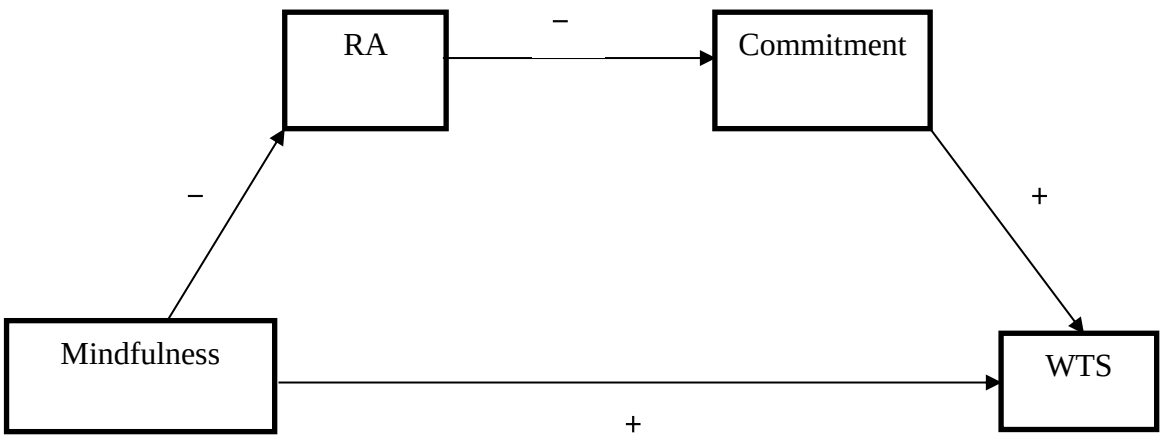
Potential Parallel Mediation Model between Mindfulness, RA, Commitment, and WTS



In section 2.2.3, we have introduced why and how RA may be negatively associated with commitment. Specifically, individuals experiencing high levels of RA are more likely to experience higher level of stay/leave ambivalence due to the fluctuating daily experiences (Joel et al., 2021), which may, in turn, be negatively associated relationship commitment. Integrating these arguments with our arguments on how RA and commitment may be related to WTS in the previous paragraphs, we believe it is theoretically plausible to propose a serial mediation model in which RA and commitment may jointly mediate the link between mindfulness and WTS (see Figure 2).

Figure 2

Potential Serial Mediation Model between Mindfulness, RA, Commitment, and WTS



2.3 Research overview and aims

The first aim of this thesis was to investigate the association between mindfulness and WTS, and explore how relevant psychological factors (i.e., RA and commitment) may explain such an association. Therefore, in our first exploratory study (Study 1), we explored the following theoretically plausible research questions:

1. Is trait mindfulness associated with greater WTS?
2. Do RA and commitment each uniquely or jointly contribute to the association between mindfulness and greater WTS?

We then confirmed the established model(s) in a subsequent confirmatory study (Study 2). Once we have gained an initial understanding on the correlations among the study variables in the initial correlational studies (Study 1-2), we tested the established model(s) in cross-sectional experimental studies (Study 3-6), in which we employed an experimental manipulation on mindfulness and carried out causal tests of the links in the established model(s). Finally, we investigated the potential prospective influence of mindfulness on the downstream study variables in a 5-week longitudinal study (Study 7).

Chapter 3: Study 1 and 2 (Correlational Studies)

Although mindfulness has attracted wide-ranging interest from psychologists in recent years, no prior research to our knowledge has systematically investigated the relation between mindfulness and WTS. As illustrated in the introduction, greater mindfulness may be indirectly related to greater WTS through lower RA. Cultivating mindfulness may contribute to lower RA as it allows individuals to experience less discrepancies in romantic relationships (Kappen et al., 2018) and lower negative affect in general (Kiken & Shook, 2011). Greater RA may contribute to lower WTS as it is associated with lower relationship satisfaction (Lavner et al., 2012) and higher likelihood of relationship dissolution (Le et al., 2010), and may exert more difficulty for individuals to make behavioural decisions (Emmons & King, 1988; Pratt & Pradies, 2011; Weick, 1998). We also demonstrated in the introduction that greater mindfulness may be indirectly related to greater WTS through higher commitment as a) cultivating mindfulness can promote individuals' feelings of closeness (Brown et al., 2007) and empathy (Birnie et al., 2010; Block-Lerner et al., 2007; Hutcherson et al., 2008) towards others that may in turn facilitate commitment (Karremans et al., 2017; Park et al., 2019; Rusbult et al., 1998; Wieselquist et al., 1999), and b) commitment serves as one important relationship-specific motive that facilitates WTS (Finkel et al., 2002; Rusbult et al., 1991, Van Lange et al., 1997). In addition, we have demonstrated in the introduction that RA and commitment may jointly mediate the link between mindfulness and WTS by introducing the potential negative association between RA and commitment. Specifically, individuals with greater RA may exhibit greater stay/leave ambivalence as a result of the fluctuating daily experiences (Joel et al., 2021), and may therefore be less committed to the relationship.

Integrating the aforementioned arguments, Studies 1 and 2 sought to discover a) whether trait mindfulness may be directly or indirectly associated with WTS, and b) whether RA and commitment may each uniquely mediate the association between trait mindfulness

and WTS, and c) whether RA and commitment may jointly explain the mindfulness-WTS link via serial mediation where RA precedes commitment. Data were taken from two cross-sectional, correlational online studies examining individuals' psychological experiences in romantic relationships. Study 1 and 2 were designed using an exploratory-confirmatory approach. In Study 1, we explored the above research questions in an initial, exploratory dataset. We then attempted to replicate the findings in a second, confirmatory dataset (Study 2).

3.1 Method

Participants

Study 1 (Exploratory Sample)

Our original target sample size was 350-400, which was based on study budget and data collection time constraints. We were able to recruit a total of 360 participants online via Prolific Academic. Participants were eligible to take part in the study if they were a) adults (≥18 years), b) currently involved in a romantic relationship, and c) fluent in English. A total of 25 participants were excluded: Six people were not in a romantic relationship, seven people did not finish the entire survey, three people finished the survey too fast (in less than two minutes) or too slow (in more than an hour), and nine people failed attention checks.[9] As a result, responses from a total of 335 eligible participants were analysed, of which 170 were women, 162 were men, two were bigender, and one was agender. Participants received £1.00 for completing the study. Participants were between 18 and 69 years of age (M = 28.10, SD = 8.95) and were in relationships lasting 1 month to 46 years 9 months (M = 8.54 years, SD = 8.41 years). Participants identified themselves as White/Caucasian (83.9%, N = 281), Asian

[9] An attention check question (i.e., "For this question, please select "Neither agree nor disagree" as the response") was included in one questionnaire in the middle of the survey. The same, or similar attention check questions (e.g., "For this question, please select the 4th column as the response") were used in the following studies as well.

(3%, *N* = 7), Black/African/Caribbean (1.8%, *N* = 6), Hispanic/Latinx (6.3%, *N* = 21), Middle Eastern/Arab (2.1%, *N* = 7), Mixed/Multi-Ethnic (2.1%, *N* = 7), and "Other" (0.9%, *N* = 3). Approximately 91.3% of participants were heterosexual (*N* = 306), 4.8% were bisexual/pansexual (*N* = 16), 0.9% were asexual (*N* = 3), 2.1% were gay (*N* = 7), and 0.9% were lesbian (*N* = 3). Approximately 46.3% of participants were dating their current partner exclusively (*N* = 155), 1.8% were dating their current partner and others (*N* = 6), 35.8% were married (*N* = 120), 11.0% were engaged (*N* = 37) and 5.1% were in a common-law relationship (*N* = 17). The sample size was initially determined based on study budget and data collection time constraints.

Study 2 (Confirmatory Sample)

A total of 359 participants were originally recruited online via Prolific Academic. As in Study 1, the sample size was initially based on study budget and data collection time constraints. The inclusion criteria were the same as Study 1. Custom pre-screening was applied to exclude participants who participated in Study 1 (and who therefore may have been familiar with the study purpose) to avoid any participant bias. A total of nine participants were excluded: Three people were not in a romantic relationship, and six people did not finish the entire survey. As a result, responses from a total of 350 eligible participants were collected, of which 176 were women, and 174 were men. Participants received £1.00 for completing the study. Participants were between 21 and 76 years of age (*M* = 39.48, *SD* = 9.86) and were in relationships lasting 3 months to 52 years (*M* = 14.65 years, *SD* = 9.35 years). Participants identified themselves as White/Caucasian (90.0%, *N* = 315), Asian (3.7%, *N* = 13), Black/African/Caribbean (3.1%, *N* = 11), Hispanic/Latinx (1.1%, *N* = 4), Middle Eastern/Arab (0.6%, *N* = 2), Mixed/Multi-Ethnic (0.9%, *N* = 3), and "Other" (0.6%, *N* = 2). Approximately 95.4% of the participants were heterosexual (*N* = 334), 2.9% were bisexual/pansexual (*N* = 10), and 0.9% were gay (*N* = 3), and 0.9% were lesbian (*N* = 3).

Approximately 2.3% of the participants were dating their current partner exclusively (N = 8), 96.9% were married (N = 339), 0.6% were engaged (N = 2) and 0.3% were in a common-law relationship (N = 1).

Measures and Procedure

In each study, participants completed a battery of questionnaires including basic demographic questions (including gender, age, ethnicity, sexual orientation, relationship status and relationship length), and the variables of interest to the present study. Each study took approximately 10-15 minutes to complete in full. After completing the study, participants were debriefed as to the nature of the study and compensated.

Primary Measures

All questionnaires are available online via the Open Science Framework (https://mfr.osf.io/render?url=https://osf.io/4nc3r/?direct%26mode=render%26action=download%26mode=render).

Trait Mindfulness. In Study 1, trait mindfulness was measured using the Cognitive and Affective Mindfulness Scale–Revised (CAMS-R; Feldman et al., 2007; see Appendix A). This is a 12-item scale rated on a 4-point scale (1 = *rarely/not at all*, 4 = *almost always*), assessing mindfulness on four components: attention regulation, present-focus, awareness, and non-judgment. An example item is "It is easy for me to concentrate on what I am doing." Responses across items were averaged and scored such that higher values reflected greater trait mindfulness. Existing evidence has shown that the CAMS-R demonstrates acceptable-to-good internal consistency (Cronbach's α ranging from 0.61 to 0.81; see Table 1 for the reliability in the current study) (Park et al., 2013; Schmertz et al., 2009), and good construct validity (supported by positive associations with assessments of openness, adaptive regulation, and well-being, and negative associations with assessments of neuroticism, emotion regulatory problems, and dissociation; see Baer et al., 2006). As illustrated in section

2.1.1.3, the CAMS-R has been designed to measure mindfulness in the general population regardless of previous meditation experiences and is the shortest holistic mindfulness measure to date in the literature (Park et al., 2013). Therefore, the CAMS-R is a suitable mindfulness measure for Study 1, which aims to assess mindfulness in the general population in a short online study.

In Study 2, trait mindfulness was measured using the Mindful Attention Awareness Scale (MAAS; Brown and Ryan, 2003; see Appendix B). This is a 15-item inventory rated on a 6-point scale (1 = *almost always*, 6 = *almost never*), measuring mindfulness during general daily occurrences based on respondent's attention to and awareness across four domains (e.g., cognitive, physical, emotional, and general). Participants rated how frequently they have the experiences of acting on automatic pilot, being preoccupied and being inattentive in the present moment. An example item is "I find it difficult to stay focused on what's happening in the present." Responses across items were averaged and scored such that higher values reflected greater trait mindfulness. Existing evidence has shown that the MAAS demonstrates good internal consistency (Cronbach's α ranging from 0.78 to 0.92; see Table 1 for the reliability in the current study) and good test-retest reliability (ICC = 0.81) (Park et al., 2013). The MAAS has been shown to be positively related to assessments of openness, internal state awareness, positive emotions, and well-being, and negatively related to neuroticism, rumination, stress, and anxiety (Baer et al., 2006; Brown & Ryan, 2003; Carlson & Brown, 2005; Christopher & Gilbert, 2010; Frewen et al., 2008; Ghorbani et al., 2009), therefore demonstrating good construct validity. As illustrated in section 2.1.1.3, the MAAS is the second shortest mindfulness measure, and can be applied to both meditators and non-meditators (Park et al., 2013). Therefore, the MAAS is a suitable mindfulness measure for

Study 2, where we aim to briefly assess mindfulness in a general population using a different scale than the CAMS-R.[10]

RA. In both studies, RA was measured as the extent to which participants simultaneously reported positive and negative evaluations towards their current romantic relationship. Participants completed the 16-item Positive and Negative Relationship Quality (PN-RQ; Fincham & Rogge, 2017; see Appendix C) scale. This measure uses a 7-point scale (1 = *not at all*, 7 = *completely*) to separately assess participant's ratings on 8 positive relationship qualities (e.g., "Considering only the positive qualities of your relationship and ignoring the negative ones, evaluate your relationship on the following qualities: e.g., enjoyable"), and 8 negative relationship qualities (e.g., "Considering only the negative qualities of your relationship and ignoring the positive ones, evaluate your relationship on the following qualities: e.g., unpleasant"). RA scores were calculated using Thompson, Zanna, and Griffin's (1995) well-validated formula: $\frac{(\mathrm{P}+\mathrm{N})}{2} - |\mathrm{P} - \mathrm{N}|$, where P refers to the averaged positive ratings and N refers to the averaged negative ratings on relationship quality. In other words, we subtracted the absolute difference between respondent's positive and negative relationship quality ratings from the average of those ratings, with higher scores indicating greater RA.

Commitment. Participant's commitment in both studies was measured by one item taken from the Perceived Relationship Quality Components scale (PRQC; Fletcher, Simpson,

[10] As we proceeded to Study 2, we noticed there has been increasing criticisms of the CAMS-R. Therefore, in Study 2, trait mindfulness was measured using the MAAS, which is one of the most frequently used mindfulness assessment in recent studies investigating mindfulness and/or mindfulness-based interventions (Medvedev et al., 2016). However, we acknowledge that as we proceeded to Study 4, we further noticed that the MAAS has also been a target of criticism in the recent literature (Ruimi et al., 2019), so we changed our mindfulness measure again from Study 4 onwards. Limitations on the MAAS will be further discussed in Chapter 4.

& Thomas, 2000) (i.e., "How committed are you to your relationship?") using a 7-point scale (1 = *not at all*, 7 = *extremely*).[11]

WTS. In both studies, participant's willingness to sacrifice was assessed by Righetti et al. (2013)'s modified version of a measure originally developed by Van Lange et al. (1997) (see Appendix D). Participants were asked to indicate on a 7-point scale (0 = *I would definitely not engage in this activity*; 6 = *I would certainly engage in this activity*) to what extent they would perform each of four moderately undesirable actives presented (e.g., going out with your partner's boring friends) to maintain and improve their relationship as a measure of active WTS. The active WTS measure exhibited acceptable to good level of internal consistency (Cronbach's α = 0.75 in Study 1, and Cronbach's α = 0.63 in Study 2). In Study 1 we also assessed participants' willingness to make passive sacrifices by asking them to indicate on a 7-point scale (0 = *I would definitely not give up this activity*; 6 = *I would certainly give up this activity*) to what extent they would give up each of four moderately desirable activities presented (e.g., spend time pursuing one of your favourite hobbies) if continue engaging in the activities would harm their relationship (Righetti et al., 2013; see Appendix D). However, because the passive WTS measure exhibited poor internal consistency (Cronbach's α = 0.55),[12] we did not proceed with passive WTS in Study 1

[11] Study 1 was highly exploratory and a lot of variables were assessed in Studies 1-2. Due to budget constraint, the length of the survey was controlled, and therefore a single-item measure was used to assess commitment in Studies 1-2. While it may not be ideal, this single-item measure is high in face valid and highly correlates with the commitment subscale of the Investment Model Scale (i.e., correlation ranging from 0.84 to 0.92; Rusbult et al., 1998). The Investment Model Scale was used to assess commitment in Studies 3-7 when our research aim has been narrowed down to only focus on the proposed serial mediation model.

[12] According to Pallant (2001), Cronbach's α ranging from 0.60 to 0.80 is considered moderate but acceptable, whereas Cronbach's α below 0.60 is considered low and unacceptable. It is worth noting that although a number of researchers regarded Cronbach's α of 0.70 or above as acceptable based on Nunnally's work (Nunnally, 1967, 1978; Nunnally & Berstein, 1994), this advised cutoff level of Cronbach's α (i.e., 0.7 or above) is Nunnally's intuition (Cho & Kim, 2015), and is not based on evidence derived from empirical research (Churchill & Peter, 1984; Peterson, 1994) or the results of logical reasoning (Cho & Kim, 2015). Indeed, there has never been a clear one-size-fits-all rule and Nunnally (1967) also suggested that a Cronbach's α of 0.6 is sufficient for exploratory study. In addition, various researchers have later suggested that a Cronbach's α above 0.60 represents good level of internal stability and consistency (Cresswell, 2005, 2010; Pallant, 2001, Sekaran, 1992; Ursachi et al., 2015). Furthermore, the nature of the scale needs to be taken into consideration when

analyses, nor did we include a measure of passive WTS in Study 2 or any of the following studies (see Table 1 for the reliability of WTS in the current study). [13]

Covariates

Gender. Existing evidence has shown that gender may influence an individual's level of mindfulness and WTS. Ahmed and colleagues (2013) found that women sacrificed and opted for compromises more often than men in marriages. We therefore controlled for participant gender in both studies, which was measured by one demographic question (i.e., "What is your gender?") (see Appendix E).

Age. According to Thirumaran et al. (2020), average mindfulness scores of undergraduate students were lower than other higher age group participants, suggesting that mindfulness may increase with age. We therefore controlled for participant age in both studies, which was measured by one demographic question (i.e., "What is your age?") (see Appendix E).

Relationship Length. Existing evidence has demonstrated that relationship length is positively correlated with WTS (Van Lange et al., 1997), and commitment (Rhoades et al., 2010). We therefore controlled for participant relationship length in both studies, which was measured by one demographic question (i.e., "How long have you been in a relationship with your current romantic partner? Please provide an answer for both years and months") (see Appendix E). Participants' answers were then calculated to reflect the number of years they

evaluating the sufficiency of its internal consistency. Scholars have argued that high Cronbach's α can be antithetical to high validity (Kline, 1986; Raykov, 2008), especially for constructs exhibiting high diversity (Cho & Kim, 2015). WTS is a typical example of these types of constructs, as individuals' sacrifices may take the form of various actions. Therefore we believe it is reasonable to keep constructs with a Cronbach's α of 0.60 or above in our studies.

[13] Further reliability tests for the active and passive WTS scales in Study 1 and 2 have been conducted to check if the Cronbach's α of the scales would be higher if a particular item were deleted from the scales. None of the items would increase Cronbach's α if they were removed from the scales, and therefore the Cronbach's α reported here represents the reliability of the scales with all the original items.

have been involved in the current romantic relationship (e.g., if a participant entered 4 year 6 months, his/her answer was recorded as 4.5 years).

Data Analysis Strategy

In both studies, the first step of data analysis involved examining the associations among study variables using bivariate correlation analysis where Pearson's correlation coefficients were calculated.[14] We then tested possible parallel and serial mediation models with trait mindfulness as the independent variable, WTS as the dependent variable, and RA and/or commitment as the possible mediators. In the serial mediation models, we explored both the "mindfulness – RA – commitment – WTS" path, and the "mindfulness – commitment – RA – WTS" path. Mediation analyses were performed using Model 4 (for parallel mediation model with RA and commitment as competing mediators) and Model 6 (for serial mediation model with RA and commitment as the two mediators) in PROCESS v3.3 (Hayes, 2018) with 5000 bootstrapped[15] samples and 95% confidence intervals of the indirect association between mindfulness and WTS via the proposed mediators (lower RA and/or higher commitment). A random number generator is seeded for bootstrapping through syntax to ensure that when the same seed is used in each analysis, the bootstrap confidence intervals are based on the same set of bootstrap samples (Hayes, 2018). The indirect association is deemed significant if the 95% confidence interval does not contain zero. Post

[14] Since the purpose of presenting the correlation table is to show the bivariate correlations between the preceding variable and the following variable in the proposed mediation model (e.g., how mindfulness was correlated with RA and commitment respectively) as opposed to exploring the correlations among all study variables, multiple comparisons were not controlled for as doing so may potentially increase the probability of type II error occurrence (Lee & Lee, 2018).

[15] According to the recommendations of Hair et al. (2013) and Garson (2016), bootstrapping with 5000 iterations was chosen for Studies 1-7.

hoc Monte Carlo power analysis for indirect effects was conducted using WebPower (Zhang & Yuan, 2018) to yield statistical power of the above models in Studies 1-2.[16]

In both studies, we first tested models containing only our primary variables (i.e., trait/relationship mindfulness, relationship ambivalence, commitment, and WTS). We then tested models that included our chosen demographic covariates (i.e., gender, age, and relationship length).

3.2 Results

Table 1 displays the descriptive statistics, reliability information, and correlations of Study 1 and 2 variables. Both studies revealed that greater trait mindfulness was significantly correlated with lower RA and higher commitment but was not significantly correlated with WTS. Both studies revealed that greater RA was significantly correlated with lower commitment and lower WTS. Commitment was shown to be significantly positively correlated with WTS in both studies.

Significant parallel mediation model was established in Study 1 through both RA (representing a small indirect effect, R^2 = .04) and commitment (representing a small indirect small effect, R^2 = .04) (see Figure 1 for the model controlling for covariates),[17] but not in Study 2 (see Figure 3 for the model controlling for covariates). In Study 1, higher trait mindfulness was associated with lower RA and higher commitment, each of which then uniquely contributed to greater WTS. These links remained robust when controlling for gender, age, and relationship length. In Study 2, higher trait mindfulness was also associated with both lower RA and higher commitment. However, only higher commitment, and not

[16] It is worth noting that post hoc power analysis has been criticized by scholars for being conceptually flawed and analytically misleading (Zhang et al., 2019). Therefore the results of the post hoc power analysis provided in our studies should be treated with great caution.

[17] According to Cohen (1988), R^2 metric of .02, .13, and .26 is defined as a small, medium and large effect respectively.

lower RA, in turn contributed to greater WTS (representing a small-to-medium indirect effect of trait mindfulness on WTS through commitment, R^2 = .083). These links remained robust when controlling for gender, age, and relationship length. Results of the post hoc Monte Carlo power analysis for indirect effects showed a statistical power of 0.68 for path $a_{11}b_{11}$ in Study 1 and 0.70 for path $a_{31}b_{31}$ in Study 2, [18] and 0.59 for path $a_{12}c_{11}$ in Study 1 and 0.60 for path $a_{32}c_{31}$in Study 2 with the current sample size.

Significant serial mediation models were established in both Study 1 (representing a small indirect effect, R^2 = .04) (see Figure 2 for the model controlling for covariates) and Study 2 (representing a small indirect effect, R^2 = .06) (see Figure 4 for the model controlling for covariates), where greater trait mindfulness was associated with lower RA, which was then associated with higher commitment, which was in turn linked to greater WTS. The serial mediation path remained robust when controlling for gender, age, and relationship length. The results of the serial mediation model in Study 1 also revealed that lower RA alone mediated the positive association between trait mindfulness and WTS (representing a small indirect effect, R^2 = .03); however, this path was not significant in Study 2. Results of the post hoc Monte Carlo power analysis for indirect effects showed a statistical power of 0.68 for path $a_{21}b_{22}$ in Study 1 and 0.49 for path $a_{41}b_{42}$ in Study 2, 0.41 for path $a_{22}c_{21}$ in Study 1 and 0.40 for path $a_{42}c_{41}$ in Study 2, and 1.00 for path $a_{21}b_{21}c_{21}$ in Study 1 and path $a_{41}b_{41}c_{41}$ in Study 2 (i.e., the hypothesized indirect effect of mindfulness on WTS through RA and commitment jointly) with the current sample size.

[18] The path is labeled by its figure number, followed by the number representing it is the n_{th} link emerging from this variable. For example, path a_{11} represents the first link with trait mindfulness as the start variable in Figure 1. This labeling rule applies to all of the figures in this thesis.

Table 1

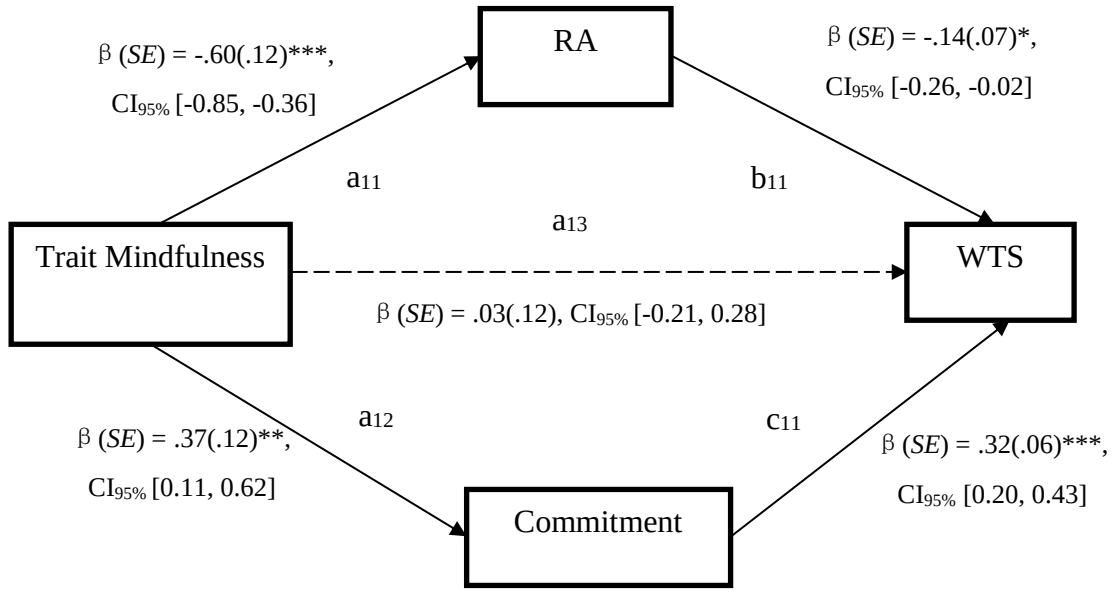
Study 1 & 2: Descriptive Statistics, Reliability Information, and Correlations among Study Variables

	Variable	Descriptives and Reliability			Correlations					
		Range	*M*(*SD*) or %	α	1	2	3	4	5	6
Study 1										
1	Trait Mindfulness	1.33-3.83	2.74(0.43)	0.74	—	-.30**	.12*	.05	.10	.07
2	RA	-2.00-5.19	-0.27(1.54)	—		—	-.46**	-.29**	.16**	.15**
3	Commitment	2.00-7.00	6.46(0.84)	—			—	.40**	-.06	-.07
4	WTS	2.00-7.00	5.92(1.01)	0.75				—	-.16**	-.10
5	Age	18.00-69.00	32.04(10.06)	—					—	.82**
6	Relationship Length	0.08-46.75	8.54(8.41)	—						—
Study 2										
1	Trait Mindfulness	1.80-6.00	3.89(0.79)	0.88	—	-.30**	.17**	.05	.11*	.08
2	RA	-2.00-5.81	0.01(1.82)	—		—	-.42**	-.27**	.04	.02
3	Commitment	2.00-7.00	6.48(0.90)	—			—	.48**	-.05	.003
4	WTS	1.75-7.00	5.61(0.88)	0.63				—	.06	.03
5	Age	21.00-76.00	39.48(9.86)	—					—	.80**
6	Relationship Length	0.24-51.99	14.65(9.35)	—						—

Note. RA = relationship ambivalence, WTS = willingness to sacrifice. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Relationship length scores are in years. *$p < .05$, **$p < .01$, ***$p < .001$

Figure 1

Study 1: Direct and Indirect Associations between Trait Mindfulness, RA, Commitment, and WTS in a Parallel Mediation Model



<u>Indirect effect of trait mindfulness on WTS via RA</u>:

β (*SE*) = .08(.04)*, $CI_{95\%}$ [0.01, 0.18]

