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UTILIZING QUALITATIVE AND QUANTITATIVE METHODS TO SHED LIGHT
ON THE RELATIONAL INFLUENCES OF YOGA ON AND OFF THE MAT

A Dissertation in
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by
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ABSTRACT

Throughout the last few decades, the mind-body practice of yoga has seen an unprecedented rise in popularity both from the general population and the scientific community. Despite the wide-array of salutary health benefits that have been demonstrated, a clear void is present in the yoga literature investigating the ways in which yoga impacts connections with oneself and social relationships (which are invaluable for one’s health and wellbeing). The overarching goal of this dissertation was to examine the influences of yoga practice on the widely neglected “relational” (intra- and interpersonal) outcomes. Utilizing a mixed methods approach, the three studies which comprised this dissertation sought to gather unique perspectives to accumulate pre-experimental evidence for the relational benefits of yoga.

Study 1 was a qualitative study which investigated the ways in which community-dwelling yoga practitioners perceived and experienced the relational influences of yoga. Through open-ended questions ($n=107$) and in-depth interviews ($n=12$), four emerging themes were identified, culminating in the development of a conceptual model of how yoga may work to bring about relational benefits. Study 2 extended this line of inquiry through a 21-day daily diary study, examining the associations of daily yoga practice with mindfulness, (self-)compassion, and social connectedness, to better understand how relational benefits would manifest in regular practitioners of yoga ($n=104$) in a real world setting. Multilevel analyses indicated that on days when an individual practiced more yoga than their usual, greater mindfulness and self-compassion were reported, which, in turn, predicted enhanced interpersonal outcomes (i.e., compassion and social connectedness).

Study 3 examined the role of trait mindfulness in impacting yoga’s relational benefits in yoga naïve practitioners ($n=21$) participating in a semester long yoga course to better understand for whom and when yoga works. Multivariate time-series analyses demonstrated that on yoga practice days, those with low trait mindfulness observed decreases in relational outcomes specifically, across the first half
of the 15-week academic yoga course, whereas those in the high mindfulness group reaped positive relational influences, with effects for self-compassion sustained at the end of the semester.

Collectively, this dissertation shed light on the understudied relational aspects of yoga, underscoring the value of employing diverse methodological approaches. The findings demonstrate relational benefits are: (1) perceived and experienced through daily yoga practice across diverse yoga styles and experiences, (2) “dynamic” phenomena varying substantially within-persons over time and in sync with daily yoga practice, and (3) realized differently for people depending on their level of dispositional mindfulness. While further prospective and experimental research is warranted to corroborate these preliminary findings, a routine yoga practice appears to hold promise in having a positive impact (on and off the mat) on preserving and strengthening the intra- and interpersonal connections which constitute the building blocks of our daily lives. As such, yoga could serve as a promising intervention to promote a “wholesome life” across diverse populations.
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“Gratitude is the wine for the soul. Go on. Get drunk.” - Rumi

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INTRODUCTION

The mind-body practice of yoga has recently gained increasing attention, both from the general population and from the scientific community, as a holistic approach to enhance one’s health and wellbeing. Currently, there are over 36 million people (a drastic surge in comparison to 20.4 million in 2012; Yoga Journal and Yoga Alliance, 2016) in the United States participating in yoga. Statistics from national surveys across the years (2002, 2007, and 2012) have demonstrated yoga to be one of the most popular mind-body practices, and, although still underutilized in this age group, incremental increases in the number of practitioners have also been observed even in people over the age of 65 (1.3, 2.2, and 3.3% respectively; Clarke, Black, Stussman, Barnes, & Nahin, 2015). This spark has also caught on to the scientific community, and the number of publications on yoga has increased since the year 2000, with a drastic surge occurring in the year 2007, mirroring yoga’s rising popularity in the Western culture (McCall, 2014). The National Institutes of Health (NIH) has also made significant investment into better understanding the effects and mechanisms of yoga practice, as evidenced from the recent increase in grant calls (through mind-body therapy focused RFAs and RFPs) and the development of a research roadmap for studying the effects of these practices. This conceptual framework put forth by The National Center for Complementary and Integrative Health (NCCIH) outlines the iterative steps in developing and testing mind-body interventions to systematically build scientific evidence to inform clinical decisions by the public, health care providers, and health policymakers (NCCIH, 2017).

In the Western context, yoga is predominantly depicted as a form of exercise and stress management technique, with the majority of people equating yoga with the “asanas”, the physical postures of yoga. Nonetheless, yoga is a comprehensive practice which consists of eight limbs (i.e., ethical principles, self-study, physical postures, breath control, sense withdrawal, concentration, meditation, and absorption), and in its entirety, is believed to cultivate peace and balance to one’s
body, mind, and spirit (Iyengar, 1982). Importantly, yoga philosophy starts with the *yamas* and *niyamas* (the ethics of yoga), which are moral precepts that act as guidelines for the practitioner to be at peace with oneself, one’s family, and one’s community (Garfinkel & Schumacher, 2000). Although cultivating positive intra- and interpersonal relationships lies at the center of yoga practice; unfortunately, there is a clear scarcity of research that has investigated whether and how yoga practice impacts the way in which one relates to oneself and the people around them.

Human beings have an inherent motivation to feel connected and build meaningful relationships with others (Baumeister & Leary, 1995), and decades of research has well established a robust association between social relationships and health (Cohen, 2004; House, Landis, & Umberson, 1988). Whereas feeling connected to others has been shown to enhance health and wellbeing (Haslam, Cruwys, & Haslam, 2014), social isolation has been strongly linked to morbidity and mortality (Umberson & Montez, 2010). Indeed, in a meta-analysis across 148 studies, it was found that individuals with stronger social relationships had a 50% greater likelihood of survival in comparison to their isolated counterparts. Notably, these effects were comparable to well-established risk factors for mortality such as smoking and alcohol consumption, with effects exceeding the mortality risk demonstrated for physical inactivity (Holt-Lunstad, Smith, & Layton, 2010). Accumulating evidence also points to how the social world can get under the skin, with socially isolated individuals demonstrating less resilient physiological systems as captured by slower wound healing (i.e., weaker immune system) and poorer sleep efficiency (Cacioppo, Hawkley, & Berntson, 2003; McEwen, 2012).

While the literature on social relationships has placed substantial emphasis on one’s relationship to others (*interpersonal dimensions*), also relevant to one’s health is how one relates to oneself (*intrapersonal dimensions*), which is often at the root of contemplative practices. Self-compassion has recently gained popularity as a healthy, caring way of relating to oneself in the face
of one’s own shortcomings and inadequacies, and as a complementary construct to mindfulness (Neff, 2003; Neff & Vonk, 2009). Specifically, there is evidence that self-compassion serves as a strong predictor of psychological wellbeing in young adults (Barnard & Curry, 2011; Neely, Schallert, Mohammed, Roberts, & Chen, 2009), with emerging evidence suggesting it can act as a promising resource particularly for middle-aged and older adults in the pursuit of successful aging (Brown et al., 2015; Phillips & Ferguson, 2013). Self-compassion has also been linked to positive motivational processes such as intrinsic motivation and perceived self-efficacy (Neff, Hsieh, & Dejitterat, 2005; Neff et al., 2007), and to health-related behaviors including physical activity (Magnus, Kowalski, & McHugh, 2010), further demonstrating its’ potential as a resource that may positively spillover to the engagement and sustainment of health promoting behaviors.

In summary, despite the increased popularity and demand for yoga research and the wide-array of health benefits (e.g., physiological, cognitive, emotional; For reviews see: Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005; Patel & Hu, 2008; Raub, 2002; Ross, Friedmann, Bevans, & Thomas, 2013; Uebelacker et al., 2010; Woodyard, 2011) that have been linked to yoga, the literature to date has largely neglected examining the relational (i.e., how one relates to oneself and to others around them) benefits that may be derived from this mind-body practice. It is also important to recognize the overall yoga literature suffers from methodological shortcomings (e.g., small sample size, inadequate description of procedures) and lack of quality randomized control trials (e.g., lack of appropriate and active control groups, non-randomization; (Elwy et al., 2014; Park et al., 2014), with little understanding of the underlying mechanisms of how yoga works (Gard, Noggle, Park, Vago, & Wilson, 2014; Schmalzl, Powers, & Henje Blom, 2015). Clearly, more high quality experimental research is necessary to establish stronger evidence for the effects of yoga but in case of outcomes that are understudied, such as relational outcomes, another crucial step would be to conduct innovative pre-experimental studies. The NCCIH conceptual framework precisely
articulates a six-stage process for testing mind-body interventions broadly consisting of:

1) establishing an initial effect, 2) refinement, 3) pilot studies, 4) efficacy studies (such as large sample powered RCTs), 5) effectiveness and comparative research, and finally, 6) implementation and dissemination. With respect to the understudied intra- and interpersonal outcomes of yoga, the initial step is critical as it evaluates whether an intervention can provide a clinically meaningful and measurable effect; hence, determining whether or not investment should be made in future work.

Importantly, the key characteristics of the NCCIH framework are that it is non-linear, iterative, and encourages accumulation of evidence through diverse methodological approaches. Research studies can also be proposed at any stage of the continuum (i.e., they operate more in a circular fashion), depending on a combination of factors such as the inquiry of interest, population under study, as well as the context of research. Considering the fact that the potential relational outcomes that may be derived from yoga have received little attention, there is a need to bolster pre-experimental data (stage 1) which can guide decision making for the development of yoga interventions to optimize not only health and well-being outcomes, but specifically, for the optimization of relational outcomes. Further, it will be worthwhile to employ a mixed methods approach (as emphasized by the heterogeneity of methods that are welcomed at the initial stage of the NCCIH framework) including qualitative data, which hold promise in deepening the understanding of the phenomena under investigation, and could potentially aid in refining and guiding measurement decisions surrounding the outcomes of interest. This dissertation is an effort to close the current gap in the literature, which exists bridging yoga practice with the cultivation of intra- and interpersonal outcomes, which are integral, yet understudied, aspects of yoga practice and essential ingredients for one’s health and well-being across the lifespan. By providing data on intra- and interpersonal outcomes from studies employing a mixed methods approach, this work will help enrich the evidence base that can be drawn upon in the initial stages of the NCCIH framework. As
such, this dissertation is interdisciplinary in that it attempts to synthesize evidence across diverse disciplines of kinesiology, psychology, and contemplative sciences, to present novel research on the generally understudied relational outcomes of yoga.
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benefits of group engagement in enhancing cognitive health in aging. *Social Science and Medicine, 120*, 57–66. http://doi.org/10.1016/j.socscimed.2014.08.037


CHAPTER 1. Literature Review

Yoga

The ancient practice of yoga has roots dating back to approximately 5,000 BC India, a discipline of aligning the mind and body for spiritual purposes, founded on the Yoga Sutras (Patanjali’s eight limbs of yoga; Iyengar, 1982). Yoga is a Sanskrit word which is derived from the root yug (to join), or yoke, its’ essence describing unity of the individual self and the transcendental self (unity of mind and body to soul; Garfinkel & Schumacher, 2000). Although in contemporary settings and particularly in the West, yoga tends to be characterized predominantly through yoga postures, breathing, and some meditation techniques, the traditional form of yoga is broader in scope in that it is characterized by a diverse array of techniques to promote health, wellbeing, and balance for the mind, body, and spirit; for instance, through paths of service, devotion, intellectual discernment, and meditation (Feuerstein, 2002). For the ancient seers and gurus (great teachers), yoga was life, an art of living at one’s optimal level of physical and mental functioning through the alleviation of suffering, a means for exploring both the inner (intrapersonal) and outer (interpersonal) world, with an ultimate goal to achieve wisdom and knowledge through guidance from the sacred Indian texts (i.e., the Vedas, Upanishads, and Shastras).

Yoga as mind-body practice. Despite the ancient history of this practice, more recently, yoga has widely been adapted and embraced in Western societies, identified to be one of the many mind-body practices. According to the United States National Institutes of Health (NIH) National Center for Complementary and Alternative Medicine (NCCAM), mind-body practices encompass a wide variety of practices (e.g., acupuncture, hypnosis, massage therapy, meditation, and tai chi) with the common intention of utilizing the mind to influence physical functioning and promote health. Importantly, emphasis is placed “on the interactions among the brain, mind, body, and behavior,” which captures the complexity and multi-dimensionality of these practices (Barnes, Bloom, & Nahin,
2008; NIH2015). Notably, a component that may be unique is that these practices are often taught or delivered by a trained practitioner or facilitator (NIH, 2015). Since the year 2008, the terms mind-body interventions, mind-body practices, and mind-body medicine has been utilized rather interchangeably.

Yoga as physical activity. It is also important to acknowledge that yoga is a form of physical activity. Yoga (specifically, Hatha yoga) requires participants to hold and move between a series of static physical postures, and depending on the style of practice, yoga may include components of both aerobic and resistance exercise (i.e., a yoga pose can involve isometric contraction of specific muscle groups). Importantly, due to its qualities as a mind-body practice, with benefits such as relaxation that may extend beyond conventional modes of physical activity, yoga may appeal from an affective viewpoint (e.g., it may appear more enjoyable, less effortful, and more wholesome), which is reflected by the increased popularity of yoga as an alternative exercise modality (Clarke, Black, Stussman, Barnes, & Nahin, 2015). Initial studies examining the energy expenditure of yoga have indicated the intensity of yoga is too low for deriving cardiovascular health benefits (Burger, Hale, Dennerstein, & Robertson, 2008) although improvements in cardiorespiratory fitness have been documented (Prasad, Ramana, Raju, Reddy, & Murthy, 2001; Tran, Holly, Lashbrook, & Amsterdam, 2001). For example, a study conducted by Hagins et al., (2007) demonstrated metabolic costs of yoga across one acute session to be low in intensity, equivalent to walking on a treadmill (approximately 2.5 METS). These results suggest yoga does not meet what is considered to be a “moderate” intensity level of physical activity (based on the American College of Sports Medicine and the American Heart Association standards; Haskell et al., 2007). The authors also highlighted however, that a portion of yoga practice in sun salutations did meet moderate physical activity levels, suggesting a more active yoga practice with continuous movement (what is typically referred to as a “flow” sequence) exceeding a 10-minute bout may
contribute to cardiovascular fitness. In fact, a more recent study on vinyasa yoga (vigorous with continuous movement) indicated this type of yoga to meet the requirements (approximately 4METs) necessary to be considered moderate intensity physical activity (Sherman et al., 2017). To summarize, the fitness benefits of yoga practice may vary depending on the duration of yoga practice, the components or type of yoga training (postures, breathing, versus meditation), as well as the characteristics of the sample (Cowen & Adams, 2007; Raub, 2002; Ross & Thomas, 2010).

**Yoga as meditative movement.** While yoga is recognized to be a form of physical activity, it is often referred to as “meditation in motion” (Khalsa, Butzer, Shorter, Reinhardt, & Cope, 2013) due to the unique characteristics (e.g., focused attention on a specific body part, or the breath) it involves in addition to physical activity. In this way, yoga also falls under the realm of “Meditative Movement,” a class of physical activity that combines meditative focus with movement (including, ancient practices such as tai chi, qigong, yoga, and Western methods such as the Alexander Technique and Feldenkrais). Specifically, meditative movement is defined by elements of: (1) movement or body positioning that may be prescribed or spontaneous, (2) explicit attention on the breath, and (3) a meditative, calm state of mind (which is often focused directly on bodily experiences), to attain (4) a state of deep relaxation (Larkey, Jahnke, Etnier, & Gonzalez, 2009). To highlight the radical differences that exist between meditative movement and physical activity, Payne & Crane-Godreau (2013) in their review article of meditative movement for anxiety and depression further elaborated on its’ unique characteristics. In particular, they stressed the distinct awareness of the “mind” in meditative movement that is placed on spatial, interoceptive, proprioceptive, and kinesthetic cues. This awareness has been captured as “mind-in-body” (Kerr, 2002) instead of the familiarized concept of mind-body practices. Lastly, it may be important to note that the deep relaxation (often acquired through corpse pose, or savasana in yoga practice), that is an element of meditative movement refers to a state of balance (as opposed to slackness) such that the overarching
aim of meditative movement is to reach a state of homeostasis. For Yoga’s recognition and study as meditative movement, it will therefore be meaningful to better design research studies for inquiring and answering relevant scientific questions, and to continue the process of evaluating and refining the definition of meditative movement (Payne & Crane-Godreau, 2013).

**Yoga as contemplative practice.** In the tree of contemplative practices (Center for Contemplative Mind in Society, 2015), yoga is categorized under the branch of movement-based contemplative practices. Contemplative practices (originally founded in contemplative traditions such as Buddhism) refer to a wide array of approaches and methods that often involve mental and behavioral training that are intended to produce shifts in basic cognitive and emotional processes, including attention and emotion regulation, ultimately resulting in the development of virtue and wholesome characteristics (e.g., honesty and compassion; Davidson et al., 2012). In a broad sense, these practices require first-person reflection or the cultivation of specific modes of experience (i.e., they require individuals to exercise volitional control). Specifically, in yoga practice, interoceptive awareness is cultivated such that practitioners are often asked to sustain their focus of attention to particular objects (including the breath), or to specific sensations in the body (soles of feet). This aspect of yoga practice is also reflected in the historical text of Raja Yoga, *The Yoga Sutras of Patanjali* (the classic text to first describe yoga philosophy and practice sometime between the sixth century BC and first century AD), as it clearly states that the objective of yoga is to still and clear the mind of its’ many fluctuations that are the causes of suffering (Gard, Noggle, Park, Vago, & Wilson, 2014).

**Yoga: the shared and the unique.** Traditionally, yoga is practiced within the context of a lineage, and a wide-array of variations exist from teacher to student, which has resulted in the development of numerous styles of yoga. Each style may have a slightly different emphasis on the limbs of yoga, and depending on the specific style of yoga, as well as the nature of the practice (e.g.,
the length in which poses are held, how much “flow” there is from one pose to another, what breathing techniques are used), the intensity of the movements will also vary. Despite the heterogeneity of yoga practice, the yoga that is typically seen in the West focuses on the two branches of Hatha and Raja yoga, which together encompass the physical postures, breathing, and meditation techniques, which are key elements that are commonly observed throughout modern yoga practices. Together, Raja (classical) yoga refers to a system of meditation, whereas Hatha (post-classical; which came after Raja) yoga, focuses on postures and breathing techniques with the purpose of stilling the mind for meditation.

Notably, in *The Yoga Sutras of Patanjali*, only 3 of the 196 sutras (aphorisms) mention asana, the physical postures of yoga, with the remaining sutras discussing a wide array of techniques and teachings of yoga (e.g., conscious breathing, meditation, lifestyle and dietary changes) that are provided as a means to reduce suffering (Desikachar, 1999). Specifically, Patanjali outlines the eight limbs, or disciplines of yoga, which includes the yamas and niyamas (ethical principles), asana (physical postures), pranayama (breath control), pratyahara (sense withdrawal), dharana (concentration), dhyana (meditation), and samadhi (absorption or enlightenment), considered to be the key ingredients of yoga. While the eight limbs are thought to be a progression or series of steps or disciplines to purify the body and mind, which leads to enlightenment, it is often not thought to be a linear process, and that working on one limb will also influence the remaining limbs (Farhi, 2000). Despite the diversity that is encompassed across the eight limbs, Gard et al. (2014) categorized these eight limbs into four major limbs of yoga: (1) ethics, (2) physical postures, (3) breath regulation, and (4) meditation, based on what is taught in modern yoga classes as well as the aspects of practice that have been researched scientifically. Hence, despite the pluralism across yoga practices, commonality can be found in that every yoga practice will consist of these four major limbs, although the degree and extent to which each limb is emphasized will vary across different style of yoga. Below, the four major limbs are
outlined, including their theorized and evidenced connection to intra- and interpersonal health and wellbeing.

**Yamas and Niyamas (Ethics of Yoga).** The first two limbs of yoga can be regarded as the ethics of yoga, which is comprised of ten moral precepts that act as guidelines for the practitioner to be at peace with oneself, one’s family, and one’s community (Garfinkel & Schumacher, 2000). In the historical context, the *yamas* and *niyamas* were considered to be at the foundations of yoga practice, meant to facilitate the other limbs. The *yamas* refer to the moral precepts of relating to the outside world, and facilitates one’s relationship to others (interpersonal) in the social context. The five *yamas* comprise non-violence (*ahimsa*), commitment to truth (*satya*), not stealing (*asteya*), moderation of senses (*brahmacharya*), and greedlessness (*aparigraha*). The *niyamas* on the other hand, are disciplines which serve to develop an individual’s intrapersonal attitudes, skills, and behaviors, facilitating one’s process of self-realization (Farhi, 2000). These include purity (*saucà*), contentment (*santosha*), burning enthusiasm (*tapai*), self-study (*svadaya*), and surrendering oneself to something greater than oneself (*isvara pranidhana*). Importantly, the *yamas* and *niyamas* act as guideposts (i.e., they are not a list of do’s and don’ts), framing yoga with an ethical foundation, which makes it a “wisdom-based” contemplative practice (Cope, 2006; Gard et al., 2014).

While it is rare for these ethical precepts to be taught formally in modern yoga classes, the *yamas* and *niyamas* are often conveyed implicitly, even though they may not be the central focus of a practice (Gard et al., 2014). For instance, in many yoga practices, emphasis is often placed on being kind to oneself (e.g., through cues such as “Listen to your body”, “Accept where your body is right now, today”), and using props or making modifications when necessary, perhaps, reflecting the attitude of self-compassion. The approach taken in yoga classes may also create an environment of acceptance and kindness, which adds potential to the practitioner but may also permeate into one’s interpersonal relationships. Importantly, however, Shapiro and colleagues (2012) have also argued
that even without the explicit teachings of these ethical principles or exposure to the philosophy and history of these contemplative practices in general, it is possible for these practices to influence one’s ethical behavior and morality, as has been evidenced two months following participation in an MBSR program (Shapiro et al., 2012).

Asana (Postures). The third limb of Patanjali’s Yoga sutras is asana, which represents the physical postures, the most familiar and commonly utilized limb of yoga in the West. Historically, asana was characterized to be a comfortable and steady posture (Cope, 2006) with the physical postures serving as a vehicle to prepare the mind for sitting meditation (Feuerstein, 2002). Although the majority of yoga practitioners may initiate yoga for exercise-related purposes, many yoga classes will touch on the mind-body-spirit connection (Iyengar, 1982). Indeed, when yoga asanas are practiced with awareness (i.e., not simply as physical activity, but as a contemplative, meditative movement practice), practitioners are able to experience this sense of “yoking” between one’s emotional, physical, and even spiritual states through the utilization of postures and breath.

In particular, the interoceptive, proprioceptive, kinesthetic, and spatial cues that are brought to awareness in yoga practice (which is a distinct element of meditative movement modalities) may offer tools for embodiment (Impett, Daubenmier, & Hirschman, 2006; Laura Schmalzl, Crane-Godreau, & Payne, 2014). In fact, it is even proposed yoga can challenge beliefs about the limits of one’s own physical body (especially for those with chronic illness, or with trauma and psychopathology patients; Rhodes, 2015; van der Kolk et al., 2014). As practitioners develop greater awareness of the sensations in one’s body (at a more fine-grained level), they may be able to relate to their bodies and themselves in a refreshed way, such that they are able to accept the limitations for some parts of their body, but at the same time, recognize other parts of their body are still healthy and functional (Hamilton, Kitzman, & Guyotte, 2006). Additionally, when considering the context of modern yoga classes which often occurs in a group setting, the act of moving through the same
postures together may cultivate feelings of connectedness through shared experience, or a sense of belonging to a community (Mehta, Keshavan, & Gangadhar, 2016).

**Pranayama (Breath Regulation).** Another key limb of yoga, which comes after attaining posture or control of body through *asana* is *pranayama*, or breath regulation exercises, which act as the bridge between the body and mind. In yoga, “*prana*” is the life sustaining force; what is referred to as “*chi*” or “*qi*” in tai chi and qi gong (Brown & Gerbarg, 2009). *Pranayama* is therefore depicted as a tool used to control the breath in order to facilitate flow of both the breath and life force. Although different techniques may be linked to distinct psychophysiological changes (e.g., slow exhales have been demonstrated to influence the parasympathetic system which leads to stress reduction; Sovik, 1999; and more forceful breathing practices such as the *kapalabhati* (fire) breath may result in an invigorating effect; Beauchaine, 2001; Brown & Gerbarg, 2005), the key traditional objectives of *pranayama* are to down-regulate arousal, and to increase awareness of the mind-body connection (Sovik, 1999). Despite the multitude and complexity of breathing techniques that are available however, the majority of contemporary yoga classes utilize the breath through simplified practices. For instance, instructors may select to cultivate rhythmic breathing, focus on belly breaths, whereas some may specifically instruct inhalation during expansive, chest-opening movements and exhalation during contractile, rounding the back movements.

Although breathing techniques may be simplified in a typical modern yoga class, the breath is a powerful tool and a key element of meditative movement which impacts both physical and psychological wellbeing (Telles, Singh, & Balkrishna, 2014). Not only does the breath bring the mind back to the present moment, it also serves to attain the relaxation response (Benson & Hartz, 2000) facilitating calm emotional states, which has been shown to strengthen cardiac vagal (parasympathetic) tone. Enhanced vagal tone has been associated with emotion regulation and emphatic response, and also to the recruitment of neural circuits that support social engagement.
This is suggestive of a physiological pathway in which breath regulation may help to strengthen interpersonal pathways. Further, there is some research specifically linking breath regulation to structures of the brain (e.g., hippocampus, amygdala, hypothalamus), which has potential to facilitate emotional processing and form social bonding through improving autonomic functioning (Brown & Gerbarg, 2005; Jerath, Edry, Barnes, & Jerath, 2006), again, signifying a way in which breathing work can contribute to one’s relational health and wellbeing.

**Pratyahara, Dharana, Dhyana, Samadhi (Meditation).** Finally, the last four limbs of yoga place emphasis on meditative forms as the overarching aim of yoga is primarily cognitive; one which seeks to still the fluctuations and ruminations of the mind (Desikachar, 1999; Farhi, 2000); an objective which aligns well with that of sitting meditation and mindfulness. The components of *asana* and *pranayama* are therefore purported to help and foster these meditation practices (*pratyahara, dharana, dhyana, samadhi*; sensory withdrawal, concentration, meditation, enlightenment, subsequently). The last limb, “*samadhi*”, the ultimate goal of meditation, and one that is characterized as a transcendent state of consciousness, may be a distant objective even to highly experienced meditators.

Although these meditation techniques are often described in phases (with the ultimate objective of reaching enlightenment), in modern yoga classes, components of meditation are often combined with the other major limbs, rather than taught separately, that is, as a meditation class. Each of these meditative limbs facilitate the ability for one to see clearly without bias (considered to be a powerful self-regulation tool; Cope., 2006), by helping the practitioner to observe and witness one’s inner experience, without judgement; hence, mapping onto the state of mindfulness. In particular, the meditative component of yoga has potential to strengthen qualities of mindfulness such as meta-awareness (an individual’s explicit awareness of one’s contents of thought; Schooler et al., 2011), equanimity (the ability to rapidly recover from emotional stability; Desbordes et al., 2015),
and positive reappraisal (with reappraisal resources presented, for example, through concepts such as compassion and non-judgment in a yoga class; Gard et al., 2012; Garland, Gaylord, & Fredrickson, 2011). These skills can enhance the way in which an individual relates to oneself, but more importantly, they also hold promise to positively spillover to one’s interpersonal domains.

The Positive Effects of Yoga on Health and Wellbeing

What we know and do not know. First, considering yoga is a form of physical activity, and practitioners initiate yoga mainly for exercise-related purposes, fundamentally, yoga promotes physical health and musculoskeletal strength (Raub, 2002). Specifically, yoga improves balance and flexibility in both children (Berger & Stein, 2009) and older adults (Oken et al., 2006), and has been shown to decrease the risk of falls and injury in the elderly (Balk & Bernardo, 2011). A wide range of the physiological effects of yoga have also been explored, with yoga improving cardiovascular health (for a review, see Jayasinghe, 2004) through its positive effects on key biomarkers such as heart rate, heart rate variability, and blood pressure (Hagins, States, Selfe, & Innes, 2013; Sarang & Telles, 2006). Additionally, as aided by the breathing techniques that are an integral part of yoga practice, yoga enhances respiratory functioning by improving characteristics of the respiratory system such as increased oxygen consumption and vital capacity (Birkel & Edgren, 2000; Telles, Reddy, & Nagendra, 2000). With respect to yoga’s effects on health conditions, reviews have demonstrated yoga’s promise in improving conditions such as arthritis (Haaz & Bartlett, 2011), asthma (Cramer, Posadzki, Dobos, & Langhorst, 2014; Posadzki & Ernst, 2011) metabolic syndrome (Innes & Vincent, 2007), and pain (Büssing, Ostermann, Lüdtke, & Michalsen, 2012).

There is also evidence for the efficacy of yoga to enhance psychological health and wellbeing. In particular, yoga has been shown to ameliorate anxiety (Kirkwood et al., 2005), depression (Pilkington, Kirkwood, Rampes, & Richardson, 2005; Uebelacker et al., 2010), stress (Chong, Tsunaka, Tsang, Chan, & Cheung, 2011), cognitive functioning (Gothe & McAuley, 2015),
and improve wellbeing and quality of life (Lin, Hu, Chang, Lin, & Tsauo, 2011; Woodyard, 2011) across different population groups and ages.

Despite the growing body of evidence demonstrating both the preventive and therapeutic effects of yoga, the literature has been heavily focused on a narrow scope of health and wellbeing outcomes. In a study examining yoga-related titles from the year 1950 – 2012, mental health outcomes of stress, anxiety, pain, and depression had the most number of articles (each exceeding 200 articles), followed by physical health conditions such as cardiovascular disease, hypertension, cancer, and diabetes (McCall, 2014). While a more scrutinized look spanning the latter years (i.e., 2008 – 2012) reported cancer related outcomes in yoga research to be an emerging area of interest, the prevalent mental and physical health outcomes that have been studied in yoga research have remained relatively stable. Moreover, the most recent meta-analyses and reviews have focused on similar outcomes such as cardiovascular disease and metabolic syndrome (Chu, Gotink, Yeh, Goldie, & Hunink, 2014; Cramer, Langhorst, Dobos, & Lauche, 2016), pain and fatigue (Morgan & Morgan, 2017; Cramer et al., 2017), and positive mental health outcomes (Hendriks, de Jong, & Cramer, 2017), reflecting the available empirical support that can be drawn upon in the existing literature. Yet, considering the entirety of yoga practice (i.e., the eight limbs of yoga), it should be recognized that yoga’s salutary effects hold potential to be much more expansive and comprehensive.

One clear gap in the yoga literature is the scarcity of studies that have examined the potential social benefits from yoga practice. Previous research has demonstrated the robust association of social relationships to health and wellbeing (Cohen, 2004; House et al., 1988; Umberson & Montez, 2010). Moreover, when considering the eight limbs, and especially the ethics of yoga, the way in which yoga may impact how one relates to oneself and to others is an invaluable aspect, engrained in the roots of yoga practice that deserves further attention. The importance of yoga’s role in positively impacting the social dimensions of one’s life has been depicted from participant beliefs in regards to
their yoga practice. In a National survey of 4,307 randomly selected yoga practitioners examining both the mental and physical health benefits associated with yoga, participants agreed yoga enhanced happiness (86.5%) and energy (84.5%), with 67% also indicating yoga to enhance interpersonal relationships (Ross et al., 2013). Further, a review investigating the perceived benefits of meditative movements in older adults found the majority of practitioners initiated meditative movement as a means to exercise in a social context. Importantly, it was found this social aspect was linked to reasons for continuing one’s practice (Rogers, Keller, & Larkey, 2010). Although the social benefits of yoga and meditative movement have been reported as important for practitioners’ well-being and sustainment of these practices, these dimensions represent a realm of research that has largely been neglected, warranting further systematic investigation.

How does it work? In addition to the scarcity of research examining the potential relational influences of yoga, there is still little understanding of the mechanisms in which yoga works. While researchers have begun to put forth potential scientific frameworks to facilitate understanding the pathways in which yoga works to enhances health and wellbeing outcomes (e.g., Gard, Noggle, Park, Vago, & Wilson, 2014; Riley & Park, 2015; Schmalzl, Powers, & Henje Blom, 2015), the multi-component and holistic nature of yoga adds to the complexity of this process, and a clear insufficiency exists in the empirical testing of these pathways. Moreover, despite the plethora of mechanisms that have been suggested, they originate from diverse fields and literatures, making it difficult to synthesize the information in the near absence of empirical testing of the proposed hypothesis. Some of the key theorized mechanisms are reviewed below.

Riley & Park (2015) conducted a review examining the mechanisms in which yoga reduces stress, indicating yoga increased psychosocial resources, including self-awareness, changed attitudes towards stress, strengthened coping skills, calmness (as a result from breath work), enhanced mindfulness, self-compassion, and spiritual wellbeing. When empirically studied pathways were
identified however, the mediators that had been studied were limited to positive affect (Kiecolt-Glaser et al., 2010; West et al., 2004), mindfulness, and self-compassion (Gard et al., 2012). Positive affect mediated the yoga and stress relation in West et al. (2004)’s study examining the effects of yoga in college students across one session of yoga. Conversely, in a study by Kiecolt-Glaser (2012), although positive affect increased from pre to post yoga (again, in the context of one acute session of yoga), mediation was not substantiated as there were no changes observed in cortisol, their objective marker of stress. In a yoga intervention conducted by Gard et al. (2012), it was found self-compassion mediated the yoga and stress pathway. Yet, no effects were observed for mindfulness as a mediator, although significant positive associations between yoga and mindfulness, and a negative correlation between mindfulness and perceived stress were found.

In another review of yoga’s potential correlates and mechanisms, Menezes et al., (2015) proposed three integral pathways in which yoga enhances psychological wellbeing through the cultivation of different emotion regulation skills. For instance, one suggested hypothesis is that yoga fosters both attention allocation (Ochsner & Gross, 2005) and acceptance, which are both conceptualized to be key elements of mindfulness (Bishop et al., 2004). The authors propose the cultivation of these specific emotion regulation skills allow yoga practitioners to enhance one’s reappraisal skills (i.e., be less reactive to negative emotional stimuli; Froeliger, Garland, Modlin, & McClernon, 2012; Gootjes, Franken, & van Strien, 2011). Due to the numerous studies that have demonstrated the effects of yoga to reduce anxiety (Innes & Vincent, 2007) and its’ impact on the sympathetic system (Harinath et al., 2004) another theorized route involved yoga’s influence on autonomic activity, thereby leading to reductions in anxiety. Finally, the last proposed pathway by Menezes and colleagues (2015) was based on a biological mechanism, with the idea that autonomic, endocrine, and inflammatory responses are linked to emotional contexts, which influence the impact of stress on the individual.
Collectively, it can be seen that a wide array of potential pathways have been proposed across diverse sets of literatures but only few have been subjected to empirical testing. While the aforementioned mechanisms were primarily psychological, additional pathways (e.g., biological) have also been suggested, depending on the specific health and wellbeing outcome under investigation. Perhaps, the most comprehensive model has been put forth by Gard et al. (2014), proposing a self-regulation model of yoga involving both top-down and bottom-up operating pathways. Although the authors made an effort to create an overarching framework (including cognitive, emotional, behavioral, and automatic domains) to better understand how yoga works, systematic testing of this framework is still warranted. Accordingly, given the breadth of possible outcomes and the fact that most pathways to date remain theoretical, the support for these mechanisms is yet to be obtained. Furthermore, as also recognized by Gard et al. (2014), the relational dimensions of yoga practice have been studied minimally in spite of their relevance for health and wellbeing. While inherent challenges exist in making sense of a diverse literature and theoretical propositions, based on what has been established and known to date in the existing literature, a strong case can be made for the following factors to play a role in facilitating the relational benefits of yoga and their influence on health and wellbeing.

**Cultivating Mindfulness**

Mindfulness has been suggested as a key ingredient of meditative movement modalities in general (Larkey, Jahnke, Etnier, & Gonzalez, 2009; Payne & Crane-Godreau, 2013), and has been identified to be a potent mediator of the benefits of these practices (Gard et al., 2012; Salmon, Lush, Jablonski, & Sephton, 2009; Wayne & Kaptchuk, 2008). With its’ roots in Buddhism, mindfulness is considered to be a universal human capacity proposed to foster clarity in one’s thinking and an open-heartedness (Kabat-Zinn, 1993) and in this way, is considered to be a trait that is deep-seated within each individual. Notably, the literature has placed emphasis on the multi-dimensionality and
complexity of mindfulness. While there are several well-validated, self-report assessments of mindfulness (with the most commonly used being the FFMQ; Baer, 2006 and MAAS; Brown & Ryan, 2009), it could be stated they all capture the key dimensions of mindfulness which consist of observing, awareness/attention, non-judgment/acceptance, non-reactivity, and describing.

**Mindfulness as a trait and state.** The term “mindfulness” has been used to capture a broad array of phenomena, ranging from mindfulness as a state, trait, practice, or as an independent variable manipulated in experimental settings (Davidson, 2010). When conceptualized as a trait, it is understood that each individual has a certain predisposition to be mindful in one’s everyday life. Hence, without intervention, an individual’s trait mindfulness is hypothesized to remain relatively stable over time (Brown & Ryan, 2004). On the other hand, when conceptualized as a state, mindfulness is practiced and cultivated in mind-body practices including yoga (e.g., Lau et al., 2006). The state of mindfulness has famously been captured and defined by Kabat-Zinn as, “paying attention in a particular way, on purpose, in the present moment, and non-judgmentally” (2009, pg.4). Thus, a lack of state mindfulness would indicate not being aware and attentive to the underlying processes in one’s consciousness in the moment; perhaps, well captured by the term automaticity (e.g., an individual performing a complex, well-learned task on auto-pilot; Anderson, 1992).

**Mindfulness as a practice.** In comparison to Mindfulness-Based Stress Reduction (MBSR) programs (Kabat-Zinn, 1990) where mindfulness is a skill that is cultivated with intention, the term “mindfulness” may not explicitly be mentioned or defined in a yoga class. Nonetheless, yoga is an integral component of the MBSR program, and meditation and yoga have commonalities in that these contemplative practices reduce autonomic nervous system reactivity (i.e., stress) through the cultivation of mindfulness (Kabat-Zinn, 2003). To illustrate, in yoga, students are often led into a series of instructions where they hold different postural configurations (attention to body), breath in
the posture, and then are guided to witness one’s internal experiences such as one’s thoughts, emotions, and experiences (Gard et al., 2014; Payne & Crane-Godreau, 2013). Consequently, an awareness is cultivated through practice, and this skill of observing one’s state of being without judgment or reactivity (Cope, 2006) is congruent to state mindfulness. Theory posits that mindfulness-based practices cultivate state mindfulness, and that through repeated practice and over time, it can lead to enhancements in one’s propensity towards mindfulness, or trait mindfulness (Davidson, 2010; Vago & Silbersweig, 2012), with emerging evidence to support this claim (Kiken, Garland, Bluth, Palsson, & Gaylord, 2015). In this way, it could be speculated one could derive the same benefits through continuous yoga practice. Although studies have yet to examine both state and trait mindfulness in relation to yoga, there are a handful of studies that have linked yoga practice with enhanced trait mindfulness (Conboy, Wilson, & Braun, 2010; Gard et al., 2012; Shelov, Suchday, & Friedberg, 2009).

**Mindfulness and relational outcomes.** Just as in resistance exercise in which a muscle becomes strengthened with repetition, through yoga practice, practitioners also learn to strengthen their mindfulness muscle. It could therefore be speculated one acute session of yoga may restore one’s resources (e.g., cognitive, emotional, psychological) for being more aware and mindful, leading to increased state mindfulness. With repeated practice, there is potential for mindfulness to translate “off of the mat” into practitioner’s daily lives. Individuals may first learn to become more self-aware of their own thoughts and feelings by learning to decenter oneself. Hence, “on the mat”, it could be stated a practitioner may specifically be cultivating one’s relationship to oneself (mindfulness serving to facilitate the intrapersonal), although practice often occurs in a group setting, and mindfulness may also impact the interpersonal domain. Similarly, “off the mat”, mindfulness may further extend to one’s interpersonal domains as practitioners start to notice their own “presence” (i.e., being in the
moment) in interactions with family and friends, or their own reactivity to certain people or situations.

Simultaneously, the openness and nonjudgmental attitude that is part of mindfulness and cultivated in the yoga context may facilitate social interactions and connections with practitioners in the class, or even outside the studio space. Accordingly, with repeated on and off the mat practice and application of mindful states, it could be conjectured practitioners’ trait mindfulness may change over time, with impact on both intra- and interpersonal domains. At the same time, an interplay may exist between an individual’s trait mindfulness (predisposition) and how one may benefit from yoga practice with respect to relational outcomes. For instance, it could be speculated individuals with higher overall levels of trait mindfulness may observe benefits in intra- or interpersonal domains to a greater extent, or faster, as a result of yoga practice, compared to those with overall lower levels of trait mindfulness (who may need more practice to achieve the same benefits). In fact, individuals low in dispositional mindfulness (at the start of yoga practice) may even encounter challenges during the initiation of yoga practice due to associations that have previously indicated low trait individuals to lack emotion and attention regulation skills (Creswell, Way, Eisenberger, & Lieberman, 2007; Schmertz, Anderson, & Robins, 2009). The specific role trait mindfulness plays as it pertains to relational outcomes remain to be scientifically tested in the context of yoga-based research.

**Cultivating Relationship to Oneself: Self-compassion.**

Yoga also holds promise to cultivate self-compassion, a valued intrapersonal quality that has been linked to numerous salutary effects, with one of the most consistent findings being its’ association with reduced anxiety and depression (Neff et al., 2007; Werner et al., 2012). The writings of numerous Buddhist teachers have indicated self-compassion to be a quality of showing kindness to oneself in the face of hardship or inadequacy (Salzberg, 2004; Kornfield, 2008). More recently, Neff (2003) has conceptualized self-compassion to be comprised of three interacting and
overlapping components: self-kindness, common humanity, and mindfulness. First, as the terms represent, self-kindness refers to an attitude of being kind, supportive, and caring towards oneself. Instead of embracing self-judgment and criticism that is typically observed in Western cultures (especially as it relates to one’s own shortcomings and inadequacies), with self-kindness, one has the ability to soothe and nurture oneself. Common humanity is the recognition that one is not alone in one’s experiences. Hence, there is a sense of being connected to others (e.g., the struggles and imperfections are all part of the human experience) rather than feeling a sense of isolation and alone in one’s experiences (e.g., it’s only me who is suffering). While mindfulness is a core element of self-compassion, the mindfulness aspect of self-compassion is specific in that it is the awareness of one’s negative thoughts and feelings without over identifying with them.

Only a handful of studies have assessed whether yoga practice can generate self-compassion. For instance, in an observational study of experienced yoga practitioners going through a four-week teacher training program, Conboy et al. (2010), utilizing Neff’s three component Self-compassion scale (SCS), found significant changes only in the mindfulness subscale of the SCS. Conversely, a four-month residential yoga intervention conducted by Gard et al. (2012) demonstrated a total increase in self-compassion with improvements in self-compassion on all subscales of the SCS, except common humanity. Another qualitative study (Crews, Stolz-Newton, & Grant, 2016) in survivors of sexual violence also found women who participated in the trauma-sensitive yoga program reported enhancements in self-compassion (as indicated by qualitative reports of Neff’s conceptualization of self-compassion). Of note, both the Conboy et al. (2010) and Gard et al. (2012)’s studies focused on the specific style of Kripalu yoga, which places compassion at the foundation of its’ practice (i.e., the Sanskrit word kripalu, literally translates to “being compassionate”; Faulds, 2005). Similarly, the trauma-sensitive yoga (Crews et al., 2016) was also taught in such a way that encouraged participants to modify poses when necessary, and to make
active choices that were appropriate for one’s own body and practice. Hence, Kripalu’s style and the specific instructions of the trauma-sensitive yoga practice (e.g., gentleness, respecting one’s own boundaries) may have contributed to the enhancements observed in self-compassion, warranting further research into whether similar benefits would be observed across a diversity of yoga styles. Clearly, the literature examining the effects of yoga to enhance self-compassion is still nascent. Previous research has identified self-compassion to be a pivotal mediator in mindfulness-based interventions (Birnie, Speca, & Carlson, 2010; Kuyken et al., 2010; Shapiro, Carlson, Astin, & Freedman, 2006), and research has also demonstrated the ability for self-compassion to mediate the link between mindfulness and wellbeing (Hollis-Walker & Colosimo, 2011). Owing to the interrelatedness of mindfulness and self-compassion (e.g., previous research has indicated high correlations of $r = 0.69$; Hollis-Walker et al., 2011; which may be the artifact of assessment), teasing their distinct effects may pose inherent challenges. Still, better understanding of how, and whether yoga influences mindfulness and self-compassion, as well as the relation between these variables specific to the context of yoga practice will help to delineate potential mechanisms of action.

**Cultivating Relationship to Others: Compassion and Social-connectedness**

Congruent to many mind-body practices, yoga is often depicted as an individual practice with a focus on intrapersonal processes (e.g., reaching a clear state of mind, cultivating mindfulness and self-compassion), which leads to enhancements in an individual’s sense of self. Yet, the introspective awareness of one’s body, breath, and emotions which develops through practice, both acutely and in the long-term, may also serve to enhance interpersonal outcomes and for relating to one’s outer world (Damasio, 2010; Germer et al., 2013). Indeed, despite the scarcity of research examining the potential relational outcomes that may be derived from contemplative practices in general, yoga has been linked to interpersonal outcomes such as compassion and connectedness (Ivtzan & Papantoniou, 2014; Kinser, Bourguignon, Taylor, & Steeves, 2013; Ross, Bevans,
Friedmann, Williams, & Thomas, 2014), which are both essential predictors of health and wellbeing (Seppala, Rossomando, & Doty, 2016). For instance, in a qualitative study with depressed women, it was found yoga served both as a self-care (intrapersonal) and relational (interpersonal) technique (Kinser et al., 2013). An intriguing line of inquiry therefore concerns whether yoga not only impacts intrapersonal outcomes (mindfulness and self-compassion), but could also extend its’ impact in enhancing interpersonal outcomes (compassion and social connectedness).

**Compassion.** Compassion can be defined as an affective state with the primary function to understand the suffering of others and to act upon ameliorating this suffering (Goetz, Keltner, & Simon-Thomas, 2010). Practicing concern for others (i.e., through acts of altruism, volunteering, and maintaining a communal role) has been linked to physical and psychological health benefits (Piliavin & Siegl, 2007; Sheldon & Cooper, 2008; Weinstein & Ryan, 2010), and individuals taught to develop compassion for others acutely in a lab-based setting have also felt a greater sense of connectedness and enhanced mood in comparison to controls (Hutcherson, Seppala, & Gross, 2008). In Buddhist psychology, it is thought that one who has compassionate awareness can extend their compassion, not just to the self, but to others, as well as to all sentient beings, as is cultivated specifically in practices such as the Loving-Kindness meditation (Hofmann, Grossman, & Hinton, 2011; Salzberg, 2004). Moreover, a dichotomy between compassion for others and for oneself represents a false separation between self and others, according to contemplative traditions.

The literature examining yoga and its’ potential to enhance compassion is limited; however, traces from qualitative research suggest yoga may indirectly cultivate compassion. In a qualitative research study investigating how yoga influences interpersonal relationships, one of the emerging themes that was identified was that yoga leads to personal transformation, with participants reporting enhanced positive intrapersonal traits (e.g., insight, happiness, mindfulness, peacefulness) as a result of one’s practice (Ross et al., 2014). While a wide-array of positive characteristics were
reported, participants reported being more compassionate and generous to others as a consequence of these intrapersonal changes, including increased self-awareness and less reactivity. Similarly, although not specific to yoga practice, a qualitative study examining the influences of qigong practice for 15 weeks also observed similar changes (i.e., intra- to interpersonal) such that at the start of the program, participants reported increased awareness of their sensations in their body and emotional states. Once they were familiar with the movements of qigong however, participants talked about shared experience within a group context, and a sense of connectedness to both themselves and to group members (Christopher, 2006).

Although this is a suggested pathway based on qualitative studies in meditative movement modalities, the way in which yoga influences compassion may occur through an indirect pathway, as a result of the positive intrapersonal changes that take place. Since self-compassion and compassion are theorized and evidenced (Neff & Pommier, 2013) to go hand-in-hand, it is possible that in the context of yoga practice, one first learns to become self-compassionate, which then, facilitates the extension of compassion towards others. Thoughtfully designed observational and/or experimental studies are needed to help tease out the nature and timing of the self-compassion and compassion association.

**Social connectedness.** Another interpersonal outcome that may be essential to the relational pathways in which yoga works is social connectedness. While there are many indicators (e.g., perceived social support, quantity and types of social network) which capture one’s relational health and wellbeing, social connectedness is specific to an internal sense of belonging, defined as a subjective recognition of being in close relationship with others in the social world (Lee & Robbins, 1995, 1998). The health risks for feeling socially isolated have been compared in magnitude to risks of smoking and obesity (Holt-Lunstad et al., 2010; House et al., 1988). Indeed, individuals who are more socially connected are resourceful in that they are protected from negative consequences of
loneliness such as low self-esteem, anxiety, depression (Cruwys et al., 2013) cognitive decline (Haslam, Cruwys, & Haslam, 2014; Ertel, Glymour, & Berkman, 2008), and even from the detrimental physiological effects that get “under the skin” (Cacioppo et al., 2003).

Only a few studies have alluded to the potential for yoga to positively influence social connectedness (Kinser et al., 2013; Ross et al., 2014). Through qualitative data, Ross et al. (2014) found that feelings of connectedness were experienced both on a practical (i.e., meeting new friends) and spiritual (i.e., sense of belonging) level, with practitioners’ beliefs outlining their enhanced interpersonal relationships due to changes in their intrapersonal processes (e.g., being less reactive, more mindful, and self-aware). Increases in social connectedness were also captured in a randomized control trial (RCT) conducted by Kinser et al. (2013) investigating the effects of yoga on women with depression. In this study, although women in the attention control group (i.e., receiving lecture/video-based health education of equivalent frequency and duration in a group context) reported gains from simply talking and hearing about others’ similar experiences, participants in the yoga group uniquely benefited by gaining a sense of connectedness which “transcended dialogue” (Kinser et al., 2013). The authors therefore attributed this “added value” from the yoga group to the shared experience and pro-social context of the yoga practice. Although not specific to yoga, participants taking part in tai chi and qi gong interventions have also reported a sense of connection fostered by the context of meditative movement, often, along with a unique, shared, transformative experience (Christopher, 2006; Fischer, Fugate-Woods, & Wayne, 2014; Yang et al., 2011; Yeh, Chan, Wayne, & Conboy, 2016). This highlights the importance of acknowledging the unique social context of group-based yoga, and meditative movement modalities in general. Whereas many group physical activity contexts are likely to promote social connections, yoga’s unique focus on the intrapersonal and the internalized experience of movement within a group context may lead to
distinct experiences for practitioners. The underlying mechanisms of such (potentially context-specific) actions should be investigated further in future research.

**Strengthening the Quality of Yoga Research on Intra- and Interpersonal Outcomes.**

Despite the enthusiasm in advancing the literature as well as the wide-array of salutary benefits that have been associated with yoga, it is important to recognize the aforementioned mediators and proposed mechanisms are not a result of systematic and long-term efforts; rather, they have been piecemealed from different studies, including anecdotal or case study reports. It must also be acknowledged that the yoga literature more generally is replete with contradictory findings (Innes & Vincent, 2007; Posadzki & Ernst, 2011), due to the nascence of yoga research, and the lack of consistency in its’ operational definition and assessment (Li & Goldsmith, 2012). Accordingly, the majority of reviews have come to the conclusion that the overall evidence for yoga as an effective intervention is rather weak, owing to methodological shortcomings such as small sample size, inadequate description of procedures, and lack of quality RCTs, reflecting the current state of mind-body research in general (Payne & Crane-Godreau, 2013).

While it is clear additional experimental studies are warranted to advance the current state of yoga research, one way to strengthen the quality of yoga research (which is a necessity in leading up to future high quality RCTs) is to conduct additional hypothesis-generating pre-experimental research (i.e., the initial stage of NCCIH’s conceptual framework (2017) for developing and testing mind-body interventions) to theorize, and provide preliminary support for potential pathways that could be further tested and manipulated in future research. Indeed, fortifying this initial evidence will be imperative when it comes to studying the understudied intra- and interpersonal effects of yoga. Importantly, one means to provide richness to the quality of these pre-experimental studies will be to employ a diverse array of methodological approaches. First, more qualitative data are needed to capture the experiences of yoga practitioners in terms of relational outcomes which are
poorly defined. Second, understanding how relational outcomes may vary over time (both at the within and between-person level) and as a result of yoga practice must be established to more clearly delineate the natural variability and estimate the size of the effects in relational outcomes as a function of initiated yoga practice in novice and experienced practitioners. This information is essential for designing sufficiently powered RCTs as well as selection of appropriate tools for assessment of relational outcomes. Third, preliminary evidence must be established to help guide decisions relative to potential mediators or moderators of treatment effects, so as to better understand how and for whom yoga generates relational benefits. Such information may then be utilized to further refine and tailor interventions for maximum impact.