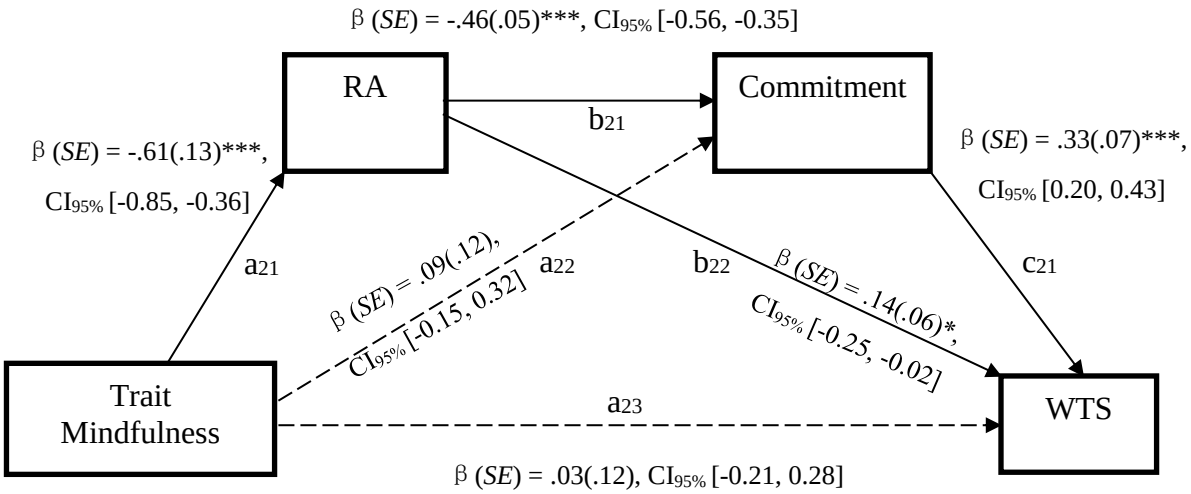
<u>Indirect effect of trait mindfulness on WTS via commitment</u>:

β (*SE*) = .11(.05)*, $CI_{95\%}$ [0.04, 0.22]

Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Solid lines indicate statistically significant paths, and dashed lines indicate statistically non-significant paths ($p > .05$). Analyses control for gender, age, and relationship length. *$p < .05$, **$p < .01$, ***$p < .001$

Figure 2

Study 1: Direct and Indirect Associations between Trait Mindfulness, RA, Commitment and WTS in a Serial Mediation Model



Indirect effect of trait mindfulness on WTS via RA:

β(*SE*) = .08(.04)*, $CI_{95\%}$ [0.004, 0.177]

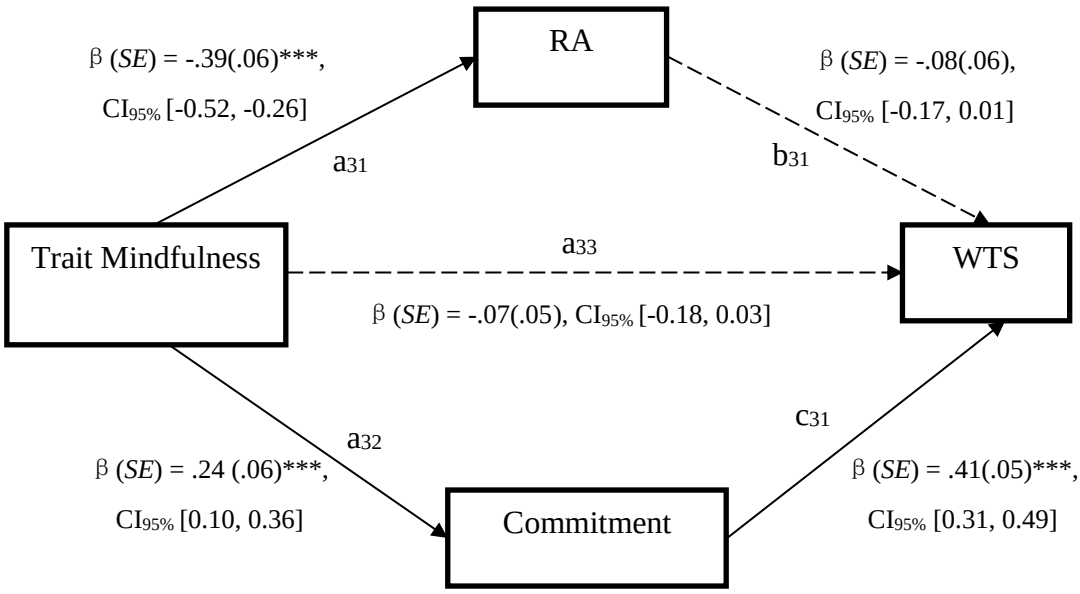
Indirect effect of trait mindfulness on WTS via RA & commitment:

B(*SE*) = .09(.03)***, $CI_{95\%}$ [0.04, 0.15]

Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Solid lines indicate statistically significant paths, and dashed lines indicate statistically non-significant paths ($p > .05$). Analyses control for gender, age, and relationship length. *$p < .05$, **$p < .01$, ***$p < .001$

Figure 3

Study 2: Direct and Indirect Associations between Trait Mindfulness, RA, Commitment, and WTS in a Parallel Mediation Model



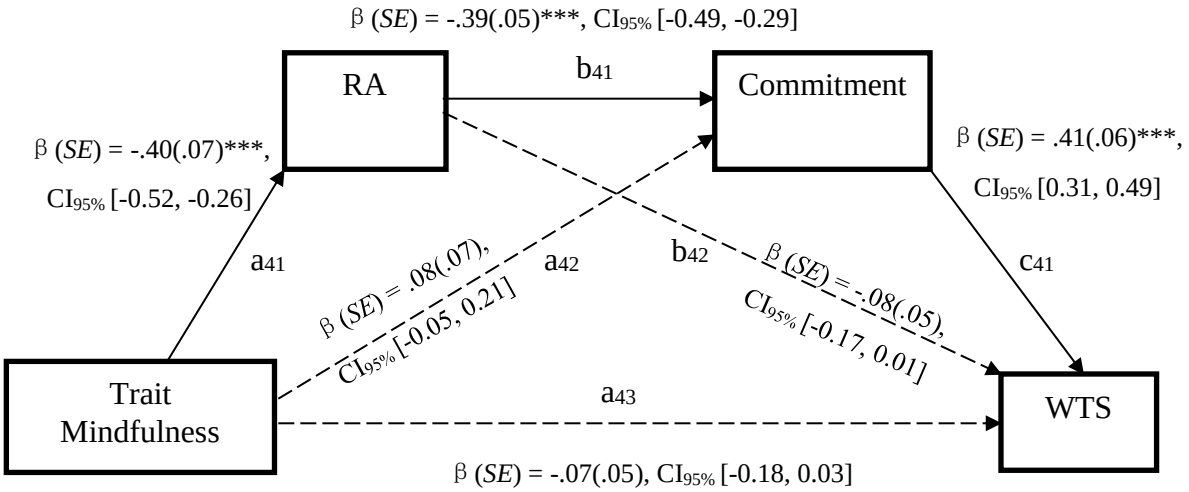
<u>Indirect effect of trait mindfulness on WTS via commitment</u>:

β (*SE*) = .09(.04)**, $CI_{95\%}$ [0.03, 0.17]

Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Solid lines indicate statistically significant paths, and dashed lines indicate statistically non-significant paths ($p > .05$). Analyses control for gender, age, and relationship length. *$p < .05$, **$p < .01$, ***$p < .001$

Figure 4

Study 2: Direct and Indirect Associations between Trait Mindfulness, RA, Commitment and WTS in a Serial Mediation Model



<u>Indirect effect of trait mindfulness on WTS via RA & commitment</u>:

β (*SE*) = .06(.02)***, $CI_{95\%}$ [0.03, 0.09]

Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Solid lines indicate statistically significant paths, and dashed lines indicate statistically non-significant paths ($p > .05$). Analyses control for gender, age, and relationship length. *$p < .05$, **$p < .01$, ***$p < .001$

3.3 Discussion

Both studies revealed evidence that trait mindfulness is indirectly associated with active WTS via relational ambivalence and commitment. In both studies, the direct association between trait mindfulness and WTS was nonsignificant. In terms of mediation, the results of Study 1 demonstrated a significant indirect link between greater trait mindfulness and greater WTS, which was uniquely mediated by lower RA and higher commitment. Interestingly, in Study 2, only higher commitment, and not lower RA, uniquely explained the positive association between trait mindfulness and WTS, suggesting RA alone may not explain how the two variables are linked. Furthermore, the findings of serial mediation models in both studies consistently demonstrated that greater trait mindfulness was indirectly associated with greater WTS through lower RA and, in turn, higher commitment. Taken together, the findings from Study 1 and 2 suggest that people who pay open and non-judgmental attention to and awareness of their present moment experiences tend to report less ambivalence towards their relationship and greater dedication to the long-term future of their relationship, and therefore report greater willingness to forego self-interests for the sake of a partner's needs.

The significant links between our study variables in the serial mediation model echo some extant theories and study findings. First, across the two studies, mindfulness was linked with lower RA. These findings integrate with work that has linked mindfulness with lower levels of subjective (Dummel, 2018; Haddock et al., 2017) and objective ambivalence (Haddock et al., 2017). Our findings highlight the possibility that the beneficial influence of mindfulness on individuals' ambivalence towards non-relational attitude objects may be generalized to the context of romantic relationship.

Second, the significant negative link between RA and commitment echoes with the investment model (Rusbult, 1983) and previous work on stay/leave ambivalence and

commitment (Joel et al., 2021). As introduced in section 2.2.3, the investment model offers promising insights into ambivalence studies in romantic relationships as it points out the fact that individuals' level of commitment may be jointly accounted for by various dimensions of the relationship (i.e., relationship satisfaction, perceived quality of alternatives, investment in the relationship) (Joel et al., 2021). Since individuals may experience high positivity on one aspect (e.g., high satisfaction), and high negativity on the other aspect (e.g., perceive high quality of alternatives), it is not necessarily the pure positivity, or negativity in the relationship that may account for the individual differences in commitment. Rather, the extent to which individuals' have inconsistent experiences across different relationship dimensions (i.e., simultaneous high positivity and high negativity) may uniquely influence their commitment. Supporting this claim, our findings indicate that romantically involved individuals who experience simultaneous high positivity and high negativity in a relationship tend to report less dedication to their relationship than individuals with more congruent relationship experiences. Of particular relevance to our findings, Joel et al (2021) found that people who were ambivalent on whether to stay or end the current relationship exhibited greater daily fluctuations in commitment. Our findings suggest that in addition to a specific ambivalence (e.g., stay/leave ambivalence), general RA may be negatively associated with commitment in romantic relationships.

Third, the results across the two studies revealed a significant positive link between commitment and WTS. These findings integrate with the interdependence theory (Rusbult & Van Lange, 2003), which proposes that commitment acts as a central relationship-specific motive that helps to initiate the transformation of motivation and promotes pro-relationship responding.

It is also worth mentioning that almost all (i.e., 96.9% of the entire sample) of our participants in Study 2 were married, whereas the sample of Study 1 was more evenly

balanced in terms of relationship status (i.e., 35.8% of the sample were married). Despite the divergent composition in terms of relationship status across samples, the results across the two studies consistently revealed an indirect association between higher levels of mindfulness and greater WTS, through lower RA and higher commitment. This indicates that our findings may be generalized to the population in all types of relationships, and not just those who are dating or married.

Taken together, Study 1 and 2 provided preliminary evidence on whether and how trait mindfulness may be indirectly associated with WTS in romantic relationships, and how RA and commitment may play important roles in explaining such an association. The fact that only the serial mediation model, but not the parallel mediation model, has been replicated across the two studies suggests that RA is not consistently directly linked to WTS, but is consistently indirectly linked to WTS through commitment. Therefore, we decided to only focus on the serial mediation model (i.e., the mindfulness – RA – commitment – WTS model) in the following studies.

Although the results of Studies 1 and 2 are promising, they are limited by their fully correlational nature, which makes conclusions about causation impossible. In the next study, we sought to provide an initial causal test of the links in the serial mediation model. In particular, we investigated whether experimentally manipulating mindfulness via a brief meditation exercise may predict greater WTS through lower RA and higher commitment in participants receiving the manipulation.

Chapter 4: Study 3-6 (Experimental Studies)

4.1 Study 3

After gaining preliminary knowledge on how RA and commitment can jointly explain the positive correlation between mindfulness and WTS in the previous correlational studies, we sought to investigate how an experimental manipulation of mindfulness may influence subsequent reports of RA, commitment, and WTS. In the current study, we randomly assigned participants into either an experimental group, where a brief auditory mindfulness manipulation was implemented aiming to increase their mindfulness, or a control group, where participants received an auditory introduction to a topic irrelevant to mindfulness. Our pre-registered hypotheses consist two parts. First, we hypothesized that receiving a brief mindfulness manipulation would contribute to subsequent lower RA and higher commitment, and eventually higher WTS. Second, to further clarify whether this experimental manipulation may have a direct effect on participants' subsequent RA, or this potential experimental effect may need to be carried forward by participants' enhanced post-manipulation state mindfulness, we assessed whether the experimental manipulation may predict greater WTS through enhanced post-manipulation state mindfulness, lower RA and higher commitment. That is to say, in addition to RA and commitment, we also aimed to explore the role of participants' post-manipulation state mindfulness in the potential association between experimental conditions and WTS. Therefore, we hypothesized that the serial mediation model established in Studies 1-2 would be replicated in a laboratory setting such that experimentally promoted post-manipulation state mindfulness, if exists, may predict lower RA, higher commitment, and greater WTS in romantic relationships.

4.1.1 Method

Participants

Our original target sample size was 250-300, which was based on study budget and data collection time constraints. We were able to recruit a total of 296 participants online via social media (e.g., Facebook and WeChat) and Prolific Academic. The inclusion criteria were the same as Study 1 and 2. Custom pre-screening was applied to exclude participants who participated in Study 1 and 2 (and therefore may be familiar with the study purpose) to avoid any participant bias. A total of 55 participants were excluded: 15 people were not in a romantic relationship, 10 did not finish the entire survey, 23 people finished the survey too fast (in less than 7 minutes;[19] N = 20) or too slow (in more than two hours; N = 3), and seven people did not pass attention checks. As a result, responses from a total of 241 eligible participants were analysed, of which 147 were women, and 94 were men. Participants recruited from Prolific Academic were compensated with £1.50 for taking part in the study, while participants recruited from social media were entered into a prize draw to win one of two £15.00 Amazon gift cards. Participants' ages ranged from 18 to 61 years (M = 29.34, SD = 9.46), and participants reported being in relationships lasting 1 month to 33.83 years (M = 6.25 years, SD = 6.57 years). Participants identified themselves as White/Caucasian (78.4%, N = 189), Asian (9.9%, N = 24), Black/African/Caribbean (0.8%, N = 2), Hispanic/Latino (5.0%, N = 12), Middle Eastern/Arab (2.5%, N = 6), Mixed/Multi-ethnic (2.5%, N = 6), and "Other" (0.8%, N = 2). Approximately 86.3% of the participants were heterosexual (N = 208), 8.7% were bisexual/pansexual (N = 21), 2.1% were gay (N = 5), and 2.9% were lesbian (N = 7). Approximately 63.1% of the participants were dating their current partner exclusively (N = 152), 2.5% were dating current partner and others (N = 6), 23.7% were married (N = 57), 2.9% were engaged (N = 7), 4.6% were in a common-law relationship (N = 11), and 3.3% were in a civil partnership (N = 8). 45.2% of the participants had never

[19] Since the audio recording included in this study was about 4.5 minutes, it was not possible for participants to attentively finish the survey in less than 7 minutes.

meditated before (N = 109), 33.2% meditated a few times each year (N = 80), 11.6% meditated about 1-2 times each month (N = 28), 4.2% mediated 1-2 times each week (N = 10), 2.9% meditated 3 or more times each week (N = 7), and 2.9% meditated every day or nearly every day.

Measures and Procedure

Participants first completed some basic demographic questionnaires and a questionnaire measuring their pre-manipulation state mindfulness. Participants were then randomly assigned into either the experimental condition, in which they were asked to follow a 5-minute audio guidance of mindfulness exercise developed by Erisman and Roemer (2010; see Appendix F for the transcript), or the control condition, in which they listened to a 5-minute audio recording introducing the solar system, which was transcribed from a YouTube video (National Geographic, 2017; see Appendix G for the transcript).[20] After the audio recording, participants' post-manipulation state mindfulness, RA, commitment and WTS were measured using self-reported questionnaires. The entire study took approximately 15-20 minutes to complete. After completing the study, participants were fully debriefed and then compensated by either Academic Prolific or through prize draw.

Primary Measures

All questionnaires are available online via the Open Science Framework (https://mfr.osf.io/render?url=https://osf.io/kdnxj/?direct%26mode=render%26action=download%26mode=render).

[20] The control condition was designed to let participants focus their attention to an audio recording that is content-neutral (i.e., the content is unlikely to evoke positive or negative feelings or thoughts), and not relevant to mindfulness components (i.e., the content is irrelevant to being mindfully aware of and attentive to the internal and external states). The audio recordings of the experimental and control conditions are of similar time length (i.e., approximately four and half minutes), and are narrated by the same person to avoid any potential confounding effects caused by different narrators.

State Mindfulness. Participant's state mindfulness was measured by the Mindful Attention Awareness Scale (MAAS)–State (Brown & Ryan, 2003; see Appendix H), which is adapted from the MAAS, a trait mindfulness measure. The MAAS-State is a 5-item inventory rated on a 7-point scale (0 = *not at all*, 6 = *very much*), assessing the short-term or current expression of the core characteristic of mindfulness (i.e., attention/awareness). An example item is "I was finding it difficult to stay focused on what was happening." Responses across items were averaged and scored such that higher values reflected greater state mindfulness. Existing evidence has shown that the MAAS-State demonstrates good internal consistency (Cronbach's alpha = 0.92; Brown & Ryan, 2003) and convergent construct validity (Brown & Ryan, 2003). Like the MAAS, the MAAS-State can be applied to the general population regardless of previous meditation experiences (Quaglia et al., 2015), and is the shortest state mindfulness measure in the literature. Therefore, the MAAS-State was a suitable mindfulness measure for Study 3.

Relational Ambivalence. Participant's relationship ambivalence was assessed and scored using the same method as in Study 1 and 2.

Commitment. Participant's commitment was assessed using the commitment subscale of the Investment Model Scale (IMS; Rusbult et al., 1998; see Appendix I). This is a 7-item measure rated on 9-point scale (0 = *not at all,* 8 = *completely*) with excellent internal consistency (Cronbach's α ranging from 0.91 to 0.95), assessing the degree one intends to persist in the current relationship. An example item is "I want our relationship to last for a very long time." Responses across items were averaged and scored such that higher values reflected higher commitment.

WTS. Participant's WTS was measured with the same method as in Study 1 and 2.

Covariates

Gender, Age, and Relationship Length. In Study 3, we controlled for the same demographic covariates included in Study 1 and 2 (see Appendix J).

Meditation Experience. Existing evidence has demonstrated that experienced meditators, compared to naïve meditators, show reduced neural activity associated with mind-wandering (Brewer et al., 2011). Mind-wandering is known as the tendency to be preoccupied with thoughts of the past or future (Berkovich-Ohana et al., 2012; Pagnoni, 2012), and is generally referred to as the opposite mental state to a mindful state (Mooneyham et al., 2016; Schooler et al., 2013). In other words, habitual meditators with less mind-wandering may exhibit higher levels of mindfulness, at baseline and/or after the manipulation, compared to non-meditators. We therefore controlled for participants' previous meditation experience in Study 3, which was measured by one demographic question (i.e., "How often do you meditate?"; see Appendix J).

Data Analysis Strategy

The first step of data analysis was examining the associations among study variables using bivariate correlation analysis, where Pearson's correlation coefficients were calculated . We then inspected the homogeneity of the baseline mindfulness scores between groups. An independent samples *t*-test was conducted to examine if the pre-manipulation state mindfulness scores between the intervention and control group were significantly different at baseline. The experimental conditions were effect-coded such that -1 = control condition, 1 = experimental condition.

To evaluate whether the 5-minute mindfulness exercise was effective at increasing participants' state mindfulness, the primary analyses performed using IBM SPSS version 25 were one-way analyses of covariance (ANCOVA) on post-intervention state mindfulness scores, including baseline measures of pre-intervention state mindfulness scores as covariates to control for baseline differences between the intervention and control groups.

Consistent with our preregistered analytic plan, mediation analyses were performed using Model 6 and 81 in PROCESS v3.3 by Andrew F. Hayes (2018) with 5000 bootstrapped samples and 95% confidence intervals of the indirect effect of the experimental manipulation on greater WTS through the proposed mediators (i.e., lower RA and higher commitment). We then further explored whether the experimental manipulation may predict greater WTS through enhanced post-manipulation state mindfulness, lower RA and higher commitment. A random number generator is seeded for bootstrapping through syntax to ensure that when the same seed is used in each analysis, the bootstrap confidence intervals are based on the same set of bootstrap samples (Hayes, 2018). The indirect effect was deemed significant if the 95% confidence interval did not contain zero. Post hoc Monte Carlo power analysis for indirect effects was conducted using WebPower (Zhang & Yuan, 2018) to yield statistical power of the above models in Study 3.

We first tested the models containing only our primary variables (i.e., experimental/control condition, RA, commitment, and WTS for the first hypothesis, and experimental/control condition, post-intervention state mindfulness, RA, commitment, and WTS for the second hypothesis) with pre-intervention state mindfulness as the covariate. We then tested the models that included our chosen covariates (i.e., gender, age, and relationship length, and meditation experience).

4.1.2 Results

Table 1 displays the descriptive statistics, reliability information, and correlations among study variables. The results from the independent samples *t*-test suggested that participants' baseline state mindfulness scores in the experimental group (M = 5.33, SD = 1.26) were not significantly different from those in the control group (M = 5.18, SD = 1.23), t (239) = 0.93, p = 0.355. An ANCOVA showed a significant main effect of experimental condition on post-manipulation state mindfulness scores controlling for baseline pre-

manipulation state mindfulness scores, $F(1, 238) = 4.15$, $p = .043$ Simple contrasts revealed that performing a brief mindfulness exercise significantly increased participants' post-manipulation state mindfulness ($M = 5.44$, $SD = 1.21$) compared to listening to an auditory introduction of the solar system ($M = 5.09$, $SD = 1.24$), $t(238) = 2.04$, $p = .043$.

Study 3 results revealed that the experimental manipulation did not significantly predict greater WTS through RA and commitment (see Figure 1 for the model controlling for covariates). Performing a brief mindfulness exercise did not significantly reduce participants' subsequent RA. However, lower RA significantly predicted greater commitment, which in turn predicted greater WTS, controlling for gender, age, relationship length, and meditation experiences. Therefore, the first hypothesis was not supported. Results of the post hoc Monte Carlo power analysis for indirect effects showed a statistical power of 0.01 for path $a_{11}b_{12}$, 0.10 for path $a_{12}c_{11}$, and 0.05 for path $a_{11}b_{11}c_{11}$ (i.e., the hypothesized serial mediation path) with the current sample size.

Study 3 results further revealed that the experimental manipulation significantly predicted greater WTS through post-manipulation state mindfulness, RA, and commitment (representing a medium indirect effect, $R^2 = .16$) (see Figure 2 for the model controlling for covariates). In particular, participants in the experimental group exhibited significantly greater post-manipulation state mindfulness, which then significantly predicted lower RA, which then significantly predicted higher commitment, which in turn significantly predicted greater WTS, controlling for gender, age, relationship length, and meditation experiences. Therefore, the second hypothesis was supported. Results of the post hoc Monte Carlo power analysis for indirect effects showed a statistical power of 0.23 for path $a_{21}b_{23}$, 0.01 for path $a_{22}c_{22}$, 0.28 for path $a_{23}d_{21}$, 0.02 for path $a_{21}b_{21}c_{22}$, 0.11 for path $a_{21}b_{22}d_{21}$, 0.06 for path $a_{22}c_{21}d_{21}$, and 0.81 for path $a_{21}b_{21}c_{21}d_{21}$ (i.e., the hypothesized serial mediation path) with the current sample size.

Table 1

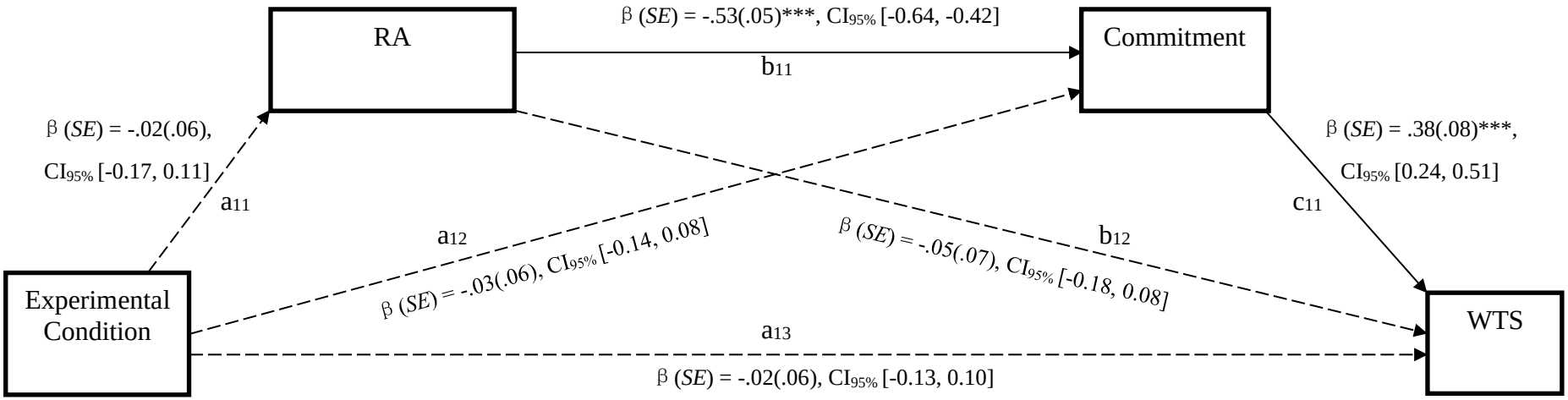
Study 3: Descriptive Statistics, Reliability Information, and Correlations among Study Variables

		Descriptives and Reliability			Correlations							
	Variable	Range	*M*(*SD*) or %	α	1	2	3	4	5	6	7	8
1	State Mindfulness (Pre)	2.20-7.00	5.25(1.25)	0.86	—	.46**	-.11	.14*	.05	.11	.10	-.08
2	State Mindfulness (Post)	1.60-7.00	5.27(1.24)	0.81		—	-.19**	.14*	.12	.03	.04	-.08
3	RA	-2.00-5.56	-0.04(1.70)	—			—	-.52**	-.25**	.04	.06	-.03
4	Commitment	3.29-9.00	7.98(1.25)	0.85				—	.42**	.01	.09	.01
5	WTS	2.25-7.00	5.99(0.95)	0.69					—	-.05	-.01	-.03
6	Age	18.00-61.00	29.34(9.46)	—						—	.76**	.11
7	Relationship Length	0.08-33.83	6.25(6.57)	—							—	.06
8	Meditation Experience	1.00-7.00	2.04(1.37)	—								—

Note. RA= relationship ambivalence, WTS = willingness to sacrifice. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Relationship length scores are in years. *$p < .05$, **$p < .01$, ***$p < .001$

Figure 1

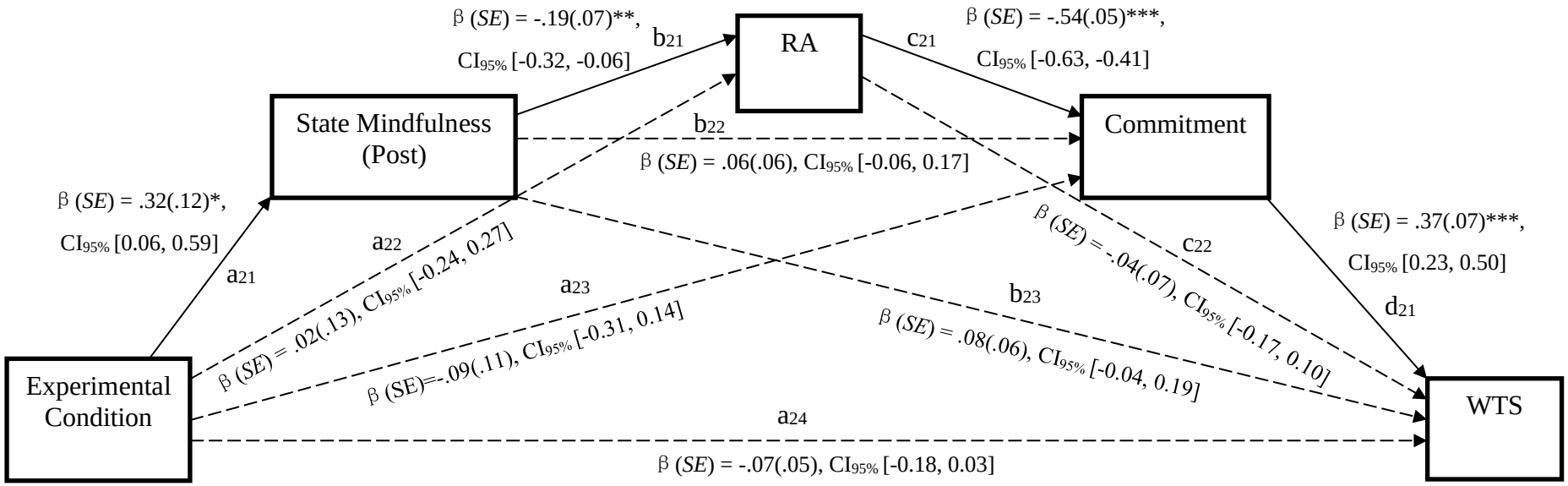
Study 3: Direct and Indirect Associations of Experimental Condition, RA, Commitment, and WTS



Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Experimental condition was effect-coded (-1 = control condition, 1 = experimental condition). Analyses control for gender, age, relationship length, and meditation experience. *p < .05, **p < .01, ***p < .001

Figure 2

Study 3: Direct and Indirect Associations of Experimental Condition, State Mindfulness, RA, Commitment, and WTS



<u>Indirect effect of experimental condition on WTS via post-manipulation state mindfulness, RA, & commitment</u>: β (*SE*) = .01(.01)**, $CI_{95\%}$ [0.001, 0.029]

Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Experimental condition was effect-coded (-1 = control condition, 1 = experimental condition). Analyses control for gender, age, relationship length, and meditation experience. *$p < .05$, **$p < .01$, ***$p < .001$

4.1.3 Discussion

The results of Study 3 suggest that, relative to participants randomly assigned to a control group, participants who performed a brief mindfulness exercise reported significantly greater state mindfulness at post-manipulation. The findings from Study 3 further demonstrated that experimentally manipulating participants' mindfulness could indirectly predict greater self-reported WTS. However, this indirect experimental effect must be carried forward by greater post-manipulation state mindfulness. This indicates that the experimental manipulation itself did not predict lower RA; rather, greater post-manipulation state mindfulness as a result of the experimental manipulation predicted lower RA, which predicted greater self-reported commitment, which in turn predicted greater self-reported WTS. In other words, a mindfulness exercise may only promote positive relationship responses for individuals who actually benefit from the exercise (i.e., whose state mindfulness was successfully enhanced). Taken together, the findings from the current study are consistent with the findings from Study 1 and 2, suggesting that increased levels of mindfulness can allow romantically-involved individuals to be less ambivalent towards their relationships, which then leads to increased dedication to the relationship, which eventually leads to greater WTS in the relationships.

Our findings suggest that even a brief 5-min online mindfulness exercise could be effective at enhancing individuals' state mindfulness, which echoes with extant evidence supporting the effectiveness of brief mindfulness manipulations (Call et al., 2014; Keng et al., 2011; Lam et al., 2015). Considering that studies employing traditional mindfulness-based interventions or meditations are relatively time-consuming (Lam et al., 2015) and are usually troubled with high drop-out rates (Vettese et al., 2009), knowing that a brief mindfulness manipulation could as well be effective would be helpful for many researchers interested in mindfulness-related topics. More importantly, our findings stressed that such intervention

may not be equally effective or beneficial to every participant, further highlighting the importance of active personal engagement in experimental manipulations.

Our findings suggest that successfully enhanced mindfulness can positively influence a number of relationship outcomes, such as RA, commitment, and WTS. This offers promising insights for couple-level interventions aiming to promote relationship well-being. Specifically, gaining a better understanding on the link between mindfulness and WTS allows psychotherapists to enhance the design of mindfulness-based interventions (MBI) targeting at certain relationship issues such as conflicts of interests between partners, which may be beneficial for future applications of MBI aiming to promote romantic relationship well-being more effectively.

Given that individuals' self-reported hypothetical willingness to perform certain activities in an imagined scenario may not always map onto their actual willingness to perform these activities in a given moment (Prins et al., 2020), in the next chapter, we investigated whether the serial mediation model established in the current study would be replicated when we assessed participant's actual WTS, instead of hypothetical WTS, by asking participants to indicate their willingness to perform mildly unpleasant tasks which could benefit their partners.[21] We believe that examining the potential difference, or similarity, between individuals' hypothetical and actual WTS would be helpful for us to unpack the individuals' decision making processes on sacrificial behaviours.

[21] This is referred to as actual WTS, but not enacted sacrifice because participants were not actually asked to proceed with any of the tasks, they indicated to be willing to perform for their partner's sake – our aim was just to convince them that they were about to perform the tasks at the time they indicated their WTS. More details regarding the methodology will be provided in the following section.

4.2 Studies 4 and 5

Study 3 revealed that performing a brief mindfulness exercise could indirectly predict greater WTS sequentially through enhanced post-manipulation state mindfulness, lower RA, and higher commitment. In the next two studies, we sought to investigate whether the established model would replicate when participants' WTS is assessed by their actual willingness to do unpleasant tasks as a favour to their partner, as opposed to responses to hypothetical scenarios in Study 3. According to existing evidence, individuals' hypothetical willingness to perform certain activities may be overestimated from their actual willingness (Prins et al., 2020). In Studies 4-5, we designed laboratory tasks in which participants were confronted with an immediate decision. In Study 4, we presented three distinct, mildly unpleasant tasks to participants, and assessed their self-reported WTS by asking them how many of these tasks they were willing to complete for their partner's sake. As we proceeded with our research, we noticed that this measure on actual WTS may be limited as participants may regard certain sacrifice task as more "demanding" than others. Therefore, in Study 5, we optimized our measure on actual WTS by presenting participants with one of the mildly unpleasant tasks in Study 4 and assessed their self-reported WTS by the number of trials they were willing to complete for their partner's sake. In both studies, we implemented the same mindfulness exercise and measures of RA and commitment as in Study 3. We hypothesized that the previously established serial mediation model would be replicated in Studies 4 and 5. In other words, a brief mindfulness manipulation would indirectly predict individuals' subsequent WTS when confronted with a potentially real sacrifice sequentially through higher post-manipulation state mindfulness, lower RA, and higher commitment.

4.2.1 Method

Participants

Study 4

The original targeted sample size was 250-300, which was determined based on study budget and data collection time constraints. We were able to recruit 393 participants online via Prolific Academic. The inclusion criteria were the same as Study 3. Custom pre-screening was applied to exclude participants who participated in Study 1–3 (and who therefore may have been familiar with the study purpose) to avoid any participant bias. A total of 130 participants were excluded: 9 people were not in a romantic relationship, 106 participants did not finish the entire survey,[22] one participant finished the survey too slow (in more than 2 hours), and 14 people failed attention checks. As a result, responses from a total of 263 eligible participants were analysed, of which 116 were women, 140 were men, 4 were genderqueer, and 3 were agender.

Participants were compensated with £1.50 for taking part in the study. Participants' ages ranged from 18 to 68 years (M = 27.23, SD = 8.74), and participants reported being in relationships lasting 1 month to 32.83 years (M = 5.16 years, SD = 5.81 years). Participants identified themselves as White/Caucasian (76.8%, N = 202), Asian (3%, N = 8), Black/African/Caribbean (1.5%, N = 4), Hispanic/Latino (13.7%, N = 36), Middle Eastern/Arab (0.8%, N = 2), Mixed/Multi-ethnic (3%, N = 8), and "Other" (1.1%, N = 3). Approximately 82.0% of the participants were heterosexual (N = 218), 11.4% were bisexual/pansexual (N = 30), 0.4% was asexual (N = 1), 2.7% were gay (N = 7), 1.1% were lesbian (N = 3), and 1.5% were "Other" (N = 4). Approximately 63.5% of the participants were dating their current partner exclusively (N = 167), 6.1% were dating current partner and others (N = 16), 16% were married (N = 42), 6.8% were engaged (N = 18), 3.0% were in a

[22] There was a mistake in the initial survey flow and the auditory guidance was not displayed successfully to some participants. Although the mistake was spotted and corrected shortly after we launched the survey, a larger number of participants were excluded as their responses were incomplete due to the incorrect survey flow. It is worth noting that the larger number of participants being excluded was not due to abnormal study design.

common-law relationship (*N* = 8), and 4.6% were in a civil partnership (*N* = 12). 43.3% of the participants had never meditated before (*N* = 114), 31.6% meditated a few times each year (*N* = 83), 11.0% meditated about 1-2 times each month (*N* = 29), 6.5% mediated 1-2 times each week (*N* = 17), 2.7% meditated 3 or more times each week (*N* = 7), and 1.9% meditated every day or nearly every day (*N* = 5).

Study 5

The original targeted sample size was 250-300, which was determined based on study budget and data collection time constraints. We were able to recruit 291 participants online via Prolific Academic. The inclusion criteria were the same as Study 3 and 4. Custom pre-screening was applied to exclude participants who participated in Study 1–4 (and who therefore may have been familiar with the study purpose) to avoid any participant bias. A total of 41 participants were excluded: 12 people were not in a romantic relationship, one participant finished the survey too fast (in less than 7 minutes), and 28 people failed attention checks. As a result, responses from a total of 250 eligible participants were analysed, of which 120 were women, 127 were men, and 3 were genderqueer.

As in Study 4, participants were compensated with £1.50 for taking part in the study. Participants' ages ranged from 18 to 61 years (*M* = 28.20, *SD* = 9.35), and participants reported being in relationships lasting 1 month to 42.33 years (*M* = 5.81 years, *SD* = 6.70 years). Participants identified themselves as White/Caucasian (86.8%, *N* = 217), Asian (2.4%, *N* = 6), Black/African/Caribbean (2.4%, *N* = 6), Hispanic/Latino (5.6%, *N* = 14), Middle Eastern/Arab (0.4%, *N* = 1), Mixed/Multi-ethnic (1.6%, *N* = 4), and "Other" (0.8%, *N* = 2). Approximately 80.0% of the participants were heterosexual (*N* = 200), 15.2% were bisexual/pansexual (*N* = 38), 0.4% was asexual (*N* = 1), 2.4% were gay (*N* = 6), 0.8% were lesbian (*N* = 2), and 1.2% were "Other" (*N* = 3). Approximately 61.2% of the participants were dating their current partner exclusively (*N* = 153), 1.6% were dating current partner and

others (*N* = 4), 23.6% were married (*N* = 59), 7.6% were engaged (*N* = 19), 3.6% were in a common-law relationship (*N* = 9), and 2.4% were in a civil partnership (*N* = 6). 46.0% of the participants had never meditated before (*N* = 115), 31.6% meditated a few times each year (*N* = 79), 10.0% meditated about 1-2 times each month (*N* = 25), 6.8% mediated 1-2 times each week (*N* = 17), 1.2% meditated 3 or more times each week (*N* = 3), and 4.4% meditated every day or nearly every day (*N* = 11).

Measures and Procedure

In both studies, participants first completed some basic demographic questionnaires and a questionnaire measuring their pre-manipulation state mindfulness (see Appendix J). Participants were then randomly assigned into either the experimental condition, in which they were asked to follow a 5-minute audio guidance of mindfulness exercise, or the control condition, in which they listened to a 5-minute audio recording introducing the solar system. The audio recordings of the experimental and control group were the same as the ones employed in Study 3 (see Appendix F & G). After the audio recording, participants' post-manipulation state mindfulness, RA, commitment and WTS were measured using self-reported questionnaires. The entire study took approximately 15-20 minutes to complete. After completing the study, participants were fully debriefed and then compensated by Prolific Academic.

Primary Measures

All questionnaires are available online via the Open Science Framework (https://mfr.osf.io/render?url=https://osf.io/4vd2r/?direct%26mode=render%26action=download%26mode=render).

State Mindfulness. In both studies, participant's state mindfulness was measured by the 21-item State Mindfulness Scale (SMS) (Tanay & Bernstein, 2013; see Appendix K). The SMS addresses the responder's level of perceived mindfulness across a recent period (e.g.,

the past 15 minutes), and can be applied to the general population regardless of previous meditation experiences (Tanay & Bernstein, 2013). This scale consists of two subscales, State Mindfulness of Body (6 items) and Mind (15 items), addressing physical and mental objects of state mindfulness respectively. Responses are rated on a 5-point scale (1 = *not at all*, 5 = *very well*), and an example item is "I was finding it difficult to stay focused on what was happening." Responses across items were averaged and scored such that higher values reflected greater state mindfulness. Existing evidence has shown that the SMS demonstrates strong internal consistency (Cronbach's α ranging from 0.90 to 0.95; Mantzios, Egan, & Asif, 2020; Seabrook et al., 2020; Tanay & Berstein, 2013), and strong construct validity through positive correlations between the SMS scores and state mindfulness scores measured by the Toronto Mindfulness Scale (TMS; Lau et al., 2006), but not trait mindfulness scores measured by the MAAS (Brown & Ryan, 2003; Tanay & Berstein, 2013). Tanay and Bernstein (2013) proposed that the SMS exhibits incremental sensitivity to change relative to State-MAAS, and they further suggested that it may be because SMS addresses a context-sensitive state of awareness and attention, whereas the MAAS addresses trait-like awareness and attention to the current moment. We therefore chose the SMS as the measure of state mindfulness in Study 4 and 5.

RA, and Commitment. In both studies, participant's RA and commitment were assessed and scored using the same method as in Study 1-3 (see Appendix C & I).

WTS. In Study 4, participant's WTS was assessed by one question, which was designed by the researchers (see Appendix L). Participants were presented with 3 moderately boring or unpleasant tasks (i.e., reading, spot the difference, and violent images task) and were told that for each task they completed, their partner would be entered into a prize draw to win one of three £20 Amazon gift cards. For the reading task, participants were told that they would be required to read a 500-word biography and answer a few questions about it.

For the spot the difference task, participants were told that they would be required to identify the differences between two landscape photos of the moon captured by two different astronomical telescopes. For the violent images task, participants were told that they would be shown several disturbing/violent/uncomfortable photos and answer some questions about them. Participants were then asked to select as many of the presented tasks as they would like. Responses were rated from 0 (no task selected) to 3 (3 tasks selected). Participants were not required to actually perform any of the tasks. The tasks were designed to fit naturally into a laboratory setting such that participants were able to complete the tasks using the online questionnaire platform, and were confronted with an immediate decision. The tasks commonly used in the existing WTS researches were not specific to close relationships (e.g., lending partner money, going out with partner's boring friends) (Righetti et al., 2013; Yan et al., 2022)[23], as it is extremely challenging, or even impractical, to adjust these tasks into laboratory tasks that require participants to offer an immediate response without being obliged to proceed with their response. Therefore the content of the tasks used in the current study was not relationship-specific. However, by completing these mildly unpleasant tasks, participants were told that they could benefit their partners.

The same instructions were employed in Study 5, except that participants were presented only with the spot the difference task and asked to indicated how many trials they

[23] In the current literature, the commonly used laboratory tasks measuring actual WTS were not specific to romantic relationships. For example, in Righetti et al.'s (2013) study, participants were told that they and their partner had to approach a total of 12 strangers and say: "I have an important job interview in a bit. Do you think I'm dressed appropriately?" Participants were told that they could decide the number of strangers assigned to them and their partners respectively, and were asked to indicate the number of strangers they would like to approach. After making the decision, participants were not asked to proceed with this embarrassing task. Further example includes the Cold Pressor Task, which is introduced in a more recent study investigating sacrifice in close relationship (see Yan et al., 2022 for more details).

were willing to complete. Responses were rated from 0 (no trial selected) to 3 (3 trials selected).[24] Similar to Study 4, participants were not required to perform any trials of the task.

Covariates

Gender, Age, Relationship Length, and Meditation Experience. In both studies, we controlled for the same demographic covariates included in Study 3 (see Appendix J).

Data Analysis Strategy

The first step of data analysis was examining the associations among study variables using bivariate correlation analysis where Pearson's correlation coefficients were calculated. We then inspected the homogeneity of the baseline mindfulness scores between groups. An independent samples *t*-test was conducted to examine if the pre-manipulation state mindfulness scores between the intervention and control group were significantly different at baseline. The experimental conditions were effect-coded such that -1 = control condition, 1 = experimental condition.

To evaluate whether the 5-minute mindfulness exercise was effective at increasing participants' state mindfulness, the primary analyses performed using IBM SPSS version 25 were one-way analyses of covariance (ANCOVA) on post-intervention state mindfulness scores, including baseline measures of pre-intervention state mindfulness scores as covariates to control for baseline differences between the intervention and control groups.

Consistent with our pre-registered analytic plan, mediation analyses were performed using Model 6 in PROCESS v3.3 by Andrew F. Hayes (2018) with 5000 bootstrapped samples and 95% confidence intervals of the indirect effect of the experimental group on greater WTS through the proposed mediators (higher post-manipulation state mindfulness,

[24] Since it took approximately 15-20 mins to complete the entire survey, participants were likely to expect they would spend an extra 10-15 mins, but not too much longer than that, on the actual WTS task if they agreed to proceed with it. Therefore, to make our actual WTS task convincing to the participants, we set the max number of trials to be three.

lower RA, and higher commitment). A random number generator is seeded for bootstrapping through syntax to ensure that when the same seed is used in each analysis, the bootstrap confidence intervals are based on the same set of bootstrap samples (Hayes, 2018). The indirect effect was deemed significant if the 95% confidence interval did not contain zero. Post hoc Monte Carlo power analysis for indirect effects was conducted using WebPower (Zhang & Yuan, 2018) to yield statistical power of the above models.

We first tested a model containing only our primary variables (i.e., experimental/control condition, post-intervention state mindfulness, RA, commitment, and WTS) with pre-intervention state mindfulness scores as covariates. We then tested a model that included our chosen covariates (i.e., gender, age, relationship length, and meditation experience).

4.2.2 Results

Study 4

Table 2 displays the descriptive statistics, reliability information, and correlations among study variables of Study 4. Results from the independent samples *t*-test suggested that participants' baseline state mindfulness scores in the experimental group (M = 3.96, SD = 0.50) were significantly higher than those in the control group (M = 3.84, SD = 0.48), $t(262) = 2.03$, $p = .043$ An ANCOVA showed a significant main effect of experimental manipulation on post-manipulation state mindfulness scores controlling for baseline pre-manipulation state mindfulness scores, $F(1, 261) = 18.44$, $p < .001$. Simple contrasts revealed that performing a brief mindfulness exercise significantly increased participants' post-manipulation state mindfulness (M = 4.15, SD = 0.59) compared to listening to an auditory introduction of the solar system (M = 3.96, SD = 0.62), $t(261) = 4.29$, $p < .001$.

Results of the serial mediation model (see Figure 3 and 4) suggested that when controlling for pre-manipulation state mindfulness, gender, age, relationship length and

meditation experience, the experimental condition indirectly predicted participants' WTS only through enhanced post-manipulation state mindfulness (representing a small indirect effect, $R^2 = .06$)[25]. Experimentally manipulating mindfulness also predicted lower levels of commitment in the covariate model. Besides, higher RA predicted lower commitment and greater WTS in the covariate model. When controlling for pre-manipulation state mindfulness, the experimental condition did not indirectly predict WTS through enhanced post-manipulation state mindfulness, lower RA, and higher commitment, in either the no-covariate (see Figure 4) or covariate model. Results across the two models generate similar patterns: Performing a brief mindfulness exercise significantly increased participants post-manipulation state mindfulness scores, but this did not lead to lower RA (which was inconsistent with the finding of Study 3). Participants' lower RA was linked to higher commitment (which was consistent the finding of Study 3), which did not predict greater WTS (which was inconsistent with the finding of Study 3). Results of the post hoc Monte Carlo power analysis for indirect effects showed a statistical power of 0.73 for path $a_{41}b_{43}$, 0.01 for path $a_{42}c_{42}$, 0.13 for path $a_{43}d_{41}$, 0.07 for path $a_{41}b_{41}c_{42}$, 0.01 for path $a_{41}b_{42}d_{41}$, 0.01 for path $a_{42}c_{41}d_{41}$, and 0.02 for path $a_{41}b_{41}c_{41}d_{41}$ (i.e., the hypothesized serial mediation path) with the current sample size.[26]

Study 5

Table 2 displays the descriptive statistics, reliability information, and correlations among study variables of Study 5. Results from the independent samples *t*-test suggested that participants' baseline state mindfulness scores in the experimental group ($M = 3.88$, $SD = 0.49$) were not significantly different from those in the control group ($M = 3.91$, $SD = 0.46$), *t*

[25] Given the high similarity between the non-covariate model and the covariate model, only the effect sizes regarding the covariate model were reported here for a concise and better presentation.
[26] Given the high similarity between the non-covariate model and the covariate model, only the statistical power regarding the covariate model were reported here for a concise and better presentation.

(249) = 0.46, p = .713. An ANCOVA showed a significant main effect of experimental manipulation on post-manipulation state mindfulness scores controlling for baseline pre-manipulation state mindfulness scores, $F(1, 248) = 12.84$, $p < .001$. Simple contrasts revealed that performing a brief mindfulness exercise significantly increased participants' post-manipulation state mindfulness (M = 4.05, SD = 0.60) compared to listening to an auditory introduction of the solar system (M = 3.92, SD = 0.56), $t(248) = 3.58$, $p < .001$.

Similar to Study 4, results of the serial mediation model suggested that when controlling for pre-manipulation state mindfulness, the experimental manipulation did not indirectly predict WTS through enhanced post-manipulation state mindfulness, lower RA, and higher commitment, in either the no-covariate (see Figure 5) or covariate model (see Figure 6). Results across the two models generate similar patterns: Performing a brief mindfulness exercise significantly increased participants post-manipulation state mindfulness scores, but this did not lead to lower RA (which was inconsistent with the finding of Study 3). Participants' lower RA was linked to higher commitment (which was consistent with the finding of Study 3), which did not predict greater WTS (which was inconsistent with the finding of Study 3). Results of the post hoc Monte Carlo power analysis for indirect effects showed a statistical power of 0.58 for path $a_{61}b_{63}$, 0.01 for path $a_{62}c_{62}$, 0.54 for path $a_{63}d_{61}$, 0.01 for path $a_{61}b_{61}c_{62}$, 0.08 for path $a_{61}b_{62}d_{61}$, 0.01 for path $a_{62}c_{61}d_{61}$, and 0.01 for path $a_{61}b_{61}c_{61}d_{61}$ (i.e., the hypothesized serial mediation path) with the current sample size.

Table 2

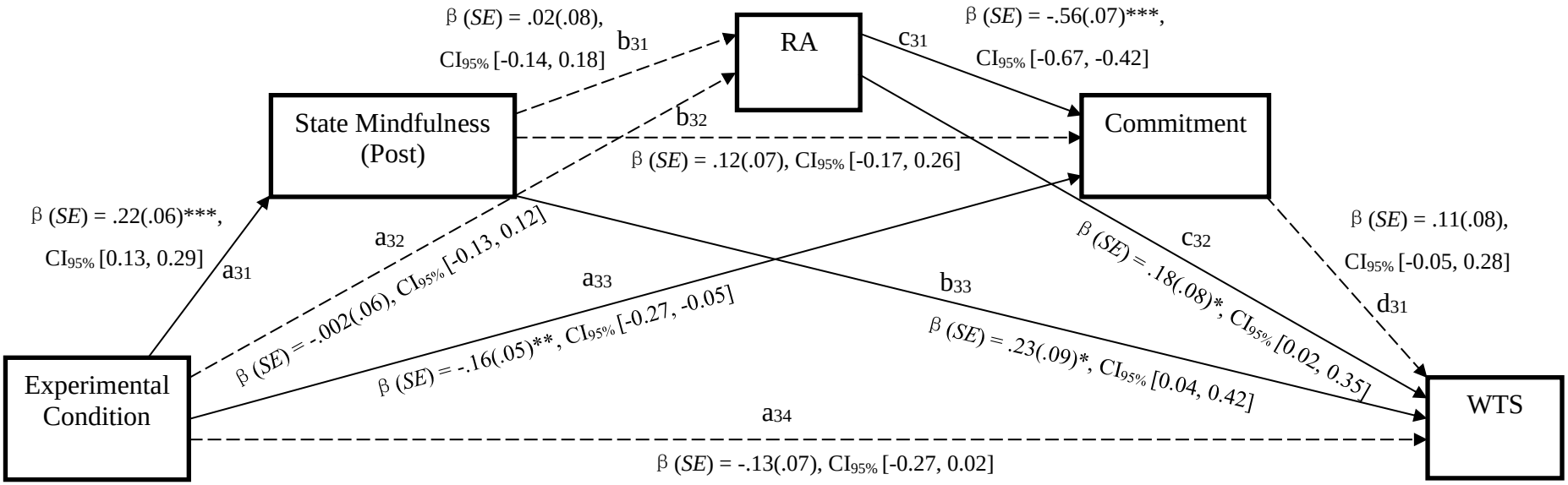
Study 4 & 5: Descriptive Statistics, Reliability Information, and Correlations among Study Variables

	Variable	Descriptives and Reliability			Correlations							
		Range	*M*(*SD*) or %	α	1	2	3	4	5	6	7	8
Study 4												
1	State Mindfulness (Pre)	2.52 – 5.00	3.90(0.50)	0.88	—	.64**	-.23**	.07	.15*	.02	.01	.10
2	State Mindfulness (Post)	1.90 – 5.00	3.97(0.62)	0.93		—	-.14*	.08	.19**	-.03	-.04	.05
3	RA	-2.00 – 5.44	0.13(1.84)	—			—	-.53**	.07	.02	-.07	.01
4	Commitment	1.57 – 9.00	7.68(1.61)	0.90				—	.05	-.09	.05	-.06
5	WTS	0.00 – 3.00	1.09(1.16)	—					—	.05	.07	.02
6	Age	18.00 – 68.00	27.23(8.74)	—						—	.72**	.17**
7	Relationship Length	0.08 – 32.83	5.16(5.81)	—							—	.05
8	Meditation Experience	1.00 – 7.00	2.10(1.42)	—								—
Study 5												
1	State Mindfulness (Pre)	2.05 – 5.00	3.90(0.47)	0.88	—	.78**	-.18**	.04	.08	.06	.09	.04
2	State Mindfulness (Post)	2.24 – 5.00	3.99(0.58)	0.93		—	-.17**	.09	.01	.10	.08	.14*
3	RA	-2.00 – 4.81	-0.13(1.72)	—			—	-.58**	-.01	.09	.10	-.05
4	Commitment	1.57 – 9.00	7.98(1.44)	0.90				—	.09	.15*	.17**	.08
5	WTS	0.00 – 3.00	1.54(1.41)	—					—	.05	.08	.02
6	Age	18.00 – 61.00	28.20(9.35)	—						—	.77**	.11
7	Relationship Length	0.08 – 42.33	5.81(6.70)	—							—	.07
8	Meditation Experience	1.00 – 7.00	2.05(1.40)	—								—

Note. RA= relationship ambivalence, WTS = willingness to sacrifice. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Relationship length scores are in years. *$p < .05$, **$p < .01$, ***$p < .001$

Figure 3

Study 4: Direct and Indirect Associations of Experimental Condition, State Mindfulness, RA, Commitment, and WTS (No-Covariate Model)

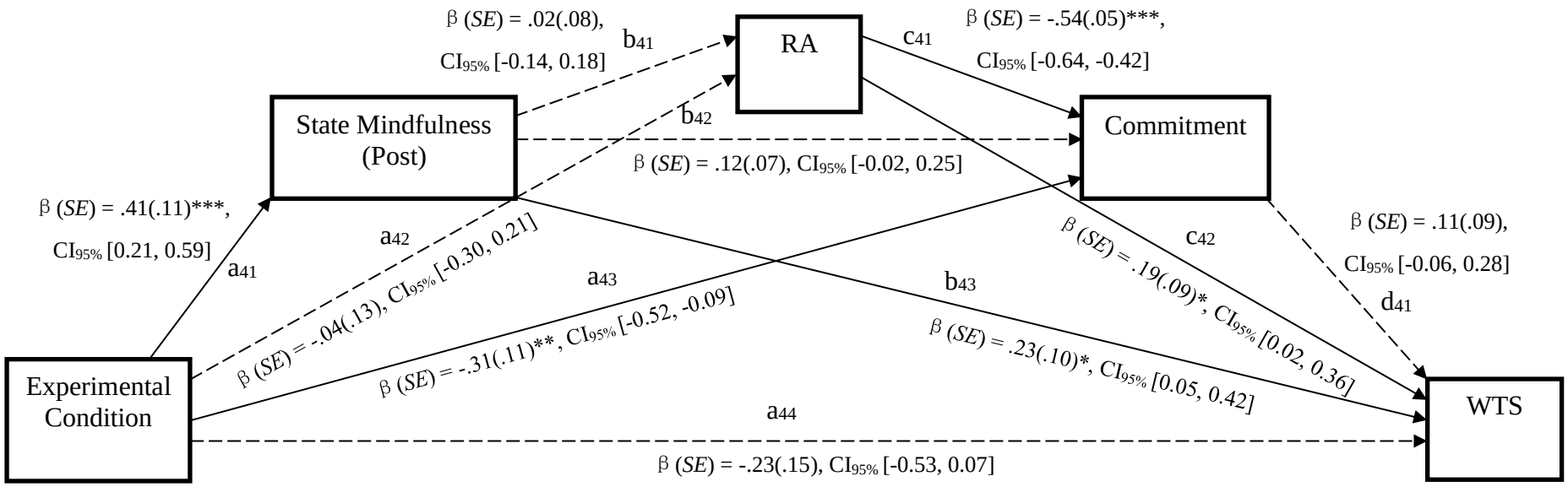


Indirect effect of experimental condition on WTS via post-manipulation state mindfulness: β (*SE*) = .05(.02)*, $CI_{95\%}$ [0.01, 0.09]

Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Experimental condition was effect-coded (-1 = control condition, 1 = experimental condition). Analyses control for gender, age, relationship length, and meditation experience. *p < .05, **p < .01, ***p < .001

Figure 4

Study 4: Direct and Indirect Associations of Experimental Condition, State Mindfulness, RA, Commitment, and WTS (Covariate Model)

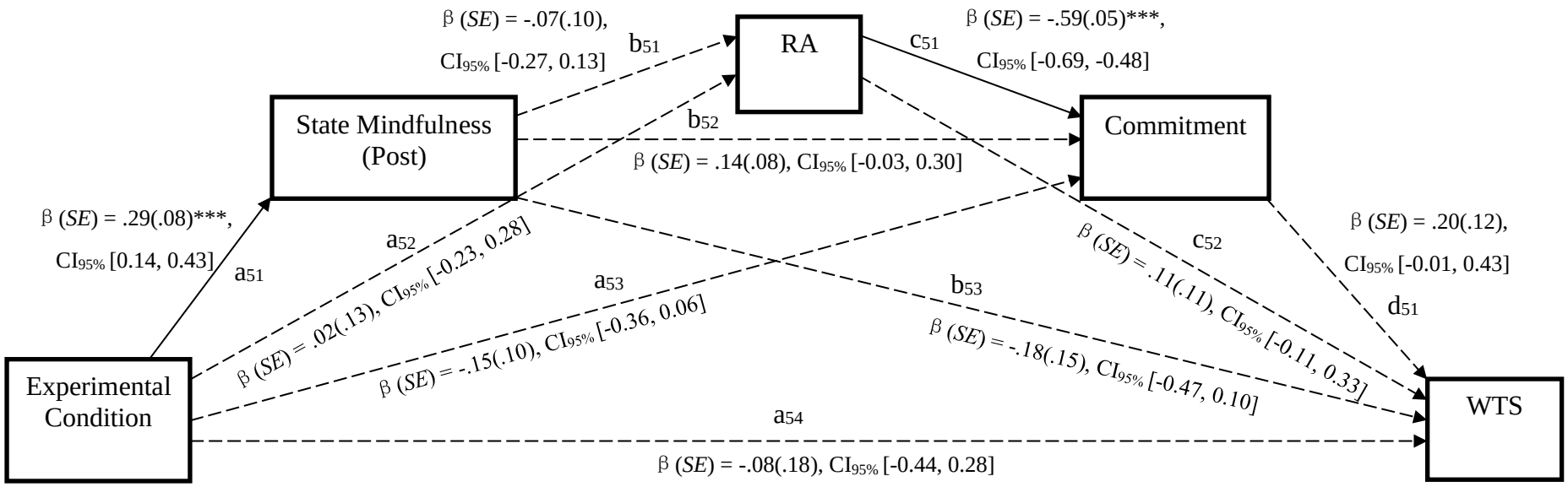


Indirect effect of experimental condition on WTS via post-manipulation state mindfulness: β (*SE*) = .16(.05)*, $CI_{95\%}$ [0.07, 0.27]

Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Experimental condition was effect-coded (-1 = control condition, 1 = experimental condition). Analyses control for gender, age, relationship length, and meditation experience. *p < .05, **p < .01, ***p < .001

Figure 5

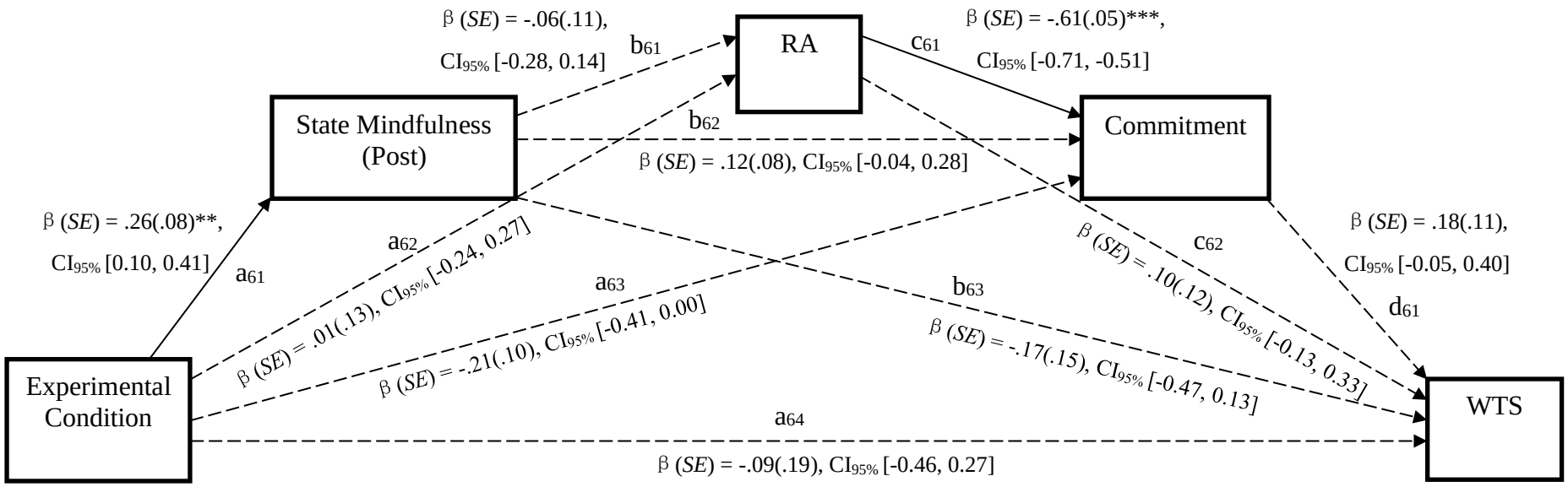
Study 5: Direct and Indirect Associations of Experimental Condition, State Mindfulness, RA, Commitment, and WTS (No-Covariate Model)



Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Experimental condition was effect-coded (-1 = control condition, 1 = experimental condition). Analyses control for gender, age, relationship length, and meditation experience. *p < .05, **p < .01, ***p < .001

Figure 6

Study 5: Direct and Indirect Associations of Experimental Condition, State Mindfulness, RA, Commitment, and WTS (Covariate Model)



Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Experimental condition was effect-coded (-1 = control condition, 1 = experimental condition). Analyses control for gender, age, relationship length, and meditation experience. *p < .05, **p < .01, ***p < .001

4.2.3 Discussion

Although the results of Study 4 demonstrated that performing a brief mindfulness exercise indirectly predicted greater WTS through enhanced post-manipulation state mindfulness, the results of Study 5 did not reveal any significant indirect links between experimental conditions and WTS through any mediators. Neither Study 4 nor Study 5 replicated the serial mediation model established in Study 3. While receiving a brief mindfulness manipulation predicted greater self-reported WTS in hypothetical scenarios through higher post-manipulation state mindfulness, lower RA, and higher commitment (as shown in Study 3), this manipulation may not predict WTS through the proposed mediators when individuals are confronted with real sacrifices they may have to make for a partner (as shown in Study 4 and 5).

The inconsistent findings across our experimental studies illuminate the possibility that individuals' actual WTS may function differently than hypothetical WTS. The threshold of individuals' decision on whether or not to make hypothetical sacrifices may be lower than that of the decision on whether or not to make an actual sacrifice. A brief mindfulness manipulation, which may be effective at increasing participants' self-reported hypothetical WTS, may not be powerful enough to increase participants' actual WTS. As a matter of fact, while having the positive intentions to sacrifice has been consistently linked to positive relationship outcomes (Righetti & Impett, 2017; Van Lange et al., 1997), actual performed sacrifices may not always benefit the relationship (Righetti et al., 2020; Totenhagen & Curran, 2011; Whitton et al., 2007; Curran et al., 2016). Specifically, Righetti et al (2020) found that enacted sacrifice may have negative consequences to personal and relationship well-being. By cultivating heightened awareness and attention to one's internal and external experiences, mindful individuals may be more aware and attentive to these potential negative consequences during their decision-making process. This may cancel out some potential

beneficial effect of mindfulness on WTS introduced earlier, such as the enhanced attention and awareness of one's self-interest and partner's needs. As a result, greater level of mindfulness may not necessarily lead to greater actual WTS.

Another possible explanation for the divergent results between the present studies and Study 3 might be that different scales were employed as measures of state mindfulness. Unlike the SMS (which is a multifaceted construct), the State-MAAS employed in Study 3 is a unidimensional construct (Shankland et al., 2017). The State-MAAS focuses on measuring an individual's present-moment attention and awareness during general daily activities (e.g., "I was finding it difficult to stay focused on what was happening"), but does not address one's attentiveness and awareness of physical sensations and mental events (e.g., being aware and attentive to one's passing thoughts, emotions or feelings), or mindfulness in certain context, notably during mindfulness exercises (Ruimi et al., 2019; Shankland et al., 2017; Tanay & Bernstein, 2013). Besides, all of the items of the State-MAAS are negatively phrased. Researchers have therefore argued that the scale measures mind-wandering and lack of attention and awareness, as opposed to mindfulness (Grossman, 2008; Ruimi et al., 2019), although Höfling and colleagues (2011) proposed that mindful attention and awareness can be measured by both positively and negatively phrased MAAS items as long as trait-method models are applied to control for method effects associated item wording. Taken these limitations together, the State-MAAS may lack content validity and may not comprehensively address participants' pre- and post-manipulation state mindfulness in Study 3, which may be the reason why the results across Study 3-5 do not converge.

To address the aforementioned issue, in the next study, we sought to investigate whether experimentally manipulating mindfulness may indirectly predict greater WTS through greater post-manipulation mindfulness, lower RA and higher commitment when we employ two different types of mindfulness scales to assess participants' state mindfulness.

We aim to explore whether the experimental effect on subsequent self-reported WTS would be significant when we control mindfulness scale type as a covariate.

4.3 Study 6

As discussed in the previous chapter, the divergent results across Studies 3-5 may be accounted for by the variation of mindfulness measures. The two mindfulness scales employed in Studies 3-5, the State-MAAS and SMS, have different factor structures and are constructed based on considerably different description of mindfulness, and therefore may reflect the phenomenon of state mindfulness differently (Shankland et al., 2017; Tanay & Bernstein, 2013). We have proposed two possible explanations for the divergent results across Studies 3 – 5: a) hypothetical and actual WTS may function differently, and b) different mindfulness scales were used. Ideally, to fully address these two concerns, we would need to design two studies, measuring hypothetical and actual WTS respectively as the dependent variable, while randomly allocating participants to either the State-MAAS or SMS in both studies. This way we would gain a full picture of whether the type of mindfulness scales, or the type of WTS being measured, or both, may be the reason why the mediation model established in Study 3 was not replicated in Studies 4-5. However, we acknowledge that the measure of actual WTS in Studies 4-5 likely lacks ecological validity. A more effective method for assessing active WTS would require participants to come to the lab in-person. Unfortunately, due to COVID-19 lockdown, this was not possible at the time of these studies. In Study 6, then, we tested the model only with hypothetical WTS as the dependent variable.

In the current study, we sought to examine the same mediation model as in Study 3, while controlling for the type of mindfulness scale as a covariate.[27] Participants were randomly assigned to answer either the State-MAAS or SMS before and after performing the brief mindfulness exercise. In comparison to the previous studies, this study was more

[27] Due to budget and time constraints, it was not practical to ask participants to answer both scales in the current study. We therefore decided to investigate the type of mindfulness scale as a covariate, which required participants to answer to only one scale.

exploratory and we were trying to reconcile the divergent findings of the previous experimental studies. We aimed to investigate when controlling for mindfulness scale type along with our previous demographic covariates (i.e., gender, age, relationship length, and meditation experiences), whether experimentally manipulating mindfulness may predict greater subsequent hypothetical WTS through greater post-manipulation state mindfulness, lower RA and higher commitment when participants' state mindfulness scores were assessed using two different mindfulness scales.

4.3.1 Method

Participants

The original targeted sample size was 400-450, which was determined based on study budget and data collection time constraints. We were able to recruit 458 participants online via Prolific Academic. The inclusion criteria were the same as Study 3. Custom pre-screening was applied to exclude participants who participated in Study 1–5 (and who therefore may have been familiar with the study purpose) to avoid any participant bias. A total of 64 participants were excluded: 17 people were not in a romantic relationship, 22 participants did not finish the entire survey, and 25 people failed attention checks. As a result, responses from a total of 394 eligible participants were analysed, of which 209 were women, 182 were men, 1 was genderqueer, and 2 were bigender.

Participants were compensated with £1.50 for taking part in the study. Participants' ages ranged from 18 to 55 years (M = 27.57, SD = 8.19), and participants reported being in relationships lasting 2 months to 32.42 years (M = 5.76 years, SD = 5.96 years). Participants identified themselves as White/Caucasian (80.2%, N = 316), Asian (5.8%, N = 23), Black/African/Caribbean (0.3%, N = 1), Hispanic/Latino (9.4%, N = 37), Middle Eastern/Arab (0.8%, N = 3), Mixed/Multi-ethnic (3.3%, N = 13), and "Other" (0.3%, N = 1). Approximately 83.0% of the participants were heterosexual (N = 327), 14.2% were

bisexual/pansexual (*N* = 56), 0.3% was asexual (*N* = 1), 0.5% were gay (*N* = 2), 1.3% were lesbian (*N* = 5), and 0.8% were "Other" (*N* = 3). Approximately 64.5% of the participants were dating their current partner exclusively (*N* = 254), 1.8% were dating current partner and others (*N* = 7), 22.3% were married (*N* = 88), 4.8% were engaged (*N* = 19), 3.6% were in a common-law relationship (*N* = 14), and 3.0% were in a civil partnership (*N* = 12). 46.7% of the participants had never meditated before (*N* = 184), 29.9% meditated a few times each year (*N* = 118), 11.4% meditated about 1-2 times each month (*N* = 45), 4.8% mediated 1-2 times each week (*N* = 19), 3.3% meditated 3 or more times each week (*N* = 13), and 3.8% meditated every day or nearly every day (*N* = 15).

Measures and Procedure

Participants first completed some basic demographic questionnaires (see Appendix J), and then were randomly allocated to either the State-MAAS or SMS group, where they were required to respond to either the State-MAAS, or SMS as indications of their pre- and post-manipulation state mindfulness. Participants in both groups were then randomly assigned into either the experimental condition, in which they were asked to follow a 5-minute audio guidance of mindfulness exercise, or the control condition, in which they listened to a 5-minute audio recording introducing the solar system. The audio recordings of the experimental and control group were the same as the ones employed in Study 3-5 (see Appendix F & G). After the audio recording, participants' post-manipulation state mindfulness, RA, commitment and WTS were measured using self-reported questionnaires. The entire study took approximately 15-20 minutes to complete. After completing the study, participants were fully debriefed and then compensated by Prolific Academic.

Primary Measures

State Mindfulness. Participants' levels of state mindfulness were measured by either the State-MAAS (Brown & Ryan, 2003; see Appendix H), the same method as in Study 3, or the SMS (Tanay & Bernstein, 2013; see Appendix K), the same method as in Studies 4 and 5.

RA, Commitment, and WTS. Participants' RA, commitment, and WTS were assessed and scored using the same method as in Study 1-3 (see Appendix C, I, & D).

Covariates

Gender, Age, Relationship Length, and Meditation Experience. We controlled for the same demographic covariates included in Study 3 (see Appendix J).

Mindfulness Scale Type. We controlled for the type of mindfulness scale administered in this study.

Data Analysis Strategy

The first step of data analysis was examining the associations among study variables using bivariate correlation analysis where Pearson's correlation coefficients were calculated. We inspected the homogeneity of the baseline mindfulness scores between experimental conditions in both the State-MAAS and SMS group. An independent samples *t*-test was conducted to examine if the pre-manipulation state mindfulness scores between the manipulation and control condition were significantly different at baseline. The experimental conditions were effect-coded such that -1 = control condition, 1 = experimental condition. Mindfulness scale type was effect-coded such that -1 = State-MAAS, 1 = SMS.

To evaluate whether the 5-minute mindfulness exercise was effective at increasing participants' state mindfulness in both the State-MAAS and SMS group, the primary analyses performed using IBM SPSS version 25 were one-way analyses of covariance (ANCOVA) on post-intervention state mindfulness scores, including baseline measures of pre-intervention state mindfulness scores as covariates to control for baseline differences between the intervention and control groups.

Participants' mindfulness scores measured by either the State-MAAS or SMS were then standardized for serial mediation analyses. Mediation analyses were performed using Model 6 in PROCESS v3.3 by Andrew F. Hayes (2018) with 5000 bootstrapped samples and 95% confidence intervals of the indirect effect of the experimental group on increase in WTS through the proposed mediators (lower RA and/or higher commitment). A random number generator is seeded for bootstrapping through syntax to ensure that when the same seed is used in each analysis, the bootstrap confidence intervals are based on the same set of bootstrap samples (Hayes, 2018). The indirect effect was deemed significant if the 95% confidence interval did not contain zero. Post hoc Monte Carlo power analysis for indirect effects was conducted using WebPower (Zhang & Yuan, 2018) to yield statistical power of the above models in Study 3.

We first tested a non-covariate model containing only our primary variables (i.e., experimental/control condition, post-intervention state mindfulness, RA, commitment, and WTS) with pre-intervention state mindfulness scores as covariates. We then tested our first covariate model that included the same covariates as with Study 3 (i.e., gender, age, relationship length, meditation experience). We then tested a second covariate model that included mindfulness scale type as an additional covariate.

4.3.2 Results

Table 3 displays the descriptive statistics, reliability information, and correlations among study variables of Study 6. Results from the independent samples *t*-test suggested that participants' baseline SMS scores in the experimental group (M = 3.79, SD = 0.55) were not significantly different from those in the control group (M = 3.80, SD = 0.55), t (199) = 0.07, p = .758. An ANCOVA showed a significant main effect of experimental condition on post-manipulation SMS scores controlling for baseline pre-manipulation SMS scores, F(1, 198) = 11.35, p = .001. Simple contrasts revealed that performing a brief mindfulness exercise

significantly increased participants' post-manipulation SMS scores (M = 3.97, SD = 0.58) compared to listening to an auditory introduction of the solar system (M = 3.80, SD = 0.61), $t(198) = 3.37$, $p = .001$.

Similarly, results from the independent samples t-test suggested that participants' baseline State-MAAS scores in the experimental group (M = 5.24, SD = 1.35) were not significantly different from those in the control group (M = 5.18, SD = 1.27), t (193) = 0.33, p = .831. However, an ANCOVA showed a non-significant main effect of experimental condition on post-manipulation State-MAAS scores controlling for baseline pre-manipulation State-MAAS scores, $F(1, 191) = 1.82$, $p = 0.072$. Simple contrasts revealed that performing a brief mindfulness exercise increased participants' post-manipulation state mindfulness (M = 5.62, SD = 1.09) compared to listening to an auditory introduction of the solar system (M = 5.33, SD = 1.17), but this difference was not significant, $t(192) = 3.30$, $p = .072$.

Results of the serial mediation model suggested that when controlling for pre-manipulation state mindfulness, the experimental condition did not indirectly predict WTS through enhanced post-manipulation state mindfulness, lower RA, and higher commitment, in either the no-covariate (see Figure 7) or the two covariate models (see Figures 8 and 9). Results across the three models generate similar patterns: Performing a brief mindfulness exercise significantly increased participants post-manipulation state mindfulness scores (which is consistent with results of Study 3-5), but this did not lead to lower RA (which is inconsistent with results of Study 3, but consistent with results of Study 4-5). However, participants' lower RA was linked to higher commitment (which is consistent with results of Study 3-5), which in turn predicted greater WTS (which is consistent with results of Study 3, but inconsistent with results of Study 4-5). Results of the post hoc Monte Carlo power analysis for indirect effects showed a statistical power of 0.08 for path $a_{91}b_{93}$, 0.01 for path $a_{92}c_{92}$, 0.05 for path $a_{93}d_{91}$, 0.01 for path $a_{91}b_{91}c_{92}$, 0.02 for path $a_{91}b_{92}d_{91}$, 0.08 for path

$a_{92}c_{91}d_{91}$, and 0.02 for path $a_{91}b_{91}c_{91}d_{91}$ (i.e., the hypothesized serial mediation path) with the current sample size.[28]

[28] Given the high similarity between the non-covariate model and the covariate models, only the statistical power regarding the covariate model were reported here for a concise and better presentation.

Table 3

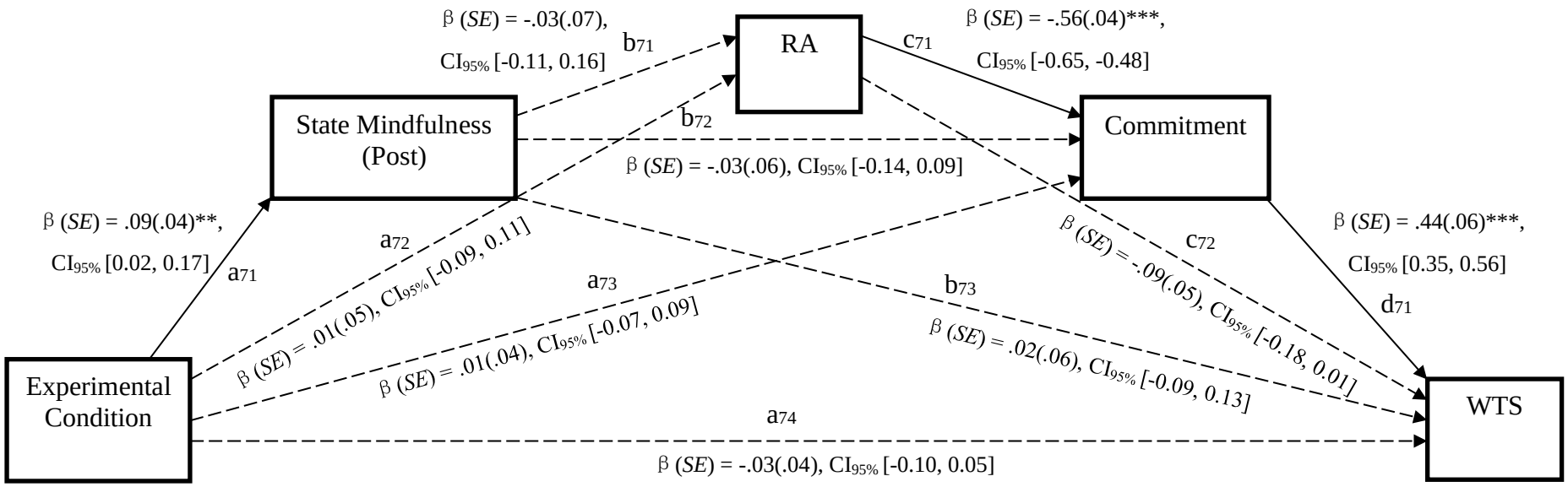
Study 6: Descriptive Statistics, Reliability Information, and Correlations among Study Variables

		Descriptives and Reliability			Correlations										
	Variable	Range	*M*(*SD*) or %	α	1	2	3	4	5	6	7	8	9	10	11
1	SMS (Pre)	2.19 – 5.00	3.80(0.55)	0.91	—	.79**	—	—	-.12	-.06	.05	.05	.12	.09	—
2	SMS (Post)	1.81 – 5.00	3.85(0.60)	0.92		—	—	—	-.07	-.10	.05	.02	.05	.000	—
3	State-MAAS (Pre)	1.00 – 7.00	5.21(1.31)	0.84			—	.44**	-.21**	.20**	.17*	.06	.08	-.003	—
4	State-MAAS(Post)	2.20 – 7.00	5.48(1.31)	0.78				—	-.16*	.13	.15*	.08	.08	.12	—
5	RA	-2.00 – 5.00	-0.05(1.79)	—					—	-.57**	-.37**	.07	.06	-.02	-.04
6	Commitment	1.71 – 9.00	7.93(1.55)	0.90						—	.54**	.02	.06	-.05	-.02
7	WTS	2.00 – 7.00	6.04(0.92)	0.69							—	-.07	-.06	-.11*	.05
8	Age	18.00 – 55.00	27.57(8.19)	—								—	.78**	.08	-.003
9	Relationship Length	0.17 – 32.42	5.76(5.96)	—									—	.02	-.04
10	Meditation Experience	1.00 – 6.00	1.99(1.30)	—										—	.09
11	Mindfulness Scale Type	-1.00 – 1.00	0.02(1.00)	—											—

Note. RA= relationship ambivalence, WTS = willingness to sacrifice. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Mindfulness scale type was effect-coded (-1 = State-MAAS, 1 = SMS). Relationship length scores are in years. *$p < .05$, **$p < .01$, ***$p < .001$

Figure 7

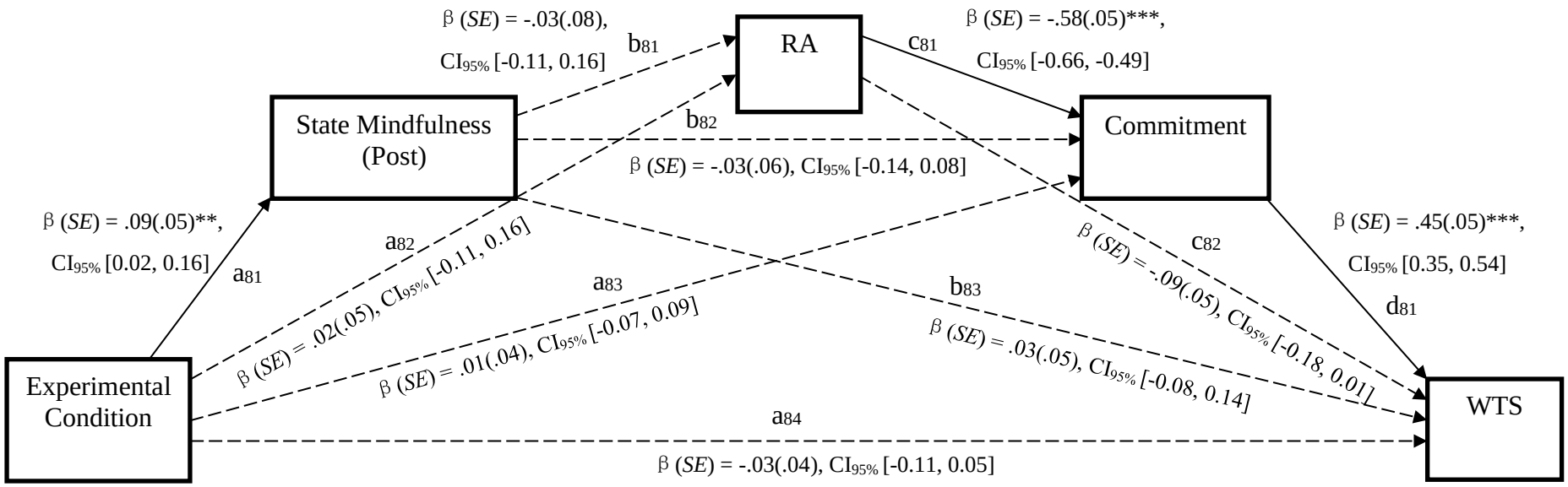
Study 6: Direct and Indirect Associations of Experimental Condition, State Mindfulness, RA, Commitment, and WTS (No-Covariate Model)



Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Experimental condition was effect-coded (-1 = control condition, 1 = experimental condition). *p < .05, **p < .01, ***p < .001

Figure 8

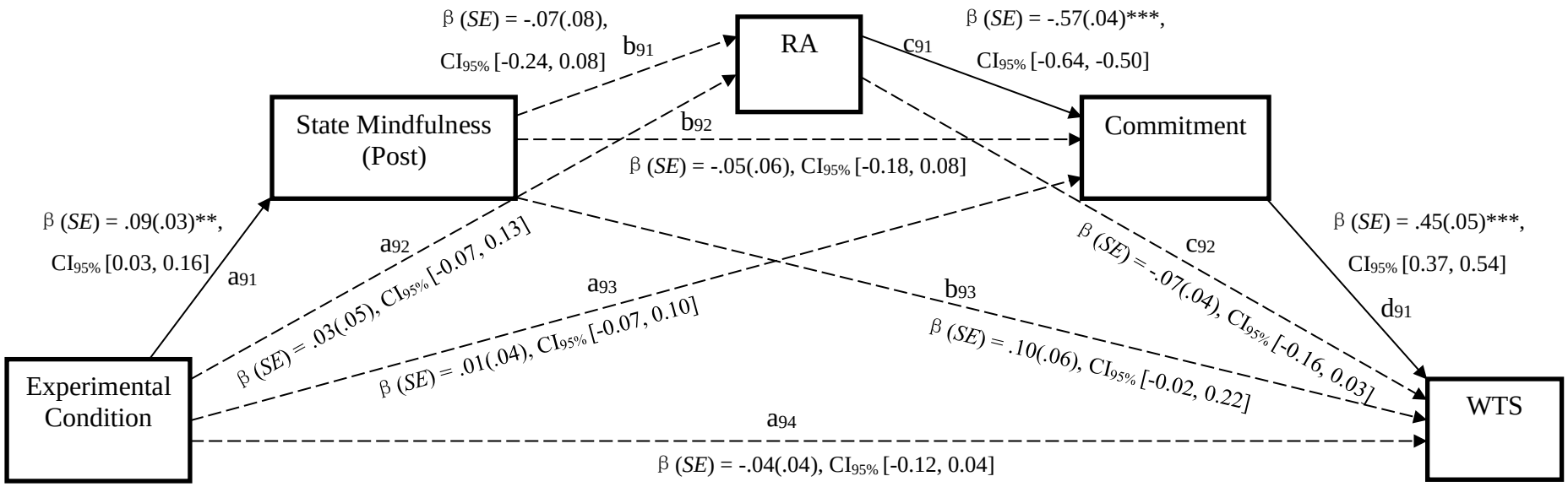
Study 6: Direct and Indirect Associations of Experimental Condition, State Mindfulness, RA, Commitment, and WTS (Covariate Model 1)



Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Experimental condition was effect-coded (-1 = control condition, 1 = experimental condition). Analyses control for gender, age, relationship length, meditation experience, and mindfulness scale type. *p < .05, **p < .01, ***p < .001

Figure 9

Study 6: Direct and Indirect Associations of Experimental Condition, State Mindfulness, RA, Commitment, and WTS (Covariate Model 2)



Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). Experimental condition was effect-coded (-1 = control condition, 1 = experimental condition). Analyses control for gender, age, relationship length, meditation experience, and mindfulness scale type. **p* < .05, ***p* < .01, ****p* < .001

4.3.3 Discussion

Results of the current study revealed that when controlling gender, age, relationship length, meditation experience, and mindfulness scale type, performing a brief mindfulness exercise could not indirectly predict greater self-reported WTS in hypothetical scenarios through enhanced post-manipulation state mindfulness, lower RA, and higher commitment. This serial mediation model remains non-significant when a) no covariate was controlled for, and b) only the four demographic covariates were controlled for. Therefore, we cannot conclude that the inconsistent results across Study 3-5 were due to divergent mindfulness operationalizations. Results across the non-covariate and covariate models in the current study were similar that while the brief mindfulness manipulation successfully increased participants' post-manipulation state mindfulness, such enhanced state mindfulness did not lead to lower RA, which was inconsistent with the findings of Study 3, but consistent with the findings of Study 4-5. Similar to Study 3-5, results of the current study revealed that lower RA predicted higher commitment. Higher commitment was also found to predict greater WTS, which was consistent with the findings of Study 3, but inconsistent with the findings of Study 4-5.