Understanding how yoga practitioners perceive experience and articulate social benefits on intra- and interpersonal outcomes: Need for qualitative inquiries. The use of qualitative data is often undervalued in the behavioral sciences and within the field of complementary and alternative medicine (Cochrane & Possamai-Inesedy, 2013). Yet, many studies have begun to incorporate mixed methods (i.e., a combination of quantitative and qualitative research methods), as they enhance the quality of study design in yoga-based and mind-body research, and qualitative methods provide another lens in which practitioners’ perceived experiences can be captured, with potential to facilitate the investigation of its’ effects and mechanisms. Qualitative data allow researchers to identify significant findings even amongst quantitatively non-significant findings (Cochrane & Possamai-Inesedy, 2013; Verhoef, Casebeer, & Hilsden, 2002). To illustrate the utility of qualitative methods in meditative movement, Witt et al., (2005) examined the effects of qigong in school children but found no effects when assessing improvement in quality of life (QOL) through quantitative assessments. However, through qualitative data, calming and relaxing influences were identified, domains not captured by the particular QOL instrument used in their study. Accordingly, through a case-oriented approach (rather than a variable-oriented
approach), qualitative assessments may provide valuable information when attempting to capture the so-far poorly defined relational outcomes of yoga.

Moreover, qualitative data may be specifically useful in supplementing quantitative data for contemplative practices such as yoga, considering the methodological and measurement conundrums that have been highlighted (Creswell & Clark, 2011). For instance, despite the prevalence of mindfulness-based research, researchers are still refining instruments to better capture the construct of mindfulness, and an ongoing debate exists whether a construct such as mindfulness with roots in Buddhism can be self-reported at all (Brown & Ryan, 2004; Brown, Ryan, Loverich, Biegel, & West, 2011; Grossman, 2011; Davidson, 2010). Indeed, a clear shortcoming of quantitative research in general is its’ reliance on preselected measures and scales. This may limit the potential scope of outcomes assessed in contemplative practices as participants may want to elaborate or freely express their own perceived experiences (e.g., subtle changes in body awareness, as well as psychosocial processes; Broom, 2005; Mehling et al., 2011) of these sophisticated practices. To illustrate, in a qualitative sub-study with heart failure participants undergoing a larger RCT on tai chi, relevant themes such as renewed social roles, awareness and mindfulness, as well as additional levels of empathy and compassion in the tai chi group relative to the education group emerged, which were not captured, or considered through quantitative results (Yeh et al., 2016).

Selecting methodologies that allow participants to elaborate on their own experiences, such as through qualitative inquiries, may also lead to discovering participants’ viewpoints with respect to the pathways and contexts in which change is occurring, enabling researchers to theorize unique mechanisms at play. For example, in Ross et al. (2013)’s qualitative study, evidence was found demonstrating the potential for yoga to enhance compassion indirectly, as participants mentioned intrapersonal changes leading to enhanced interpersonal relationships, a pathway previously not considered by the researchers. Clearly, the nascence of research examining the relational outcomes
of yoga could be enriched by additional studies providing qualitative data on participants’ experiences and self-defined schemata with respect to these understudied outcomes.

**Understanding how relational outcomes manifest “in vivo” in yoga practitioners with diverse experiences: Utilizing intensive longitudinal methods.** Additional information so far missing from the literature is understanding the natural variability in relational outcomes of daily yoga practice. This information holds value to guide selection of best study designs and outcome assessment schemes to capture changes in relational outcomes as a result of yoga practice, or in the context of a yoga intervention. One form of pre-experimental evidence can be generated through the application of intensive longitudinal designs, which provide multivariate, multi-subject data with multiple time points than are typically found in the behavioral sciences (Bolger & Laurenceau, 2013; Walls & Schafer, 2012). In comparison to a classical longitudinal study in which participants are followed-up over time (across months or years), intensive longitudinal designs can be advantageous in that these take less time to complete, with some increase in participant burden through repeated assessments (Shiffman, Stone, & Hufford, 2008). Some of the key advantages of these approaches are nonetheless, that they provide ecological validity as data collection takes place in a natural setting (Bolger et al., 2003), and through more frequent assessments, thus also minimizing the recall and cognitive bias that is often associated with overall self-report assessments. An added benefit of these types of designs is their potential to help unveil day-to-day variability in outcomes of interest in practices that often occur at the daily level, such as daily yoga practice.

Despite the increase in the number of intensive longitudinal designs in physical activity research, to date, there are no studies that have tracked day-to-day fluctuations in relational outcomes as a function of daily yoga practice, which these methods allow for. With the application of these designs, the “dynamic” nature of intra- and interpersonal phenomena can be captured, for example, by contrasting yoga practice days and non-practice days, to facilitate better understanding
the impact of yoga in the natural context. Despite the fact intra- and interpersonal phenomena tend to be dynamic in nature, these specific relational outcomes (e.g., self-compassion, social connectedness) of interest have, to our knowledge, never been studied in the daily context as it pertains to yoga, and in the literature overall. Consequently, employing these methods can provide a “snapshot” of how and whether these intra- and interpersonal outcomes vary over time, specifically across days in relation to one’s yoga practice.

Intensive longitudinal data (ILD) are typically collected in the context of participants’ everyday lives. Hence, ILD enable researchers to determine the extent to which the effects of daily yoga practice can be transferrable, and detected in the natural context of participants’ day-to-day lives (Bolger & Laurenceau, 2013; Reis, 2012), which is compatible with the conventional philosophy of approaching yoga as a way of life. Considering the bulk of yoga research has been conducted in controlled experimental settings, taking this research out in the real world is indeed an innovative and necessary avenue of exploration. In addition to the value that can be provided through qualitative methods, observational studies also offer enhanced ecological reliability (Cochrane & Possamai-Inesedy, 2013). In particular, employing these methods in a real world setting amongst community-dwelling yoga practitioners with varying styles of practice will allow for the identification of the shared, style-invariant influences of yoga practice.

Importantly, intensive longitudinal methods can yield results as meaningful and comparable to RCTs (Benson & Hartz, 2000; Concato, Shah, & Horwitz, 2000), and may be particularly useful to examine yoga-based outcomes (e.g., mindfulness, self-compassion), due to the wide range of questions it allows researchers to address. For example, in a daily diary study that was conducted involving an 8-week loving-kindness program for chronic low back pain patients, it was found more loving-kindness practice on a given day was associated with lower pain on the same day, and lower anger the subsequent day (Carson, Carson, Gil, & Baucom, 2006). Similarly, in an intervention of
mindfulness-based relationship enhancement in which daily data were collected, it was found that greater mindfulness-based practice was associated with increased relationship happiness and decreased relationship stress (Barnes, Brown, Krusemark, Campbell, & Rogge, 2007). In terms of substantive questions regarding yoga practice and relational outcomes, one can specifically examine both the between- and within-person influences (e.g., Between: Do experienced practitioners tend to report higher overall mindfulness in comparison to novice practitioners; Within: On days when yoga is practiced, do individuals tend to report higher mindfulness than one’s usual level of mindfulness), as well as concurrent and lagged effects of yoga practice (e.g., differences between practice days and non-practice days in terms of mindfulness or relational outcomes). Moreover, despite their non-experimental nature, intensive longitudinal methods offer an alternative in exploring potential mediational pathways, in comparison to RCTs that are designed mainly to test the efficacy of treatment. Indeed, the clear imbalance that is present between proposed versus empirically tested mechanisms, warrants explorations utilizing ILDs to obtain insight into potential pathways of action, and for building evidence with respect to how yoga may work to enhance relational benefits.

Utilizing the person-specific approach to better understand for whom and when yoga works. Another promising approach that can add to diversifying methods to accumulate data on intra- and interpersonal outcomes of interest is the n-of-1 trial, or single case experimental designs (SCDs; Dallery & Raiff, 2014; Molenaar & Campbell, 2009), which takes a person-specific approach, where rather than one group being compared to another, participants themselves act as their own controls (within-person design vs. between person design). There is substantial heterogeneity and patient uniqueness in behavioral issues (e.g., in yoga, practitioners may have a preferred style or teacher of yoga), making the SCD approach appealing due to its’ treatment of individuals as the center of analyses. SCDs have been demonstrated to be a useful way to establish preliminary efficacy of health interventions as well as for the optimization of interventions (Dallery & Raiff, 2014).
Specifically, this approach can be advantageous over conventional research designs such as the RCT in cases when, rather than seeking to estimate an average effect of a treatment group, researchers are interested in meaningful information on individuals or a subgroup of individuals (i.e., although there have been misconceptions due to its’ name, single case does not mean “n of 1”; Aeschleman, 1991), such as the opportunity to identify and scrutinize differences between low- and high-responders. Notably, through these designs, one can obtain not only information on individual participants but also pool across subjects to unveil subgroups that share commonalities in their responses; hence, aiding to understand individual difference characteristics or moderators of treatment response.

To illustrate, researchers have been intrigued by psychological resiliency factors such as trait mindfulness, and how it acts as a protective factor in stressful situations (Barnes et al., 2007; Brown, Weinstein, & Creswell, 2012; Bullis, Boc, Asnaani, & Hofmann, 2014). Trait mindfulness could indeed be one individual difference factor that influences the way a subgroup of individuals (i.e., high mindfulness sub-group vs. low mindfulness sub-group) responds or benefits from a yoga intervention. Shapiro and colleagues (2011) in an effort to identify which subgroups of participants benefited most from an MBSR program found that individuals with higher levels of pre-treatment mindfulness demonstrated greater increases in well-being, empathy, and hope, and also experienced larger reductions in perceived stress one year after the intervention. Accordingly, by pooling across subjects through an SCD approach, the importance of taking into consideration the interaction between participant characteristics (trait mindfulness) and intervention (yoga practice) in the prediction of relational outcomes (e.g., (self)-compassion, social connectedness) can be investigated (Kazdin, 2007).

An additional advantage of the SCD is that the studied effects are not limited to examining interventions producing large, immediate changes in behavior, and can be used to detect small but meaningful change in behavior. For example, in novice or inexperienced practitioners of yoga, the
efficacy of yoga to influence one’s ability to relate to other people or garner the benefits of enhanced interpersonal outcomes may take time to develop. To adequately account for individual differences in conventional RCTs is challenging (especially when relevant individual difference characteristics are unknown or not planned for apriori) and generally requires large sample sizes. Applying SCDs enables identification of potential moderators of treatment responses that could be adequately powered for in designing RCTs. Additionally, the dynamic nature of these methods is powerful in that they have the ability to identify the timing of the effects (e.g., a specific time point in which enhancements in self-compassion are observed); hence, having the potential to identify opportune time windows for intervening, or for bolstering intervention effects. This dissertation represents the first attempt to apply alternative research designs (i.e., intensive longitudinal methods and person-specific approaches) to explore the effects of daily yoga practice on relational outcomes in day-to-day lives of practitioners with varying yoga experiences.
The Present Research

The overarching aim of this dissertation was to examine the effects of daily yoga practice on the largely understudied, intra- and interpersonal outcomes utilizing a mixed methods approach, bringing unique perspectives and helping build pre-experimental evidence for the relational benefits of yoga practice. Currently, there are numerous outstanding limitations in the yoga literature:

1) Lack of understanding the potential intra- and interpersonal effects of yoga practice, including how practitioners perceive and experience the relational benefits of yoga.

2) Lack of understanding how yoga practitioners in a community-based setting (i.e., across diverse approaches and styles of yoga) experience relational outcomes in the context of their day-to-day lives.

3) Lack of empirical testing of proposed theoretical pathways to shift from theorizing to building empirical evidence.

4) Lack of understanding individual difference variables that can help to explain the variability for whom and when yoga works, especially with respect to the relational outcomes.

This dissertation addresses these critical gaps in the literature through the following objectives. The first objective was to characterize, through qualitative data, whether and how yoga practitioners perceive intra- and interpersonal outcomes such as mindfulness, (self-)compassion, and social connectedness, in the context of one’s yoga practice. Given the nature of qualitative inquiries that allow for capturing a breadth of issues around practitioner’s perceptions and meaning of yoga practice, this research will provide unique insight and provide added value to better characterize the understudied relational constructs which are pertinent from the perspective of one’s health and wellbeing. A clear gap in the literature exists examining the intra- and interpersonal outcomes, and
such qualitative data will aid in hypothesis generation about potential mechanistic pathways, providing fruitful information for the development of future experimental research.

Secondly, through an observational study employing intensive longitudinal methods, another objective was to examine the potential relational influences of yoga practice as they unfold in the context of one’s daily life in the natural environment, off of the mat (Bolger, Davis, & Rafaeli, 2003; Bolger & Laurenceau, 2013). Drawing from community-based yoga practitioners with diverse yoga experiences will allow for the identification of the “shared” relational experiences in face of the heterogeneity that exists across yoga practices. Further, although ILD are becoming more prevalent in the behavioral sciences across diverse contexts and samples as a way to provide rich information about the dynamics of psychosocial processes, these approaches remain underutilized in yoga research. In particular, as part of this objective, we sought to capture the dynamic relations between mindfulness, (self-)compassion, and social connectedness (unveiling intra- and interindividual variability), and to understand potential pathways in which yoga may work to enhance these relational outcomes.

The final objective was to apply an exploratory approach, a single case design (a special case of intensive longitudinal methods), to identify whether an individual’s trait mindfulness may help to explain heterogeneity in the intra- and interpersonal outcomes of yoga in a context of a structured supervised yoga program targeting novice practitioners.

In its’ entirety, this dissertation is an effort to improve the quality of yoga research by addressing some of the critical gaps in the literature, specifically as it pertains to understanding the influences of yoga on relational outcomes. Through a mixed methods approach, this dissertation will contribute to better understanding of whether, how, when, and for whom, the intra- and interpersonal benefits of yoga may realize, and will provide valuable information for the
development of interventions to enhance and optimize both relational outcomes and subsequent health and wellbeing. To this end, data from three studies are presented:

**Study 1: Qualitative Study**

The initial study utilized qualitative methods (a combination of open-ended survey responses and in-depth interviews) to examine the perceived intra- and interpersonal benefits of yoga practice amongst community-dwelling practitioners with varying levels of yoga experience. In this initial study, a conceptual model of yoga’s effects on relational health and wellbeing was also developed, which included specific pathways that could be further tested, fine-tuned, and elaborated on by future research.

**Study 2: Daily Off the Mat (OM) Study**

The second research study was an observational 21-day diary study of community-dwelling yoga practitioners with varying levels of yoga experience. After the familiarization visit of obtaining participants’ baseline characteristics, participants started the daily assessment portion of the research to complete daily Internet surveys at the end of the day, which included self-report assessments with respect to their yoga practice, mindfulness, (self-)compassion, and social connectedness. The first aim focused on understanding the daily effects of yoga practice on mindfulness, (self-)compassion, and social connectedness, and to evaluate the intra- and interpersonal variability in these relational constructs. A second aim was to test mediational pathways proposed in the conceptual model from the qualitative study (study 1) in a daily context, with a focus on examining mindfulness as an integral mediator of yoga practice.

**Study 3: Kinesiology Physical Activity Program (KPAP) Yoga Study**

The final study involved undergraduate students who were enrolled in Yoga I, an introductory yoga course that is offered as part of the KPAP courses at the Pennsylvania State University during the Spring 2016 semester. A measurement burst design (Sliwinski, 2008) was
utilized such that participants went through six bursts (i.e., intensive data collection periods with seven days of rest between each burst) of eight consecutive daily Internet-based surveys, which resulted in 48 data points from each participant. Participants also completed two overall lab-based assessments, one at the beginning, and one towards the end of the semester to examine any overall changes in relational outcomes throughout the semester. The main objective of this study was to examine the daily effects of participating in a KPAP yoga course throughout the academic semester through a person-specific approach, and to examine both the time course of effects and whether these vary depending on an individuals’ dispositional mindfulness.
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CHAPTER 2. Qualitative Study of Yoga Practitioners’
Perceived Relational Influences and Pathways of How Yoga Works

Abstract

The purpose of this qualitative study was twofold: (1) to better understand how yoga practitioners perceive intra- and interpersonal outcomes of their yoga practice, and (2) to develop a conceptual model of yoga effects on intra- and interpersonal outcomes that may underlie the “relational” influences of yoga. As part of a larger study, 107 community-dwelling yoga practitioners (age $M=41.2 \pm 15.9$ years) completed open-ended questions which asked questions focusing on whether yoga influences one’s relationship to oneself and to others. A subsample ($n=12$) completed in-depth interviews. The open-ended responses were analyzed through a content analysis, and verbatim interview transcripts were analyzed for emergent themes using a constant comparison approach. Four emerging themes were identified such that practitioners talked about the ability of yoga to generate calm states, mindfulness, (self-)compassion, and a sense of connectedness. Throughout the themes, a common pattern emerged such that yoga practice first led to positive intrapersonal changes, which then influenced one’s interpersonal relationships. Based on these results, a conceptual model was developed depicting potential relational pathways of how yoga works. Findings demonstrate the potential of yoga to improve one’s relationship to oneself (intrapersonal) through mindfulness and self-compassion, and to others (interpersonal), through the enhancement of compassion and social connectedness, which may lead to enhanced health and wellbeing outcomes. Further empirical testing of the model is warranted.
Qualitative Study of Yoga Practitioners’
Perceived Relational Influences and Pathways of How Yoga Works

Over the past few years, the mind-body practice of yoga has gained increasing interest from both the general population and the scientific community. In fact, yoga has evolved from a niche activity to a mainstream practice, as is reflected by the 29% increase in the participation rates of yoga from the year 2008 to 2012 (Yoga Journal and Yoga Alliance, 2016). A wide-array of styles of yoga exist; however, in the West, a typical yoga practice generally consists of a combination of breathing, physical postures, and meditative components, which together facilitates the union of the body, mind, and spirit for health and wellbeing (Iyengar, 1982). Previous research has shown a wide-array of psychological health benefits such as decreased anxiety, stress, depression, and improved cognitive functioning and quality of life (Gothe & McAuley, 2015; Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005; Pilkington, Kirkwood, Rampes, & Richardson, 2005; Uebelacker et al., 2010; Woodyard, 2011). Yoga has also been shown to generate positive effects on a variety of health conditions such as arthritis, cancer, cardiovascular disease, and metabolic syndrome (Bower, Woolery, Sternlieb, & Garet, 2005; Cramer, Lange, Klose, Paul, & Dobos, 2012; Cramer, Posadzki, Dobos, & Langhorst, 2014; Haaz & Bartlett, 2011; Innes & Vincent, 2007; Posadzki, Cramer, Kuzdzal, Lee, & Ernst, 2014).

In contrast to the individual oriented outcomes of yoga that have received predominant attention; to date, there is however a scarcity of research that has examined the “relational” (the way in which one relates to oneself and to others) benefits of yoga practice. While the literature on social relationships has placed substantial emphasis on one’s relationship to others (interpersonal dimensions), also relevant to one’s health is how one relates to oneself (intrapersonal dimensions), which occurs through awareness of one’s own thoughts, feelings, and experiences, and is often at the foundation of contemplative practices. For instance, a means in which one relates to oneself or
the inner state of one’s mind can be captured through mindfulness, which includes relating to and approaching one’s own experiences with non-judgmental awareness in the present moment (Kabat-Zinn, 2003). Mindfulness cultivated through yoga may help individuals to better connect to others and oneself (Conboy, Wilson, & Braun, 2010; Gard et al., 2012; Shelov, Suchday, & Friedberg, 2009), leading to enhanced social relationships, health, and wellbeing across the lifespan (Cohen, 2004; Holt-Lunstad, Smith, & Layton, 2010; House, Landis, & Umberson, 1988). Yet, little is known on the influences and mechanisms through which yoga impacts social relationships and connections with oneself to improve health and wellbeing. In this study, we apply qualitative methodology to investigate the perceived relational benefits of yoga among practitioners of varying levels of yoga experience.

**Interpersonal Benefits of Yoga Practice**

Previous research has well-established the worth of healthy social relationships in sustaining health and wellbeing across the lifespan (Cohen, 2004), and the health risks for feeling socially isolated have been compared in magnitude to risks of smoking and obesity (Holt-Lunstad et al., 2010; House et al., 1988). Whereas social isolation can get “under the skin” with detrimental consequences on biological processes (Cacioppo, Hawkley, & Berntson, 2003), individuals who are more socially connected are protected from the development of depression and are treated with a “social cure” for existing depression (Cruwys et al., 2013, pg.185). The protective effects of social connectedness have also been shown to extend to one’s cognitive functioning (Haslam, Cruwys, & Haslam, 2014), and individuals who are more socially connected have 50% slower rates for memory decline (Ertel, Glymour, & Berkman, 2008).

One route in which yoga may enhance social relationships is through the *yamas* and *niyamas*, the ethics of yoga practice, which act as guidelines for practitioners to be at peace with oneself, one’s family, and one’s community (Garfinkel & Shumacher, 2000). In particular, the first precept, *ahimsa,*
or compassion for all beings (including self), is a characteristic that is often embedded in yoga; hence, it is feasible one may become more compassionate with repeated practice. Despite the scarcity of research examining relational outcomes, yoga has previously been linked to compassion and a sense of connectedness (Kinser, Bourguignon, Taylor, & Steeves, 2013; Ross, Bevans, Friedmann, Williams, & Thomas, 2014) In a qualitative study with depressed women, it was found yoga served both as a self-care (intrapersonal) and relational (interpersonal) technique, reflecting the ethical precepts (Kinser et al., 2013).

Mindfulness cultivated through yoga (Conboy et al., 2010; Curtis, Osadchuk, & Katz, 2011; Gard et al., 2012; Shelov et al., 2009) may also play an integral role in generating the potential relational benefits of yoga (Gard, Noggle, Park, Vago, & Wilson, 2014). Although the literature and intervention development has been skewed on the intrapersonal domains of mindfulness, it is important to recognize mindfulness encompasses an awareness of both internal and external experiences, including both self and other. Accordingly, mindfulness also extends to interpersonal domains in that it involves one’s awareness and behaviors towards others (Frank, Jennings, & Greenberg, 2016). In this way, the nonjudgmental attitude and openness that is cultivated through yoga practice may also facilitate one’s ability and willingness to connect to others.

**Intrapersonal Influences of Yoga Practice**

In parallel to the potential of mindfulness to strengthen interpersonal relationships, mindfulness cultivated through yoga practice may help individuals to better connect, in a healthier manner, with one’s own thoughts and feelings, regarding the “self.” Enhancing mindfulness could also promote self-compassion, a kind and caring way of relating to oneself in the face of one’s own shortcomings and inadequacies (Neff, 2003; Neff & Vonk, 2009). Since *ahimsa* (compassion for all beings), includes kindness to oneself, it could be said that self-compassion is engrained in the philosophy of yoga. Due to Neff’s three-component conceptualization of self-compassion (self-
kindness, common humanity, and mindfulness), mindfulness and self-compassion are thought to be interconnected, yet, also with distinct characteristics. Previous research has identified self-compassion to be a pivotal mediator in mindfulness-based interventions (Birnie, Speca, & Carlson, 2010; Hollis-Walker & Colosimo, 2011; Kuyken et al., 2010), with preliminary evidence suggesting yoga has the ability to generate self-compassion (Conboy et al., 2010; Gard et al., 2012).

Interestingly, in a yoga intervention conducted by Gard et al. (2012), it was found self-compassion mediated the yoga and stress pathway; yet, no effects were observed for mindfulness as a mediator (although significant positive associations between yoga and mindfulness, and a negative correlation between mindfulness and perceived stress was reported). Despite the burgeoning evidence, whether practitioners perceive yoga helps them become more accepting and compassionate towards themselves, remains to be determined, as no studies to date have examined this from a qualitative perspective.

**Need for Qualitative Studies on Relational Benefits of Yoga Practice**

There has been a growing appreciation in the contemplative sciences to obtain perceived experiences from participants, with a handful of studies that have begun to incorporate mixed methods for better understanding mind-body practices and to obtain comprehensive assessments (Kinser et al., 2013; Ritenbaugh, Verhoef, Fleishman, Boon, & Leis, 2003; Verhoef, Casebeer, & Hilsden, 2002; Yeh, Chan, Wayne, & Conboy, 2016). Qualitative methodologies have numerous advantages as they provide a more meaningful interpretation of the phenomena under study, and facilitate tapping into abstract constructs that may be particularly relevant to these practices, but challenging to quantitatively assess, such as mindfulness (Brown, Ryan, Loverich, Biegel, & West, 2011; Grossman, 2011). Despite the richness of understanding human experience that may be gathered through these methods; to date, relational variables have been mostly examined through quantitative lenses, if at all. Yet, given the unique nature of meditative movement modalities that
encompass both contemplative and physical dimensions; the relational influences of yoga may manifest in ways that may not have been considered or assessed through conventional quantitative methods. Consequently, qualitative methods are warranted to obtain the subtle nuances that may arise in relational outcomes as part of yoga practice.

In one of the few existing studies that have examined the effects of yoga on one’s interpersonal relationships and social health, Ross et al., (2014) adapted Engel (1977)'s biopsychosocial model to represent the yogic approach (i.e., integrating biological, psychological, social aspects) in attaining health and wellbeing. The authors highlighted the existing limitations in yoga research, pointing to the clear imbalance that is found amongst the numerous randomized control trials (RCT) that have been conducted on the biological and psychological influences from yoga practice, which have largely neglected the investigation of potential social influences. In their study, they demonstrate an aspect of community linked to yoga practice, which is consistent with findings from another qualitative study highlighting feelings of connectedness and shared experiences in women with major depressive disorder through yoga practice (Kinser et al., 2013). While utilizing the comprehensive, biopsychosocial framework helps to illustrate limitations in yoga research, and models of this sort are purposeful, they also tend to be generic and abstract, providing insufficient detail with respect to the specific constructs and potential mechanisms at play. An additional step that can help to further advance the literature is through qualitative research methods, as they can aid in hypothesis generation about concrete pathways in which yoga works to enhance intra- and interpersonal outcomes.

In this study, we present qualitative data generated through open-ended survey questions and in-depth interviews of yoga practitioners with diverse levels of experience. The purpose of this work was twofold: (1) to better understand how yoga practitioners perceive intra- and interpersonal outcomes of their practice, and (2) to develop a conceptual model of yoga effects on intra- and
interpersonal outcomes that may underlie the relational benefits of yoga, by proposing specific pathways that could be further tested and fine-tuned by future research.

Methods

Design and Setting

This qualitative study is part of a larger study, the Daily Off the Mat (Daily OM) study, which took place between February and August 2016. In the Daily OM study, community-dwelling yoga practitioners were recruited to participate in an observational study, with an overarching purpose to better understand the intra- and interpersonal influences of yoga practice. Details of the study are reported in the subsequent chapter (Chapter 3). The study protocol was reviewed and approved by the Institutional Review Board, and participants provided written informed consent prior to participation.

Community-dwelling yoga practitioners were recruited to the Daily OM study in person and via fliers posted in community locations (e.g., cafes, public bulletin boards, studios). With approval from owners, local and regional studio instructors made a short announcement during classes and study information was posted in studio newsletters. Eligible participants were at least 18 years of age, practicing yoga at least once a week (e.g., studio, home practice), and had daily access to the Internet for the completion of surveys.

All participants (N=107) took part in the qualitative portion of the study, which included completing a set of open-ended questions during their post-study lab visit. A subsample of participants (n=12) were recruited to complete in-depth interviews in March 2017 using a purposive sampling strategy (Marshall, 1996) (See Figure 2.1).

Data Collection

Participants completed a computer-based questionnaire about their yoga practice.

Specifically, participants were asked to indicate their (dis)agreement with the following statements:
“Q1. I have a better relationship to myself, as a person, because of yoga,” and “Q2. My relationships with others are better because of yoga.” Participants were asked to indicate 1)yes, 2)neutral, or 3)no, and to elaborate on their answer choices for Q1 and Q2, and to share the perceived relational benefits of yoga practice in separate text boxes by providing a specific example of a situation which reflected or did not reflect the two statements.

To better understand practitioners’ perceptions of how (including directionality of effects) these relational influences occur through yoga practice, a subsample of participants (n=12) who completed the computer-based questionnaire were invited to complete a 45-minute in-depth interview to better understand practitioners’ perceptions of yoga’s relational influences. A semi-structured interview guide was created and included open-ended questions that focused on the intra- and interpersonal dimensions of yoga practice (See Table 2.1). In-depth interviews were conducted by a trained researcher in a laboratory setting and were audiotaped, transcribed, and compared with recordings for accuracy. Following the interview, participants completed an interactive activity, where they were asked to describe associations among key constructs of interest (e.g., mindfulness, social connectedness) that were derived from the literature and emerged from the initial open-ended responses.

Data Analysis

The Statistical Package for Social Sciences (SPSS V.24.0) was utilized to obtain frequencies of agreement with respect to intra- and interpersonal statements for the 107 participants. Qualitative analyses were managed using nVIVO version 11 by a single coder. A two-step process was utilized such that first, a list of codes was generated based on study objectives and open-ended questionnaire responses through a content analysis. Subsequently, emerging themes using a constant comparison method (Glaser, 1965) was employed for the in-depth interviews (n=12). This approach facilitates the development of explanations through patterns and allows the coder to draw from theory and the
existing literature to answer research questions (Bernard & Ryan, 2010). The first reading of interview transcripts allowed new codes and themes to emerge, which were added to the initial codebook (developed on basis of open-ended question data from the previous step). In the second reading of transcripts, themes were confirmed, modified, or rejected, as each transcript was compared and contrasted with the updated codebook. A final reading found all categories to be saturated, and no additional themes were identified. Qualitative findings were combined with interactive activity outcomes to generate a conceptual model depicting yoga’s relational pathways. Results with emergent themes are presented in aggregate, reflecting both the open-ended responses and in-depth interviews.

Results

The final sample comprised of 107 participants (88% Caucasian, 92.6% female, 92.6% heterosexual), and the mean age of the entire sample was 41.2 (SD=15.9; Range: 18-76) years old. Table 2.2 compares participant characteristics for the entire Daily OM Study with the in-depth interview subsample. The majority of participants agreed with the statement, “I have a better relationship to myself as a person because of yoga.” (96.2% agree, 3.8% neutral). Less agreement was observed with the statement, “My relationships with others are better because of yoga,” (81.9% agree, 16.2% neutral, 1.9% disagree; See Table 2.3). Key findings from the open-ended responses and in-depth interviews are presented below through capturing of the four emerging themes (See Table 2.4), supported by specific quotes, to characterize the key perceived relational benefits from yoga practice.

Emerging Themes

Theme 1: States of calm.

The majority of practitioners talked about attaining calm states through yoga practice, which has been identified to be one of the key elements of meditative movement (Larkey, Jahnke, Etnier,
& Gonzalez, 2009), with the breath often cited as powerful tool in which relaxation was achieved. This immediate calmness allowed practitioners to feel more in tune with themselves, which provided a “self-nurturing and restorative feeling”. Moreover, practitioners commented on how their calmness permeated into other aspects of their life, including interpersonal domains (e.g., in arguments with one’s spouse, children, or in stressful situations), and how people in their social networks could even detect or feel the influences from their practice. Perhaps, the immediate calm derived from yoga was best captured by one of the in-depth participants who stated:

“But I keep going back to the asanas because that is the thing that [helps me] when I get out of filter… I just told a friend I have to reset my inner peace barometer. [Laughter] It was going out of wack.” (71yrs old, 15yrs of practice, F)

**Theme 2: Yoga as a practice that cultivates mindfulness.**

The words, “awareness,” “attention,” “non-judgement,” “less reactivity,” and “openness” were repeatedly mentioned, reflecting the nature of yoga as a practice that cultivates qualities conceptualized as mindfulness (Baer, 2006; Bishop et al., 2004; Brown et al., 2011). A few practitioners touched specifically on the present-moment awareness cultivated on the yoga mat:

“…Being aware of your body in space, and how much strength and flexibility you have in a yoga pose, trying to keep good posture. Knowing when to deepen the pose, knowing when to relax the pose. So, I’m just totally thinking about my body in the pose, and my breathing. Nothing else.” (64yrs old, 3yrs of practice, F)

Notably, the mindfulness extended off the mat, suggesting perhaps, with time, practitioners were able to enhance their skills outside of the yoga context. In the question asking about how yoga influenced one’s relationship to oneself, one practitioner shared:

“Yoga encourages me to be conscious of my thoughts and actions both on and off the mat. I have more awareness of the types of thoughts running through my mind and feel that I can
better redirect them if need be. By redirecting thoughts of anxiety or worry, I am less judgmental and harshly critical of myself, while still noticing areas of my life in which I can improve.” (24yrs old, 1yr of practice, F) The theme of mindfulness also emerged in response to the question of whether yoga enhanced one’s relationship with others, as qualities such as nonjudgement and patience benefited practitioners’ social interactions (e.g., with spouses, children, and friends):

“I try to make space between input and response. So if my husband says or does something frustrating, I don't immediately say or do anything in response (reaction) because my higher goal is to stay in peaceful communication with him.” (30yrs old, 4.3yrs of practice, F) Notably, not all practitioners agreed yoga enhanced social relationships; however, most participants acknowledged the role of mindfulness in improving their relationship with themselves:

“I am somewhat neutral on how yoga benefits my relationships. I can say that I try not to let others provoke me and I am better able to let things slide because I am more aware of myself due to my yoga practice.” (55yrs old, 2.2yrs of practice, F)

Theme 3: Kindness to oneself and to others.

Many practitioners referred to their yoga practice as a time for self-care, which helped them to cultivate more kindness towards themselves, perhaps, particularly beneficial to those who identified as being a perfectionist or a “workaholic.”

“I think yoga has given me more of a "self-care" attitude rather than a "self-punishing" attitude. I am kinder to myself, and less of a perfectionist...When I'm taking a yoga class and fall out of a posture or can't do the most "difficult" version of the posture, I am now able to just smile at myself or even laugh. Before yoga, I used to always beat myself up over mistakes. Now I know that "mistakes" are ok!” (30yrs old, 7yrs of practice, F)
A handful of women from the in-depth interviews also elaborated on how their body served as a vehicle in which this self-kindness arose, as they learned to accept their bodies through the physical postures:

“…Self-acceptance of self as I am, finally. There is that great exhalation there. That sigh… In terms of, really, finally looking at my body. Instead of being in denial about this aspect or that aspect…Taking an honest inventory of every physical part of my body. I think you have to do that when you are doing the poses.” (64yrs old, 3yrs of practice, F)

Practitioners also mentioned how their yoga practice helped them to become a better version of themselves (e.g., through qualities such as patience and openness), which generated compassion in their relationships:

“I’m also just more compassionate and understanding than I was before. I mean I thought I was a good person before, but pre-yoga [Participant name] and post, [laughter], I’m just, more in tune especially with my emotional side when I’m at work and in social settings […] My husband will tell you, yoga is my medicine and I’m a better person when I’m practicing yoga.” (47yrs, 4yrs of practice, F)

When specifically asked about the directionality between self-compassion and compassion through interviews, nearly all twelve women talked of yoga cultivating self-compassion, which facilitated compassion for others:

“…Self-compassion is not something that I had before I started yoga…if I had compassion for people before, I feel like it was kind of an incomplete compassion. Because it maybe didn’t take into account, ways in which I wasn’t compassionate with myself. It was outwardly directed but not inwardly directed. So I wasn’t as loving as I could have.” (26 yrs old, 2.9yrs of practice, F)
Theme 4: Sense of feeling connected and part of a community

Lastly, participants talked about the sense of belonging in a “community,” a word which was repeatedly mentioned. This sense of community appeared to develop over time, as a result of practicing with familiar practitioners, teachers, and studio space. A practitioner highlighted how yoga served as a “social outlet,” specifically, with respect to her personality (introvert), being retired, and living alone:

“…The more I attend this yoga class, the more I get to know people, and feel like part of a community… I feel connected to those people. It reduces my feeling of isolation or loneliness and kind of gets me out.” (64yrs old, 10yrs of practice, F)

Additionally, many practitioners referred to feelings of common humanity, with a handful remarking on the feeling of closeness (over separation from others) which was strengthened by the experience of moving together with others in the same space:

“The key social benefits of yoga seem to be found within the sharing of common experiences in a class. The person next to you isn't going through the same thing internally or externally, but somehow we are going through the same things. I know that is paradoxical, but it's the only way I can describe it. It's exactly the same, yet completely individual. These things bring you closer together, as you begin to speak with classmates while putting on your shoes. Seeing people regularly creates familiarity, and feeling someone flow right beside you (once a week, or maybe more) creates a sense of closeness.” (35yrs old, 7yrs, F)

Practitioners with a studio practice also mentioned a sense of feeling at home, and comfort in one’s skin. This safe and trusted space seemed to be facilitated by the instructor of the class, which a handful of practitioners touched on. While the sense of connectedness was a shared enjoyment amongst studio practitioners, not everyone resonated with the social aspects of yoga practice:
“Community practice is fine, but I don't get into socializing when I go. That's just my nature. It's nice to say hi to familiar faces. I do love the power of a community OM!!” (57yrs old, 5.6yrs of practice, F)

Conceptual Model of Yoga and Relational Health and Wellbeing

Based on the emerging themes and interactive activity, a conceptual model (see Figure 2.2) was developed, depicting potential pathways in which yoga enhances intra- and interpersonal outcomes, ultimately leading to enhanced health and wellbeing. First, yoga is represented in its’ entirety, as a practice that is comprised of four main skillsets: (1) ethical precepts, (2) physical postures, (3) breath regulation, and (4) meditation techniques (adapted from Gard et al., 2014). Specific emphasis was placed on the key intra- and interpersonal constructs which may be uniquely enhanced through meditative movement modalities such as yoga (based on previous research), and which, were talked about and confirmed through participant responses. Three direct pathways from yoga to: (1) mindfulness, (2) self-compassion, and (3) social connectedness, are depicted, with an indirect pathway to compassion, through enhanced mindfulness or self-compassion. Dotted arrows represent pathways which have insufficient evidence based on the qualitative responses, but can be theorized from the existing literature. Intra- and interpersonal moderators that could influence the strength of the association(s) are also listed, as touched upon from participants. Finally, the suggested relational pathways are presumed to be linked to enhanced health and wellbeing (distal outcomes).

Discussion

The objective of this study was to gain insight into the ways in which yoga may influence practitioner’s relationship to oneself and to others, and to develop a conceptual model of yoga through qualitative methods, specifically with respect to the understudied relational pathways. From a combination of the open-ended questions and in-depth interviews, it was found yoga was linked to
states of calm, mindfulness, (self)-compassion, and connectedness. Throughout the first three themes, a common pattern emerged such that yoga first led to positive intrapersonal changes, which then, influenced one’s interpersonal relationships. That is, the majority of participants talked about how, through yoga, one was able to cultivate this non-reactive and compassionate nature in oneself, which often translated into their social interactions, as they were able to extend these ways of being towards others. Although additional research is needed to better understand the specific routes in which these intrapersonal changes impact interpersonal outcomes, a similar qualitative study in Iyengar yoga practitioners focusing specifically on the interpersonal benefits also found yoga led to personal transformation, which subsequently, benefitted social relationships (Ross et al., 2014). In the conceptual model, this pattern may be suggestive of mindfulness and self-compassion being cultivated before interpersonal benefits through yoga practice can be realized, although additional research is warranted to fine-tune mechanisms and time sequencing of effects.

The first emerging theme of attaining a calm state of mind is suggestive of a key underlying physiological mechanism in which yoga may work to enhance relational wellbeing. According to the polyvagal theory (Porges, 2007), yoga serves its’ function as a neural practice in which attaining physiological states of calm facilitates the social engagement system. As outlined by Lucas et al., (2016) in their proposed polyvagal perspective of mindfulness-based movement, the shifts which occur in yoga practice between movement (sympathetic activation) and relaxation (parasympathetic activation) strengthen vagal inhibition, enhancing the ability of the autonomic nervous system to shift efficiently from arousal to calm. Indeed, this upward spiral generated by enhanced autonomic flexibility (Cherland, 2012; Souza et al., 2007) may be pertinent for the stress-relieving effects of yoga, and for optimal self-regulation (e.g., attaining relaxation may restore cognitive resources which are necessary for successful regulation of behavior).
The present study also provided ample evidence for the yoga and mindfulness association, adding to the existing evidence (Conboy et al., 2010; Curtis et al., 2011; Gard et al., 2012; Shelov et al., 2009). Although future research is warranted to untangle yoga’s potential to specifically enhance state and, or trait mindfulness, qualitative responses tapped into both such that practitioners talked about yoga immediately enhancing state mindfulness, and that learning how to be mindful extended off of the yoga mat (including social contexts). Perhaps, this illustrates the possibility that with repeated practice, a practitioner’s state mindfulness is enhanced, first, in the context of one’s yoga practice, subsequently spilling over to other contexts, ultimately, improving trait mindfulness.

Practitioners also acknowledged the cultivation of self-compassion through yoga, particularly; the component of self-kindness was reflected through the words of many. Quantitative research incorporating Neff’s Self-Compassion Scale (Neff, 2003) will help to further scrutinize whether certain subdomains of self-compassion (i.e., self-kindness, common humanity, mindfulness) are more likely to be influenced over others with practice.

Lastly, the fourth theme paralleled previous research demonstrating the effects of yoga to enhance connectedness (Kinser et al., 2013; Ross et al., 2014). While a few practitioners underscored the fact they do not necessarily seek out the “social” benefits of yoga, community was a central word that emerged, which often grew with time and familiarity. Interestingly, a handful of participants made remarks that moving together with others through the same sequence in the same space fortified this sense of connectedness. This therapeutic mechanism has been discussed by Mehta and colleagues (2016) who propose that in a community-based class setting, a transactional process is occurring amongst the instructor and practitioners such that practitioners will experience his or her own movement (i.e., postures) being imitated by the instructor, and others. This imitation process called, “automatic sharing of affective and somatosensory experience” (Schmalzl, Crane-Godreau, & Payne, 2014) appears to result in enhanced connectivity and resonance. The involvement of
biological pathways such as the release of oxytocin and activation of the mirror neuron system has been suggested (Mehta et al., 2016); yet, these potential mechanisms still deserve systematic evaluation.

Limitations and Future Directions

The present study is not without its limitations. Participants in this study were volunteers who took part in a larger study on yoga. Results are therefore representative of individuals who were motivated and interested. Further, participants were predominantly Caucasian, female, and of high educational and socioeconomic status. Although this mirrors the general demographics of yoga practitioners in the U.S., (Ross, Friedmann, Bevans, & Thomas, 2013) exploring this inquiry in under-represented populations will be a fruitful avenue for future work, especially, to identify any racial, cultural, or gender dynamics that may play out pertaining to relational domains.

Practitioners in the study were also drawn from different yoga studios and styles. On the one hand, it is encouraging key themes emerged despite the heterogeneity across practices, suggesting common grounds. Yet, certain elements of a practice (e.g., style and type, personality of the instructor, use of props) may be more beneficial than others for cultivating relational benefits. The eight limbs also merit further attention, considering the first two limbs of yoga (yamas and niyamas) specifically relate to one's intra- and interpersonal domains. A lack of research exists investigating the influences of the yamas and niyamas, and it is still unclear whether these moral precepts have unique effects in the promotion of health and wellbeing.

Data analyzed in this study were qualitatively collected from a larger observational study; hence, a subsequent step would be to conduct a RCT to determine whether these relational benefits are unique to yoga, in comparison to other group-based physical activities such as walking, or even to other meditative movement forms such as tai chi and qi gong. A final significant limitation, although not uncommon in qualitative research, was the use of a single coder due to cost and time
constraints. Still, the twelve in-depth interviews used an issue-focused analysis which requires fewer number of coders (Weiss, 1994), and it is unlikely reliability of findings was affected. The single coder also discussed emerging themes with the co-authors, which further enhanced reliability.

**Implications and Conclusions**

This is the first study that evaluated in a qualitative manner, the perceived relational benefits of yoga in community-based yoga practitioners across various styles of practice, providing evidence which may be especially useful for guiding hypotheses to be tested in experimental context (contributing to the first stage of evidence in the recently developed NCCIH’s framework for developing and testing mind-body interventions, NCCIH 2017). Specifically, the proposed conceptual model enriched the existing literature by demonstrating yoga’s potential to enhance mindfulness, (self-)compassion, and social connectedness. Preliminary evidence was also found for indirect pathways that could be tested in future research. Although it is clear future research is warranted to continue the work of understanding the relational influences and pathways of yoga (e.g., fine-tuning, the current model, developing alternative models), the qualitative findings from the present study illuminates the potential of yoga, as a practice of improving one’s relationship to oneself and to others, which can ultimately lead to enhanced health and wellbeing (Seppala et al., 2013).
References


Table 2.1. In-depth interview questions asked for the Daily OM subsample

<table>
<thead>
<tr>
<th>Key Questions</th>
<th>Follow-up Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Yoga Practice</strong>: How often do you do yoga? When you do yoga what do you do?</td>
<td>a. Could you remind me how long you have practiced yoga?</td>
</tr>
<tr>
<td></td>
<td>b. Describe your yoga practice to me in whatever way is meaningful to you.</td>
</tr>
<tr>
<td><strong>2. Intrapersonal</strong>: Describe how yoga makes you feel about yourself. For instance, do you see yourself differently because of your yoga practice? Or describe whether yoga makes you see yourself differently.</td>
<td>a. You’ve been practicing yoga for XX years, is it the same now as it was when you first started?</td>
</tr>
<tr>
<td></td>
<td>b. Tell me in your own words how you think/feel these changes take place</td>
</tr>
<tr>
<td><strong>3. Interpersonal</strong>: How has your yoga practice impacted your relationships with family, friends, coworkers, or your social network?</td>
<td></td>
</tr>
<tr>
<td><strong>4. Interpersonal</strong>: How has your yoga practice impacted your relationships with strangers or how you relate to people you don’t know?</td>
<td></td>
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</tbody>
</table>

*Note: Probes were used with respect to responses (e.g., what do you mean by…?, can you tell me more about…?, You mentioned …, can you describe that in more detail?)*
Table 2.2. Participant characteristics in the total Daily OM sample and in-depth subsample

<table>
<thead>
<tr>
<th>Participant Characteristic</th>
<th>Daily OM Sample</th>
<th>In-depth Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n=107 )</td>
<td>( n=12 )</td>
</tr>
<tr>
<td>Age (years)</td>
<td>41.38 (15.99)</td>
<td>49.25 (18.38)</td>
</tr>
<tr>
<td>Gender (% Female)</td>
<td>92.6%</td>
<td>100%</td>
</tr>
<tr>
<td>Race/Ethnicity (% Caucasian)</td>
<td>88.6%</td>
<td>100%</td>
</tr>
<tr>
<td>Education (% college graduate)</td>
<td>78.1%</td>
<td>91.6%</td>
</tr>
<tr>
<td>Income (&gt; $75,000)</td>
<td>37.9%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Employment (Full-time)</td>
<td>43.8%</td>
<td>50%</td>
</tr>
<tr>
<td>Yoga Experience (years)</td>
<td>8.17 (7.13)</td>
<td>7.42 (5.57)</td>
</tr>
<tr>
<td>Studio/In-class Yoga Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Times/Week</td>
<td>2.03 (1.54)</td>
<td>2.25 (1.55)</td>
</tr>
<tr>
<td>Duration (minutes)</td>
<td>69.59 (32.14)</td>
<td>78.33 (20.04)</td>
</tr>
<tr>
<td>Home Yoga Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Times/Week</td>
<td>2.48 (1.99)</td>
<td>2.08 (1.98)</td>
</tr>
<tr>
<td>Duration (minutes)</td>
<td>29.83 (22.85)</td>
<td>19.17 (14.89)</td>
</tr>
<tr>
<td>Body Mass Index (kg/m(^2))</td>
<td>25.03 (4.92)</td>
<td>25.81 (4.86)</td>
</tr>
</tbody>
</table>
Table 2.3. Percentages across intra- and interpersonal statements related to yoga practice

<table>
<thead>
<tr>
<th>Statement</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intrapersonal:</strong> &quot;I have a better relationship to myself as a person because of yoga&quot;</td>
<td>96.2%</td>
<td>3.8%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Interpersonal:</strong> “My relationships with others are better because of yoga&quot;</td>
<td>81.9%</td>
<td>16.2%</td>
<td>1.9%</td>
</tr>
</tbody>
</table>
Table 2.4. Emerging themes, categories, and exemplar statements

<table>
<thead>
<tr>
<th>Theme</th>
<th>Category</th>
<th>Exemplar Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>States of calm</td>
<td>Calm, peaceful, and grounded (stability)</td>
<td>“I find that I crave the peace I find in yoga and extend it to all aspects of my life. I can’t say the same with other exercise routines that I’ve tried in the past because yoga is a lot more than exercise. It’s a type of meditation.” (46yrs old, 2.9yrs practice, F)</td>
</tr>
<tr>
<td></td>
<td>Breathing as a technique that leads to relaxation</td>
<td>“Friends comment that I am more relaxed and able to deal with stressful situations in a calm manner than ever before.” (67yrs old, 6.5yrs of practice, F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“The ability to be calm and feel relaxed with oneself in and around others where anxiety may manifest itself.” (42yrs old, &lt;1yr practice, M)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Reconnect with breath – deepest breaths of my day. Sense of everything will be ok” (32yrs old, 13yrs practice, F)</td>
</tr>
<tr>
<td>Yoga as a practice that</td>
<td>Awareness, including present moment awareness</td>
<td>“That whole class, that one and a half hours, it was like I was on vacation. Nothing else was in my mind, besides the practice.” (71yrs old, 15yrs practice, F)</td>
</tr>
<tr>
<td>cultivates mindfulness</td>
<td>Attention/Clarity</td>
<td>“I appreciate the quiet time, the time to observe, and stop the judgment process” (65yrs old, 21yrs practice, F)</td>
</tr>
<tr>
<td></td>
<td>Nonjudgement/Non-reactivity/Patience</td>
<td>“Helped me observe people and myself in specific contexts and to listen better which enables more appropriate responses.” (33yrs old, 3 yrs practice, M)</td>
</tr>
<tr>
<td></td>
<td>Listening/Observing one’s thoughts and</td>
<td>“It's improved my relationships with my children because I’ve learned to listen, really listen to what they are saying before I react.” (46yrs old, 7yrs practice, F)</td>
</tr>
<tr>
<td></td>
<td>emotions, witnessing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acceptance/Openness</td>
<td></td>
</tr>
<tr>
<td>Kindness to oneself and</td>
<td>Yoga as a time for self-care, self-nurturing</td>
<td>“If I am cared for properly, then I can care for others better.” (39yrs old, 7yrs practice, F)</td>
</tr>
<tr>
<td>to others</td>
<td>activity</td>
<td>“Having a more loving relationship with my body” (26 yrs old, 2.9yrs practice, F)</td>
</tr>
<tr>
<td></td>
<td>Body as a vehicle for cultivating self-kindness</td>
<td>“The whole start of that is, toward the self...So all these little acts of self-compassion when trying to do these poses that are difficult for me. And the more I age, sometimes, poses I could do, I can’t do quite as well anymore. But to have compassion for myself. Which increases my capacity, I think, to have compassion for others.” (71yrs old, 15yrs practice, F)</td>
</tr>
<tr>
<td></td>
<td>Developing more patience and acceptance for</td>
<td>“Yoga reminds us that we all have our struggles, to stay truthful and to not harm others. When we approach everything with an open loving heart. Relationships can more easily form” (36yrs old, 16yrs practice, F)</td>
</tr>
<tr>
<td></td>
<td>oneself leading to compassionate attitude</td>
<td>“I am a workaholic. Since I've practiced yoga, though, I’ve noticed that I am not nearly as hard on myself. ” (39yrs old, 14yrs practice, F)</td>
</tr>
<tr>
<td></td>
<td>towards others</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Forgiveness/Vulnerability</td>
<td></td>
</tr>
<tr>
<td>Sense of feeling connected and part of a community</td>
<td>“It definitely feels like a home to me…Not a feeling I ever expected to have about a yoga studio. It’s a place where you are free to be fully yourself.” (26 yrs old, 2.9yrs practice, F)</td>
<td></td>
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<tr>
<td>-------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>• A sense of belonging, safety, and space for a supported practice</td>
<td>“Community and all of its advantages: friends, support, laughter, yoga tips, common service.” (63yrs old, 14yrs practice, F)</td>
<td></td>
</tr>
<tr>
<td>• Role or relationship of/with teachers to facilitate trusted sense and safeness</td>
<td>“I’ve seen and felt, personally, the benefits of moving synchronously with others. It helps overcome the sense of isolation. Struggling and succeeding and breathing on the mat together helps us to see how we are more alike than different. Practicing in community helps with others, while in a calm, mindful state, is a connector.” (48yrs old, 8.7yrs practice, F)</td>
<td></td>
</tr>
<tr>
<td>• Shared experience and sense of closeness through movement</td>
<td>“I am connected to ‘self’ and ‘something more’ in a way that supports all aspects of my life.” (51yrs old, 1.2yrs practice, F)</td>
<td></td>
</tr>
<tr>
<td>• A sense of connectedness to oneself, others, and to the greater whole</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 2.1. CONSORT flow diagram to depict participation in qualitative aspect for the Daily OM Study