It is worth noting that the commitment-WTS path was significant in studies assessing hypothetical WTS (i.e., Study 3 and Study 6), but was non-significant in studies assessing actual WTS (i.e., Studies 4-5). Put differently, while exhibiting higher dedication to a relationship leads to greater hypothetical WTS, such predictive effect of greater commitment was not depicted when it came to actual WTS. This finding echoes with our earlier argument that factors precede individuals' self-reported WTS in hypothetical scenarios may be different from factors precede individuals' self-reported WTS when confronted with a potentially real sacrifice. We will further address this argument and its potential insight to the interdependence theory in the general discussion chapter.

It is also worth noting that the mindfulness–RA path is the only path reflecting inconsistency in findings between the two studies assessing hypothetical WTS (i.e., Study 3 and Study 6). It seems that being more mindful does not necessarily reduce ambivalence towards one's relationship, or at least the link between higher mindfulness and lower RA is not as robust as other links in the serial mediation model that were replicated across Study 3 and 6. One possible explanation may be that RA, or RA as measured in the current study, may be relatively resistant to change over a single experimental session, and we may need to allow more time between measurements of our study variables. Indeed, one of the limitations of using cross-sectional data to study mediation models is that cross-sectional designs assume that mediating effects occur instantly, while it actually takes various length of time for mediating effects to unfold (Selig & Preacher, 2009). As a result, mediation models using longitudinal approach may offer better statistical inference as longitudinal design makes it possible for researchers to set suitable time intervals between measurements, allowing more precise depiction of the potential mediating effect.

One common limitation of the experimental studies worth noting is that the sample size was determined based on the study budget and time available for data collection, and we did not conduct a power analysis before collecting data. Therefore it was unclear whether the studies were adequately powered to detect a significant meditating effect. Indeed, the results of our post hoc power analysis suggest that Studies 4-6 may be significantly under-powered. However, it should be noted that post hoc power analysis has been significantly criticized as it is conceptually flawed and statistically misleading (Cohen, 1988; Heonig & Heisey, 2001; Kraemer et al., 2006; Levine & Ensom et al., 2001; Zhang et al., 2019). Therefore our results of the post hoc power analyses may fail to indicate the true power for detecting a significant effect in a randomly selected sample. Flaws of the post hoc power analysis will be further discussed in section 6.2.2.

To address the aforementioned limitations of applying mediation models to cross-sectional data, in the next chapter, we sought to investigate the prospective influence of mindfulness on WTS in a 5-week longitudinal study, where we examined whether participants' mindfulness in the first week predicted lower RA, higher commitment, and eventually greater WTS in the following weeks.

Chapter 5: Study 7 (Longitudinal Study)

So far, we have conducted four cross-sectional experimental studies (i.e., Studies 3-6). Study 3 and 6 assessed the indirect experimental effect of a brief mindfulness manipulation on subsequent self-reported hypothetical WTS, and revealed divergent results: Performing a brief mindfulness exercise predicted greater hypothetical WTS through higher post-manipulation state mindfulness, lower RA and higher commitment in Study 3, whereas such indirect experimental effect was not depicted in Study 6 due to the non-significant link between post-manipulation state mindfulness and RA. Study 4 and 5 assessed the indirect experimental effect of a brief mindfulness manipulation on subsequent self-reported actual WTS, and revealed consistent results: Performing a brief mindfulness exercise did not indirectly predict greater hypothetical WTS. Specifically, participants who became more mindful after the manipulation did not become less ambivalent towards their relationship. Besides, participants who were more dedicated to the relationship did not report greater willingness to do unpleasant task for the sake of their partner.

The divergent results of these four experimental studies may be accounted for by the limitations of applying mediation models to cross-sectional data. As illustrated in the previous chapter, studies employing a longitudinal design are preferred for testing mediation hypotheses because the mediating effect can take time to unfold, and, given this reason, the magnitude of the mediating effect may differ and be dependent on the length of interval between the measurements of the study variables (Maxwell et al., 2011; Selig & Preacher, 2009). Longitudinal study designs allow researchers to set appropriate time intervals between the measurements, and therefore may be able to depict the mediating effect more precisely (Selig & Preacher, 2009).

In the current study, we sought to capitalize on the strengths of longitudinal designs to examine the potential positive prospective effect of higher mindfulness on greater WTS

through lower RA and higher commitment. We designed a 5-week longitudinal study, in which participants were required to answer a battery of self-reported questionnaires assessing our variables of interests once per week for five consecutive weeks, and data collected through the first survey was treated as the baseline measure (Week 0).[29] We tested whether higher mindfulness measured at Week 1 indirectly predicted greater WTS measured at Week 4 through lower RA measured at Week 2 and higher commitment measured at Week 3. As a further robustness check of the cross-sectional mediation model established in Studies 1-2, we also tested whether greater mindfulness is indirectly linked to greater WTS through lower RA and higher commitment in each week's cross-sectional data.

5.1 Method

Participants

The original target sample size was 100-150, which was determined based on study budget and data collection time constraints, and the results of the Monte Carlo power analysis for indirect effects written by Schoemann et al. (2017; see Appendix M for information of the model parameters).[30] We were able to recruit 238 participants online via Prolific Academic and convenience sampling. The inclusion criteria were the same as Study 1-6. Custom pre-screening was applied to exclude participants who participated in Study 1-6 (and who therefore may have been familiar with the study purpose) to avoid any participant bias. A total of 93 participants were excluded: 74 people dropped out and missed more than two week's survey or the initial survey containing baseline measures, one person was not in a

[29] Five week was chosen for the length of study because it is the minimal time required to assess the proposed serial mediation model, i.e., the Mindfulness – RA – Commitment – WTS model, where Week 1 mindfulness will be linked to Week 2 RA, which will be linked to Week 3 commitment, which will be linked to Week 4 WTS when controlling for Week 0 mindfulness.

[30] The model parameters were determined based on Schoemann et al.'s (2017) suggestions, and the averaged values of the correlations among study variables in Studies 1-2, which are the only studies assessed trait mindfulness.

romantic relationship, and 18 people failed attention checks. As a result, responses from a total of 145 eligible participants were analysed, of which 81 were women, 62 were men, 1 was genderqueer, and 1 was bigender.

Participants were entered into a prize draw to win one of ten £50 Amazon gift cards. Entries into the prize draw were incrementally awarded to participants based on the number of sessions completed. Participants received one entry into the prize draw per session completed and were given 10 extra entries if they completed all 5 sessions of the study. Participants' ages ranged from 18 to 59 years (M = 27.49, SD = 8.17), and participants reported being in relationships lasting 1 month to 38.42 years (M = 5.40 years, SD = 7.29 years). Participants identified themselves as White/Caucasian (67.6%, N = 98), Asian (22.7%, N = 33), Hispanic/Latino (6.2%, N = 9), Mixed/Multi-ethnic (1.4%, N = 2), Middle Eastern/Arab (0.7%, N = 2), and "Other" (1.4%, N = 2). Approximately 86.2% of the participants were heterosexual (N = 125), 10.3% were bisexual/pansexual (N = 15), 1.4% were gay (N = 2), 0.7% were lesbian (N = 1), and 1.4% were demisexual (N = 2). Approximately 66.2% of the participants were dating their current partner exclusively (N = 96), 1.4% were dating current partner and others (N = 2), 23.4% were married (N = 34), 4.8% were engaged (N = 7), 2.1% were in a common-law relationship (N = 3), and 2.1% were in a civil partnership (N = 4). 37.9% of the participants had never meditated before (N = 55), 35.9% meditated a few times each year (N = 52), 13.8% meditated about 1-2 times each month (N = 20), 6.9% mediated 1-2 times each week (N = 10), 2.1% meditated 3 or more times each week (N = 3), and 0.7% meditated every day or nearly every day (N = 1).

Measures and Procedure

Participants were asked to answer a battery of questionnaires once every week for five consecutive weeks. When signing up for the study, participants chose the weekday (i.e., from Monday to Sunday) that they would like to receive the questionnaire. The weekly survey was

sent out at 12 p.m. at noon and expired at 12 a.m. at midnight of that day. In the first week (Week 0), participants were asked to answer some basic demographic questions, followed by questionnaires measuring their trait mindfulness, RA, commitment, and WTS in the past week. In the following weeks (Week 1 - 4), participants were asked to answer the same sets of questionnaires except the demographic questions. The first week's survey took approximately 7-10 minutes to complete. The following weekly surveys took approximately 4-7 minutes to complete. In total, the time taken to participate in this study was approximately 23-38 minutes across five weeks. Participants' relationship status was checked by a multiple choice question (i.e., "Which of the following best describes your current relationship status?") at the beginning of each weekly survey, and only participants who were still in a romantic relationship were able to proceed with the questionnaire. After completing the study, participants were fully debriefed and then entered into the prize draw.

Primary Measures

Trait Mindfulness. Participants' levels of trait mindfulness were measured by the Five Facet Mindfulness Questionnaire - 24 (FFMQ-24; Bohlmeijer et al., 2011; see Appendix N). This is a 24-item scale rated on a 5-point scale (1 = *never or very rarely true*, 5 = *very often or always true*), and is an abbreviated form of the original 39-item Five Facet Mindfulness Questionnaire (FFMQ-39; Baer et al., 2006). An example item is "When I have distressing thoughts or images, I don't let myself be carried away by them". Similar to the original FFMQ, the FFMQ-24 assesses mindfulness from five dimensions: observing, describing, acting with awareness, non-judging of inner experience, and nonreactivity to inner experience (Pelham et al., 2011). Compared to the FFMQ-39, the FFMQ-24 allows quicker administration and therefore is preferable to studies with repeated measures (Pelham et al., 2011). Existing evidence has shown that the FFMQ-24 demonstrated adequate internal consistency (Cronbach's alpha ranging from 0.73 to 0.91), good construct validity (supported

by positive associations with acceptance, openness, and positive mental health, and negative associations with symptoms of depression and anxiety, and neuroticism), and good sensitivity to change (Bohlmeijer et al., 2011). Considering that the MAAS has recently been critiqued because it is a unidimensional construct with all items negatively phrased (Grossman, 2008; Ruimi et al., 2019; Shankland et al., 2017), we chose the FFMQ-24 as the mindfulness measure in this study.

RA and Commitment. Participants' RA and commitment were assessed and scored using the same method as in Study 1-6 (see Appendix C & I).

WTS. Participants' WTS was measured by five questions rated on a 7-point scale (1 = *completely disagree*, 5 = *completely agree*). The questions were created by the researchers because none of the existing WTS measures can be easily adapted for multiple assessments each week (see Appendix O). The questions were designed to measure the extent to which participants are willing to engage in active sacrifices (i.e., willingness to do something undesirable) for the sake of their partner. An example question is "I was willing to do things that I don't particularly enjoy, but that my partner wanted me to do". Results from the current sample demonstrated good internal consistency (Cronbach's α ranging from 0.82 to 0.89 across the five weeks).

Covariates

Gender, Age, Relationship Length, and Meditation Experience. We controlled for the same demographic covariates included in Study 3 (see Appendix J).

Data Analysis Strategy

The first step of data analysis was using an independent samples *t*-test to inspect a) the homogeneity of the baseline mindfulness scores between participants who completed the study and participants who dropped out, b) whether the average trait mindfulness scores significantly differed between participants who completed the study and participants who

dropped out, and c) whether the average WTS scores significantly differed between participants who completed the study and participants who dropped out. The completion status was effect-coded such that -1 = drop-out, 1 = completion.

Mediation analyses of the four cross-sectional data were performed using Model 6 in PROCESS v3.3 by Andrew F. Hayes (2018) with 5000 bootstrapped samples and 95% confidence intervals of the indirect effect of higher mindfulness on greater WTS through the proposed mediators (lower RA and/or higher commitment), controlling for mindfulness scores measured in the previous week. A random number generator is seeded for bootstrapping through syntax to ensure that when the same seed is used in each analysis, the bootstrap confidence intervals are based on the same set of bootstrap samples (Hayes, 2018). The indirect effect was deemed significant if the 95% confidence interval did not contain zero.

Mediation analyses for the longitudinal data were performed using the lavaan package in R (Rosseel, 2012) with 5000 bootstrapped samples and 95% confidence intervals. To investigate the autoregressive and cross-lagged effects of the longitudinal data, autoregressive cross-lag model (ACLM) was employed as the conceptual model to examine whether participants' mindfulness in Week t-3 affects subsequent change in RA in Week t-2, which affects subsequent change in commitment in Week t-1, which affects subsequent change in WTS in Week t. ACLM was chosen because it is considered suitable for studies a) assessing rank-order changes and time-lagged associations with multivariate longitudinal data, b) examining interindividual changes, c) of which all variables were repeatedly tested at N time points (i.e., no time-invariant variable), and d) of which the intervals between measurements were held constant (Nestler et al., 2015).

The non-covariate ACLM of the current study can be written as:

$$MF_{nt} = a_{0t} + a_{1t} \cdot MF_{nt-1} + a_{2t} \cdot RA_{nt-1} + a_{3t} \cdot CM_{nt-1} + a_{4t} \cdot WTS_{nt-1} + r_{nt}$$

$$RA_{nt} = b_{0t} + b_{1t} \cdot RA_{nt-1} + b_{2t} \cdot MF_{nt-1} + b_{3t} \cdot CM_{nt-1} + b_{4t} \cdot WTS_{nt-1} + s_{nt}$$

$$CM_{nt} = c_{0t} + c_{1t} \cdot CM_{nt-1} + c_{2t} \cdot MF_{nt-1} + c_{3t} \cdot RA_{nt-1} + c_{4t} \cdot WTS_{nt-1} + t_{nt}$$

$$WTS_{nt} = d_{0t} + d_{1t} \cdot WTS_{nt-1} + d_{2t} \cdot MF_{nt-1} + d_{3t} \cdot RA_{nt-1} + d_{4t} \cdot CM_{nt-1} + u_{nt}$$

The covariate ACLM controlling for gender, age, relationship length and mediation experience of the current study can be written as:

$$MF_{nt} = a_{0t} + a_{1t} \cdot MF_{nt-1} + a_{2t} \cdot RA_{nt-1} + a_{3t} \cdot CM_{nt-1} + a_{4t} \cdot WTS_{nt-1} + a_{5t} \cdot gender + a_{6t} \cdot age + a_{7t} \cdot relleng + a_{8t} \cdot medexp + r_{nt}$$

$$RA_{nt} = b_{0t} + b_{1t} \cdot RA_{nt-1} + b_{2t} \cdot MF_{nt-1} + b_{3t} \cdot CM_{nt-1} + b_{4t} \cdot WTS_{nt-1} + b_{5t} \cdot gender + b_{6t} \cdot age + b_{7t} \cdot relleng + b_{8t} \cdot medexp + s_{nt}$$

$$CM_{nt} = c_{0t} + c_{1t} \cdot CM_{nt-1} + c_{2t} \cdot MF_{nt-1} + c_{3t} \cdot RA_{nt-1} + c_{4t} \cdot WTS_{nt-1} + c_{5t} \cdot gender + c_{6t} \cdot age + c_{7t} \cdot relleng + c_{8t} \cdot medexp + t_{nt}$$

$$WTS_{nt} = d_{0t} + d_{1t} \cdot WTS_{nt-1} + d_{2t} \cdot MF_{nt-1} + d_{3t} \cdot RA_{nt-1} + d_{4t} \cdot CM_{nt-1} + d_{5t} \cdot gender + d_{6t} \cdot age + d_{7t} \cdot relleng + d_{8t} \cdot medexp + u_{nt}$$

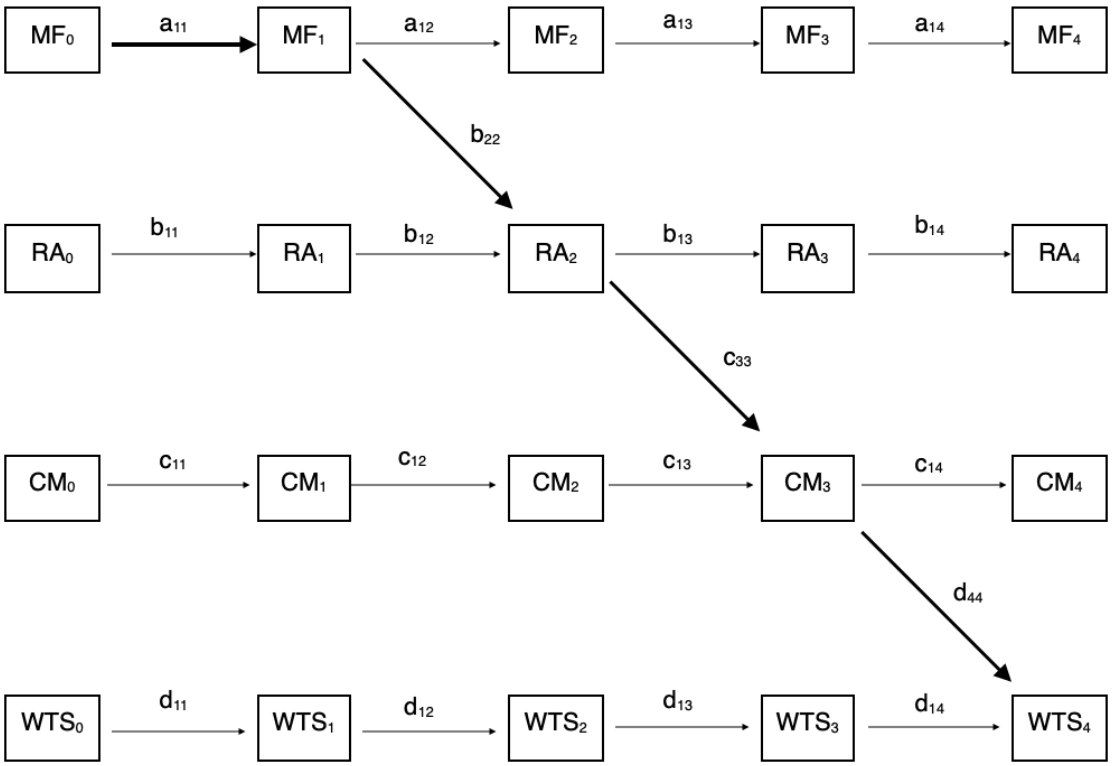
where MF_{nt}, RA_{nt}, CM_{nt}, and WTS_{nt} are the repeatedly measured variables for participant n at Week t, of which t ranges from 0 (i.e., Week 0 = data collected at baseline) to 4 (i.e., Week 4 = data collected through the 5th survey), a_{0t}, b_{0t}, c_{0t}, and d_{0t} are time-dependent intercepts, and r_{nt}, s_{nt}, t_{nt}, and u_{nt} are time-dependent residual scores. Each variable has an autoregressive effect (e.g., a_{1t} for MF_{nt}, b_{1t} for RA_{nt}, c_{1t} for CM_{nt}, and d_{1t} for WTS_{nt}) and cross-lag effects from other repeatedly assessed variables (e.g., d_{2t}, d_{3t} and d_{4t} for WTS_{nt}). In the current study, the only mediation path that is eligible for analysis is whether the effect of mindfulness measured at Week 1, on WTS assessed at Week 4 is mediated by RA measured at Week 2 and commitment measured at Week 3 (see Figure 1). The indirect effect is operationalized as the product of the respective cross-lag coefficients, that is $b_{22} * c_{33} * d_{44}$.

For both the cross-sectional and longitudinal data, we first tested a no-covariate model containing only our primary variables (i.e., mindfulness, RA, commitment, and WTS). We

then tested our covariate model that included the same covariates as with Study 3 (i.e., gender, age, relationship length, meditation experience).

Figure 1

Study 7: Autoregressive Cross-Lag Model of Trait Mindfulness, RA, Commitment, and WTS (Conceptual Model)



Note. Only the cross-lag paths reflecting the indirect effect of MF_1 on WTS_4 are depicted. Other cross-lag paths irrelevant to our research question are omitted to enhance the comprehensibility of this Figure. The paths that are key to the mediation model being assessed are in bold.

5.2 Results

T-test Results

The results from the independent samples *t*-test suggested that a) the baseline trait mindfulness scores were not significantly different between participants who completed the study (M = 3.23, SD = 0.48) and participants who dropped out (M = 3.01, SD = 0.40), t (167) = 1.52, p = 0.130, b) the average trait mindfulness scores were not significantly different between participants who completed the study (M = 3.27, SD = 0.47) and participants who dropped out (M = 3.04, SD = 0.44), t (167) = 1.60, p = 0.111, and c) the average WTS scores were not significantly different between participants who completed the study (M = 4.89, SD = 1.07) and participants who dropped out (M = 4.95, SD = 0.91), t (167) = -0.19, p = 0.854.

Cross-sectional Results

Week 1-3

Results of the serial mediation model of Week 1 (see Figure 2), 2 (see Figure 3), and 3 (see Figure 4) generated similar patterns, suggesting that when controlling for mindfulness measured in the previous week, higher mindfulness was not indirectly related to greater WTS through lower RA and higher commitment, in either the no-covariate or covariate models. Specifically, higher mindfulness was not associated with lower RA. However, lower RA was associated with higher commitment (representing a large effect, R^2 = .32 in Week 1, R^2 = .35 in Week 2, and R^2 = .51 in Week 3), which was in turn linked to greater WTS (representing a large effect, R^2 = .27 in Week 1, R^2 = .19 in Week 2, and a large effect, R^2 = .26 in Week 3).

Week 4

Results of Week 4 demonstrated a significant serial mediation model (representing a medium indirect effect, R^2 = .13) (see Figure 5), where greater trait mindfulness was associated with lower RA (representing a small-to-medium effect, R^2 = .11), which was then associated with higher commitment (representing a large effect, R^2 = .40), which was in turn

linked to greater WTS (representing a medium-to-large effect, R^2 = .24), controlling for gender, age, and relationship length, and meditation experience.

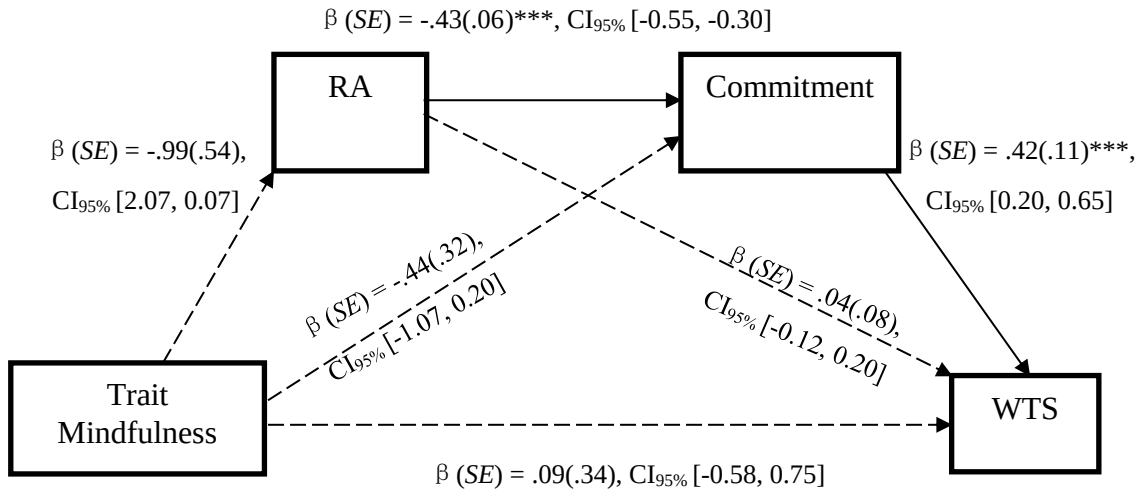
Longitudinal Results

Figures 6 and 7 respectively show the results of the no-covariate and covariate ACLM, which demonstrated similar patterns. Results demonstrated significant autoregressive effects for all repeated measures (i.e., a_{1t} for MF_t, b_{1t} for RA_t, c_{1t} for RA_t, and d_{1t} for WTS_t were all statistically significant), suggesting that all four constructs were temporarlly stable. However, the RA_2 - CM_3 path (c_{33}) was the only significant cross-lagged path, while the MF_1 - RA_2 (b_{22}) and CM_3 - WTS_5 (d_{44}) cross-lagged paths were non-significant. This indicated that participants' mindfulness scores measured at Week 1 did not indirectly predict their WTS at Week 4 through lower RA measured at Week 2 and higher commitment measured as Week 3, in either the no-covariate or covariate model. Results showed that higher mindfulness measured at Week 1 did not significantly predict lower RA measured at Week 2. However, lower RA measured at Week 2 predicted higher commitment measured at Week 3. Commitment measured at Week 3 did not predict greater WTS measured at Week 4.

These results were inconsistent with the findings of Study 3, but were consistent with the results of Studies 4-5, where a) increase in mindfulness from pre- to post-manipulation did not predict lower RA, b) lower RA predicted higher commitment, and c) higher commitment did not predict greater WTS. In addition, these results are partially consistent with the results of Study 6, where a) increase in mindfulness from pre- to post-manipulation did not predict lower RA, and b) lower RA predicted higher commitment. However, contrary to the findings of the current study, the results of Study 6 showed that higher commitment in turn predicted greater WTS.