Assessed for eligibility \((n=149)\)

- Excluded \((n=29)\)
  - Lost interest, lost at follow-up \((n=23)\)
  - Not meeting inclusion criteria \((n=6)\)

Consented \((n=120)\)

- Excluded \((n=11)\)
  - Lost at follow-up \((n=2)\)
  - Dropped out after enrollment \((n=9)\)

Analysed open-ended responses \((n=107)\)
- Excluded from analysis \((n=2)\)
  (incomplete post-study survey)

Contacted for in-depth interviews \((n=23)\)
- Agree to participate \((n=12)\)
- Unable to participate \((n=11)\)

Analyzed in-depth interviews \((n=12)\)
Figure 2.2. Proposed conceptual model depicting yoga and relational variables of interest. Note: While the proposed model is depicted linearly, the dynamic relations that may exist between constructs should not be omitted, based on context and timescale. Yoga could also directly lead to improved health and wellbeing (e.g., in case of physical function as an outcome), depending on the specific health and wellbeing outcome of interest.
CHAPTER 3. Yoga Off the Mat: An Intensive Longitudinal Study to Understand How Relational Outcomes Manifest “In Vivo” in Yoga Practitioners with Diverse Experiences

Abstract

Given the majority of previous yoga-based research has been conducted in lab-based contexts, it is unclear whether and how the benefits of yoga practice translate “off of the mat”, in the context of one’s day-to-day life. Community-dwelling yoga practitioners (N=104, age range 18-76 years) with a yoga practice of at least once a week were recruited for a 21-day daily diary study. Practitioners were asked to complete daily Internet surveys at the end of the day which included questions with respect to one’s yoga practice and relational domains (i.e., mindfulness, (self-)compassion, and social connectedness). First, multilevel analyses revealed yoga and relational outcomes to be “dynamic” phenomena, indicated by substantial variation (ICCs=0.34 - 0.48) at the within-person level. Further, on days when an individual practiced more yoga than their usual, greater mindfulness ($b=2.93, SE=0.39, p< .05$) and self-compassion ($b=1.45, SE=0.46, p< .05$) were also reported. 1-1-1 multilevel mediation models demonstrated yoga had an indirect effect on both compassion and social connectedness through increases in mindfulness at the within-and between-person levels. In models testing self-compassion as the mediator, the indirect effect of daily yoga practice on compassion was significant, although limited to the within-person level. These findings suggest a routine yoga practice could positively impact how a practitioner connects and relates to themselves and to others, both on a day-to-day basis, and with accumulated practice. Future research is warranted to determine whether these relational benefits and pathways manifest using experimental manipulation.
Yoga Off the Mat: An Intensive Longitudinal Study to Understand How Relational Outcomes Manifest “In Vivo” in Yoga Practitioners with Diverse Experiences

Presently, there are approximately 20 million adults in the U.S. practicing yoga, with statistics from national surveys demonstrating continuous growth (Barnes, Bloom, & Nahin, 2008; Clarke, Black, Stussman, Barnes, & Nahin, 2015). This spark has also caught on to the scientific community, with the National Institutes of Health making significant investment into better understanding the effects and mechanisms of mind-body approaches such as yoga, as evidenced by the establishment of the National Center for Complementary and Integrative Health (NCCIH, 1991), the Mind and Life Institute (1991), and increase in grant calls through mind-body therapy focused RFAs and RFPs. While the literature has certainly proliferated over the past decades demonstrating a wide array of salutary health benefits (For reviews see: Hendriks, de Jong, & Cramer, 2017; Hofmann, Andreoli, Carpenter, & Curtiss, 2016; Ross & Thomas, 2010; Ubelacker et al., 2010; Woodyard, 2011), a clear gap in the literature is present examining the “relational” (intra- and interpersonal) influences of yoga practice. Understanding the extent to which yoga can influence the relational aspects of one’s life is a worthwhile endeavor, considering human beings have an inherent need to feel connected, trusted, and loved (Baumeister & Leary, 1995). Moreover, positive interpersonal relationships such as feeling connected to others and practicing concern for others have been linked to psychological and physical wellbeing (Haslam, Cruwys, & Haslam, 2014; House, Landis, & Umberson, 1988; Lee & Robbins, 1995; Piliavin & Siegl, 2007; Weinstein & Ryan, 2010).

Although according to yoga philosophy, the effects of yoga practice are purported to extend off of the mat, not just to oneself (intrapersonal), but also to others (interpersonal; Iyengar, 1982), the evidence is lacking and relational outcomes remain understudied. Some preliminary support has been presented that yoga influences interpersonal domains such as compassion and a sense of connectedness (Kinser, Bourguignon, Taylor, & Steeves, 2013; Ross, Bevans, Friedmann, Williams,
& Thomas, 2014; Wertman, Wister, & Mitchell, 2016), but the potential mechanisms of these effects are not understood. One proposed pathway through which yoga can help individuals relate to others, is by instigating intrapersonal changes (e.g., facilitating self-awareness and positive attitude towards oneself), which may subsequently lead to a more compassionate and/or non-reactive nature, in which one handles interpersonal relationships, thereby, also enhancing social connectedness (Kinser et al., 2013; Ross et al., 2014). Two key intrapersonal resources that can be cultivated through yoga in such a way are mindfulness and self-compassion. Many researchers have proposed and demonstrated the integral role of mindfulness in attaining the health benefits derived from contemplative practices, including yoga practice (Gard et al., 2012; Gard, Noggle, Park, Vago, & Wilson, 2014; Park, Riley, Bedesin, & Stewart, 2014). Defined as a skill of paying attention in the present moment with a nonjudgmental attitude (Kabat-Zinn, 1993), mindfulness has been studied primarily as an “intrapersonal” skill, although it encompasses both internal and external experiences, potentially impacting the way in which one relates not to self but also others (Cohen & Miller, 2009; Kristeller & Johnson, 2005).

In addition to the meditative (mindfulness) element which lies at the core of yoga practice, yoga also embraces a compassionate and non-harmful attitude which is founded on the yamas and niyamas, the ethics, or guiding life principles of yoga practice. Self-compassion, defined as a kind way of relating to oneself in the face of one’s own shortcomings and inadequacies (Neff, 2003; Neff & Vonk, 2009), may therefore compliment mindfulness as another essential ingredient of yoga practice which underlies its’ effects on interpersonal outcomes. Research has indicated self-compassion to serve as a potent predictor of health and wellbeing (Raque-Bogdan, Ericson, Jackson, Martin, & Bryan, 2011; Neely, Schallert, Mohammed, Roberts, & Chen, 2009), and emerging evidence demonstrates yoga can generate self-compassion (Conboy, Wilson, & Braun, 2010; Crews, Stolz-Newton, & Grant, 2016; Gard et al., 2012). In a pilot study by Gard and colleagues (2012), self-
compassion mediated the effects of a four-month residential yoga intervention on increased quality of life and reductions in stress. Whether self-compassion derived from yoga practice, as complimentary to mindfulness, can facilitate how one relates to others remains to be determined.

In the present study, we utilize intensive longitudinal methods to evaluate whether daily yoga practice is associated with relational outcomes (i.e., both intra- and interpersonal). Intensive longitudinal designs generate multivariate, multi-subject data with multiple time points (Bolger & Laurenceau, 2013; Walls & Schafer, 2012) that have potential to examine how effects of yoga unfold in the context of one’s day-to-day life, as practitioners go about their everyday lives in the natural environment, “off” of their mats (Bolger, Davis, & Rafaeli, 2003). While these methods have become prevalent in the physical activity literature as a means to provide rich information about the dynamics of psychosocial processes underlying physical activity behavior, the majority of yoga research has been conducted in controlled, experimental settings, with conventional pre-to-post time point assessments. Consequently, there is an absence of ecological validity of previous findings, and to date, no study has characterized the natural variability in relational (or other psychosocial) outcomes of daily yoga practice. In particular, whether the potential relational influences from yoga translate off of the mat is a valuable inquiry in the contemplative sciences (as the benefits of these practices are purported to extend beyond the individual; Iyengar, 1982); which, as a field has begun to increase efforts in better understanding the relational benefits of these practices in the real world setting (Mind & Life, 2017). Capturing how relational outcomes fluctuate from day to day as a function of daily yoga practice can also prove useful for developing and refining subsequent randomized control trials incorporating intensive assessments to capture both effects and variability in yoga outcomes.

In this first intensive longitudinal study, we conduct an observational study to examine the influences of yoga practice on the understudied relational outcomes amongst community-dwelling
yoga practitioners with varying levels of experience. Specifically, our initial objective was to characterize the potential fluctuations that may be present in the relational variables of interest (i.e., mindfulness, (self-) compassion, and social connectedness) at the within- and between-person level as a function of daily yoga practice across a period of 21 days. Second, we sought to examine the daily influences of yoga practice on relational domains, and explore whether daily mindfulness and self-compassion are associated with (i.e., mediate) these effects. At the within-person level, it was hypothesized that on days when practitioners practiced more yoga than their usual (or on yoga practice days), they would report enhanced daily mindfulness and self-compassion, which would be associated with enhancements in the interpersonal outcomes of compassion and social connectedness at both the within- and between-person level.

**Methods**

**Participants and procedures**

Community dwelling yoga practitioners with varying yoga experience were recruited for a prospective 21-day diary study. Interested participants completed screening procedures through an online screening survey, or over the phone. Eligibility criteria included (a) being at least 18 years of age, (b) practicing yoga at least once a week (e.g., community studio, home practice), and (c) having daily access to Internet. Of the 149 practitioners that were screened, 13 expressed initial interest but did not consent, 6 did not meet the inclusion criteria ($n=4$ not practicing at least once a week, $n=2$ did not have daily Internet access), 2 cancelled their initial lab assessment and declined to reschedule, 2 could not participate due to injury (unrelated to yoga practice and the present study), and 6 changed their minds after study procedures were explained (e.g., insufficient compensation, schedule does not allow for participation). The remaining 120 participants were consented and completed the first baseline survey. Of the 120 which started the daily assessment portion of the study, 9 participants discontinued after enrollment due to inability to comply with study procedures, 3
participants did not complete the final questionnaire, and 2 provided insufficient daily data (<50%) to be included in the analyses (See Figure 3.1 for participant flow).

Participants were recruited through handouts and flyers placed in community locations (e.g., cafes, public bulletin boards) and word of mouth. Recruitment was initiated in yoga studios in the local communities (in February 2016); however, in an effort to increase recruitment efforts, the study was expanded to include regional yoga studios (mainly targeting yoga studios in the state of Pennsylvania in August 2016). With approval from the yoga studio owners, hand-out flyers were distributed in class, and study announcements were also made in the studios’ newsletter(s) when appropriate. An online ad was also posted on the research studies website for volunteers at the local institution.

At the first laboratory assessment, participants provided informed consent and completed a baseline survey which included demographic and psychosocial questionnaires. During this initial visit, participants were instructed on how to access the daily Internet surveys through a secure website at the end of each day (between 7:00 p.m. and 2:00 a.m.) over the course of the three-week period. After the 21 days in which participants completed their daily surveys, the participants returned for a second visit to complete one final psychosocial questionnaire (Note: regional participants were asked to complete all of the surveys at home, but were provided extensive instruction over the phone). All procedures were approved by the Institutional Review Board at the local institution.

**Measures**

**Demographics.** At the initial laboratory visit, basic demographic (e.g., age, education, employment, gender, race/ethnicity) and background information was collected, including questions on participants’ yoga practice and experience. Body mass index (BMI) was assessed from height and weight obtained in the laboratory using standard procedures. Regional participants (n=28) provided
self-reported height and weight. Daily self-reported yoga practice, mindfulness, (self-)compassion, and social connectedness were assessed at the end of each day during the 21-day assessment period.

**Yoga practice.** Self-reported yoga practice was assessed from the question, “Did you practice yoga today?” (Yes/No response). If participants indicated yes, follow-up questions asked about the duration (in minutes) and location (community studio, home practice, other) of the day’s yoga practice.

**Mindfulness.** Four items were modified for the daily time scale to capture mindfulness of mind and body. Two items captured mindfulness of the mind: “I noticed thoughts and emotions as they came and went” and “I was caught up in thinking about the past or the future instead of being in the present.” These two items have previously been used to capture mindfulness through intensive longitudinal methods in a mindfulness-based intervention in first year college students (Dvořáková et al., 2017). For mindfulness specific to the body, two items were utilized from the State Mindfulness for Physical Activity Scale (SMS-PA; Cox, Ullrich-French, & French, 2015): “Today, I felt present in my body” and “Today, I listened to what my body was telling me.” Ratings were made on a visual 0-100 scale, with anchors marked as ranging from 0 (strongly disagree) to 100 (strongly agree). The within-person reliability (R) across the four items for mindfulness was 0.61. Mindfulness of mind with body had within- and between-person correlations of $r = 0.40 - 0.51$.

**Self-compassion.** Two items from Neff’s Self-Compassion Scale-Short Form (SCS-SF) was modified to be used in the daily context to assess self-compassion: “Today, I gave myself the caring and tenderness I needed.” and “Today, I was disapproving and judgmental about my own flaws and inadequacies.” (Raes, Pommier, Neff, & Van Gucht, 2011). The first item represented a self-kindness item, and the second represented a self-judgment item. The second item was reverse coded, and averaged with the first for a daily self-compassion score. Ratings were made on a visual 0-100 scale, with anchors marked as ranging from 0 (strongly disagree) to 100 (strongly agree). The within-person
reliability ($R_c$) for self-compassion was 0.37. Responses to the two items to assess self-compassion had within- and between-person correlations of $rs = 0.30 - 0.45$.

**Compassion.** Two items from the modified differential emotions scale (mDES; Fredrickson, Tugade, Waugh, & Larkin, 2003) were used to capture compassion. Participants were asked to indicate how often they have felt a combination of emotions throughout the day (three sets of emotions are listed for each overarching emotion in the mDES). For the present work, the emotions, (1) sympathy, concern, compassion and (2) love, closeness, or trust, were combined to obtain a daily compassion score. These two items were combined to create a compassion score due to the fact compassion and love are both primarily emotions that facilitate the development and maintenance of intimate social bonds with others (Bowlby, Ainsworth, & Bretherton, 1992), and previous instruments of compassion include love (i.e., altruistic love) as a component of compassion (Sprecher & Fehr, 2005). The within-person reliability ($R_c$) for compassion was 0.36. Responses to the two items to assess compassion had within- and between-person correlations of $rs = 0.37 - 0.40$.

**Social connectedness.** Two items from the Social Connectedness Scale (i.e., “I was able to relate to the person(s) around me.” and “I felt isolated from others.”) (Lee & Robbins, 1995) were used to assess social connectedness (with the second item being reverse coded). Ratings were made on a visual 0-100 scale, with anchors marked as ranging from 0 (**strongly disagree**) to 100 (**strongly agree**). These two items have been used previously for an end-of-day assessment in mindfulness research (Dvořáková et al., 2017). The within-person reliability ($R_c$) for social connectedness was 0.55. Responses to the two items to assess social connectedness had within- and between-person correlations of $rs = 0.48 - 0.49$.

**Covariates included in the analyses:**

**Psychological and physical health status.** The literature has demonstrated positive influences of relational variables on both psychological and physical wellbeing (Grossman, Niemann,
Schmidt, & Walach, 2004; Hall, Row, Wuensch, & Godley, 2013; MacBeth & Gumley, 2012; Seppala, Rossomando, & Doty, 2016; Sheldon & Cooper, 2008); hence, in the analyses, psychological and physical health were included as covariates. Two items from the Health-Related Quality of Life Questionnaire were adapted to assess global mental and physical health status (Hennessy, Moriarty, Zack, Scherr, & Brackbill, 1994). Psychological and physical health was assessed through two items each, “Today, my emotional/physical health was…” (rated on a 0-100 scale from very poor to excellent), and “Today, my emotional/physical health interfered with my daily activities” (rated on a 0-100 scale from not at all to extremely). The two items were combined (i.e., the second item was reverse coded) to create an overall psychological and physical health score. The within-person reliability ($R_c$) for physical and psychological health were 0.67 and 0.66 respectively. Responses to the two items for both psychological and physical health status were moderately correlated at the within- and between-person level ($rs = 0.48 - 0.58; 0.56 - 0.67$, respectively).

**Time/reactivity.** The day in study sequence was controlled for to account for any changes related to reactivity in daily self-reports of the relational outcomes as a result of exposure to repeated assessments. Since relational outcomes are likely to be influenced by the social calendar, time of week was defined to contrast weekdays (0=Monday through Friday) with weekends (1=Saturday and Sunday).

**Additional covariates.** Overall yoga experience was also included due to the possibility that experienced practitioners may differ in their overall levels or variability on the relational outcomes of interest. Since the present sample consisted of a wide age range (18 - 76 yrs) of practitioners, and there is some evidence suggesting that self-compassion may increase with age, especially later in life (Neff, 2011; Neff & Vonk, 2009), age also served as a covariate in the final models.
Data Analysis

Considering the nested nature of the data (days nested within persons), two-level multilevel models were tested to examine within- and between-person associations. All models were estimated using SAS 9.3 PROC MIXED (Littell, Milliken, Stroup, & Wolfinger, 1996) with restricted maximum likelihood estimation (treating any incomplete data as missing at random). Equation (1) was used to calculate the pseudo-\(R^2\) statistic (as per standard multilevel modeling practice; Singer & Willett, 2003) to determine the additional proportion of variance explained by the predictors in comparison to the baseline model:

\[
Pseudo\,R^2_e = \frac{\sigma^2_{(unconditional\,means\,model)} - \sigma^2_{(unconditional\,growth\,model)}}{\sigma^2_{(unconditional\,means\,model)}}
\]  

Of the total enrolled sample of 120 participants, 109 completed the 21-daily assessment component of the study and 104 women provided sufficient data (≥50%) to be included in the analysis (See Figure 1). Prior to analyses, all between-person predictors were grand mean centered and all within-person predictors were person-day centered following standard procedures (Snijders & Bosker, 1999), with an exception to the dichotomous (Y/N) yoga practice variable. For instance, a practitioner \(i\)'s mean score across the 21 days constituted their level 2, between-person variable (e.g., Overall Yoga Practice\(i\)). The difference between their daily score and their mean score constituted the level 1(within-person) person-centered variable representing day-to-day deviations relative to their average across the 21 days (Daily Yoga Practice\(i\)).

To investigate the daily influences of yoga practice to enhance relational outcomes (mindfulness, (self-)compassion, social connectedness), these outcomes were regressed on daily yoga practice, controlling for individual differences in covariates (psychological and physical health, age, yoga experience, day in study, weekend). Yoga practice was operationalized both as a dichotomous yoga practice (Y/N) variable and a continuous yoga practice (minutes) variable in separate models.
All analyses were conducted examining the two different yoga exposure variables. To illustrate, a final model representing self-compassion on day $d$ for practitioner $i$, self-compassion ($Self\text{-}Compassion_{d}$) was analyzed by Equations (2) through (6):

**Within-Person Model (Level-1) predicting Self-compassion**

Level-1:

$$Self\text{-}Compassion_{d_i} = \beta_{0i} + \beta_{1i}(\text{Daily Yoga Practice}_{d_i}) + \beta_{2i}(\text{Daily Mindfulness}_{d_i})$$

$$+ \beta_{3i}(\text{Daily Psychological Health}_{d_i}) + \beta_{4i}(\text{Daily Physical Health}_{d_i})$$

$$+ \beta_{5i}(\text{Weekend}_{d_i}) + \beta_{6i}(\text{Study Day}_{d_i}) + e_{d_i}$$

(2)

Level-2:

$$\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{Overall Yoga Practice}_{i}) + \gamma_{02}(\text{Overall Mindfulness}_{i})$$

$$+ \gamma_{03}(\text{Overall Psychological Health}_{i}) + \gamma_{04}(\text{Overall Physical Health}_{i})$$

$$+ \gamma_{05}(\text{Age}_{i}) + \gamma_{06}(\text{Yoga Experience}_{i}) + u_{0i}$$

(3)

$$\beta_{1i} = \gamma_{10} + u_{1i}$$

(4)

$$\beta_{(2-6)i} = \gamma_{(2-6)0}$$

(5)

where $\gamma_{00}$ represents the average level of self-compassion for the average individual in the sample, $\gamma_{01}$ to $\gamma_{06}$ represent the between-person influences of overall yoga practice, mindfulness, psychological and physical health, age, and yoga experience on self-compassion, and $\gamma_{10}$ to $\gamma_{06}$ represent the average strength of the within-person influences (i.e., daily yoga practice, mindfulness, psychological and physical health, weekend, and day in study) on daily self-compassion. $u_{0i}$ and $u_{1i}$ represent individual-level residual deviations that are uncorrelated with the day-level residuals $e_{d_i}$. For parsimony, the remaining residual deviations (i.e., $u_{2i}$ to $u_{6i}$) for mindfulness, psychological and physical health, weekend, and day in study sequence were treated as unconditional fixed effects. The duration of yoga practice was natural log transformed, and was the only transformed variable due to
skewness (2.58). Transformed values were used to calculate correlations and to estimate parameters in the multilevel models examining the continuous yoga practice (minutes) variable.

**Multilevel Mediation Analysis**

To empirically test the intra- to interpersonal pathways proposed in the conceptual framework developed in the initial study (Ch.2), a second series of multilevel models were tested to examine the possible mediating roles of mindfulness and self-compassion in the between- and within-person relations linking yoga and the interpersonal outcomes (i.e., compassion and social connectedness). As all variables of interest were measured at the daily level (i.e., Level-1), 1-1-1 multilevel mediation models were estimated at the within-subjects level. In Figure 3.2., the top panel illustrates a single-level mediation whereas the bottom panel depicts the 1-1-1 multilevel mediation model of the present analysis. In single-level mediation, paths $a$, $b$, and $c'$ are assumed to be fixed effects across all persons $i$. In multilevel mediation models however, it is possible for these effects to vary from person to person as represented in the circled random effects of the $a$, $b$, and $c'$ fixed effect path coefficients (Figure 1, bottom panel, 1-1-1 multilevel model). When both slopes in the $a$ and $b$ paths are random, the calculation and inferential test of the indirect or mediated effect must account for the covariance of the $a$ and $b$ random effects (see for example: Bauer, Preacher, & Gil, 2006), and will be different than the sum of $ab + c'$ as in classic mediation analysis. As random effects were not of central concern in the present analyses however, we focused on the indirect effects (product of the $a$ and $b$ paths) to test the mediating pathways.

Current recommendations were followed that place emphasis on the higher power direct test of the indirect effect for demonstrating mediation (MacKinnon, Fairchild, & Fritz, 2007). Because traditional approaches in testing multilevel mediation using hierarchical linear modeling are prone to confounding within-group effects with between-group effects, the suggested principles outlined in Zhang, Zyphur, & Preacher (2008) were used to appropriately test multilevel mediation at both the
between- and within-person levels. To provide a specific illustration, the following analyses tested whether daily yoga practice (X) indirectly influenced daily social connectedness (Y) through the enhancement of daily mindfulness (M):

**Level-1:** Daily Mindfulness\(_{di}\) = \(\beta_0 + \beta_1\text{(Daily Yoga Practice}_{di}) + e_{di}\)  \(\ldots(6)\)

**Level-2:** \(\beta_0 = \gamma_{00} + \gamma_{01}\text{(Overall Yoga Practice}_{i}) + u_{0i}\)  \(\ldots(7)\)

\[\beta_1 = \gamma_{10} + u_{1i}\]  \(\ldots(8)\)

**Level-1:** Daily Social Connectedness\(_{di}\) = \(\beta_0\text{DSC}_{i} + \beta_2\text{(Daily Yoga Practice}_{di})\)

\[+ \beta_3\text{(Daily Mindfulness}_{di}) + e_{di}\]  \(\ldots(9)\)

**Level-2:** \(\beta_0\text{DSC}_{i} = \gamma_{00\text{DSC}} + \gamma_{02}\text{(Overall Yoga Practice}_{i}) + \gamma_{03}\text{(Overall Mindfulness}_{i})\)

\[+ u_{0\text{DSC}_{i}}\]

\[\beta_2 = \gamma_{11} + u_{2i}\]  \(\ldots(11)\)

\[\beta_3 = \gamma_{21} + u_{3i}\]  \(\ldots(12)\)

The first set of equations (6-8) predicts the mediator, daily mindfulness from daily yoga practice (i.e., path \(a\)). The second set of equations (9-12) then estimates the path of daily mindfulness predicting daily social connectedness while controlling for daily yoga practice (paths \(b\) & \(c'\), respectively). After fitting these two sets of models, the within-person indirect effect \((ab)\) was estimated as the product of \(\gamma_{10}\) from equation (8) and \(\gamma_{21}\) from equation (12). Similarly, the indirect effects of the between-person effects were estimated from the product of \(\gamma_{01}\) from equation (7) and \(\gamma_{02}\) from equation (10).
In order to make inferential conclusions about the $ab$ path, the Monte Carlo bootstrapping procedure was utilized to test the significance of the indirect effect with 20,000 replications to make inferential conclusions about the $ab$ path. Monte Carlo simulation is a simple yet powerful technique, and the appropriate between- and within- coefficients were used to generate separate confidence intervals appropriate for each level of analysis (Preacher & Selig, 2012).

**Results**

Characteristics of study participants are depicted in Table 3.1. Participants were on average 41.7 years old ($SD=16.1$ yrs; Range: 18 – 76 yrs), consisting of a predominantly non-Hispanic white (88.5%), Female (92.3%), and well-educated (78.9% college graduate) sample. Practitioners represented a wide range in yoga experience; however, on average, they had been practicing yoga for 8.23 years ($SD=7.15$ yrs; Range: 0.33 – 40 yrs). Many styles and types of yoga practice were represented (e.g., Hatha, Iyengar, Bikram, Ashtanga). Participants completed surveys for a total of 2,059 of the 2,184 possible person days (94.3% completion rate) to be included in the analysis. Out of the 1,035 times that yoga was practiced across participants and throughout the 21 day period (% of yoga days), studio practice occurred 42.7% of the time, home practice 49.3% of the time, and 8% in a different context (e.g., outdoors, YMCA, yoga room at the airport). On average, participants practiced yoga on 9.41 days ($SD=4.53$ days; Range 2 – 21 days) out of the 21-day period (approximately 2.23 times a week). The total number of yoga practice days during the study was normally distributed, with the majority of participants (58.2%) within the 7-14 days, 26.3% were on the low end (<7 days), and the remaining participants were avid practitioners (15.5%) practicing more than 14 days out of the 21 days.

Descriptives, intraclass correlations (ICCs), and correlations are presented in Table 3.2. On yoga practice days, participants practiced yoga for approximately 50.08 minutes ($SD=39.47$). Overall, participants demonstrated moderate to high levels of mindfulness ($M=64.53$, $SD=19.24$), self-
compassion ($M=65.06, \text{SD}=23.25$), and compassion ($M=67.07, \text{SD}=21.77$), with the highest
between-person means observed in social connectedness ($M=81.59, \text{SD}=16.09$), all assessed on a 0-
100 scale. ICC estimates indicated more than half of the variability in the duration of yoga practice
(i.e., on yoga practice days) to be attributed to within-person differences (66.2%, ICC=0.34), with all
of the intra- and interpersonal outcomes of interest demonstrating substantial within-person
variability. Table 3.2 presents between-person correlations (i.e., correlations between each
individual’s average rating of variables throughout the 21-days; above diagonal), and within-person
correlations (correlations between each day’s rating of variables; below diagonal).

**Daily Yoga Practice predicting Intra- and Interpersonal Outcomes**

Unstandardized parameter estimates from the multilevel models predicting the intra- and
interpersonal outcomes are presented in Table 3.3 (dichotomous yoga practice variable (Y/N)) and
3.4 (continuous yoga practice variable (minutes)). Below, we present coefficients from the
continuous yoga practice variable. However, results which were inconsistent across the dichotomous
and continuous yoga practice variable are also reported for each outcome.

**Mindfulness.** Unstandardized parameter estimates from the multilevel models predicting
mindfulness are presented in Table 3.3 and 3.4 (See columns M1). Model 1 regressed daily
mindfulness on self-reported yoga practice and the remaining covariates. Both a within- ($\gamma_{10}=2.93,$
$SE=0.39, p<.05$), and between-person association ($\gamma_{01}=7.39, SE=2.44, p<.05$) between yoga
practice and mindfulness emerged, such that on days when an individual practiced more yoga than
their usual, greater mindfulness was reported (within; i.e., based on parameter estimates, for every
five additional minutes of yoga practice, practitioners reported a 0.27 increase in mindfulness). And
practitioners practicing more yoga overall reported greater mindfulness in comparison to
practitioners practicing less yoga overall. This between-person association did not emerge in the
multilevel model utilizing the dichotomous yoga practice variable such that no differences were
found in mindfulness between more and less frequent yoga practitioners ($\gamma_{01} = 6.63, SE = 4.24, p = .12$). Daily and overall yoga practice explained 3.7% and 12.9% of the variance in mindfulness, as calculated by the pseudo-$R^2$ statistic. A significant random slope for daily yoga practice ($\sigma^2_{u1} = 3.83, SE = 2.02, p < .05$) also arose, indicating the within-person effect of daily yoga practice on mindfulness varied across practitioners. The random effect indicated 93.3% of practitioners had a positive relation between yoga practice and mindfulness (95% CI of slope 0.98, 6.84). The final predictive model for mindfulness was determined by a log likelihood ratio test ($X^2(1) = 5.5, p < .05$), which included the random slope for daily yoga practice.

Positive relations were also found linking mindfulness and psychological health at both the daily ($\gamma_{30} = 0.29, SE = 0.02, p < .05$) and overall ($\gamma_{03} = 0.50, SE = 0.09, p < .05$) level. That is, on days when practitioners reported greater psychological health than their usual, practitioners reported enhanced mindfulness (within), and practitioners with higher psychological health overall reported greater mindfulness in comparison to practitioners with lower psychological health overall (between). A significant association was demonstrated between daily physical health and mindfulness ($\gamma_{40} = 0.05, SE = 0.02, p < .05$); however, the between-person effect of overall physical health on mindfulness was nonsignificant such that no differences in overall physical health was observed in relation to one’s overall physical health. The total between- and within-person variation explained by the final predictive model was 47.9% and 22.3% respectively.

**Self-compassion.** Unstandardized parameter estimates from the multilevel models predicting self-compassion are presented in Table 3.3 and 3.4 (See columns M2). The within-person association between yoga practice and self-compassion was significant, such that on days when an individual practiced more yoga than their usual, greater self-compassion was reported ($\gamma_{10} = 1.45, SE = 0.46, p < .05$). Parameter estimates indicated that for every five additional minutes of yoga practice, practitioners reported a 0.11 increase in self-compassion. As calculated by the pseudo-$R^2$
A significant random slope for daily yoga practice ($\sigma^2_u = 6.28, SE = 2.89, p < .05$) arose, indicating the within-person effect of daily yoga practice on self-compassion varied across practitioners. The random effect demonstrated 71.5% of practitioners had a positive association between yoga practice and daily self-compassion (95% CI of slope 3.61, 6.46). The final predictive model for self-compassion was determined by a log likelihood ratio test ($X^2(1) = 7.9, p < .05$), which included the random slope for daily yoga practice.

Significant associations also emerged linking self-compassion and mindfulness such that on days when participants reported being more mindful than their usual, they reported higher self-compassion ($\gamma_{20} = 0.45, SE = 0.03, p < .05$). Overall trait mindfulness was also associated with greater overall self-compassion ($\gamma_{02} = 0.58, SE = 0.09, p < .05$). Both daily ($\gamma_{30} = 0.28, SE = 0.02, p < .05$) and overall ($\gamma_{03} = 0.32, SE = 0.09, p < .05$) psychological health were also positively associated with self-compassion. That is, on days when practitioners reported greater psychological health than their usual, practitioners reported enhanced self-compassion (within), and practitioners with higher psychological health overall reported greater self-compassion in comparison to practitioners with lower psychological health overall (between). Conversely, no significant associations emerged between physical health (daily and overall) and self-compassion. The total between- and within-person variation explained by the final predictive model was 67.1% and 33.2% respectively.

**Compassion.** Unstandardized parameter estimates from the multilevel models predicting compassion are presented in Table 3.3 and 3.4 (See columns M3). Model 3 examined whether self-reported yoga practice and the remaining covariates predicted greater compassion. The within-person association between yoga practice and compassion was non-significant at the within-person level. However, at the between-person level, a positive and significant association emerged between yoga practice and overall compassion ($\gamma_{01} = 8.01, SE = 3.63, p < .05$), indicating that participants
practicing more yoga overall (across the 21-days) reported greater compassion overall. In this model, the random effect of daily yoga practice was non-significant ($\sigma^2_{u1} = 0.77, SE = 2.67, p = .39$), indicating the daily influence yoga practice on compassion did not vary across practitioners.

Positive and significant associations arose between mindfulness and compassion at both the within- and between-person level. That is, on days when participants reported being more mindful than their usual, they reported enhanced compassion (within: $\gamma_{20} = 0.18, SE = 0.02, p < .05$), and when practitioners reported greater mindfulness overall, they also reported greater compassion overall (between: $\gamma_{02} = 0.51, SE = 0.14, p < .05$). Both daily ($\gamma_{30} = 0.18, SE = 0.02, p < .05$) and overall ($\gamma_{03} = 0.31, SE = 0.14, p < .05$) psychological health were positively associated with compassion. No significant associations emerged between physical health (daily and overall) and compassion. The total between- and within-person variation explained by the final predictive model was 36.6% and 13.1% respectively.

**Social Connectedness.** Unstandardized parameter estimates from the multilevel models predicting social connectedness are presented in Table 3.3 and 3.4 (See columns M4). Model 4 regressed daily social connectedness on self-reported yoga practice and the remaining covariates. The within-person association between yoga practice and social connectedness was non-significant at the within-person level. However, at the between-person level, a positive and significant association emerged between yoga practice (i.e., only with the dichotomous yoga practice variable) and overall social connectedness ($\gamma_{01} = 9.14, SE = 3.88, p < .05$), indicating that participants practicing more yoga practice days overall (across the 21-days) reported greater social connectedness overall. The within-person effect of daily yoga practice on social connectedness did not vary across practitioners ($\sigma^2_{u1} = 0.48, SE = 1.99, p = .41$); hence, the random slope was excluded for parsimony.

Positive and significant associations also emerged linking mindfulness and social connectedness ($\gamma_{20} = 0.25, SE = 0.03, p < .05$), such that on days when practitioners reported being
more mindful than their usual, they also felt a greater sense of connectedness \((within)\). The between-person influence of overall mindfulness on social connectedness was also significant \((\gamma_{02}=0.38, SE=0.09, p<.05)\) demonstrating that practitioners with higher mindfulness overall reported greater social connectedness in comparison to individuals with lower overall levels of mindfulness \((between)\). Both daily \((\gamma_{30}=0.22, SE=0.02, p<.05)\) and overall \((\gamma_{03}=0.55, SE=0.09, p<.05)\) psychological health were positively associated with social connectedness. No significant relations were found between physical health (daily and overall) and social connectedness. The total between- and within-person variation explained by the final predictive model was 58.3% and 19.3% respectively.

**Multilevel Mediation Analysis of Yoga Practice and Interpersonal Outcomes**

1-1-1 multilevel mediation models testing both the dichotomous yoga practice (Y/N) variable and the continuous yoga variable (minutes) demonstrated consistent results. Accordingly, coefficients from the continuous yoga variable (minutes) are reported below, and in Table 3.5.

**Role of Mindfulness as a Mediator.** The first set of multilevel mediation analyses examined whether yoga had an indirect effect on compassion through enhancements in mindfulness. Results from the analyses are presented in Table 3.5. A positive and significant association between yoga practice and mindfulness emerged at both the within- \((\gamma_{10}=2.88, SE=0.34, p<.05)\) and between-person level \((\gamma_{01}=7.38, SE=2.44, p<.05)\). Mindfulness demonstrated both a within- \((\gamma_{21}=0.18, SE=0.03 p< .05)\) and between-person effect \((\gamma_{03}=0.51, SE=0.14, p< .05)\) on compassion. The indirect effect of daily yoga practice on compassion at the within-person level was 0.53 \((p<.05; 95\% \text{ CI } [0.34, 0.75])\). That is, on days when a practitioner practiced more yoga than their average, they reported greater mindfulness, which in turn, was associated with improvements in their levels of compassion. The between person effect was 3.77 \((p<.05; 95\% \text{ CI } [0.98, 7.48])\) demonstrating mindfulness also mediated the yoga and compassion pathway, at the between-person level.
The second set of multilevel mediation analyses examined whether yoga practice
demonstrated an indirect effect on social connectedness through improvements in mindfulness.
Results from analyses are presented in Table 3.5. Daily yoga practice demonstrated a positive and
significant association with mindfulness at both the within- ($\gamma_{10} = 2.88, SE=0.34, p< .05$) and
between-person level ($\gamma_{01} = 7.38, SE=2.44, p = .05$). Mindfulness was also positively and significantly
linked to social connectedness both at the within- ($\gamma_{21} = 0.25, SE=0.03, p< .05$) and between-person
level ($\gamma_{02} = 0.38, SE=0.09, p< .05$). The indirect effect of daily yoga practice on social connectedness
at the within-person level was 0.72 ($p< .05$; 95% CI [0.51, 0.96]), indicating that on days when a
practitioner practiced more yoga than their usual, they reported greater mindfulness, which was
associated with enhancements in social connectedness. The between-person effect was 2.80 ($p< .05$;
95% CI [0.83, 5.44]), indicating mindfulness also mediated the yoga and social connectedness
pathway at the between-person level.

**Role of Self-compassion as a Mediator.** The last set of multilevel mediation analyses
examined whether yoga had an indirect effect on compassion through increased self-compassion.
Results from the analyses are presented in Table 3.6. A positive and significant association between
yoga practice and self-compassion emerged at both the within- ($\gamma_{10} = 2.73, SE=0.40, p< .05$) and
between-person level ($\gamma_{01} = 6.17, SE=2.51 p< .05$). Self-compassion indicated a within-person effect
on compassion ($\gamma_{21} = 0.17, SE=0.02, p< .05$), and the between-person effect was non-significant
($\gamma_{03} = 0.15, SE=0.15, p=0.31$). The indirect effect of daily yoga practice on compassion at the within-
person level was 0.47 ($p< .05$; 95% CI [0.30, 0.67]), demonstrating that when a practitioner practiced
more yoga than their usual, greater self-compassion was reported, which in turn was linked to
improvements in compassion. The between-person effect (0.94) was not significant, with the CIs
overlapping with zero (95% [-0.86, 3.38]). Simplified, cross sectional diagrams of the 1-1-1 and person-level mediation models can be found in Figure 3.3 and 3.4.

**Discussion**

The present study was the first intensive longitudinal study to examine the influences of yoga practice on the understudied relational outcomes of mindfulness, (self-)compassion and social connectedness in yoga practitioners with a diverse range of yoga experience. Given that in general, yoga research has been dominated by controlled experimental studies in lab-based settings, a particular strength of the current work was the use of a community-dwelling sample, which suggests results reflect “shared experiences” of yoga practitioners of varying backgrounds (i.e., in terms of yoga experience, style, and age), suggesting the unfolding of one’s yoga practice in an ecological, real world setting. The methodological approach taken in this work also helped to characterize the day-to-day variability in these key relational variables of interest. Collectively, findings demonstrated substantial within-person variability in the relational (intra- and interpersonal) outcomes of yoga and support the notion that practitioners can reap relational benefits from yoga practice (both daily and overall), which may be facilitated by yoga’s effects on intrapersonal resources; namely, mindfulness and self-compassion.

First, a positive within-person association emerged between yoga practice and self-compassion, such that on days when practitioners engaged in more yoga than their usual, enhancements in self-compassion were also found. Qualitative studies have highlighted the ways in which yoga practice serves as a self-care strategy for practitioners (Kinser et al., 2013; Ross et al., 2014), including, the qualitative results presented in study 1 (Chapter 2). The present findings support this notion of yoga as a practice that may generate greater kindness towards oneself, adding to the current evidence base (Conboy et al., 2010; Crews et al., 2016; Gard et al., 2012). It should be noted however, that the measure of self-compassion used here reflects only selected self-kindness
items, but not mindfulness and common humanity items, as is the case in the SCS-SF instrument by Raes et al. (2011) and conceptualization of this construct according to Neff (Neff, 2003). Perhaps that is why the strength of the yoga and self-compassion association in this study was modest, at least at the daily level (although pseudo-$R^2$ values warrant careful interpretation; Singer & Willet, 2003). Still, over time, these daily-level influences from yoga practice, may help practitioners garner a steady diet of self-compassion, helping them obtain a self-compassionate nature, which, may translate not only to enhanced health and wellbeing, but also extend positively to healthy interpersonal relationships.

Results from the self-compassion literature have consistently shown a negative association of self-compassion with depression, anxiety, rumination, and self-criticism (Neff, 2003; Neff, Kirkpatrick, & Rude, 2007). Yoga may therefore be a promising and accessible tool that can specifically tap onto an individual’s kindness towards themselves, with potentially, far reaching consequences on their health and wellbeing. It should be recognized interventions have been developed to specifically foster compassion (e.g., Neff’s Mindful self-compassion program, and Gilbert’s (2005) compassionate-focused therapy; Gilbert, 2009; Neff & Germer, 2013). Yet, in general, these programs are less accessible to the general population, and offer less flexibility to participants (i.e., different styles, types, as in yoga practice). Given yoga’s rising popularity, as well as the numerous health benefits that have been documented with practice, it is encouraging to note self-kindness is yet another resource that can be cultivated. Moreover, yoga may serve as an alternative modality for clinical populations, or for individuals who may be unresponsive to other structured programs. For instance, the movement-based nature of yoga (which allows the body to serve as a vehicle to access one’s mind) and implicit attention to cultivate a compassionate attitude may prove more effective and suitable to specific individuals or subgroups (e.g., in depressed and anxious persons, self-compassion has been perceived to be inaccessible, or difficult to embrace;
Pauley & McPherson, 2010). It is also interesting to consider these findings in light of other research that typically demonstrates greater impact of yoga (as a movement-based practice cultivating mindfulness) on reduction of psychological symptoms as compared to other contemplative practices (e.g., body scan and sitting meditation) (Carmody & Baer, 2008). It may be that the physical/movement, contemplative, and relational aspects of yoga practice reinforce each other to generate more potent psychological effects. This may be particularly meaningful in contexts where enhanced self-compassion can be therapeutic such as when dealing with body image issues where yoga may help practitioners to become more compassionate and loving towards their own bodies (Dittmann & Freedman, 2009; Impett, Daubenmier, & Hirschman, 2006).

With respect to the interpersonal outcomes of compassion and social connectedness, no direct within-person influences emerged from yoga practice. A between-person effect of yoga practice on compassion was demonstrated such that practitioners with a greater overall yoga practice reported greater overall compassion. Interestingly, this between-person association was unique to compassion, and did not emerge for social connectedness. A few studies have indicated compassion to be a means (i.e., a precursor) for generating feelings of closeness and connectedness (Cosley, McCoy, Saslow, & Epel, 2010; Hutcherson, Seppala, & Gross, 2008; Seppala, Rossomando, & Doty, 2008). Hence, it could be that a longer time span is warranted to detect the overall influence of yoga on social connectedness. An experimental study with novice practitioners may help clarify these relations. In addition, as the current sample scored high on social connectedness in general, there may have been a ceiling effect. Perhaps, a multicomponent assessment of social connectedness in future studies may help to better elucidate the influence of yoga on social connectedness, which could also help to tease out the effect of time. It should also be noted the conceptualization of compassion was limited in that it was captured through the mDES (Fredrickson et al., 2003), which is a validated instrument assessing emotions. While compassion is viewed as an emotion which
facilitates intimate bonds with others (Shiota, Keltner, & John, 2006), it has been defined theoretically, and has been perceived qualitatively, to go beyond emotions, translating into actual acts of compassion (Goetz, Keltner, & Simon-Thomas, 2010; Pauley & McPherson, 2010). Accordingly, from the present study, whether yoga practice actually translates to compassionate behaviors (both directly and indirectly) remains to be determined. Because terms such compassion, empathy, and altruism have been used rather interchangeably, future research studies seeking to assess these qualities should invest sufficient time and effort in determining appropriate ways in which to assess these relational outcomes.

Consistently through the study, mindfulness was strongly linked to yoga practice both at the within- and between-person levels. This was perhaps not surprising; given meditative components are integral aspects of the practice (Gard et al., 2014; Salmon, Lush, Jablonski, & Sephton, 2009). In addition, the examination of the indirect pathways provided preliminary evidence to support the notion that one of the mechanisms through which yoga may work to influence one's interpersonal...
domains (here compassion and social connectedness) is through greater mindfulness. The findings corroborate previous results (Chapter 2, Ross et al., 2014), which noted intrapersonal changes taking place prior to interpersonal effects. The central role of mindfulness also bears the question of how dispositional characteristics such as trait mindfulness influence how one benefits from mind-body practices including yoga. For instance, it could be speculated trait mindfulness may potentially be a moderator that can account for the random effect which arose for the within-person association between yoga practice and self-compassion, especially given Neff’s work which states mindfulness is a necessary precursor of self-compassion (Neff & Dahm, 2013). While the current work did not assess any of the key personality traits (e.g., Big-Five personality traits), previous research has indicated openness to positively influence the use of complementary and alternative medicine use (Honda & Jacobson, 2005). Consequently, examining personality traits, or other potential moderators (e.g., gender, context of practice, style of yoga) will be a meaningful step for future work to better understand for whom and when yoga practice may have the maximum impact on relational outcomes, thus aiding in the optimization and tailoring of intervention programs.

Clearly, additional research is warranted to replicate (or refute) current findings and to further examine the potential relational influences in the context of yoga practice. With respect to studies conducted in real world settings, researchers may consider obtaining more intensive data (despite the increased participant burden and reactivity that may be associated with it) as a means to not only “fine-tune” sequencing of effects (e.g., does yoga practice lead to greater self-compassion, or does being more self-compassionate lead to yoga practice?) and mechanisms, but to also examine how long the effects from yoga practice are sustained throughout one’s day. Research which also carefully examines the interpersonal context (i.e., where people spend the majority of their lives) in which these variables operate will also be crucial as it has been observed as a limitation of previous
research on psychological processes and wellbeing (Fincham & Beach, 2010; McNulty & Fincham, 2012).

Limitations and Future Directions

The results should be interpreted with respect to the following shortcomings. In particular, as this was the first intensive longitudinal study investigating relational outcomes of yoga, limited empirical evidence was available to help guide study design (e.g., duration of study, time scale of assessments). The present study thus provides preliminary empirical basis for designing future intensive longitudinal studies examining the effects of yoga on comparable outcomes, especially given the substantial variability that was observed across the 21-day period. Another limitation of this work lies in the observational, concurrent nature of the work, which precludes any conclusions about the causality of these associations (Stone-Romero & Rosopa, 2008). Future studies should carefully consider their outcomes of interest and adjust the frequency of assessment (i.e., appropriate timescale) to best meet their objectives. In a similar vein, as this study was observational in nature, a subsequent step would be to test whether the direct and indirect pathways hold true in a controlled experimental context.

While it is clear intensive longitudinal studies can enrich the repertoire of research inquiries that can be addressed and provide ecological validity, perhaps, a warranted step (one, which is often neglected in intensive longitudinal methods, but one, which can lay the important groundwork for future studies) that can enhance the rigor of contemplative sciences literature overall, is to establish reliable instruments that can accurately assess these relational variables in shorter time scales and with repeated assessments (i.e., daily, momentary). In fact, the within-person reliabilities observed in the present study were in the low to moderate range (although, what is considered to be a valid within-person reliability value in ILD is still debatable, and this is an issue which requires systematic work in the field in general). While this may have partially been due to the low number of items that
were employed to reduce participant burden and maximize compliance, it could be that a few additional items are needed to more accurately capture these relational constructs.

Another methodological limitation of this work lies in the multilevel mediational approach that was utilized. It has been noted multilevel modeling fails to separate variability in time-varying predictors (i.e., both the predictor and the mediator in the 1-1-1 model) into daily and individual levels, which creates confounding as it cannot fully separate the between- and within-person effects without introducing bias. Using the recommendations put forth by Zhang et al. (2008) however, the issues with confounding across levels were addressed. Yet, multilevel structural equation modeling (Preacher, Zyphur, & Zhang, 2010) is an alternative approach (with flexibility), that could be considered for future work.

Finally, generalizability of findings is clearly restricted due to the homogeneity of the present sample, who were predominantly Caucasian, female, and of high socioeconomic status. While this reflects the demographics of yoga practitioners in the United States (and users of CAM in general; Birdee et al., 2008; Ross, Friedmann, Bevans, & Thomas, 2013), it will be imperative for future yoga research to expand the sample pool to include a diversity of healthy and clinical populations, especially as the acceptability of yoga continues to grow and expand; encouragingly, even amongst those with diverse cultural backgrounds (Ho, Nguyen, Liu, Nguyen, & Kilgore, 2015; Middleton et al., 2013).