Figure 2

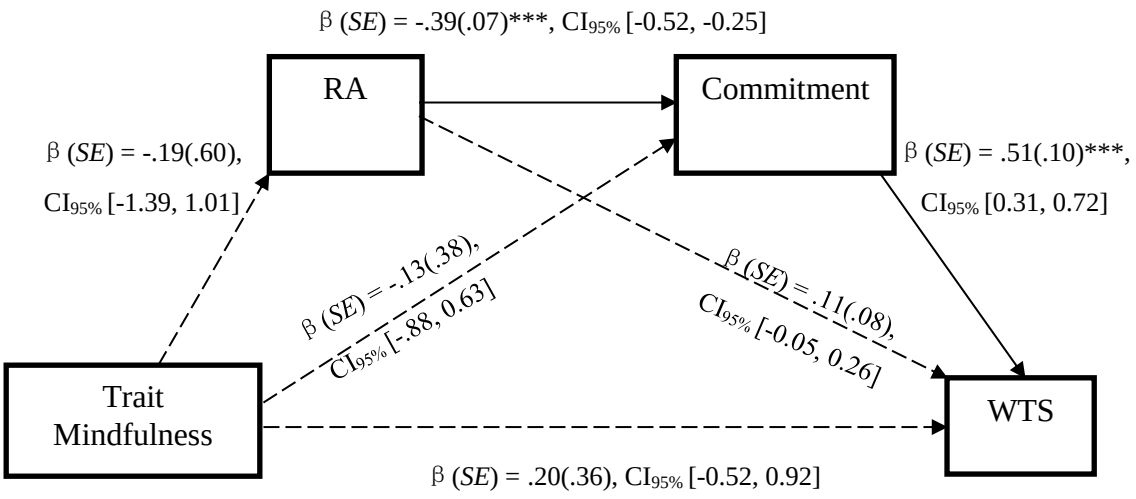
Week 1 of Study 7: Direct and Indirect Associations between Trait Mindfulness, RA, Commitment and WTS in a Serial Mediation Model (Covariate Model)



Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). All of the scores on continuous variables represent the score of that variable at time t controlling for the score of the same variable at time t-1 (e.g., mindfulness at Week 1 controlling for baseline mindfulness assessed at Week 0). Solid lines indicate statistically significant paths, and dashed lines indicate statistically non-significant paths ($p > .05$). Analyses control for gender, age, relationship length, and meditation experience. *$p < .05$, **$p < .01$, ***$p < .001$

Figure 3

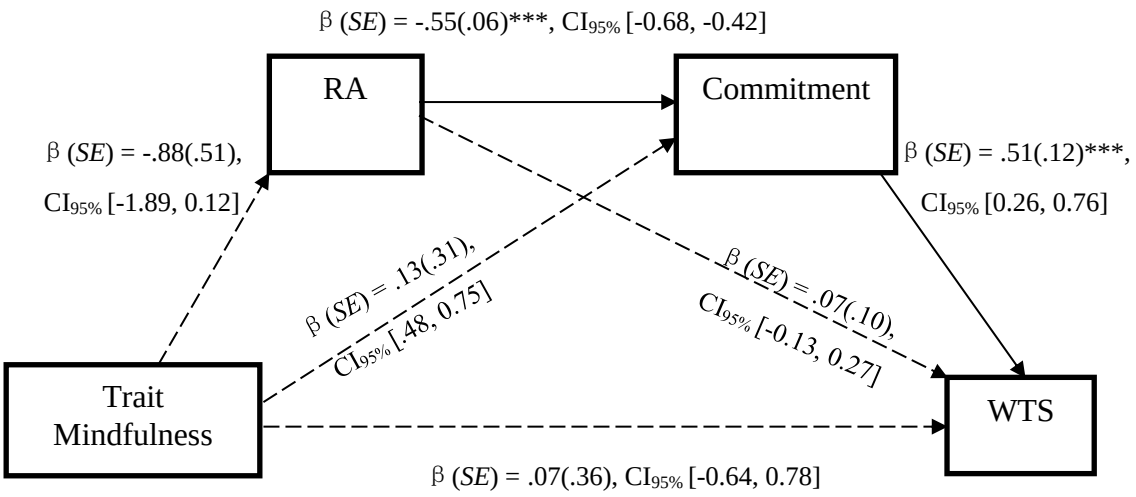
Week 2 of Study 7: Direct and Indirect Associations between Trait Mindfulness, RA, Commitment and WTS in a Serial Mediation Model (Covariate Model)



Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). All of the scores on continuous variables represent the score of that variable at time t controlling for the score of the same variable at time t-1 (e.g., mindfulness at Week 1 controlling for baseline mindfulness assessed at Week 0). Solid lines indicate statistically significant paths, and dashed lines indicate statistically non-significant paths ($p > .05$). Analyses control for gender, age, relationship length, and meditation experience. *p<.05, **p<.01, ***p<.001

Figure 4

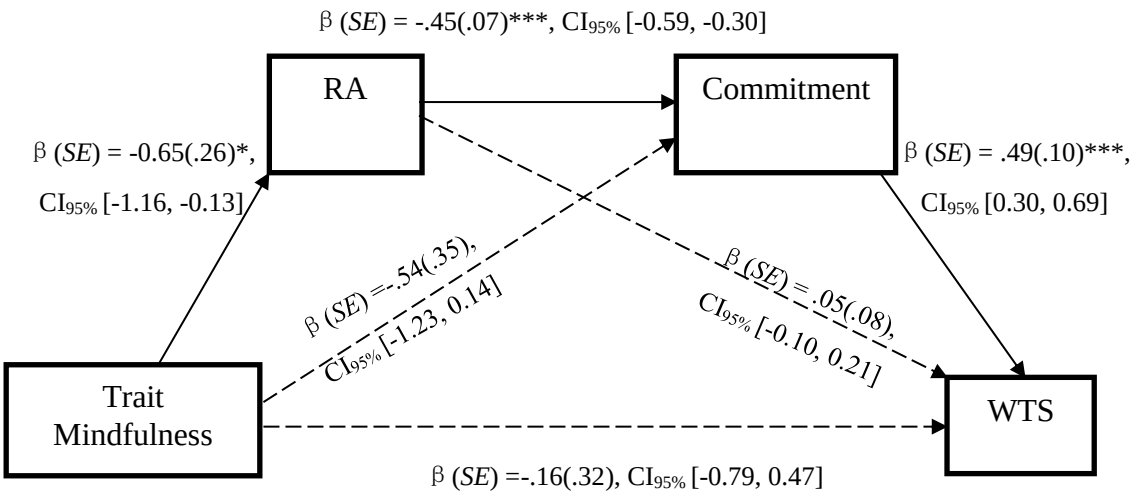
Week 3 of Study 7: Direct and Indirect Associations between Trait Mindfulness, RA, Commitment and WTS in a Serial Mediation Model (Covariate Model)



Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). All of the scores on continuous variables represent the score of that variable at time t controlling for the score of the same variable at time t-1 (e.g., mindfulness at Week 1 controlling for baseline mindfulness assessed at Week 0). Solid lines indicate statistically significant paths, and dashed lines indicate statistically non-significant paths ($p > .05$). Analyses control for gender, age, relationship length, and meditation experience. *p<.05, **p<.01, ***p<.001

Figure 5

Week 4 of Study 7: Direct and Indirect Associations between Trait Mindfulness, RA, Commitment and WTS in a Serial Mediation Model (Covariate Model)

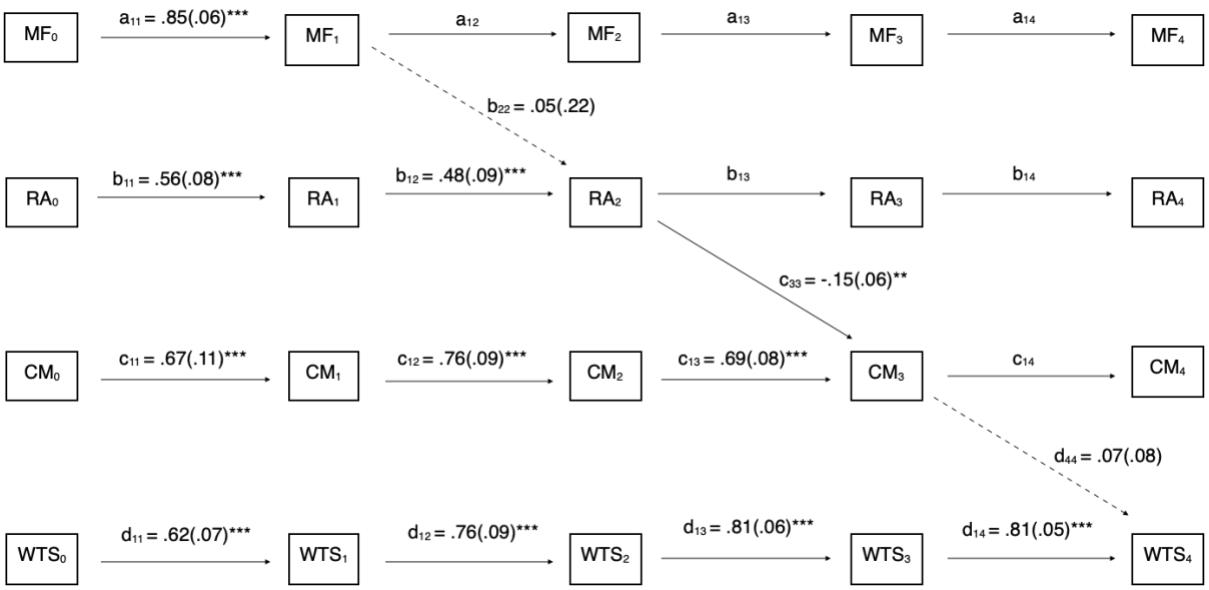


Indirect effect of trait mindfulness on WTS via RA & commitment: β (*SE*) = .12(.06)*, $CI_{95\%}$ [0.014, 0.246]

Note. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). All of the scores on continuous variables represent the score of that variable at time t controlling for the score of the same variable at time t-1 (e.g., mindfulness at Week 1 controlling for baseline mindfulness assessed at Week 0). Solid lines indicate statistically significant paths, and dashed lines indicate statistically non-significant paths (p > .05). Analyses control for gender, age, relationship length, and meditation experience. *p<.05, **p<.01, ***p<.001

Figure 6

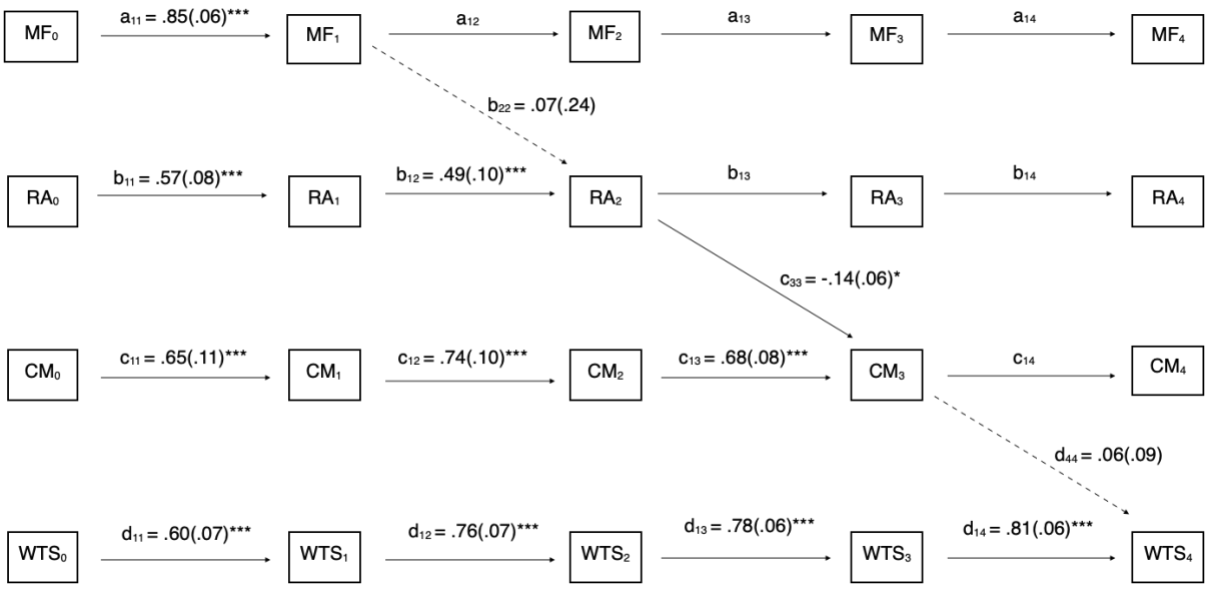
Study 7: Autoregressive Cross-Lag Model of Trait Mindfulness, RA, Commitment, and WTS (No-Covariate Model)



Note. Only the cross-lag paths reflecting the indirect effect of MF_1 on WTS_4 are depicted. Other cross-lag paths irrelevant to our research question are omitted to enhance the comprehensibility of this Figure. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). All of the scores on continuous variables represent the score of that variable at time t controlling for the score of the same variable at time t-1 (e.g., mindfulness at Week 1 controlling for baseline mindfulness assessed at Week 0). *p < .05, **p < .01, ***p < .001

Figure 7

Study 7: Autoregressive Cross-Lag Model of Trait Mindfulness, RA, Commitment, and WTS (Covariate Model)



Note. Only the cross-lag paths reflecting the indirect effect of MF_1 on WTS_4 are depicted. Other cross-lag paths irrelevant to our research question are omitted to enhance the comprehensibility of this Figure. Higher scores on continuous variables represent greater standing on the variable (e.g., higher mindfulness). All of the scores on continuous variables represent the score of that variable at time t controlling for the score of the same variable at time t-1 (e.g., mindfulness at Week 1 controlling for baseline mindfulness assessed at Week 0). *p < .05, **p < .01, ***p < .001

5.3 Discussion

The present 5-week longitudinal study investigated whether higher mindfulness measured at one time point would be prospectively linked to subsequent self-reported RA, commitment, and WTS assessed at later time points. To gain a more fine-grained and comprehensive understanding of the link between the four constructs, we employed both cross-sectional and autoregressive cross-lagged analyses to examine the proposed serial mediation model cross-sectionally each week for Weeks 1-4, as well as longitudinally across all five weeks. The cross-sectional findings were mixed, with just the result of Week 4 supporting the serial mediation model found in Studies 1-3, and the results of Week 1-3 demonstrating a non-significant mediation effect of mindfulness on WTS (mostly consistent with Studies 4-6). Findings from the longitudinal analysis revealed that higher mindfulness controlling for previous week's mindfulness measured at Week 1 did not predict lower RA measured at Week 2. Lower Week 2 RA did predict higher commitment at Week 3, but Week 3 commitment did not predict greater WTS at Week 4. The longitudinal findings are inconsistent with the findings of Studies 1-3 but were consistent with the findings of Studies 4-5 and partially consistent with the findings of Study 6. The baseline mindfulness, average mindfulness, and average WTS scores were not different between participants who completed the longitudinal study and participants who dropped out, indicating that these inconsistent findings may not be due to sample flaw.

It is worth noting that the mindfulness-RA path, which was non-significant in Study 4-6, remains non-significant in the result of the longitudinal analysis. In the previous chapter we proposed that it might be because RA as measured in these studies may be relatively resistant to change over a single experimental session. Given the findings of the current study, it seems that a time interval of one week may still not be enough to capture

fluctuations in RA, and longer intervals between measurements may be needed for the mediation process to unfold.

It is also worth noting that the RA-commitment path, which was significant in the current study and all previous studies, seems to be the most consistent path in this mediation model. This indicates that commitment may be robustly predicted by the extent to which people experience ambivalent feelings in romantic relationships, with more ambivalent individuals feeling less dedicated to their relationship. Although little research has explicitly examined the link between general relationship ambivalence and commitment, recent work by Joel et al. (2021) found that individuals who experienced higher stay/leave ambivalence towards their relationship (i.e., conflicted feelings about whether to remain in or end their current relationship) reported greater fluctuations in commitment day-to-day, compared to less ambivalent individuals. These findings are conceptually similar to our findings, although it is worth noting that the stay/leave ambivalence is known as felt ambivalence, or attitudinal ambivalence, which is different from the RA as measured in our studies, which is objective ambivalence. With that being said, our findings still offer promising insights for future studies aiming to investigate the possible prospective effect of RA on subsequent commitment in close relationships.

Third, it is worth mentioning that participants were offered a relatively long time window (i.e., twelve hours) to answer their weekly questionnaire on their chosen weekday. We did not monitor or assess the time of the day participants completed the questionnaire or the time taken to complete the questionnaire as these factors were not directly relevant to our main research question, nor were them covered in the study rationale or the pre-registered hypotheses. With that being said, scholars have consistently found a negative correlation between trait mindfulness and procrastination, the irrational tendency to voluntarily delay the initiation and completion of an intended task (Cheung & Ng, 2019; Flett et al., 2016; Pychl &

Rotblatt, 2007; Sirois & Tosti, 2012). Explanations from a cognitive perspective suggest that challenging tasks may potentially trigger individuals' judgmental thoughts, which is usually negatively linked to persistence as these unpleasant thoughts tend to promote self-criticisms and impulsive behaviours such as acts to avoid the tasks (Gustavson et al., 2014; Teasdale et al., 1995). The accepting and non-judgmental awareness and attention cultivated by mindfulness, however, may allow individuals to become aware and down-regulate such judgmental thoughts and impulsive behaviours, which may eventually lower the tendency of procrastination (Cheung & Ng, 2019; Flett et al., 2016). In the current study, participants' tendency to procrastinate may be related to and confound their mindfulness scores because a twelve-hour time window may result considerable individuals differences in completion time (e.g., the time of the day the questionnaire was completed, the length of time taken to complete the questionnaire). Therefore future studies may distribute the questionnaire at a given time and allow shorter time window for participants to return their responses, or assess and control for procrastination using relevant scales (e.g., the Procrastination Scale; Tuckman, 1991) when long time window is inevitable.

Finally, the fact that one of the four cross-sectional data supported a significant serial mediation model while the other three did not illuminates the possibility that the mediating effect of mindfulness on WTS may sometimes be overestimated from the cross-sectional data. Study 3 may be another example of this issue, as Study 3 is the only cross-sectional study that showed a significant mediating effect of mindfulness on WTS across Study 3-6. This finding maps onto our previously introduced methodological limitation of applying mediation models to cross-sectional data, which will be addressed further in the general discussion chapter.

Chapter 6: General Discussion

6.1 Summary and Discussion of Thesis Results

In this thesis, we investigated whether higher mindfulness contributes to greater WTS through lower RA and/or higher commitment in romantic relationships in a series of seven studies. We examined the links between the proposed study variables cross-sectionally and over time through various study designs. We first investigated whether RA and/or commitment may mediate the potential association between mindfulness and WTS in response to hypothetical scenarios using an exploratory-confirmatory approach in Studies 1-2. We then examined whether mindfulness induction predicted greater hypothetical (Study 3, 6) and actual (Studies 4-5) WTS through RA and commitment in four cross-sectional experiments. Finally, we investigated whether changes in mindfulness may prospectively predict changes in hypothetical WTS through changes in RA and commitment in a 5-week longitudinal study (Study 7).

Results of the initial two correlational studies (Studies 1-2) revealed a significant indirect association between higher mindfulness and greater WTS, mediated sequentially by lower RA and higher commitment. Replicating Studies 1-2, results of the first experimental study (Study 3) suggested that participants' successfully enhanced post-manipulation state mindfulness predicted greater WTS through lower RA and higher commitment. However, this serial mediation model was not replicated in the following experimental studies (Study 4-6) or the longitudinal study (Study 7).

6.1.1 Certain links involving mindfulness

6.1.1.1 The inconsistent link between mindfulness and RA

Links involving mindfulness and RA were tenuous across studies. While Studies 1-3 revealed a significant association between higher mindfulness and lower RA, this association

was non-significant in Studies 4-7. These results are inconsistent with previous research, where greater mindfulness was positively linked to lower objective ambivalence towards non-relational objects (Haddock et al., 2017). We proposed that it might be because RA may be relatively resistant to change in a 15-min experimental study in Studies 4-6, and the results of the longitudinal study similarly revealed a non-significant association between trait mindfulness and RA, which shows that RA as measured in these studies is unlikely to fluctuate on a weekly basis as well. One potential explanation is that our operationalization of RA in these studies may reflect a relatively stable construct, which is possible as researchers have suggested that some individuals are just chronically more ambivalent than others (Schneider et al., 2021). If that is the case, future studies investigating fluctuations in RA, or general relationship quality should allow longer time span between assessments to appropriately depict meaningful, long-term changes in these constructs. Another possible explanation concerns the potential floor effect as a result of inferring meaning from temporal changes in participants' self-reported responses. When participants were asked their positive and negative experiences in a relationship, those who indicated the least ambivalent experiences (i.e., high positivity and low negativity, or low positivity and high negativity) time after time would have both low and stable levels of RA. As a result, a floor effect would occur, in which participants' initial RA would be low, the slope would be minimal or approach zero (neither decreased nor increased), and the results of the statistical analyses would indicate no fluctuation in RA. Put differently, the potential beneficial effect of enhanced mindfulness would appear to be null for participants who constantly indicated low levels of ambivalence. Given that we found a significant correlation between higher mindfulness and lower RA in our initial correlational studies (Studies 1-2) but did not find a significant predictive (Studies 4-6) or prospective (Study 7) effect of enhanced mindfulness

on subsequent change in RA in most of the following studies, it may be the RA per se, not fluctuations in RA, that is driving the significant relation with mindfulness.

The inconsistent association between mindfulness and RA also helps us to gain a more fine-grained understanding of how mindfulness may (or may not) benefit close relationships. While higher mindfulness has been consistently linked to positive relationship outcomes (Barnes et al., 2007; Carson et al., 2004; Carson et al., 2007; Karremans et al., 2017; Pakenham & Samios, 2013; Wachs & Cordova, 2007), our findings suggested that more mindful individuals are not necessarily less ambivalent towards their partner or relationship. One possible explanation is that while more mindful individuals tend to be more aware and attentive to positive experiences than less mindful individuals, they are equally more aware and attentive to negative experiences in the relationship. Of particular relevance to this argument, Britton et al (2021) suggested that it is common for individuals practicing mindfulness meditation to experience at least one mindfulness-related adverse effect (e.g., transient distress). Since mindfulness meditation requires individuals to cultivate open and non-judgmental awareness and attention to their current moment experiences, individuals may experience transient distress when they have to engage with negative thoughts in the present-moment, which may cancel the beneficial effect of enhanced mindfulness on RA. It is therefore worth investigating whether the beneficial effect of greater mindfulness may be reflected in how individuals appraise and accommodate ambivalent experiences. Indeed, Haddock et al (2017) found that more mindful participants exhibited greater comfort holding ambivalent views towards non-relational objects. An interesting research question worth examining would be whether individuals with higher levels of mindfulness may be more comfortable holding ambivalent experiences in a romantic relationship. Compared to the general presence of ambivalence, people's *attitudes* towards ambivalence may be more susceptible to change. It is therefore promising for future studies to investigate whether more

mindful individuals exhibit greater comfort holding ambivalent views towards their partner or relationship, and whether greater ambivalence comfort may in turn contribute to positive relationship outcomes such as greater WTS.

6.1.1.2 The consistent mindfulness – commitment, and mindfulness – WTS link

The aforementioned argument may similarly explain the consistently non-significant link between mindfulness and commitment, and the consistently non-significant direct link between mindfulness and WTS. As described in section 2.2.2, the cultivation of open and non-judgmental awareness and attention of one's own experiences allows individuals to gain a better understanding of how their partner's behaviours may be influenced and shaped by external factors (Block -Lerner et al., 2007), and may in turn promote individuals' feelings of closeness and commitment towards a romantic partner (Karremans et al., 2017). However, such potential beneficial influence of greater mindfulness on commitment may be cancelled by the potential adverse effect of practicing mindfulness (Britton et al., 2021). Researchers have found that mindfulness treatment can promote prefrontal control of the amygdala (Gotink et al., 2016; Tang et al., 2015), which is positively associated with emotional blunting (Sierra, 2009), the inability to experience a full range of emotions (e.g., feeling numbness instead of positive or negative emotions; Christensen et al., 2022; Ma et al., 2021). Supporting evidence has suggested that such dampening effect of mindfulness training on amygdala can lower not only the negative emotions but also the positive emotions (Taylor et al., 2011; Kral et al., 2018), resulting in emotional blunting (Cebolla et al., 2017; Lindahl et al., 2017; Sierra, 2009; Taylor et al., 2011), the fourth risky meditation-related adverse effect that may last longer than one week (Britton et al., 2021). Such emotional numbness may cancel out the positive influence of mindfulness on empathy and commitment, and as a result, more mindful individuals may not necessarily be more dedicated to their partner. Supporting this argument, Knowles et al (2015) found that while certain aspect of mindfulness (i.e., the

mindful ability to describe assessed by one subscale in the KIMS; Bear et al., 2004) significantly predict greater commitment, the other aspects of mindfulness (i.e., the mindful ability to observe, act with awareness, and accept without judgment assessed by other subscales in the KIMS; Bear et al., 2004) were not significantly predictive of commitment, highlighting the possibility that certain mindfulness aspect may play unique role

Similarly, while mindfulness may promote individuals' capacity and motivation to sacrifice in a relationship from cognitive and emotional perspectives (Karremans et al., 2017), the fact that mindful individuals may, at the same time, become increasingly aware of the potential negative experiences of performing a sacrifice may cancel the potential beneficial influence of greater mindfulness on WTS. According to Britton et al. (2021), the re-experiencing of traumatic memories is the most frequently reported meditation-related adverse effect. If the potential negative consequence of sacrifice is related to individuals' unpleasant or traumatic experiences in the past, such meditation-induced traumatic re-experiencing may further prevent them from performing sacrifice. Furthermore, Britton et al. (2021) suggested that executive dysfunction, although experienced less frequently than traumatic re-experiencing, is the most risky meditation-related adverse effect that may last longer than one week. Such executive dysfunction, if experienced, may also hinder individuals' decision-making process of performing sacrifice. Taken together, our findings indicate that while mindfulness has been found to be beneficial to pro-relationship outcomes in general (Karremans et al., 2017), when it comes to sacrifice, a special and costly pro-relationship behaviour, the picture becomes much more complicated. The cultivation of mindfulness allows individuals to become equally more aware and attentive to all aspects of their relationship, and all possible outcomes or consequences of certain behavioural choices, some of which may not necessarily enhance their willingness to perform such behaviour.

6.1.2 Certain links involving WTS

6.1.2.1 The inconsistent link between RA and WTS

To address the complex psychological processes that precede sacrificial behaviours, we investigated how RA and commitment may possibly explain the potential indirect link between mindfulness and WTS in seven studies, and obtained inconsistent results. The results from most of our studies (i.e., all studies except Studies 1 and 4) revealed that lower RA was not linked to greater WTS. This indicates that having ambivalent experiences in a romantic relationship may not necessarily lead to less willingness to forego self-interests for the sake of their partner's needs. One possible explanation may be that individuals exhibiting ambivalent experiences in a relationship may not respond negatively to the relationship when their negative experiences are not primed (Kachadourian et al., 2005). Previous studies on attitudinal ambivalence suggest that when people exhibit both positive and negative thoughts and feelings towards an attitude object, their responses could be influenced by either the positivity or negativity depending on the situation (Bell & Esses, 1997; Glick et al., 1997; Katz & Hass, 1988). Sacrificial behaviours have the potential to prime the positive relationship experiences (e.g., benefitting one's partner may make one feel strong and more connected to the partner), as well as the negative relationship experiences (e.g., sacrificing one's own interests may make one feel unpleasant or even miserable in the relationship). Such priming may in turn influence how favourably individuals respond to their partner and relationship. As a result, individuals with greater RA may not constantly report less WTS in a relationship. Of conceptual relevance to this argument, Kachadourian et al. (2005) found that individuals who exhibited more ambivalent attitudes towards a partner, and who ruminated more frequently reported lower levels of forgiveness towards a transgression, as ruminating on a transgression may prime the negative evaluations towards one's partner. However, the authors did not find such association between ambivalence and forgiveness when individuals

did not frequently ruminate on the transgression, indicating that ambivalence per se may not necessarily lead to negative relationship responses.

6.1.2.2 The inconsistent link between commitment and WTS

The link between commitment and WTS was also tenuous across studies. Among cross-sectional studies, our findings consistently revealed a significant link between higher commitment and greater WTS in response to hypothetical scenarios (Studies 1-3 and 6). These findings echo with the interdependence theory (Rusbult & Van Lange, 2003) and prior studies that found commitment to be a predictor of WTS (Etcheverry & Le, 2005; Powell & Van Vugt, 2003; Van Lange et al., 1997; Wieselquist, et al., 1999). However, we consistently found a non-significant link between higher commitment and greater WTS when participants were asked how willing they would be to make a real sacrifice (Studies 4-5), as well as a non-significant prospective effect of greater commitment on subsequent hypothetical WTS in the longitudinal study (Study 7).