Implications and Conclusions

In summary, although the daily influences of yoga still need to be examined amongst novice yoga practitioners (i.e., participants in the present study were regular yoga practitioners; defined, as practicing yoga at least once a week) and in other subgroups; it appears that with sustained practice, positive relational benefits can be garnered, both at the intra- and interpersonal level. While experimental evidence is warranted as a subsequent step, current findings re-emphasize the promise
of yoga as a holistic practice, which is associated with the often-highlighted physical and psychological benefits (Hendriks et al., 2017; Hofmann et al., 2016; Raub, 2002; Uebelacker et al., 2010; Woodyard, 2011b), but also, with relational benefits, which have been understudied. Encouragingly, for regular yoga practitioners, the positive within-person influences that emerged from the current work suggest yoga practice can make an individual better relate to oneself and to others, even, through a day’s practice.
References


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https://www.mindandlife.org/1440-grants/1440-grants/


Table 3.1. Participant characteristics for the Daily OM Study

<table>
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<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>41.7</td>
<td>16.1</td>
<td>18 – 76</td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td>25.00</td>
<td>4.93</td>
<td>17.8 – 44.0</td>
</tr>
<tr>
<td><strong>Yoga Experience (yrs)</strong></td>
<td>8.23</td>
<td>7.15</td>
<td>0.33 – 40</td>
</tr>
<tr>
<td><strong>Home Practice</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Times per week</td>
<td>2.46</td>
<td>2.00</td>
<td>0 - 7</td>
</tr>
<tr>
<td>Average Duration</td>
<td>29.25</td>
<td>32.23</td>
<td>0 - 105</td>
</tr>
<tr>
<td><strong>In-class (e.g., studio)practice</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Times per week</td>
<td>2.03</td>
<td>1.54</td>
<td>0 - 7</td>
</tr>
<tr>
<td>Average Duration</td>
<td>69.39</td>
<td>32.23</td>
<td>0 - 180</td>
</tr>
<tr>
<td><strong>Frequency of Studying Yoga</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philosophy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 times a week or more</td>
<td>7.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – 8 times per month</td>
<td>37.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than once per month</td>
<td>32.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>22.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Type/Style of Yoga Practice</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hatha Yoga</td>
<td>39.43%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iyengar</td>
<td>8.41%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bikram</td>
<td>6.59%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triyoga</td>
<td>5.02%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>4.16%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ashtanga</td>
<td>3.82%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kripalu</td>
<td>3.36%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kundalini</td>
<td>3.36%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vinyasa</td>
<td>3.31%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>22.54%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Education (college graduate)</strong></td>
<td>78.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Income (earning above&gt;$75,000)</strong></td>
<td>37.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>43.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part-time</td>
<td>30.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Married/domestic partnership</td>
<td>47.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (Female)</td>
<td>92.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexual Orientation (Heterosexual)</td>
<td>93.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity (White/Caucasian)</td>
<td>88.5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Participants were asked to indicate the type or style of yoga practice they most often engaged in. Participants who did not know specifically the type or style of yoga generally indicated Hatha Yoga.
Table 3.2. Descriptives, intraclass correlations, and correlations of yoga practice (minutes) and relational outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>ICC</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Yoga Practice (minutes)</td>
<td>50.08</td>
<td>39.47</td>
<td>0-150</td>
<td>0.34</td>
<td>-</td>
<td>0.13</td>
<td>0.18</td>
<td>-0.08</td>
<td>0.16</td>
</tr>
<tr>
<td>2. Mindfulness</td>
<td>64.53</td>
<td>19.24</td>
<td>21.5-100</td>
<td>0.38</td>
<td>0.20</td>
<td>-</td>
<td>0.63</td>
<td>0.21</td>
<td>0.34</td>
</tr>
<tr>
<td>3. Self-compassion</td>
<td>65.06</td>
<td>23.25</td>
<td>8-100</td>
<td>0.38</td>
<td>0.14</td>
<td>0.62</td>
<td>-</td>
<td>0.29</td>
<td>0.36</td>
</tr>
<tr>
<td>4. Compassion</td>
<td>67.07</td>
<td>21.77</td>
<td>4.5-100</td>
<td>0.48</td>
<td>0.04</td>
<td>0.39</td>
<td>0.31</td>
<td>-</td>
<td>0.34</td>
</tr>
<tr>
<td>5. Social connectedness</td>
<td>81.59</td>
<td>16.09</td>
<td>31.5-100</td>
<td>0.39</td>
<td>0.05</td>
<td>0.46</td>
<td>0.40</td>
<td>0.47</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* Means and standard deviations represent person-level descriptives. ICC represents the proportion of between-person variability. Coefficients above the diagonal represent between-person correlations, and coefficients below the diagonal reflect within-person, across-day correlations. In the above table, yoga practice represents yoga practice days (i.e., on days when yoga was practiced).
Table 3.3. Multilevel models predicting mindfulness, (self-)compassion, and social connectedness with the dichotomous yoga practice (Y/N) variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fixed effects</th>
<th>M1 Mindfulness</th>
<th>M2 Self-Compassion</th>
<th>M3 Compassion</th>
<th>M4 Social Connectedness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>60.36*(2.24)</td>
<td>66.80*(1.99)</td>
<td>57.54*(3.17)</td>
<td>76.29*(2.08)</td>
<td></td>
</tr>
<tr>
<td>Overall yoga practice (Y/N), $\gamma_{01}$</td>
<td>6.63 (4.24)</td>
<td>0.78 (3.79)</td>
<td>15.04*(5.98)</td>
<td>9.14*(3.88)</td>
<td></td>
</tr>
<tr>
<td>Daily yoga practice (Y/N), $\gamma_{10}$</td>
<td>4.72*(0.64)</td>
<td>2.66*(0.75)</td>
<td>0.45 (0.74)</td>
<td>-0.17 (0.66)</td>
<td></td>
</tr>
<tr>
<td>Overall mindfulness, $\gamma_{02}$</td>
<td>—</td>
<td>0.59*(0.09)</td>
<td>0.51*(0.14)</td>
<td>0.36*(0.09)</td>
<td></td>
</tr>
<tr>
<td>Daily mindfulness, $\gamma_{20}$</td>
<td>—</td>
<td>0.45*(0.02)</td>
<td>0.18*(0.03)</td>
<td>0.25*(0.03)</td>
<td></td>
</tr>
<tr>
<td>Overall psychological health, $\gamma_{03}$</td>
<td>0.51*(0.09)</td>
<td>0.30*(0.09)</td>
<td>0.31*(0.14)</td>
<td>0.56*(0.09)</td>
<td></td>
</tr>
<tr>
<td>Daily psychological health, $\gamma_{30}$</td>
<td>0.29*(0.02)</td>
<td>0.27*(0.02)</td>
<td>0.18*(0.2)</td>
<td>0.22*(0.02)</td>
<td></td>
</tr>
<tr>
<td>Overall physical health, $\gamma_{04}$</td>
<td>0.11 (0.08)</td>
<td>0.003 (0.07)</td>
<td>-0.20 (0.12)</td>
<td>-0.28*(0.02)</td>
<td></td>
</tr>
<tr>
<td>Daily physical health, $\gamma_{40}$</td>
<td>0.05*(0.02)</td>
<td>-0.02 (0.02)</td>
<td>0.01 (0.02)</td>
<td>0.03 (0.02)</td>
<td></td>
</tr>
<tr>
<td>Age, $\gamma_{05}$</td>
<td>0.08 (0.06)</td>
<td>0.02 (0.05)</td>
<td>0.07 (0.08)</td>
<td>0.05 (0.05)</td>
<td></td>
</tr>
<tr>
<td>Yoga Experience, $\gamma_{06}$</td>
<td>0.04 (0.14)</td>
<td>-0.20 (0.12)</td>
<td>0.10 (0.19)</td>
<td>-0.04 (0.12)</td>
<td></td>
</tr>
<tr>
<td>Weekend, $\gamma_{50}$</td>
<td>1.58*(0.57)</td>
<td>1.23*(0.62)</td>
<td>-0.60 (0.72)</td>
<td>0.42 (0.64)</td>
<td></td>
</tr>
<tr>
<td>Day in Study, $\gamma_{60}$</td>
<td>0.05 (0.04)</td>
<td>0.07*(0.05)</td>
<td>-0.20*(0.05)</td>
<td>-0.14*(0.05)</td>
<td></td>
</tr>
</tbody>
</table>

Random effects

| Intercept, $\sigma^2_{u0}$ | 70.50 (11.26) | 44.77*(8.03) | 138.91*(21.46) | 167.19*(5.37) |
| Daily yoga practice, $\sigma^2_{u1}$ | 12.01*(5.88) | 16.23*(6.86) | —              | —             |
| Residual variance, $\sigma^2_e$ | 128.83*(4.24) | 154.20*(5.08) | 209.78*(6.74) | 167.19*(5.37) |

$-2LL$ | 16062.1 | 16396.5 | 17053.3 | 16520.5 |

$AIC$ | 16068.1 | 16402.5 | 17057.3 | 16524.5 |

Note. Unstandardized estimates and standard errors. Coefficients for daily yoga practice represents parameter estimates from transformed scores. $-2LL = -2$ Log Likelihood, $AIC= Akaike Information Criterion. *p < .05$
Table 3.4. Multilevel models predicting mindfulness, (self-)compassion, and social connectedness with the continuous yoga practice (minutes) variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>M1 Mindfulness</th>
<th>M2 Self-compassion</th>
<th>M3 Compassion</th>
<th>M4 Social Connectedness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, ( \gamma_{00} )</td>
<td>65.72*(0.98)</td>
<td>68.47*(0.90)</td>
<td>64.93*(1.36)</td>
<td>80.59*(0.96)</td>
</tr>
<tr>
<td>Overall yoga practice (minutes), ( \gamma_{01} )</td>
<td>7.39*(2.44)</td>
<td>1.87 (2.17)</td>
<td>8.01*(3.63)</td>
<td>3.70 (2.36)</td>
</tr>
<tr>
<td>Daily yoga practice (minutes), ( \gamma_{10} )</td>
<td>2.93*(0.39)</td>
<td>1.45*(0.46)</td>
<td>0.20 (0.44)</td>
<td>-0.01 (0.39)</td>
</tr>
<tr>
<td>Overall mindfulness, ( \gamma_{02} )</td>
<td>—</td>
<td>0.58*(0.09)</td>
<td>0.51*(0.14)</td>
<td>0.38*(0.09)</td>
</tr>
<tr>
<td>Daily mindfulness, ( \gamma_{20} )</td>
<td>—</td>
<td>0.45*(0.03)</td>
<td>0.18*(0.02)</td>
<td>0.25*(0.03)</td>
</tr>
<tr>
<td>Overall psychological health, ( \gamma_{03} )</td>
<td>0.50*(0.09)</td>
<td>0.32*(0.09)</td>
<td>0.31*(0.14)</td>
<td>0.55*(0.09)</td>
</tr>
<tr>
<td>Daily psychological health, ( \gamma_{30} )</td>
<td>0.29*(0.02)</td>
<td>0.28*(0.02)</td>
<td>0.18*(0.02)</td>
<td>0.22*(0.02)</td>
</tr>
<tr>
<td>Overall physical health, ( \gamma_{04} )</td>
<td>0.09 (0.09)</td>
<td>-0.009 (0.07)</td>
<td>-0.22 (0.22)</td>
<td>-0.28 (0.08)</td>
</tr>
<tr>
<td>Daily physical health, ( \gamma_{40} )</td>
<td>0.05*(0.02)</td>
<td>-0.02 (0.02)</td>
<td>0.01 (0.02)</td>
<td>0.03 (0.38)</td>
</tr>
<tr>
<td>Age, ( \gamma_{05} )</td>
<td>0.08 (0.06)</td>
<td>0.02 (0.05)</td>
<td>0.07 (0.08)</td>
<td>0.05 (0.05)</td>
</tr>
<tr>
<td>Yoga Experience, ( \gamma_{06} )</td>
<td>0.01 (0.13)</td>
<td>-0.18 (0.11)</td>
<td>0.11 (0.19)</td>
<td>-0.03 (0.12)</td>
</tr>
<tr>
<td>Weekend, ( \gamma_{50} )</td>
<td>1.54*(0.56)</td>
<td>1.15 (0.62)</td>
<td>-0.62 (0.73)</td>
<td>0.44 (0.64)</td>
</tr>
<tr>
<td>Day in Study, ( \gamma_{60} )</td>
<td>0.04 (0.04)</td>
<td>0.06 (0.05)</td>
<td>-0.20 (0.05)</td>
<td>-0.14 (0.05)</td>
</tr>
<tr>
<td>Random effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, ( \sigma^2_{u0} )</td>
<td>68.94*(10.80)</td>
<td>46.71*(7.88)</td>
<td>141.67* (21.86)</td>
<td>55.71*(9.22)</td>
</tr>
<tr>
<td>Daily yoga practice, ( \sigma^2_{u1} )</td>
<td>3.83*(2.02)</td>
<td>6.28*(2.89)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Residual variance, ( \sigma^2_e )</td>
<td>128.17*(4.21)</td>
<td>154.64*(5.10)</td>
<td>209.91*(6.74)</td>
<td>167.21*(5.37)</td>
</tr>
<tr>
<td>-2LL</td>
<td>16040.6</td>
<td>16387.9</td>
<td>17041.8</td>
<td>16509.6</td>
</tr>
<tr>
<td>AIC</td>
<td>16046.6</td>
<td>16393.9</td>
<td>17045.8</td>
<td>16513.6</td>
</tr>
</tbody>
</table>

Note. Unstandardized estimates and standard errors. Coefficients for daily yoga practice represents parameter estimates from transformed scores. -2LL = -2 Log Likelihood, AIC= Akaike Information Criterion. *p< .05
Table 3.5. 1-1-1 multilevel mediation models with mindfulness as a mediator

<table>
<thead>
<tr>
<th>-fixed effects</th>
<th>Path $a$</th>
<th>Path $b$ and $c'$ (Model 1)</th>
<th>Path $b$ and $c'$ (Model 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept ($\gamma_{00}, \gamma_{00c}$)</td>
<td>65.73*(0.98)</td>
<td>64.93*(1.36)</td>
<td>80.59*(0.96)</td>
</tr>
<tr>
<td>Daily yoga practice (minutes) ($\gamma_{10}, \gamma_{11}$)</td>
<td>2.89*(0.34)</td>
<td>0.20 (0.44)</td>
<td>-0.009 (0.39)</td>
</tr>
<tr>
<td>Daily mindfulness ($\gamma_{21}$)</td>
<td>-</td>
<td>0.18*(0.03)</td>
<td>0.25*(0.03)</td>
</tr>
<tr>
<td>Overall yoga practice (minutes) ($\gamma_{01}, \gamma_{02}$)</td>
<td>7.37*(2.44)</td>
<td>8.01*(3.63)</td>
<td>3.70 (2.36)</td>
</tr>
<tr>
<td>Overall mindfulness ($\gamma_{03}$)</td>
<td>-</td>
<td>0.51*(0.14)</td>
<td>0.38*(0.09)</td>
</tr>
</tbody>
</table>

Random Effects

<table>
<thead>
<tr>
<th>random effects</th>
<th>Coefficient ($SE$)</th>
<th>Coefficient ($SE$)</th>
<th>Coefficient ($SE$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept ($\sigma^2_u, \sigma^2_{u0c}$)</td>
<td>68.80*(10.80)</td>
<td>141.67*(21.86)</td>
<td>55.71*(9.22)</td>
</tr>
<tr>
<td>Residual variance ($\sigma^2_e, \sigma^2_{eC}$)</td>
<td>130.47*(4.19)</td>
<td>209.91*(6.74)</td>
<td>167.21*(5.37)</td>
</tr>
</tbody>
</table>

Note. Unstandardized estimates and standard errors. Coefficients for daily yoga practice represents parameter estimates from transformed scores. Model 1 represents the $b$ and $c'$ path to compassion, Model 2 represents the $b$ and $c'$ path to social connectedness. *$p< .05$
Table 3.6. 1-1-1 multilevel mediation models with self-compassion as a mediator

<table>
<thead>
<tr>
<th></th>
<th>Path $a$</th>
<th>Path $b$ and $c'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed effects</td>
<td>Coefficient ($SE$)</td>
<td>Coefficient ($SE$)</td>
</tr>
<tr>
<td>Intercept ($\gamma_{00}$, $\gamma_{00C}$)</td>
<td>67.75* (1.05)</td>
<td>64.84* (1.42)</td>
</tr>
<tr>
<td>Daily yoga practice (minutes) ($\gamma_{10}$, $\gamma_{11}$)</td>
<td>2.73* (0.40)</td>
<td>0.26 (0.43)</td>
</tr>
<tr>
<td>Daily self-compassion($\gamma_{21}$)</td>
<td>-</td>
<td>0.17* (0.02)</td>
</tr>
<tr>
<td>Overall yoga practice (minutes) ($\gamma_{01}$, $\gamma_{02}$)</td>
<td>6.17* (2.51)</td>
<td>10.87* (3.78)</td>
</tr>
<tr>
<td>Overall self-compassion ($\gamma_{03}$)</td>
<td>-</td>
<td>0.15 (0.15)</td>
</tr>
</tbody>
</table>

Random Effects

<table>
<thead>
<tr>
<th></th>
<th>Coefficient ($SE$)</th>
<th>Coefficient ($SE$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept ($\sigma_{u0}^2$, $\sigma_{u0C}^2$)</td>
<td>70.27* (11.39)</td>
<td>159.76* (24.45)</td>
</tr>
<tr>
<td>Residual variance ($\sigma_e^2$, $\sigma_{eC}^2$)</td>
<td>184.33* (5.92)</td>
<td>208.81* (6.71)</td>
</tr>
</tbody>
</table>

*Note. Unstandardized estimates and standard errors. Coefficients for daily yoga practice represents parameter estimates from transformed scores. *$p < .05$.  

Figure 3.1. CONSORT flow diagram to depict participation in Daily OM Study

Assessed for eligibility ($n=149$)

- Excluded ($n=6$)
  - Did not meet inclusion criteria ($n=6$)
    - Not practicing once/week ($n=4$)
    - No daily Internet access ($n=2$)

Eligible ($n=143$)

- Excluded ($n=23$)
  - Lost interest, lost at follow-up ($n=19$)
  - Injury ($n=2$)
  - Cancel initial lab visit ($n=2$)

Consented and complete baseline questionnaire ($n=120$)

- Excluded ($n=11$)
  - Dropped out after enrollment ($n=9$)
  - Did not complete second lab visit ($n=2$)

Complete final questionnaire ($n=109$)

- Excluded ($n=5$)
  - Dropped out after enrollment ($n=9$)
  - Did not complete second lab visit ($n=2$)

Participants included in data analysis ($n=104$)
Figure 3.2. Illustration of single-level (top panel) and 1-1-1 multilevel mediation (bottom panel) models
Figure 3.3. Simplified cross sectional diagrams of 1-1-1 multilevel mediation and person-level mediation with mindfulness as the mediator.

Within-person Indirect effect = 0.53, [0.34, 0.75], p<.05

Between-person Indirect effect = 3.77, [0.98, 7.48], p<.05
Figure 3.4. Simplified cross sectional diagrams of 1-1-1 multilevel mediation and person-level mediation with self-compassion as the mediator.

Within-person Indirect effect = 0.47, [0.30, 0.67], p<.05

Between-person Indirect effect = 0.94, [0.86, 3.38]
CHAPTER 4. The Impact of Trait Mindfulness on Relational Outcomes in Novice Yoga Practitioners participating in a Yoga Course through an Academic Semester

Abstract

The primary objective of the present study was to examine the role of dispositional mindfulness in impacting the relational benefits of yoga in novice practitioners in an undergraduate academic yoga course. An intensive longitudinal study utilizing a measurement burst design was conducted with 21 college students enrolled in a yoga course throughout a 15-week academic semester. Participants attended lab assessments at the beginning and end of the semester and were asked to complete eight consecutive Internet-based daily surveys across six separate bursts (with seven days of rest in between each burst), which yielded 48 data points for each participant. Within-person analyses were also conducted to examine yoga’s effects across subgroups of participants based on their trait levels of mindfulness. Multivariate time-series analyses revealed within-person subgroup differences such that in general, for those in the low trait mindfulness group yoga practice had negative effects on relational outcomes (social connectedness at burst 1; $\beta_1 = -5.97$, SE = 3.58, $p < .05$, and self-compassion at burst 3; $\beta_2 = -9.26$, SE = 3.21, $p < .05$), whereas those in the high trait mindfulness group gleaned benefits from yoga practice with respect to relational outcomes (self-compassion across bursts 3 and 6; $\beta_3 = 6.55$, SE = 2.57, $p < .05$, and $\beta_7 = 6.55$, SE = 2.18, $p < .05$, respectively, and compassion at burst 2; $\beta_8 = 11.39$, SE = 5.43; $p < .05$). This study demonstrated that trait mindfulness impacts relational outcomes in novice yoga practitioners, suggesting those low in trait mindfulness may not garner immediate relational benefits from yoga and could benefit from additional strategies to bolster against any negative influences of initiating a regular yoga practice. Further studies are needed to better understand the mechanisms of these effects.
The Impact of Trait Mindfulness on Relational Outcomes in Novice Yoga Practitioners participating in a Yoga Course through an Academic Semester

In the past few decades, yoga has become a mainstream form of exercise and stress management, ranking sixth as the most commonly used complementary health practice among U.S. adults based on a 2007 national survey (NCCIH, 2016). Despite the rising popularity of yoga (Clarke, Black, Stussman, Barnes, & Nahin, 2015) and the promise that this mind-body practice holds for numerous health and wellbeing outcomes (e.g., depression, anxiety, stress, cardiovascular health; Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005; Li & Goldsmith, 2012; Riley & Park, 2015; Uebelacker et al., 2010), we still have limited understanding of the “relational” (intra- and interpersonal) benefits that may be derived from yoga. Yoga philosophy, at its core, places emphasis on the importance of improving one’s relationship to oneself and to others (Garfinkel & Schumacher, 2000; Iyengar, 1982), and voluminous research points to the value of interpersonal relationships and positive social functioning to health and wellbeing (Cohen, 2004; Holt-Lunstad, Smith, & Layton, 2010; House, Landis, & Umberson, 1988). Understanding yoga’s relational influences is therefore a line of inquiry deserving of greater attention.

Specifically, through yoga practice, an introspective awareness of one’s body, breath, and emotions, is cultivated – both acutely and in the long-term – which, may facilitate a sense of attunement, openness, and connection to oneself, but also to others (Damasio, 2010; Radford, 2000). In fact, despite the dearth of empirical research investigating the relational benefits of yoga, enhancements in both self-compassion (Conboy, Wilson, & Braun, 2010; Crews, Stolz-Newton, & Grant, 2016; Gard et al., 2012) and compassion (Ross, Bevans, Friedmann, Williams, & Thomas, 2014) have been observed with practice. Practitioners have also commented on improved social connectedness (Chapter 2; Kinser, Bourguignon, Taylor, & Steeves, 2013; Ross et al., 2014; Wertman, Wister, & Mitchell, 2016), and this enhanced sense of connectivity has been proposed to
be a putative mechanism in which yoga works (Mehta, Keshavan, & Gangadhar, 2016); further demonstrating the promise of this mind-body practice to enhance relational domains. Unfortunately however, due to the absence of well-designed and sufficiently powered randomized control trials (RCTs) (Innes & Vincent, 2007; Posadzki & Ernst, 2011; Li & Goldsmith, 2012), the mechanisms of yoga effects, including for whom, when, and how yoga is effective, remains poorly understood; both generally and with respect to relational outcomes more specifically.

Alternative research designs (Collins, Murphy, Nair, & Strecher, 2005; Collins, Murphy, & Strecher, 2007) may offer a means to answer innovative research questions that are either challenging to address through conventional RCTs (e.g., due to requirements for large sample size) or would be helpful in refining RCTs (e.g., by identifying ways to tailor intervention approaches). In particular, the n-of-1 trial, or single case research design (SCDs; Dallery & Raiff, 2014; Molenaar & Campbell, 2009), can be a fruitful means to identify individual differences that may uniquely contribute to how one responds to yoga practice. Indeed, some dispositional characteristics (e.g., personality traits) can impact the extent to which relational benefits are derived from yoga practice, including the size, directionality, or timing of the effects from the intervention (Roth & Fonagy, 2006).

More concretely, the SCD’s main strength lies in obtaining repeated assessments on individuals over time, whereby participants themselves act as their own controls (within-person design) as opposed to one group being compared to another (i.e., intervention versus controls; between-person design). Thus, this approach provides meaningful information on individuals (focus on the intrapersonal, or individual level), which are often masked when obtaining an average effect of a treatment on a group of individuals (focus on the interpersonal, or the level of the population), an approach typically taken in conventional RCTs (Nesselroade & Ram, 2011). Importantly, by tracking individuals over multiple time points, the SCD obtains rich data which allows one to also
pool across subjects, and can therefore identify subgroups that may respond differently to interventions (i.e., high vs. low responders), helping to uncover subject, or group-specificity in the effects of yoga practice.

Utilizing the SCD approach also facilitates detection of modest, but meaningful changes in behavior. For instance, in novice or inexperienced practitioners of yoga, the efficacy of yoga to influence health and wellbeing outcomes (especially, as they relate to relational outcomes such as self-compassion and social connectedness) may take time to develop. More intensive, repeated measures over time may therefore be needed to detect these effects. Given the nature of intensive assessments, these methods also have the potential to characterize the timing of effects to determine a specific time point(s) in which enhancements in the relational outcomes are observed, identifying opportune time windows for intervening or for bolstering intervention effects (e.g., by altering dosage, or through other supplemental strategies).

One moderator, which could impact the extent to which yoga influences relational outcomes, is mindfulness. Mindfulness is defined to be a quality of awareness that is cultivated when an individual is focusing on the present moment with a sense of openness and a nonjudgmental attitude (Kabat-Zinn, 2003). While mindfulness is often referred to as a “state” that is cultivated through contemplative and meditative movement modalities including yoga (Gard, Noggle, Park, Vago, & Wilson, 2014; Larkey, Jahnke, Etnier, & Gonzalez, 2009; Payne & Crane-Godreau, 2013; Salmon, Lush, Jablonski, & Sephton, 2009), it is also an inherent quality, an individual’s disposition. In general, the literature thus far has shown that individuals low in trait mindfulness are less adept in emotion and attention regulation techniques (Arch & Craske, 2010; Creswell, Way, Eisenberger, & Lieberman, 2007; Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007; Schmertz, Anderson, & Robins, 2009), which can have negative consequences on their overall health and wellbeing. With respect to yoga practice, it could thus be that low trait mindful individuals (especially, novice yoga
practitioners initiating regular yoga practice for the first time) may experience challenges and frustrations through yoga, as it is a practice requiring the use of these regulatory skills (Gard et al., 2014). To elaborate, low trait mindful individuals may have a stronger tendency to process sensations in one’s body with judgment or criticism, and instead of being fully present in “the experience” of yoga practice, may be concerned with external factors such as what one looks like while being in the physical postures (i.e., body surveillance, or mentally scanning one’s body from an observer’s perspective; Fredrickson & Roberts, 1997). Or, be distracted by irrelevant thoughts and feelings, finding oneself to be mind-wandering, which has demonstrated opposing relations with dispositional mindfulness (Mrazek, Smallwood, & Schooler, 2012) and has been associated with lower levels of happiness (Killingsworth & Gilbert, 2010).

Conversely, both theory and the existing literature have linked trait and state mindfulness to positive and healthy relational functioning (Barnes, Brown, Krusemark, Campbell, & Rogge, 2007; Brown, Ryan, & Creswell, 2007; Carson et al., 2004). It could therefore be argued that those with higher levels of trait mindfulness could be more open, or ready to gain the relational benefits that could be derived from yoga practice, whereas those with lower levels of trait mindfulness may necessitate more time to observe improvements. To illustrate, in a mindfulness-based stress reduction program (which contains elements of yoga; Shapiro et al. 2011) demonstrated, that although the intervention group fared better overall in comparison to controls, individuals with higher trait mindfulness demonstrated the largest gains in empathy (a characteristic that may specifically play a role in the maintenance of relationships; Davis & Oathout, 1987) one year after treatment. In the context of a yoga program, it is therefore conceivable divergent trajectories may be observed in relational outcomes depending on one’s disposition to be mindful. Whether trait mindfulness similarly moderates the effects of yoga practice on relational outcomes has yet to be tested.
Studies helping to unveil individual differences in the effects of mind-body practices of yoga have been encouraged by the National Center for Complementary and Integrative Health (NCCIH, 2017) to help refine intervention approaches and optimize large-scale RCTs. Identifying individual characteristics (such as trait mindfulness) that may moderate the effects of yoga, in conjunction with unveiling the timing of effects after initiating a yoga program would thus help inform choices about program tailoring, including decisions for proper dosage of an intervention in future studies, including RCTs focused on the relational benefits of yoga. Given the empirical evidence demonstrating the relational benefits of yoga is nascent and scarce, we first take an exploratory step in evaluating the extent to which trait mindfulness determines whether, and when novice yoga practitioners benefit from yoga in terms of relational outcomes in the context of a semester-long undergraduate yoga course. Since the SCD allows for an efficient way of obtaining rich data (well suited for exploratory analysis) and allows to pool across subjects (through novel analytic approaches), we use the SCD approach to examine the effects of yoga practice days on relational variables ((self-)compassion and social connectedness), and test whether these differ by dispositional mindfulness. It was hypothesized that those with high trait mindfulness would reap more gains (and earlier in the program) with respect to the relational outcomes in comparison to their low trait mindful counterparts.

Methods

The present study utilized a SCD with measurement bursts (Sliwinski, 2008) of collecting daily diaries. All participants were treated identically with the protocol consisting of two lab visits and six intensive bursts of data collection (one burst consisting of eight consecutive end-of-day surveys), with seven days of rest in between each burst throughout a semester-long yoga program. The initial burst started on February 1st, 2016, and the final burst (sixth burst) started on April 16th, 2016, spanning a period of 12 weeks across the 15-week academic semester.
Participants and procedures

Participants were undergraduate students at the Pennsylvania State University (University Park campus). To be eligible for the study, participants had to be: (1) at least 18 years of age, and (2) enrolled in a section of KINES077, Yoga I (an introductory yoga course) during the spring 2016 academic semester. The course is an introductory Hatha yoga class which fulfills the health and physical activity (GHA) component of the general education requirements for undergraduate students at the Pennsylvania State University. Participation in the research study was completely voluntary, and not linked to students’ performance in the course. Students were recruited from the Yoga I courses with assistance from the yoga instructors and research assistants who visited all six sections of Yoga I during the first two weeks of the semester. During this limited time window, information about the research study was provided at the beginning of the class period via in-class announcements and small handout flyers. Follow-up recruitment e-mails were also sent out after announcements were made in the class, and the instructors were asked to make additional in-class announcements as a reminder to the students during the recruitment window. Of the 33 initially interested participants, 29 completed screening, 27 consented and completed the first baseline questionnaire. Subsequently, 24 completed the first lab visit and commenced with the first burst (i.e., intensive data collection period). Throughout the six bursts, three participants dropped out due to inability to comply with study procedures. A total of 21 participants completed all six bursts (and were included in the within-person analysis), and 20 participants completed the post-study assessment (See Figure 4.1. for participant flow).