The inconsistent findings illuminate the possibility that the beneficial influence of commitment on individuals' hypothetical WTS may be different from that on actual WTS. In other words, having the intention to sacrifice in an imagined scenario may not be the same as being ready to make a real sacrifice in a given moment for committed individuals. While few studies investigating the link between sacrifice and relationship well-being have distinguished between hypothetical and actual WTS (Righetti & Impett, 2017), studies investigating actual performed sacrifice demonstrated an overall negative association between enacted sacrifice and relationship well-being (Righetti et al., 2020). Specifically, Righetti et al (2020) showed that romantically involved individuals reported increased negative experiences (i.e., greater negative mood, frustration, and feelings of being exploited) as well as increased positive experiences (i.e., happy and proud of being a helpful and caring partner, greater expectation of being reciprocated by a partner) after performing a sacrifice; however, the results of their

meta-analysis across the literature revealed an overall increase in negative experiences and an overall decrease in positive experiences. Therefore, when committed individuals are enquired about their intention to perform an actual sacrifice (as in the case of Studies 4-5), their decisions are likely to be influenced by the potential negative consequences of such sacrifice. For example, participants who were asked whether they would like to perform a mildly unpleasant task in Study 4 may be aware and contemplate the negative feelings they might experience during the task. This may cancel the potential beneficial influence of greater commitment on pro-relationship responses (e.g., behaving in a way that reflects long-term orientation towards the relationship; Rusbult, 1983), resulting a null effect of greater commitment on WTS.

However, when being asked about hypothetical WTS, the beneficial influence of greater commitment on WTS is unlikely to be weight out by the influence of negative consequences of performing sacrifices, as individuals may be less conscious of and attentive to, or downplay, the possible negative consequences. When facing hypothetical sacrifices, individuals' responses may be influenced by self-serving bias, the tendency that individuals ascribe positive results to their own character but ascribe negative results to external factors unrelated to their own character (Miller & Ross, 1975). Given that altruistic self-sacrifice is generally considered morally praiseworthy (Jacobs, 1987), individuals are likely to regard such good deeds as a reflection of their good character ("If I decide to sacrifice, it means that I am a good partner"), and therefore report greater WTS. However, when confronted with a potential real sacrifice, any self-serving effect and/or potential beneficial effect of greater commitment may be outweighed by individuals' concerns on the foreseeable negative consequences. As a result, greater level of commitment may not necessarily lead to greater actual WTS.

The inconsistent commitment–WTS association may also be accounted for by the different nature of the hypothetical and actual WTS measured in our studies. Two out of the four items of the hypothetical WTS measure in Studies 1-3 and 6-7 examined participants' willingness to sacrifice to spare their partner from harm (i.e., sacrifice one's leisure time to spare their partner from negative consequences at their workplace; sacrifice one's money to spare their partner from suffering financial hardship). Conversely, the actual WTS measure in Studies 4-5 assessed participants' willingness to harm themselves for their partner's benefit (i.e., enduring unpleasantness to win monetary reward for their partner). Research on moral decision-making has revealed that individuals are willing to forego gains (i.e., monetary reward) to spare others from harm (i.e., electric shock), but are unwilling to endure harm on themselves (i.e., electric shock) to win monetary rewards for others (Volz et al., 2017). These findings are conceptually similar to the findings in our research, such that committed individuals were willing to sacrifice their time or money to spare their partner from suffering negative life events but were not eager to endure boring or unpleasant tasks to gain monetary rewards for their partner. In other words, the positive influence of commitment on WTS may be highly modality dependent. Committed individuals may be more inclined to forego gains when failing to do so means failing to protect their partner from negative consequences. However, when sacrifice involves harming oneself in return for the benefit of one's partner, the altruistic influence of commitment was outweighed by individuals' egoistic harm avoidance. Therefore, it is promising for future studies to investigate if and how the decision-making processes of benefiting one's partner may be different from that of failing to save one's partner from misery.

6.1.3 The consistent link between RA and commitment

In all studies, RA was consistently negatively linked to commitment. While few study have systematically investigated the link between RA and commitment, prior studies have

revealed that certain negative relationship features, such as attachment anxiety (Mikulincer et al., 2010), and extradyadic desire (i.e., desire for attractive alternatives other than one's partner; Zoppolat et al., 2022), are correlated with greater potential ambivalence (i.e., simultaneous positive and negative explicit evaluations towards a partner; Thompson & Holmes, 1996) in romantic relationships. Scholars have also proposed that high subjective ambivalence (i.e., ambivalence assessed by directly asking participants how ambivalent or torn they felt towards their partner; Priester & Petty, 1996) predicts various negative relationship outcomes, such as greater daily fluctuations in commitment (Joel et al., 2021), and relationship instability and dissolution (Righetti et al., 2020). When individuals consciously report experiencing mixed feelings towards their partner (i.e., exhibiting high subjective ambivalence; Newby-Clark et al., 2002; Priester & Petty, 1996), they are motivated to reduce the inconsistencies within their evaluations to form a univalent (positive or negative) attitude, as ambivalent experiences tend to be highly aversive (Van Harreveld et al., 2009; Maio et al., 1996). However, since negative experiences usually carry more psychological weight than positive experiences (Baumeister et al., 2001), negative evaluations may have a greater influence in the process of forming a univalent attitude even though individuals experience positivity and negativity simultaneously (Righetti et al., 2020). As a result, when individuals repeatedly attempt to reduce ambivalence, their evaluations on their partner or relationship may be inadvertently shifted in a negative direction, which may lead to a less stable relationship or even break-up (Righetti et al., 2020). In support of this, Joel et al. (2021) found that participants torn about whether they should remain in or end their current romantic relationship (i.e., experiencing high stay/leave ambivalence) exhibited greater day-to-day fluctuations in commitment and break-up contemplation, compared to less ambivalent participants. It therefore comes as no surprise that results from all our studies consistently revealed a correlational (Studies 1-6) and prospective link (Study 7) between

higher RA and lower commitment, the second strongest predictor of nonmarital romantic relationship dissolution (Le et al., 2010).

However, it is noteworthy that most of the aforementioned ambivalence studies examined subjective ambivalence, or attitudinal ambivalence, which is different from the objective ambivalence as measured in our studies. While we referred to the rationale and findings of these studies when interpreting and explaining the results of our studies, we advise our readers to be cautious when attempting to generalize the negative influence of RA to relationship well-being beyond commitment, as existing studies supporting the negative link between ambivalence and relationship dissolution primarily focus on subjective, but not objective ambivalence. Regardless, our findings on the consistent negative link between RA and commitment may be regarded as a starting point for future studies to further investigate how and why objective ambivalence in close relationship may be detrimental to relationship well-being in general. One research question worth asking would be whether commitment may account for the potential association between objective ambivalence and certain negative relationship outcomes (e.g., relationship instability and dissolution).

6.1.4 The inconsistent findings between certain studies

Results of our two correlational studies (Studies 1-2) and the first cross-sectional experimental study (Study 3) were inconsistent with the subsequent cross-sectional experimental studies (Study 4-6) and the longitudinal study (Study 7). Specifically, although mindfulness was correlated with greater WTS through lower RA and higher commitment in Studies 1-2 and participants' enhanced post-manipulation state mindfulness predicted greater WTS through lower RA and higher commitment in Study 3, the results of Studies 4-7 revealed a non-significant indirect effect of mindfulness on WTS through the proposed mediators.

One possible explanation for the inconsistent findings may be that cross-sectional approaches to mediation models can potentially generate substantial bias (Maxwell et al., 2011). Since a cross-sectional study measures all variables at the same time *t*, it fundamentally presumes that the independent variable *X* at time *t* instantaneously causes the mediator *M* at the same time *t*, which in turn instantaneously causes the dependent variable *Y* at time *t* (Maxwell et al., 2011). However, the causal links implied by the paths in mediation models almost always occur over time; in other words, it takes time for the causal effect of *X* at time *t* on *M* at time *t+1* to unfold. Therefore, presuming that the mediating effect can occur instantaneously between the preceding and downstream variables at the same time *t* can be problematic on logical grounds (Selig & Preacher, 2009).

Second, to enhance the feasibility of the data collection process, cross-sectional studies are usually unable to control for previous levels of the mediator and outcome variables. For example, in our cross-sectional studies, we were only able to include previous assessment of participants mindfulness (i.e., measured as baseline mindfulness before manipulation), and were unable to control for baseline RA, commitment or WTS as repeatedly asking participants to answer the same sets of questions within a short time interval (i.e., approximately 5-10 minutes in our studies) would likely induce respondent fatigue that may detract from the quality of the responses (Whelan, 2008; Ben-Nun, 2008). However, failing to control for previous levels of the mediator and outcome variables in a causal model may lead to under- or overestimation of the paths in the mediation model (Judd & Kenny, 1981; Maxwell et al., 2011; Selig & Preacher, 2009).

Third, since mediating effects most often take time to unfold, the magnitude of the causal effects is likely to be dependent on the length of the time that passes between measurements (Selig & Preacher, 2009). The fact that cross-sectional studies measure all variables at the same time makes it impossible for researchers to set appropriate time

intervals between measurements. As a result, cross-sectional approaches presume by default that the magnitude of the causal effects in a mediation model are consistent regardless of the time that elapses between measurements, which makes it more difficult for researchers to depict the causal effects with precision (Selig & Preacher, 2009).

Supporting these arguments, Maxwell and colleagues (2011) demonstrated across various examples that cross-sectional studies investigating mediation models can generate biased results. The authors suggested that cross-sectional results can either overestimate or underestimate longitudinal results in both partial and complete mediation models, even when sample sizes are large. The authors further pointed out that the direction of such bias (i.e., overestimation or underestimation) is generally unpredictable, as a given pattern of cross-sectional estimates may arise from several combinations of the underlying longitudinal estimates. Taken together, a likely reason why we found inconsistent results between cross-sectional studies, and between certain cross-sectional studies (i.e., correlational cross-sectional Studies 1-2, and experimental cross-sectional Study 3) and the longitudinal study may be that the results of certain cross-sectional studies overestimated the mediating effect of lower RA and higher commitment on the indirect link between higher mindfulness and greater WTS as a result of the limitations of using cross-sectional approaches on mediation models.

6.2 Strengths, Limitations and Implications

6.2.1 Strengths and implications

Bridging the sciences of mindfulness and WTS in close relationships

This thesis is the first work to systematically investigates whether and how mindfulness may be associated with WTS in close relationships. Our studies offer novel

insight into the role mindfulness may (or may not) play in pro-relationship outcomes such as WTS.

Previous studies investigating the link between mindfulness and pro-relationship outcomes have focused heavily on the beneficial influence of greater mindfulness on interpersonal forgiveness (Johns et al., 2015; Oman et al., 2008; Shapiro et al., 2008; Webb et al., 2013) and conflict management (Barnes et al., 2007; Heppner et al., 2008; Hertz et al., 2015; Laurent et al., 2013). For instance, higher levels of state mindfulness have been found to be associated with lower levels of observed verbal aggression and negativity (Barnes et al., 2007; Heppner et al., 2008) and less negative affect and distress (Hertz et al., 2015) during conflict. While situations involving conflicts of interests between partners call for sacrifice and willingness to forego one's own interest for the sake of the partner's interests (Van Lange et al., 1997), no prior research has looked directly at whether and how mindfulness may promote individuals' WTS when encountering conflicts of this sort.

Although little is known about the link between mindfulness and WTS, researchers have consistently found WTS to be beneficial to relationship functioning, as it builds a "climate" of trust and cooperation between the two people in the relationship (Van Lange et al., 1997). In support of this claim, studies have shown that individuals with greater WTS reported higher levels of relationship satisfaction and personal well-being (Van Lange et al., 1997; Wieselquist et al., 1999; Zhang & Li, 2015), and a recent meta-analysis further supported this association (Righetti, Sakaluk et al., 2020). Taken together, having positive intentions to sacrifice is good for maintaining a relationship, and learning what might (or might not) be the precursor of such sacrifice intentions may provide helpful information for couple-level interventions aiming to promote relationship well-being.

Over the past few decades, mindfulness-based interventions (MBI) have been increasingly incorporated in couple counseling and treatment aiming to help partners

establish healthier and more satisfying relationships in both clinical and non-clinical settings (Winter et al., 2021). In their recent meta-analysis, Winter et al. (2021) showed that MBI for couples are generally effective in enhancing participants' mindfulness (Birnie et al., 2010; Khaddouma et al., 2017; May et al., 2020), relationship quality[31] (Carson et al., 2004; Khaddouma et al., 2017) and relationship satisfaction (Gambrel & Piercy, 2015; Khaddouma et al., 2017; Monin et al., 2020). While prior studies have revealed this potential beneficial influence of greater mindfulness, according to our findings, mindfulness may not be a robust predictor of WTS, especially when it comes to a potential real sacrifice. Therefore, psychotherapists applying MBI in couple interventions should not have high expectation on the intervention effect on WTS. While this may not be the most optimistic take home message, knowing what may and may not be effective at promoting WTS is informative for practitioners aiming to use MBI to alleviate certain relationship issues such as conflicts of interests between partners, and can therefore help practitioners to choose the most suitable intervention for their targeted issues.

Providing novel insight into the interdependence theory and models of mindfulness and relationship

According to the interdependence theory, commitment serves as an important relationship-specific motive that initiates and directs pro-relationship responses, including WTS (Finkel et al., 2002; Rusbult et al., 1991, Van Lange et al., 1997). In support of this argument, a number of prior studies have suggested that greater commitment predicts greater WTS (Etcheverry & Le, 2005; Powell & Van Vugt, 2003; Van Lange et al., 1997; Wieselquist, et al., 1999). According to our findings, we argue that the link between commitment and WTS may not be as robust as existing theory and research suggest, and may

[31] It should be noted that the conceptualization and operationalization of relationship quality was inconsistent across studies (see Winter et al., 2021).

depend on the type (i.e., hypothetical versus actual sacrifice) and/or the potential outcome (i.e., saving one's partner from negative consequences versus benefiting one's partner) of sacrifices. Therefore, future studies should be mindful of the type of sacrifices being measured when administering questionnaires containing hypothetical WTS scenarios or retrospective reports of previous sacrifices. Furthermore, since our findings highlight the importance of the potential outcomes of sacrifices, it is promising for future studies to investigate if and how commitment may be associated with approach-motivated (i.e., focusing on obtaining positive relationship outcomes; Carver et al., 2000) and avoidance-motivated (i.e., focusing on avoiding negative relationship outcomes; Carver et al., 2000) sacrifices, and if the beneficial influence of commitment on WTS may differ between sacrifices involving different motivational processes.

Our findings also provide novel insight into Karremans et al.'s (2017) theoretical model of how mindfulness may promote pro-relationship outcomes. While Karremans and colleagues (2017) proposed that mindfulness may promote individuals' WTS through enhanced awareness and attention to their own self-interest and their partner's interests and enhanced executive control, our findings suggest that the psychological processes between mindfulness and WTS may be more complex, and that the link between these two constructs may not be as robust as their model suggests. According to the results of our studies, mindfulness may not be directly or indirectly linked to WTS at all, or it may be indirectly linked WTS through psychological constructs apart from RA and commitment. Therefore, researchers interested in investigating the beneficial influence of mindfulness on sacrifice intentions may explore how other psychological factors may account for this association. For example, scholars have consistently found a significant association between higher levels of mindfulness and lower levels of attachment insecurities (Pepping et al., 2014; Ryan et al., 2007; McDonald et al., 2016). Extant studies have also revealed that individuals with higher

levels of attachment avoidance tend to report less willingness to make general sacrifice (Zhu et al., 2021) and approach motivated sacrifice (Impett & Gordon, 2010), while individuals with higher levels of attachment anxiety tend to report greater willingness to make general sacrifice[32] (Zhu et al., 2021) and approach motivated sacrifice (Impett & ß, 2010). The researchers explained that avoidantly attached people are likely to deactivate their emotions and be emotional detached from their partners, resulting in lower levels of responsiveness to their partner and greater motivation to distance oneself from the partner, which may lead to lower willingness to make general and approach motivated sacrifice (Impett & Gordon, 2010; Zhu et al., 2021). Individuals high in attachment anxiety, on the other hand, are likely to employ hyperactivating coping strategies when their partner is in need (Mikulincer & Shaver, 2003) and compulsively offer support due to the fear of being rejected or abandoned by their partner (Collins & Feeney, 2000), which may result in greater willingness to make general and approach motivated sacrifice (Impett & Gordon, 2010; Zhu et al., 2021). Therefore, it may be promising for future studies to investigate if mindfulness may be indirectly linked to individuals' willingness to make approach- and/or avoidance-motivated sacrifice through attachment insecurities.

Another relationship-specific factor worth examining is the perceived partner responsiveness (PPR), the extent to which the partner is perceived to be caring, understanding, and supportive to one's core interests and needs (Reis et al., 2004; Reis & Gable, 2015; Reis & Shaver,1988). Although littler research has directly investigated the link between mindfulness and PPR, it is theoretically plausible that mindfulness may promote PPR as the heightened, non-judgmental awareness and attention cultivated by mindfulness may allow individuals to be more sensitive to and more ready to accept their partners'

[32] It is worth noting that the authors found that this association was only significant in American participants, but not in Chinese participants, indicating a potential cultural difference (see Zhu et al., 2021).

responsiveness (Kappen et al., 2018). Indeed, a recent study found that relationship mindfulness, the tendency of being mindful towards feelings and thoughts influential to one's romantic relationship (Kimmes et al., 2018), predicted prospective change in relationship quality through greater PPR (Stanton et al., 2021). Furthermore, greater PPR has been found to promote more positive sacrifice appraisals (e.g., sacrifice was perceived to be less costly), which may foster greater WTS or actual sacrifices (Visserman et al., 2021). Therefore it would be promising for future studies to investigate whether greater mindfulness may be indirectly related to greater WTS through PPR.

Methodological strengths

The present research has several methodological strengths. First, this thesis addressed its research questions with the use of different types of studies, including correlational studies, cross-sectional experimental studies, and a longitudinal study. While the correlational studies allowed us to gain preliminary understanding of the research questions with limited time and budget, the cross-sectional experimental studies allowed us to exert strict control over the manipulation and assessment of the variables, as well as to make inferences about causality among the variables before launching the more expensive and time-consuming longitudinal study. The longitudinal study allowed us to better depict the prospective effect of our variables in the mediation model by choosing appropriate time intervals between measurements. The causal links revealed by a mediation model can take time to unfold, and as a result the magnitude of the mediating effect may vary and depend on the length of time that elapses between the measurements (Selig & Preacher, 2009). Unlike cross-sectional studies, which by default assumes that the mediating effects are instantaneous and consistent in terms of magnitude, our longitudinal design in Study 7 offered us the opportunity to choose an appropriate time interval for the mediating effect to unfold (Selig & Preacher, 2009). Despite our best intentions, however, the time interval of one week between

assessments did not appear to be the optimal time interval for assessing change in our variables and depicting mediation effects.

Another strength of the current thesis is that we controlled for several potential confounding variables as covariates (i.e., gender, age, relationship length, past meditation experience) in our analyses. It is important to control for these factors as prior evidence has suggested that a) women are more likely to sacrifice than men in marriages (Ahmed et al., 2013), b) individuals may become more mindful as they grow older (Thirumaran, 2020), c) relationship length is positively associated with commitment (Rhoades et al., 2010) and WTS (Van Lange et al., 1997), and d) experienced meditator may be less preoccupied in general than naïve meditators (Brewer et al., 2011). By controlling for these potential confounding variables, our findings are generalizable across these characteristics.

6.2.2 Limitations of the current thesis

Before concluding, we acknowledge some limitations of the current work. First, our measures of actual WTS may lack ecological validity. The sacrifice as presented in our questionnaire (i.e., the intention to endure boring or unpleasant online task to win prize entry for one's partner) is only remotely related to the common sacrifices that may occur in everyday life (e.g., give up one's hobby to spend more time with a partner). Therefore, it is unclear to what extent our findings on actual WTS can be generalized to real-world settings. It is similarly unclear to what extent participants were convinced that they would be required to perform the tasks selected, as we did not include questions regarding the believability of the WTS tasks in Studies 4-5. If possible, future studies aiming to investigate actual WTS may design a more ecologically-valid sacrifice task that maps on more clearly to individuals' day-to-day experiences, which may allow researchers to depict participants' actual WTS more precisely.

It is also worth noting that the actual WTS measure in Studies 4-5 potentially involves activities that may induce unpleasantness or harm to the participants (i.e., participants need to endure unpleasantness to win monetary reward for their partner). While the level of unpleasantness participants experienced in Studies 4-5 should be comparatively low and transient (given that participants were not actually asked to proceed with their chosen tasks), more ecologically-valid sacrifice task may inevitably pose greater level of unpleasantness as sacrifice in real life is a type of costly behaviour (Impett et al., 2005; Van Lange et al., 1997). It is therefore important for researchers to balance between ethics and validity when designing assessments of actual or intentional sacrifice. On example worth mentioning is the cold pressor task (CPT), which requires participants to immerse their sub-dominant hand into cold water (Birnie et al., 2011). The CPT is a common method of inducing pain in an laboratory setting (Birnie et al., 2011), and has been employed as a measure of actual and/or intentional sacrifice by some researchers (Yan et al., 2022). An evaluation of the CPT by Birnie and colleagues (2011) offers several constructive insights into experimental methods posing certain level of harm to participants. According to Birnie et al. (2011), the CPT is judged by both researchers and participants as an ethically acceptable research method as a) the participants have the total control over the duration of the experimental experience (i.e., participants may remove their hand at any time; von Baeyer et al., 2005), b) any pain and psychological risk induced by the CPT appears mild/low and transient (Tsao et al., 2004), and c) appropriate monitoring and guidance by the researcher is provided. Therefore, future researchers aiming to employ or design a sacrifice measure that may pose unpleasantness/harm on participants should consider these aspects for ethical acceptability.

Second, in Studies 3-7, participants' answers may be susceptible to response bias caused by social desirability and/or inconsistent understanding of certain mindfulness items. The first response bias is a general issue with a number of self-report measures, which

includes but is not limited to mindfulness assessments (Bergomi et al., 2013). Social desirability is defined as the tendency of respondents to choose an answer that they believe to be socially desirable, as opposed to choosing answers that truly reflect their thoughts, experiences, or actions (Grimm, 2010). As a result, respondents affected by social desirability bias tend to over-report what is regarded as socially desirable and under-report what they believe to be socially undesirable. Researchers have suggested that social desirability was positively associated with the MAAS (Brown & Ryan, 2003), although evidence regarding this issue in mindfulness measures is still insufficient and inconsistent (Bergomi et al., 2013). In Studies 3-6, the time interval between pre- and post-manipulation mindfulness measure was comparatively short (i.e., 5 minutes) due to the budget and time constraints. Therefore it is possible that participants guessed what might be the "desirable" answers when filling the mindfulness assessment for the second time at post-manipulation (i.e., participants received the mindfulness manipulation may became aware that this was an exercise aiming to cultivate their mindful awareness and attention towards their partners, and therefore over-report their level of mindfulness). One possible solution for this issue is to space out the pre- and post-manipulation mindfulness assessment with more time so that participants may be less aware of the actual aim of the assessments. Another suggestion offered by scholars is that, if time allows, a social desirability scale can be employed to help researchers identify precisely the extent to which the answers collected have been biased due to social desirability (Nederhof, 1985). The second response bias refers to the issue that answers collected by a well-validated self-reported mindfulness measure may still be problematic as the scale items may be perceived differently across various individuals (Grossman, 2008; 2011). Researchers suggested that some of the frequently used terms in mindfulness scales such as "experience", "awareness", "to notice", and "to judge" may cause ambiguity and therefore participants' perceptions on certain mindfulness items may be idiosyncratic (Belzer et al., 2011; Leigh et

al., 2005). With that being said, it should be noted that the existing evidence supporting this criticism mainly deals with the FMI and the FFMQ (i.e., the assessment used in Study 7), but not the scales used in Studies 3-6 (Bergomi et al., 2013). To address this response bias, a recent research introduced a psychophysiological method for mindfulness assessment, which used participants' pre- and post-treatment changes in the event-related brain potentials (dERPi) to assess the potential change in mindfulness. The researchers found that the dERPi was significantly negatively correlated with participants' depression symptoms, while the association between these participants' self-reported mindfulness and their depression symptoms was much weaker and non-significant (Bostanov et al., 2018). It is therefore promising for future mindfulness studies to use a more objective assessment (e.g., the psychophysiological method) to measure mindfulness.

Third, the sample size of Studies 1-6 was based on study budget and data collection time constraints, but not a priori power analysis. Although every effort has been made to increase statistical power (i.e., as suggested by Fritz and MacKinnon (2007), bootstrapping method has been used for testing the mediations in all of our studies), it is still unclear whether the cross-sectional studies were adequately powered. While we conducted a post hoc Monte Carlo simulation to investigate the statistical power of each mediating effect, it should be noted that post hoc power analysis has been severely criticized by scholars over the years (Cohen, 1988; Heonig & Heisey, 2001; Kraemer et al., 2006; Levine & Ensom et al., 2001; Zhang et al., 2019), and our results of the post hoc power analyses may not indicate the true power for detecting significant effect in a randomly selected sample. When a power analysis is performed on a readily collected sample, all of the statistical components used in the analysis are based on that particular sample but not a random sample from the applicable population, which makes the results from the power analysis meaningless as the random component of the research no longer exists (Zhang et al., 2019). Supporting this argument,

Zhang and colleagues (2019) employed the Monte Carlo simulation to investigate the performance of the prospective and post hoc power analysis for comparing two population means, and found that results of the post hoc power analysis were too variable to be informative for the true power. If possible, future studies may conduct a power analysis before data collection so that researchers could be better informed with the adequate sample size needed to detect statistically significant results in a randomly selected sample.

Fourth, the current study controlled for a limited number of demographic factors (i.e., gender, age, and relationship length), and several other demographic factors may be worth taken into consideration for future studies investigating WTS. For example, although no research has directly investigated the association between sexual orientation and WTS, Kurdek (1993) investigated whether homosexual couples (i.e., lesbian and gay couples) and married heterosexual couples differed in the way of allocating household labour. Kurdeck (1993) proposed three principles of allocating household labour: equality (i.e., housework is equally distributed and completed by both parties), balance (i.e., housework is allocated based on partner's speciality/expertise), and segregation (i.e., most of the housework is completed by one partner). Kurdeck revealed that married heterosexual couples were most likely to allocate by segregation (with wives doing most of the housework), gay couples by balancing, and lesbian couples by sharing, indicating that gender differences, or perceived gender stereotypes could influence couples' strategy for the fair allocation of labour (Kurdeck 1993). Given that common sacrifices in romantic relationships usually involve tasks reflecting gender stereotype in a heterosexual relationship (e.g., women should be responsible for the majority of housework and men should be financially supportive; Sakalli-Ugurlu, 2003), partners in a homosexual relationship, where gender stereotypes do not apply, may adopt different strategies when it comes to sacrifices as it is gender similarity, rather than gender difference, that becomes the significant part of the relationship (Kitzinger, 2001).

Therefore, it would be promising for future studies to investigate whether homosexual and heterosexual partners differ in terms of WTS, or willingness to perform certain types of sacrifices in the relationship.

Another demographic factor that was not assessed in the current study but may influence individuals' WTS is the number of children they have in the romantic relationship. Although no research has directly investigated how couples with and without offspring differ in terms of WTS, children have been consistently found to be positively correlated with marital stability (Becker, 1990; Coleman, 1988; Friedman et al., 1994; Heaton & Schoen, 2002; Tzeng, 1992; Waite & Lillard, 1991). Scholars explained that children are marriage-specific capital who create greatest value and social capital within the marriage, therefore it would be more costly for couples with children to separate and divorce (Becker, 1990; Coleman, 1988). Interestingly, researchers have also found that the number of children is generally related to decreased marital satisfaction (Dillon & Beechler, 2010; Twenge et al., 2003), and this negative association is more significant among women (Kowal et al., 2021). Given that investment and relationship satisfaction are two central components contributing to commitment in a romantic relationship (Johnson & Rusbult, 1989; Rusbult, 1983; Rusbult & Van Lange, 2003), future studies investigating commitment and/or WTS may control for the number of children as a covariate. It would also be promising for future studies to explore whether partners with children have higher WTS than those without children (e.g., considering that married couples with children are more concerned with marital stability; Friedman et al., 1994), and whether the number of children may moderate this potential relationship.

Fifth, all studies in this thesis assessed mindfulness as a unitary construct. While the multi-faceted FFMQ was used in Study 7, we did not assess how each sub-facet of the FFMQ was linked to the study variables as the initial power analysis of Study 7 was based on one

but not five predictors (i.e., the study may become under-powered if the predictor is changed from the overall mindfulness score to the five sub-facets of the FFMQ). However, a number of researchers have suggested that different sub-facets of the FFMQ may have differential associations with variables related to psychological well-being, although such evidence does not cover specifically the relationship between mindfulness sub-facets and WTS. For example, a recent meta-analysis examining the relationship between trait mindfulness (as assessed by the FFMQ) and negative affective symptoms (e.g., depression, anxiety) has found that the *nonjudgment of inner experience* and *act with awareness* facets were highly significantly correlated with negative affective symptom, while the *describe* and *nonreactivity to inner experience* facets exhibited moderate correlation, and the *observe* facet was not correlated with negative affective symptoms (Carpenter et al., 2019). Another study investigating the association between trait mindfulness (as assessed by the FFMQ) and relationship satisfaction in long-term married couples found that the *nonjudgment of inner experience* facet uniquely predicted participants' relationship satisfaction above and beyond all other sub-facets, suggesting that individuals who hold an open and accepting attitude towards their experiences perceived their relationships more positively (Lenger et al., 2016). Given that relationship satisfaction is a contributing factor to commitment (Rusbult, 1983), which may further influence individuals' WTS, it would be promising for future studies to investigate how various sub-facets of mindfulness may be uniquely linked to WTS in romantic relationships.

Another limitation of this thesis is that the time interval between measurements (i.e., one week) in the longitudinal study may not be appropriate for depicting natural fluctuations in the study variables (e.g., mindfulness, RA). As a result, the non-significant links between the study variables in the longitudinal study may be due to short time lag between measurements, rather than the null prospective effect of greater mindfulness on the

downstream variables. However, rather than providing evidence to the potential prospective influence of mindfulness on WTS, we acknowledge that the current study findings may be more informative in terms of advancing our understandings on the possible boundary conditions of mindfulness-related benefits. When we investigated the beneficial influence of enhanced mindfulness on WTS, we somehow presumed that such benefits should make individuals more willing to make sacrifices in every relationship, regardless of the healthiness of the relationship. However, not everyone is blessed with a healthy relationship that is "worth" the potential sacrifice, and our studies are limited as we did not consider if the beneficial influence of mindfulness may function differently in healthy versus unhealthy relationships. Indeed, scholars have suggested that certain positive psychological constructs (e.g., kindness, forgiveness) may promote the functioning of generally healthy relationships but may undermine relationships that are already in trouble (Luchies et al., 2010; McNulty & Fincham, 2012). Of particular relevance to this thesis, Karremans et al. (2017) offered a plausible speculation on the possible non-significant or even negative influence of enhanced mindfulness on relationship outcomes. Specifically, Karremans et al. (2017) proposed that mindful individuals in an already-troubled relationship may become more aware of the overall negative experiences in a relationship, which may shake their "self-justification" to remain in that relationship, and may eventually persuade them to end the unhealthy relationship. Furthermore, mindfulness is strongly correlated with self-compassion as it allows individuals to be aware of their unpleasant or negative experiences with a balanced manner that neither suppresses nor ruminates on the negative aspects of the self or their experiences (Neff, 2003). The cultivation of mindful awareness towards one's personal suffering helps to promote the compassionate feeling towards the self, while the accepting and non-judgmental attitude prevents individuals from over-identifying with or ruminating on the suffering (Neff, 2003). Indeed, a number of researchers have found that the positive

effects of mindfulness treatment can be partly credited to enhanced self-compassion (Birnie et al., 2010; Kuyken et al., 2010). According to Hölzel et al. (2011), the cultivation of mindfulness allows individuals to identify less with the unpleasant self-judgment, and therefore promotes their self-compassion. While individuals lack self-compassion may habitually respond to relationship problems through self-judgment and self-blame (e.g., "It must be my own issue") (Neff, 2003), mindfulness training may allow the possibility of more positive coping strategies through enhanced self-compassion (Karremans et al., 2007). Karremans et al. (2017) therefore proposed that people in an unpleasant or depressed relationship may be more likely to stand up for their interests and needs. Supporting this point, researchers have found that individuals with greater self-compassion were less likely to subordinate their interests when experiencing conflicts in the relationship (Yarnell & Neff, 2013). Therefore, a promising question for future studies would be whether mindfulness may promote individuals' WTS in healthy relationships and undermine individuals' WTS in unhealthy relationships (e.g., objectively discordant, "churning" relationships or those involving physical or psychological abuse), and whether self-compassion may mediate such potential relationship.

6.3 Conclusion

An individual's willingness to forego their own self-interests for their partner's needs has been consistently found to contribute to the well-being of romantic relationships. While existing theories and models have proposed that mindfulness may promote WTS in romantic relationships, no prior studies have systematically investigated whether and how mindfulness may predict individuals' WTS, and whether RA and commitment may mediate that link. The current thesis fills in this gap by examining the cross-sectional and longitudinal links between mindfulness and WTS through various study designs and variable operationalizations.

This thesis identified a significant association between higher mindfulness and greater hypothetical WTS, mediated by lower RA and higher commitment in the initial correlational studies (Studies 1-2). A following cross-sectional experimental study (Study 3) replicated this serial mediation model, suggesting that enhanced mindfulness prospectively led to lower RA, which in turn led to higher commitment, which eventually led to greater hypothetical WTS. However, this prospective influence of mindfulness on WTS was not replicated in other cross-sectional experimental studies assessing actual (Studies 4-5) and hypothetical (Study 6) WTS, and the longitudinal study (Study 7) assessing hypothetical WTS. The inconsistent cross-sectional findings illuminate the possibility that hypothetical and actual WTS may function differently, and the potential outcomes of sacrifices may matter when it comes to deciding whether to make a sacrifice. The inconsistent results between cross-sectional studies (Studies 1-3 versus Studies 4-6), and between certain cross-sectional study (Study 3) and the longitudinal study further highlighted the limitations of using cross-sectional approaches to examine mediation models, suggesting that the cross-sectional results can be substantially biased as cross-sectional designs fail to represent the prospective effects over time.

In summary, our findings offer novel insights into the interdependence theory and theoretical models of mindfulness and relationship outcomes by revealing the somewhat limited and inconsistent effect of mindfulness on WTS. We recommend that researchers interested in this research topic to further examine the potentially different roles mindfulness may play in various types of relationships (e.g., healthy vs. unhealthy relationships).

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Appendix

Appendix A The Cognitive and Affective Mindfulness Scale-Revised (Study 1)

Instructions: People have a variety of ways of relating to their thoughts and feelings. For each of the items below, rate how much each of these ways applies to you with the following options: 1 (Rarely/Not at all), 2 (Sometimes), 3 (Often), or 4 (Almost always).

_____ 1. It is easy for me to concentrate on what I am doing.

_____ 2. I am preoccupied by the future.

_____ 3. I can tolerate emotional pain.

_____ 4. I can accept things I cannot change.

_____ 5. I can usually describe how I feel at the moment in considerable detail.

_____ 6. I am easily distracted.

_____ 7. I am preoccupied by the past.

_____ 8. It's easy for me to keep track of my thoughts and feelings.

_____ 9. I try to notice my thoughts without judging them.

_____ 10. I am able to accept the thoughts and feelings I have.

_____ 11. I am able to focus on the present moment.

_____ 12. I am able to pay close attention to one thing for a long period of time.

Scoring: Items 2, 6, and 7 are reverse-scored. After appropriate reversals, sum values for items 1 - 12. Higher values reflect greater mindful qualities.

Appendix B The Mindful Attention Awareness Scale (Study 2)

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

1	2	3	4	5	6
almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never

_____ 1. I could be experiencing some emotion and not be conscious of it until some time later.

_____ 2. I break or spill things because of carelessness, not paying attention, or thinking of something else.

_____ 3. I find it difficult to stay focused on what's happening in the present.

_____ 4. I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.

_____ 5. I tend not to notice feelings of physical tension or discomfort until they really grab my attention.

_____ 6. I forget a person's name almost as soon as I've been told it for the first time.

_____ 7. It seems I am "running on automatic," without much awareness of what I'm doing.

_____ 8. I rush through activities without being really attentive to them.

_____ 9. I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.

_____ 10. I do jobs or tasks automatically, without being aware of what I'm doing.

_____ 11. I find myself listening to someone with one ear, doing something else at the same

time.

_____ 12. I drive places on ‘automatic pilot’ and then wonder why I went there.

_____ 13. I find myself preoccupied with the future or the past.

_____ 14. I find myself doing things without paying attention.

_____ 15. I snack without being aware that I’m eating.

Scoring: To score the scale, simply compute a mean (average) of the 15 items.

Appendix C The Positive-Negative Relationship Quality Scale (Studies 1-7)

Positive Relationship Quality

Instructions: Considering only the positive qualities of your relationship, and ignoring the negative ones, evaluate your relationship on the following qualities.

0	1	2	3	4	5	6
Not at all						*Completely*

Enjoyable

Pleasant

Fun

Strong

Full

Energizing

Alive

Exciting

Negative Relationship Quality

Instructions: Considering only the negative qualities of your relationship, and ignoring the positive ones, evaluate your relationship on the following qualities.

0	1	2	3	4	5	6
Not at all						*Completely*

Unpleasant

Miserable

Bad

Dull

Empty

Weak

Discouraging

Lifeless

Appendix D Willingness to Sacrifice Assessment (Studies 1-3, 6-7)

Imagine that it were necessary to engage in the following activities in order to maintain and improve your relationship. Please indicate to what extent would you consider engaging in this activity?

0 1 2 3 4 5 6

I would definitely not give up this activity *I would certainly give up this activity*

Help your partner with work for a few hours every weekend

Commute for an hour every time you want to see your partner

Lend your partner money because he/she is having trouble paying the rent

Go out with your partner's boring friends

Imagine that if you were to engage in the following activities, it would harm your relationship. To what extent would you consider giving up this activity?

0 1 2 3 4 5 6

I would definitely not give up this activity *I would certainly give up this activity*

Spend time with one particular friend whom your partner/best friend does not like

Go out to your favourite bar/club

Flirt with a particular person that you find attractive

Spend time pursuing one of your favourite hobbies

Appendix E Demographic Questions (Studies 1-2)

1. What is your gender?

☐ Male

☐ Female

If you feel that your gender is not represented by one of the above options, we invite you to write in how you identify your gender in the following space: _____

2. What is your age? ____ years

3. Which of the following best describes your race/ethnicity?

☐ White, Caucasian, Anglo

☐ East Asian

☐ Southeast Asian

☐ Pacific Islander

☐ Black, African, Caribbean

☐ Hispanic, Latino/a, Chicano/a

☐ Middle Eastern, Arab

☐ Bi-racial, Multi-racial

If you feel that your race/ethnicity is not represented by one of the above options, we invite you to write in how you identify your race/ethnicity in the following space:

_____

4. Which of the following best describes your current relationship status?

   ☐ Single/ Not in a relationship

   ☐ Dating my current partner and others

   ☐ Dating my current partner exclusively

   ☐ Common-law

   ☐ Engaged

☐ Married

5. How long have you been in a relationship with your current romantic partner? Please provide an answer for both years and months (e.g., if you have been with you partner for 4.5 years, please enter 4 years and 6 months).

____ years ____ months

Appendix F Mindfulness Exercise Transcript (Studies 3-6)

For the next several minutes, I'm going to ask you to think about, and try, a particular kind of awareness, called mindfulness. The term mindfulness comes from Eastern spiritual and religious traditions but psychology has begun to find that mindfulness (without the spiritual and religious context) can be helpful for people in many ways. Today I'm just going to tell you a little bit about this way of paying attention, and have you try it out, to see what it's like for you.

Mindfulness is paying attention in the present moment, with openness and curiosity, instead of judgment. We often focus on things other than what is happening in the moment – worrying about the future, thinking about the past, focusing on what is coming next, rather than what is right in front of us. And it is useful that we can do a number of things without paying attention to them. However, sometimes it is helpful to bring our attention, particularly a curious and kind attention, to what we are doing in the moment.

Sometimes we do pay close attention to what we are thinking and feeling and we become very critical of our thoughts and feelings and we try to either change them or distract ourselves because this critical awareness can be very painful. For example, we might notice while we are talking to someone new that our voice is shaky, or we aren't speaking clearly, and think, "I'm such an idiot! What is wrong with me? If I don't calm down, this person will never like me!"

Being mindful falls between these two extremes – we pay attention to what is happening inside and around us, we see events and experiences as what they are, and we allow things we can't control to be as they are while we focus our attention on the task at hand. For example, when talking to someone new we might notice those same changes in our voice take a moment to reflect, "This is how it is now, there go my thoughts again", and gently bring our attention back to the person and our conversation. This second part of

mindfulness, holding our judgments loosely and not trying to change our thoughts or feelings can be especially hard. In fact, often being mindful involves practicing not judging our tendency to have judgments!

Mindfulness is a process: We do not reach a final and total state of mindfulness. It is a way of being in one moment that comes and goes. Mindfulness is losing our focus 100 times and returning to it 101 times.

The best way to understand mindfulness is to practice it, so let's do that now.

First, just allowing your eyes to close gently, or to lower….and bringing yourself to sit in an upright position…. begin by noticing how you are sitting in the chair… noticing the places where you are touching the chair, the places where you are touching the floor… noticing where the air is touching your skin and what that feels like…and now gently drawing your attention to your breath…. noticing (without trying to change it) where your breath is coming from… noticing where it enters your body when you inhale… how it travels through your body before you exhale it…. Noticing how your body moves with each inhalation, each exhalation… allowing any thoughts or feelings that occur to naturally rise and fall, without trying to hold onto them or get rid of them……just continue bringing your awareness to your experience in this moment…. and continuing to notice your breath…as you allow whatever comes to come and whatever goes to go and whatever stays to stay....and again bringing your awareness to the room, to the way you are sitting in the chair, and gradually opening your eyes when you are ready and letting the experimenter know you are ready to continue.

Appendix G Introduction of the Solar System Transcript (Studies 3-6)

The universe is everything. From the tiniest particles, to the largest galaxies, to the very existence of space, time, and life. But how did it all begin? The origin of the universe is the origin of everything. Multiple scientific theories, plus creation myths from around the world have tried to explain its mysterious genesis. However, the most widely accepted explanation, is the Big Bang theory.

The Big Bang theory states that the universe began as a hot and infinitely dense point. Only a few millimeters wide, it was similar to a supercharged black hole. About 13.7 billion years ago this tiny singularity violently exploded. And it is from this explosion, this bang, that all matter, energy, space, and time were created.

What happened next were two major stages of the universe's evolution. Called the radiation and matter eras, they're defined by key events that helped shape the universe. First came the radiation era, named for the dominance of radiation right after the Big Bang.This era is made of smaller stages call epochs that occurred within the universe's first tens of thousands of years. The earliest is the Planck epoch. No matter existed in the universe at this time, only energy and the ancestor to the four forces of nature, the superforce. At the end of this stage, however, a key event occurred in which gravity split away from the superforce.

Next came the grand unification epoch, named for the three remaining unified forces of nature. This epoch ended when one of those forces, called strong, or strong nuclear, broke away.

Then the inflationary epoch began during which the universe rapidly expanded. Almost instantly it grew from the size of an atom to the size of a grapefruit. The universe at this time was piping hot and it churned with electrons, quarks, and other particles. Then came the electroweak epoch, when the last two forces, electromagnetic and weak, finally split off.

During the next stage, the quark epoch, all of the universe's ingredients were present, however, the universe was still too hot and dense for subatomic particles to form. Then, in the hadron epoch, the universe cooled down enough for quarks to bind together and form protons and neutrons. In the lepton and nuclear epics, the radiation era's last two stages, the protons and neutrons underwent a significant change. They fused and created nuclei. And in doing so, they created the first chemical element in the universe, helium.

The universe's new ability to form elements, the building blocks of matter, queued the matter era. Much as the name suggests, the matter era's defined by the presence and predominance of matter in the universe. It features three epochs that span billions of years. The vast majority of the universe's life span, and includes the present day.

The first was the atomic epoch. In this stage, the universe's temperature cooled down enough for electrons to attach to nuclei for the first time. Called recombination, this process helped create the universe's second element, hydrogen. This hydrogen, along with helium atoms, dotted the universe with atomic clouds. Within the clouds, small pockets of gas may have had enough gravity to cause atoms to collect. These clusters of atoms, formed during the galactic epoch, became the seedlings of galaxies. Nestled inside those galaxies, stars began to form. And in doing so, they queued the latest and current stage of the universe's development, the stellar epoch.

The formation of stars then caused a tremendous ripple effect and helped shape the universe as we know it. Heat within the stars caused the conversion of helium and hydrogen into almost all the remaining elements in the universe. In turn, those elements became the building blocks for planets, moons, life, everything we see today.

This ecosystem of everything was only possible because of the many stages in the universe's development. While countless questions about the origins of our universe remain, it's only a matter of time for some long-sought answers to emerge.

Appendix H The Mindful Attention Awareness Scale - State (Studies 3 & 6)

Instructions: Using the 0-6 scale shown, please indicate to what degree were you having each experience described below when you were paged. Please answer according to what really reflected your experience rather than what you think your experience should have been.

0 1 2 3 4 5 6

not at all somewhat very much

_____ 1. I was finding it difficult to stay focused on what was happening.

_____ 2. I was doing something without paying attention.

_____ 3. I was preoccupied with the future or the past.

_____ 4. I was doing something automatically, without being aware of what I was doing.

_____ 5. I was rushing through something without being really attentive to it.

Scoring: To have high scores reflect higher state mindfulness, reverse score all items then average all 5 values.

Appendix I The Investment Model Scale – Commitment Level (Studies 3-7)

Respondents answer each item on a 9-point scale ranging from 0 (not at all) to 8 (completely).

1. I want our relationship to last for a very long time

2. I am committed to maintaining my relationship with my partner.

3. I would not feel very upset if our relationship were to end in the near future.

4. It is likely that I will date someone other than my partner within the next year.

5. I feel very attached to our relationship-very strongly linked to my partner.

6. I want our relationship to last forever.

7. I am oriented toward the long-term future of my relationship (for example, I imagine being with my partner several years from now).

Appendix J Demographic Questions (Studies 3-7)

1. Which of the following best describes your gender?

☐ Female

☐ Male

☐ Trans Female

☐ Trans Male

☐ Nonbinary, Genderqueer

☐ Bigender, Genderfluid

☐ Agender, Genderless

☐ If you feel that your gender is not represented by one of the above options, we invite you to write in how you identify your gender in the following space:

_____

2. What is your age?

_____ years

3. Which of the following best describes your race/ethnicity?

☐ White, Caucasian, Anglo

☐ Black, African, Caribbean

☐ Hispanic, Latino/a, Chicano/a

☐ East Asian

☐ South Asian

☐ Southeast Asian

☐ West Asian

☐ Middle Eastern, Arab

☐ Aboriginal, Indigenous, Native

☐ Mixed or Multiple Ethnic Groups

☐ If you feel that your race/ethnicity is not represented by one of the above options, we invite you to write in how you identify your race/ethnicity in the following space:

_____

4. What is the highest education degree you have obtained to date?

☐ GCSE, O-Levels, or Standard Grades

☐ Levels or Highers/Advanced Highers

☐ Vocational degree (e.g., SVQ, HNC, HND)

☐ Undergraduate degree (e.g., BSc, BA)

☐ Master's degree (e.g., MSc, MPhil)

☐ PhD, PsyD

☐ Other advanced or professional degree (e.g., MD, JD)

5. Are you currently a student?

☐ No

☐ Yes

6. Are you currently employed?

☐ No

☐ Yes, part-time

☐ Yes, full-time

7. How much total combined money did you earn last year?

☐ £0-£12,500

☐ £12,501-£14,549

☐ £14,550-£24,944

☐ £24,945-£43,430

☐ £43,431-£150,000

☐ £150,001+

8. How much total combined money did all members of your household earn last year?

☐ £0-£12,500

☐ £12,501-£14,549

☐ £14,550-£24,944

☐ £24,945-£43,430

☐ £43,431-£150,000

☐ £150,001+

9. Which of the following best describes your sexual orientation?

☐ Heterosexual, Straight

☐ Gay

☐ Lesbian

☐ Queer

☐ Bisexual, Pansexual

☐ Asexual

☐ If you feel that your sexual orientation is not represented by one of the above options, we invite you to write in how you identify your sexual orientation in the following space: _____

10. Which of the following best describes your current relationship status?

☐ Single/Not in a relationship

☐ Dating my current partner and others

☐ Dating my current partner exclusively

☐ Common-law

☐ Civil partnership

☐ Engaged

☐ Married

11. How long have you been in a relationship with your current romantic partner? Please provide an answer for both years and months (e.g., if you have been with your current partner for 4.5 years, please enter 4 years 6 months).

_____ years

_____ months

12. Do you and your current romantic partner live together?

☐ No

☐ Yes

13. How often do you meditate?

☐ I have never meditated before

☐ A few times each year

☐ About 1-2 times each month

☐ About 1-2 times each week

☐ 3 or more times each week

☐ I meditate every day or nearly every day

Other (please specify): _____

Appendix K The State Mindfulness Scale (Studies 4-6)

Higher scores = higher level of mindfulness

Numeric responses: from *1 = not at all* to *5 = very well*

Instruction to be used:

Below is a list of statements. Please use the rating scale to indicate how well each statement describes your experiences RIGHT NOW.

1. I was aware of different emotions that arose in me
2. I tried to pay attention to pleasant and unpleasant sensations
3. I found some of my experiences interesting
4. I noticed many small details of my experience
5. I felt aware of what was happening inside of me
6. I noticed pleasant and unpleasant emotions
7. I actively explored my experience in the moment
8. I clearly physically felt what was going on in my body
9. I changed my body posture and paid attention to the physical process of moving
10. I felt that I was experiencing the present moment fully
11. I noticed pleasant and unpleasant thoughts
12. I noticed emotions come and go
13. I noticed various sensations caused by my surroundings (e.g., heat, coolness, the wind on my face)
14. I noticed physical sensations come and go
15. I had moments when I felt alert and aware
16. I felt closely connected to the present moment

17. I noticed thoughts come and go
18. I felt in contact with my body
19. I was aware of what was going on in my mind
20. It was interesting to see the patterns of my thinking
21. I noticed some pleasant and unpleasant physical sensations

Appendix L Measure of Actual Willingness to Sacrifice (Studies 4-5)

You have now completed the main part of the study. Thank you very much for your participation thus far!

You now have the option to either end the study or do a few optional tasks. Listed below are the optional tasks:

Reading Task: You will read a 500-word biography of a retired athlete and answer a few questions about it. (We have to be honest with you that this may be a bit dull.)

Spot the Difference Task: You will be shown two landscape photos of the moon captured by two different astronomical telescopes. You will be asked to identify the differences between the photos. (We have to be honest with you that this may be fairly boring.)

Violent Images Task: You will be shown several disturbing/violent/uncomfortable photos (for example, images of crime scenes, war, road accidents, natural disasters, decay). You will be asked to view these images and answer a few questions about them. (We have to be honest with you that this may be very unpleasant.)

For each task you complete, we will enter **your current romantic partner** into a prize draw to win one of three £20 Amazon gift cards. We will ask you to provide your partner's email address for the prize draw. Your partner's email address will be kept separate from your data and will be private. Once the prize draw is complete, we will remove your partner's email address from our database.

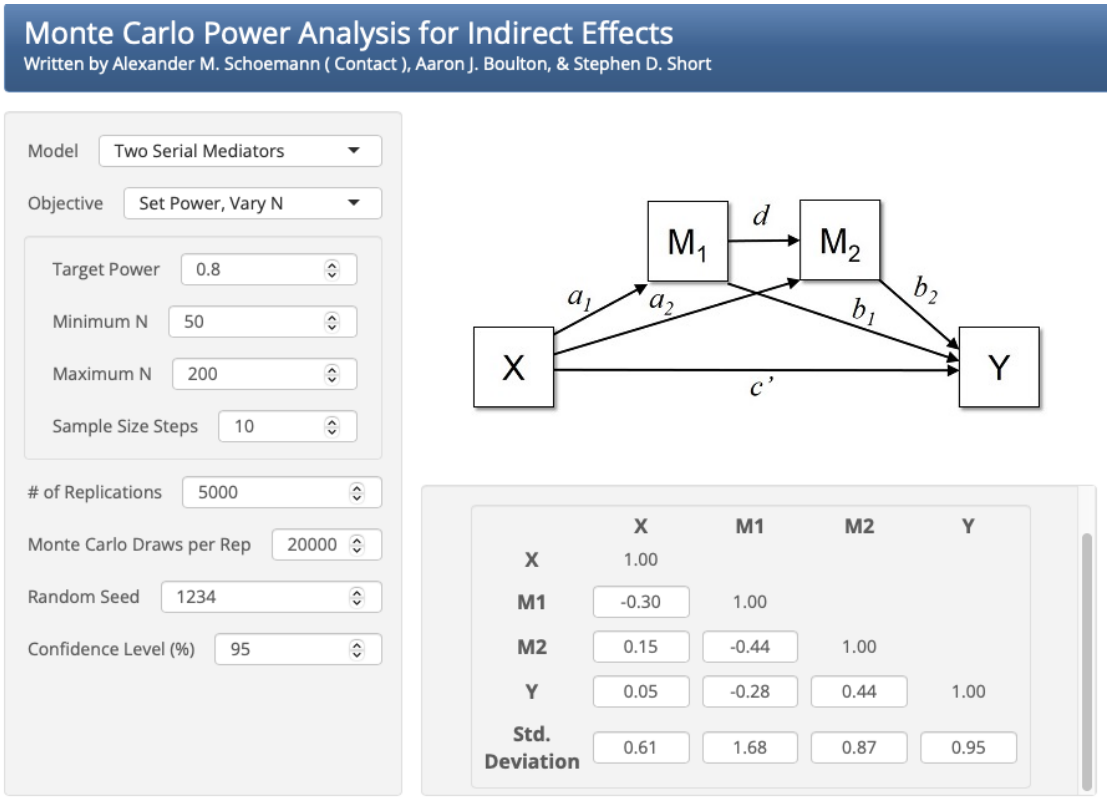
If you don’t wish to proceed with these tasks, you will still be compensated for your participation thus far.

Are you willing to complete any of these optional tasks? Indicate **as many as you like**, or select **No** and the study will end.

- ☐ Yes, I'd like to do the Reading Task
- ☐ Yes, I'd like to do the Spot the Difference Task
- ☐ Yes, I'd like to do the Violent Images Task
- ☐ No, I don't want to do any of the tasks

Appendix M Monte Carlo Power Analysis for Indirect Effects (Study 7)

Written by Schoemann and colleagues (2017)



Appendix N The Five Facet Mindfulness Questionnaire: Short Form (Study 7)

Below is a collection of statements about your everyday experience. Using the 1–5 scale below, please indicate, in the box to the right of each statement, how frequently or infrequently you have had each experience in the last month (or other agreed time period). Please answer according to what really reflects your experience rather than what you think your experience should be.

never or very rarely true	not often true	sometimes true sometimes not true	often true	very often or always true
1	2	3	4	5

1	I'm good at finding the words to describe my feelings	*DS*
2	I can easily put my beliefs, opinions, and expectations into words	*DS*
3	I watch my feelings without getting carried away by them	*NR*
4	I tell myself that I shouldn't be feeling the way I'm feeling	*/NJ*
5	it's hard for me to find the words to describe what I'm thinking	*/DS*
6	I pay attention to physical experiences, such as the wind in my hair or sun on my face	*OB*
7	I make judgments about whether my thoughts are good or bad.	*/NJ*
8	I find it difficult to stay focused on what's happening in the present moment	*/AA*
9	when I have distressing thoughts or images, I don't let myself be carried away by them	*NR*
10	generally, I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing	*OB*
11	when I feel something in my body, it's hard for me to find the right words to	*/DS*

	describe it	
12	it seems I am "running on automatic" without much awareness of what I'm doing	*/AA*
13	when I have distressing thoughts or images, I feel calm soon after	*NR*
14	I tell myself I shouldn't be thinking the way I'm thinking	*/NJ*
15	I notice the smells and aromas of things	*OB*
16	even when I'm feeling terribly upset, I can find a way to put it into words	*DS*
17	I rush through activities without being really attentive to them	*/AA*
18	usually when I have distressing thoughts or images I can just notice them without reacting	*NR*
19	I think some of my emotions are bad or inappropriate and I shouldn't feel them	*/NJ*
20	I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow	*OB*
21	when I have distressing thoughts or images, I just notice them and let them go	*NR*
22	I do jobs or tasks automatically without being aware of what I'm doing	*/AA*
23	I find myself doing things without paying attention	*/AA*
24	I disapprove of myself when I have illogical ideas	*/NJ*

Appendix O Measure of Willingness to Sacrifice (Studies 4-5)

Please indicate the degree to which you agree with each of the following statements **regarding your current relationship in the past week.**

	Completely disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Completely agree
I was willing to make sacrifices for our relationship.							
I was willing to do things that I don't particularly enjoy, but that my partner wanted me to do.							
I was willing to engage in activities that I prefer not to do, because it helped maintain and improve our relationship.							
I was willing to compromise my own interests to make my partner happy.							
I was willing to put my partner's goals, wishes, and needs ahead of my own.							