At the introductory lab visit, participants provided informed consent and completed a baseline survey which included demographic and psychosocial questionnaires. During this initial visit, research assistants explained the schedule for the intensive measurement bursts (see Figure 4.2. for measurement burst design). Participants were then instructed on how to access the daily Internet
surveys through a secure website at the end of each day (between 7:00 p.m. and 2:00 a.m.) over the course of the semester. After completion of the final burst, participants returned for a second visit to complete one final psychosocial questionnaire. All procedures were approved by the Institutional Review Board at the local institution.

**Yoga program**

Yoga I is an introductory Hatha yoga course with an overarching objective to enhance physical, mental, and lifelong wellness. While the central emphasis of the course is on the physical postures (i.e., almost all classes include a physical practice), the course provides instruction in the full entirety of yoga practice, including yoga postures, breathing techniques, meditation, philosophy, history, and applied personal practice. All sections met for 150 minutes total per week (across a 15-week academic semester), with some sections meeting three times a week for 50 minutes, and others meeting two times a week for 75 minutes. Throughout the course of the semester, students were also given reading assignments with topics which supplemented in-class material (e.g., introduction to philosophy of yoga). Although these six sections were taught by four different instructors, the course follows corresponding syllabi and content.

**Measures**

**Demographics.** At the initial laboratory visit, basic demographic (e.g., age, gender, race, education, employment) and background information was collected. Body mass index (BMI) was assessed from height and weight obtained in the laboratory using standard procedures.

**Trait Mindfulness.** The mindfulness attention awareness scale (MAAS; Brown & Ryan, 2003), is a 15-item instrument which captures dispositional mindfulness by assessing the opposing construct; mindlessness (e.g., “I find it difficult to stay focused on what’s happening in the present”). The items ask participants to rate the extent to which they function mindlessly in daily life, with a Likert scale ranging from 1 (almost never) to 6 (almost always). A mean rating score is computed across
the 15-titems, with higher scores representing greater mindfulness. The MAAS is a valid instrument of mindfulness, which has demonstrated consistent internal reliability (with Cronbach’s alphas ranging from 0.82 to 0.87; Baer, 2006; Brown & Ryan, 2003). The observed reliability for the MAAS in this sample was 0.86. Subgroups for trait mindfulness were then created to divide participants into tertiles with respect to their baseline MAAS scores (i.e., low, moderate, and high trait mindfulness subgroups).

**Self-compassion.** Self-compassion was assessed using the 12-item Self-Compassion-Scale-Short Form (SCS-SF; Raes, Pommier, Neff, & Van Gucht, 2011). This instrument has demonstrated good psychometric properties and has a near perfect correlation ($r=0.98$) with the original scale (Neff, 2003). Responses are provided on a 5-point Likert scale from 1 (almost never) to 5 (almost always). Cronbach’s alpha was 0.82 and 0.83, respectively.

**Compassion.** The Compassion Scale (CS; Pommier, 2011) is a 24-item instrument which captures the degree of sympathy and concern for others’ suffering. Responses are provided on a Likert-scale from 1 (almost never) to 5 (almost always). In this sample, observed reliabilities were 0.92 and 0.86, respectively.

**Social Connectedness.** The Social Connectedness Scale (SCC-R, Lee & Robbins, 1995) assesses the individuals’ interpersonal closeness with other people (including both friends and society overall). Responses are provided on a Likert-type scale from 1 (strongly disagree) to 6 (strongly agree). Higher scores represent stronger sense of belonging. Observed reliabilities for the SCC-R in the present sample was 0.87 and 0.88, respectively.

**Daily Measures.** Daily self-reported yoga practice and the relational outcomes ((self-)compassion and social connectedness) were assessed during the measurement bursts.

**Yoga practice.** Self-reported yoga practice was assessed from the question, “Did you practice yoga today?” (Yes/No response). If participants indicated yes, follow-up questions asked
about the location (class through yoga course, yoga class outside of the yoga course (e.g., studio, PSU yoga club), home practice) of the yoga practice.

**Daily Self-compassion.** Two items from Neff’s Self-Compassion Scale-Short Form (SCS-SF) were modified to be used for the daily context of the study (i.e., “Today, I gave myself the caring and tenderness I needed.” and “Today, I was disapproving and judgmental about my own flaws and adequacies.”) (Raes et al., 2011) to assess self-compassion. The first item was drawn from the self-kindness subscale, and the second item represented a self-judgment item. Ratings were made on a visual 0-100 scale, with anchors marked as ranging from 0 (strongly disagree) to 100 (strongly agree). The second item was reverse coded, and the mean of these two items were used to represent daily self-compassion. The within-person reliability (Rc) for self-compassion was 0.34. Responses to the two items to assess compassion had within- and between-person correlations of rs = 0.32, and 0.34, respectively.

**Daily Compassion.** Two items from the modified differential emotions scale (mDES; Fredrickson, Tugade, Waugh, & Larkin, 2003) were used to capture compassion. Participants were asked to indicate how often they have felt a combination of emotions throughout the day (three sets of emotions are listed for each overarching emotion in the mDES). For the present work, the emotions, (1) sympathy, concern, compassion and (2) love, closeness, or trust, were combined to obtain a daily compassion score. These two items were combined to create a compassion score due to the fact compassion and love are both primarily emotions that facilitate the development and maintenance of intimate social bonds with others (Bowlby, Ainsworth, & Bretherton, 1992), and previous instruments of compassion include love (i.e., altruistic love) as a component of compassion (Sprecher & Fehr, 2005). Ratings were made on a visual 0-100 scale, with anchors marked as ranging from 0 (not at all) to 100 (very much). The within-person reliability (Rc) for compassion was 0.36.
Responses to the two items to assess compassion had within- and between-person correlations of \( r_s = 0.43 \) and 0.25, respectively.

**Daily Social connectedness.** Two items from the social connectedness scale (i.e., “I was able to relate to the person(s) around me.” and “I felt isolated from others.”)(Lee & Draper, 1995) were used to assess social connectedness. Rating were made on a visual 0-100 scale, with anchors marked as ranging from 0 (strongly disagree) to 100 (strongly agree). The second item was reverse coded, and the mean of these two items were used to represent daily social connectedness. The within-person reliability (\( R_c \)) for social connectedness was 0.66. Responses to the two items to assess social connectedness had within- and between-person correlations of \( r_s = 0.57 \) and 0.55 respectively.

**Data Analysis Approach**

The intensive longitudinal data collected for this present study yielded six bursts of eight consecutive daily surveys, generating multivariate time-series consisting of 48 data points for each participant. The two lab visits including the overall assessments also yielded pre and post assessments on the relational outcomes of interest (i.e., (self-)compassion, and social connectedness) to provide estimates of average pre to post change in the relational outcomes (i.e., estimates of a typical size of effect observed across the 15-week yoga program, values potentially useful for powering future RCT studies).

To examine the daily effect of yoga practice days on relational outcomes, multivariate time-series models were run using a Fortran program developed by Dolan in mkm6 (Dolan, 2010). Considering the relatively short time-series (48 data points) available for each participant, subgroup analyses were employed (i.e., as opposed to \( n=1 \) person-specific analyses) to ensure sufficient power to detect effects. Subgroups were based on participants’ baseline levels of trait mindfulness, reflecting individuals with low, moderate, and high levels of trait mindfulness.
The time-series models across subgroups tested in mkfm6 were as follows:

$$
\begin{pmatrix}
  y_1 (t + 1) \\
  y_2 (t + 1) \\
  y_3 (t + 1)
\end{pmatrix} =
\begin{pmatrix}
  \phi_{11} & \phi_{12} & \phi_{13} \\
  \phi_{21} & \phi_{22} & \phi_{23} \\
  \phi_{31} & \phi_{32} & \phi_{33}
\end{pmatrix}
\begin{pmatrix}
  y_1 (t) \\
  y_2 (t) \\
  y_3 (t)
\end{pmatrix} +
\begin{pmatrix}
  \beta_1 \\
  \beta_2 \\
  \beta_3
\end{pmatrix}z(t) +
\begin{pmatrix}
  \epsilon_1 (t + 1) \\
  \epsilon_2 (t + 1) \\
  \epsilon_3 (t + 1)
\end{pmatrix}
$$

Where $z(t)$ represents yoga practice days (yes/no) and $\beta_1$, $\beta_2$, $\beta_3$ represent self-compassion, compassion, and social connectedness, respectively. The beta coefficients thus represent the fixed effect of yoga on the three relational variables separately. The multivariate time-series analyses also provided auto- and cross-lagged associations, as well as the contemporaneous relations among the relational outcomes (i.e., the H and Q matrices) across the three subgroups. As these associations were not the central focus of the present study, results from these matrices are not presented in this chapter.

**Results**

Characteristics of study participants are depicted in Table 4.1. Participants were $N=21$ undergraduate students with a mean age of 20.9 years old ($SD=1.4$ yrs). The majority of the participants were non-Hispanic white (81.0%) and female (81.0%), with more than half of the sample representing junior (33.3%) and senior (47.6%) status. The majority of the participants were novice practitioners of yoga (76.2%) with no prior experience. The remaining participants indicated 2-3 years of yoga experience ($n=4$) and six months of yoga experience ($n=1$).

Participants completed surveys for a total of 831 of the 1,008 possible person days (82.4% completion rate) to be included in the analysis. Out of the 275 times that yoga was practiced across participants and throughout the entire study, yoga was practiced approximately 13.09 times ($SD=3.96$) across the 48 days of data collection (approximately 1.63 times per burst), with two-thirds ($n=14$) of the participants practicing at least twice during each burst. The majority of the practices took place through the yoga course (89.1%), which across participants and days was approximately 50 minutes in length ($M=50.49$, $SD=7.28$). A few practices (2.9%; $M_{duration}=58.75$, $SD=8.35$) occurred in yoga classes separate from the course (e.g., yoga classes offered through the
University fitness classes, or through the University’s Yoga Club), and the rest of the practices were reported to be home practice (8.0%; $M_{\text{duration}}=22.50, SD=9.61$).

Descriptives, intraclass correlations (ICCs), and correlations for dispositional mindfulness and the repeated assessments are presented in Table 4.2. In this sample of undergraduate participants, the average score for trait mindfulness as scored by the MAAS (Brown & Ryan, 2003) was 3.82 ($SD=0.64$). For the subgroups, participants in the high, moderate, and low mindfulness subgroups each averaged 4.57 ($SD=0.16$), 3.75 ($SD=0.23$), and 3.12 ($SD=0.23$), respectively. With the intensive assessments, participants reported relatively low levels of self-compassion ($M=35.11$, $SD=14.98$), and moderate levels of compassion ($M=54.38$, $SD=22.97$). Highest between-person means were observed for social connectedness ($M=76.95$, $SD=17.57$). ICC estimates indicated more than half of the variability in the duration of yoga practice to be attributed to within-person differences (86.4%, ICC=0.14), with the three relational outcomes also demonstrating substantial within-person variability.

Paired sample t-tests demonstrated improvements across self-compassion from pre ($M=2.93$, $SD=0.57$) to posttest ($M=3.26$, $SD=0.61$) ($d=0.57$, $t=-3.05$, $p<.05$) and enhancements in social connectedness was also observed from pre ($M=87.40$, $SD=11.79$) to posttest ($M=93.50$, $SD=10.89$) ($d=0.54$, $t=-3.06$, $p<.05$) across the academic semester. Overall pre ($M=3.25$, $SD=0.46$) to post ($M=3.37$, $SD=0.46$) changes in compassion was non-significant ($t=-1.98$, $p=.06$).

Multivariate time-series analyses indicated that yoga practice days predicted relational outcomes differently across the mindfulness subgroups. Beta coefficients representing relational variables regressed on yoga practice (i.e., fixed effects for each mindfulness subgroup and across bursts) from the analyses are displayed in Table 4.3. across the three trait mindfulness subgroups and bursts. In the low mindfulness subgroup, days of yoga practice had negative effects on social connectedness at burst 1 ($\beta_1=-5.97$, SE=3.58; $t=-1.68$; $p<.05$) and self-compassion at burst 3 ($\beta_1=-9.26$, SE=3.21,
In the moderate mindfulness subgroup, the influence of yoga practice was mixed such that there was a positive effect of yoga practice days on social connectedness at burst 1 ($\beta_1=6.02$, SE=3.26, $t=1.85; p<.05$); however, the remaining effects were negative for both self-compassion at burst 1 ($\beta_1=-5.53$, SE=3.21, $t=-1.72; p<.05$) and compassion ($\beta_2=-9.14$, SE=4.77, $t=-2.03; p<.05$ and $\beta_2=-7.43$, SE=3.65, $t=-1.91; p<.05$; burst 2 and 3 respectively). Lastly, in the high mindfulness subgroup, yoga practice days significantly improved self-compassion across bursts 3 and 6 ($\beta_1=6.55$, SE=2.57, $t=2.55; p<.05$, and $\beta_1=6.55$, SE=2.18, $t=3.01; p<.05$, respectively), and compassion at burst 2 ($\beta_2=11.39$, SE=5.43, $t=2.10; p<.05$).

**Discussion**

The present study employed a SCD and multivariate time series analysis to examine the influence of dispositional mindfulness on relational benefits derived from yoga practice in novice yoga practitioners in an introductory yoga course throughout an academic semester. As a group, participants demonstrated improvements in the relational variables of self-compassion and social connectedness but no significant improvements in compassion from pre to post program assessments were observed. As can be expected, the effect for self-compassion in this study was substantially smaller in comparison to what has been demonstrated through Neff’s Mindful Self-Compassion (MSC) program (e.g., $d=1.19$ and 1.67; Neff & Germer, 2013; Smeets, Neff, Alberts, & Peters, 2014), which was specifically developed to enhance self-compassion. Still, a comparable effect on self-compassion has been reported in a study examining the impact of MBSR ($d=0.65$; Birnie, Speca, & Carlson, 2010); hence, it is promising that an academic yoga course can generate effects of similar magnitude. While specific interventions targeting social connectedness (such as MBSR and MSC) have not been developed, similar effects for social connectedness have also been observed through a brief loving kindness meditation (LKM) practice, although these were acute effects assessed through different measures (Hutcherson, Seppala, & Gross, 2008).
With respect to examining the role of dispositional mindfulness utilizing a within-subject analysis, as hypothesized based on theory and prior evidence (Barnes, Brown, Krusemark, Campbell, & Rogge, 2007; Brown, Ryan, & Creswell, 2007; Carson et al., 2004), the influences of yoga practice on relational outcomes varied depending on dispositional mindfulness. Overall, yoga practice days predicted decreases in relational outcomes among those with lower levels of trait mindfulness (i.e., the low and moderate subgroups). In fact, no positive associations were found between yoga practice days and relational outcomes in the low trait mindfulness subgroup, although negative relations were detected only in the first three bursts in both the low and moderate mindfulness subgroups. Perhaps, the first few weeks of an intervention represent a vulnerable time window for those who are new to yoga, and, for those who are also low in trait mindfulness. In fact, individuals low in trait mindfulness experience challenges with emotion and attention regulation more generally, also outside of the context of yoga practice (Arch & Craske, 2010; Creswell, Way, Eisenberger, & Lieberman, 2007; Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007; Schmertz, Anderson, & Robins, 2009). It is possible that learning physical postures of yoga in a new social context (with unfamiliar classmates and instructor) poses additional demands, detracting from the cultivation of mindfulness that may be necessary to realize relational benefits (Barnes, Brown, Krusemark, Campbell, & Rogge, 2007; Brown, Ryan, & Creswell, 2007; Carson et al., 2004). While the reasons for these negative associations warrant further examination, perhaps, novice yoga practitioners with lower trait mindfulness could first benefit by specific instruction in learning simple mindfulness techniques (e.g., learning to embrace qualities of openness and nonjudgment), early on in the semester.

In the moderate trait mindfulness subgroup, the results were rather mixed (both positive and negative relational influences were demonstrated). Of note, more negative relational influences from yoga practice days were demonstrated in this subgroup than the low trait mindfulness subgroup.
Admittedly, although the grouping by baseline trait mindfulness scores represents an intuitive and
typical approach, it was rather pragmatic and somewhat arbitrary. Interestingly, however, the
subgroups differed in other indicators of psychological wellbeing based on baseline scores, where
those in the moderate trait mindfulness subgroup actually fared worse with respect to anxiety,
depression, and life satisfaction (which have all been linked to self-compassion and trait
mindfulness; For reviews see: Barnard & Curry, 2011; Grossman, Niemann, Schmidt, & Walach,
2004) in comparison to those in the low trait mindfulness subgroup. Given our approach to
grouping by baseline trait mindfulness scores was pragmatic, we hesitate to over interpret the
differences between low and moderate trait mindfulness subgroups. Further investigation of
dispositional characteristics of yoga-naïve participants that could help differentiate high and low
responders is warranted (Schmalzl, Crane-Godreau, & Payne, 2014), along with identification of
predisposing characteristics potentially linked with trait mindfulness (e.g., personality, body type,
motivation; Giluk, 2009; Grinnell, Greene, Melanson, Blissmer, & Lofgren, 2011; Levesque &
Brown, 2007) to expand the understanding of moderators which impact the associations between
yoga and relational outcomes.

In this study, the high trait mindfulness subgroup appeared to benefit the most with respect
to relational outcomes. Namely, on yoga practice days, those with high dispositional mindfulness
reported greater self-compassion across bursts 3 and 6, and greater compassion at burst 2. While not
consistent across all bursts, the results indicate novice practitioners high in trait mindfulness stand to
gain most from yoga with respect to relational outcomes, particularly through enhancements in self-
compassion. Moreover, it is encouraging to note that the positive association of yoga with self-
compassion was sustained even towards the end of the semester (i.e., during a high-stress, end of
academic term period), when students may especially be depleted of effective self-care strategies.
Given the interrelatedness that has been described between the constructs of mindfulness and self-compassion (Kabat-Zinn, 2003; Marlatt & Kristeller, 1999; Neff, 2003), these results corroborate Neff’s theory that mindfulness is a likely (and necessary) precursor to self-compassion (although their associations are thought to be reciprocal; Neff, 2003). While additional research is warranted to untangle the association between these two constructs, perhaps, the path to self-compassion from yoga may have been facilitated by the proclivity for a more mindful outlook. The positive relation between yoga practice with both mindfulness and self-compassion has been previously evidenced through prior yoga interventions (Conboy et al., 2010; Gard et al., 2012). Since intensive longitudinal data can enable probing of underlying mechanisms by testing sequencing of effects (e.g., better elucidating the associations between mindfulness and self-compassion as it pertains to yoga practice), future research could be enriched by experimental studies taking advantage of repeated assessments and, if sufficiently powered, should also test for group differences by trait mindfulness.

Even among the high trait mindfulness group, yoga’s influence, specifically, on the interpersonal domains was limited, with no associations emerging for social connectedness. Previous research (the majority, which has been through qualitative reports) has demonstrated enhanced sense of connectedness and interdependence through yoga (Kinser et al., 2013; Ross et al., 2014), and in meditative movement forms (Fischer, Fugate-Woods, & Wayne, 2014; Yang et al., 2011; Yeh, Chan, Wayne, & Conboy, 2016) including participants undergoing a similar academic course (Christopher, 2006). Preliminary evidence also suggests that yoga’s relational influences first impact intrapersonal changes (Chapters 2 & 3; Ross et al., 2014); subsequently, leading to interpersonal benefits. It could therefore be speculated that in novice yoga practitioners, these interpersonal benefits may take longer to manifest. In fact, translating intrapersonal benefits gained from contemplative practices in real world settings has been considered to be a challenging process in
itself (Falb & Pargament, 2012). Additionally, even though the Yoga I course can provide an opportunity for community, or connections to develop in the class context, the safe atmosphere that is often felt in the context of a studio yoga practice may be absent in a general education classroom setting. For instance, the class size (generally consisting of 25-30 students) may be too large to foster the closeness that has been elaborated through qualitative reports; moreover, the motives for enrolling in such a class are varied. That is, if students are solely taking the course for personal gains (i.e., meeting a requirement to graduate), they may be less willing, or open to engage with oneself and others. In fact, an aspect that is often overlooked when studying contemplative practices lies in the intention for one’s practice (Shapiro, Carlson, Astin, & Freedman, 2006). Investigating the role of intention and perhaps, the shift which may occur through continuous yoga practice (previously documented through meditation practice; Shapiro, 1992) could help to gather greater understanding of the intra- to interpersonal pathway implicated in the relational effects of yoga.

It should also be noted findings from the within-person analyses contradicted the conclusions one would draw based on the observed between-person pre to post improvements (which demonstrated enhancements in overall self-compassion and social connectedness as an entire group), raising the question with respect to whether improvements detected through the between-person analyses were observed as a function of the yoga practice, or due to other unmeasured variables (Dwyer, 1983), such as an end-of-semester effect. An alternative explanation concerns the measurement of constructs and the instruments employed for the within-person analyses, which have not been subjected to extensive testing for reliability and validity in previous research. Additional work is needed to evaluate the psychometric properties of brief measures that could be utilized in intensive longitudinal designs.

In light of the divergent influences from yoga practice that were observed across the trait mindfulness subgroups, future yoga programs and interventions may benefit from obtaining an
initial assessment of trait mindfulness scores (especially given self-report assessments of trait mindfulness are easily obtained) in order to identify a priori, potential non-responders who may need additional support at the start of one’s yoga practice. Given the exploratory nature of this work, it is clear more evidence is warranted to corroborate findings. Future studies should aim to maximize statistical power by including longer time-series in larger samples. Still, these results provide preliminary support for the feasibility and utility of employing within-person analyses, supporting the notion that relations among variables do vary at the within-person level (Hamaker, Dolan, & Molenaar, 2005; Voelkle, Brose, Schmiedek, & Lindenberger, 2014). As shown here, the rich data that can be garnered (efficiently) through these approaches demonstrate potential for answering novel questions regarding for whom, when, and how yoga works and could inform future intervention research. Indeed, considering the divide between responders and non-responders can be left unobserved in conventional RCT designs (in between-person analyses), future large scale RCTs on yoga should incorporate more frequent assessments of key outcomes and consider employing approaches such as the SMART (Sequential Multiple Assignment Randomized Trail) design, which have begun to be utilized in research to develop optimal adaptive interventions (Almirall, Nahum-Shani, Sherwood, & Murphy, 2014; Collins et al., 2007).

Limitations and Future Directions

The present study is not without its shortcomings. This is the first study of yoga practitioners utilizing measurement burst design with frequent assessments of relational outcomes. For measurement burst designs, it is recommended selection of assessment intervals to be based on theoretically or empirically grounded decisions regarding the timescale (or intervals) in which the various phenomena under study unfold (Sliwinski, 2008). Due to the lack of empirical evidence and exploratory nature of this work, the duration of the intensive repeated assessments and the time intervals in between bursts were selected with respect to the course of the academic semester and
with consideration for participant burden and compliance. Hence, we cannot rule out the possibility relevant associations were uncaptured during the rest intervals (i.e., the seven days without repeated assessments in between the six bursts). Although posing substantial participant burden, future studies could consider random sampling intervals to capture data throughout the entire academic semester, or even continuous assessments (especially in the absence of data on timing of effects), and utilize methods such as the time-varying effects model, which can more specifically pinpoint how associations change (or stay stable) throughout an intervention (Tan et al., 2012). Moreover, as no clear patterns emerged in the associations across bursts with yoga practice days, future yoga-based interventions should consider documenting the content of the class. That is, certain course content (e.g., themes such as openness and compassion, or specific practices) may have a greater impact on relational outcomes. Importantly, better elucidating the role of context with respect to relational outcomes may better lead to theory development.

As noted earlier, the categorization of the trait mindfulness subgroups was pragmatic based on rather arbitrary cut off points. It may be worth noting however, that among college students the scores of the moderate mindfulness group reflect what is generally reported to be a mean score in other samples (e.g., in larger college samples, mean scores of 3.72 (N=313) and 3.82 (N=205) have been reported; Brown & Ryan, 2003; Rasmussen & Pidgeon, 2011). Nonetheless, the divergent findings which emerged among subgroups should be taken with caution, and not over-interpreted. While this approach allowed us to obtain sufficient power for the multivariate time-series analyses, conducting a sensitivity analysis could help in making slight adjustments to strengthen these arbitrary cut off points (although in the present work, this would inadvertently reduce power for subgroups if the number of participants in groups are altered). It is therefore recommended for future work to increase the number of repeated assessments for the time-series and to treat trait mindfulness as a continuous variable. It may further be of interest to evaluate the relations between state mindfulness
and relational outcomes with respect to varying levels of trait mindfulness. In the present study, we also examined the associations of yoga practice days with (self-)compassion and social connectedness. The majority of the yoga practices (75.3%) in the present study were held within the class period of 50 minutes. Yet, considering the diversity of yoga practices available in community-based settings, a potential direction for future research is to scrutinize the dose-response (frequency, duration, and intensity) association between yoga and relational benefits.

Lastly, participants were a homogenous (i.e., predominantly female, Caucasian, undergraduate students) and select group of Yoga I students, who chose to participate in research without any compensation. Consequently, although the within-person analyses shed light to the role of trait mindfulness in yoga-naïve participants, additional research is warranted to investigate the influence of dispositional mindfulness in more diverse and larger samples of yoga practitioners.

Conclusions & Implications

In this sample of college students enrolled in an academic yoga course, it was found dispositional mindfulness determined the extent to which yoga novices derived relational benefits through practice. To highlight, those with high dispositional mindfulness garnered relational benefits throughout the course of the semester, with yoga practice predicting self-compassion even at the end of the semester. Conversely, overall, yoga practice had negative impacts on relational domains for those low in dispositional mindfulness, especially during the first half of the yoga course.

Considering the potential discomfort that may be felt at the initial phase(s) of yoga practice in novice practitioners, future intervention programs should consider tailoring of approaches (in particular, with respect to individuals who may be lacking mindfulness skills to start off with), as a means to bolster against any negative consequences through initiating yoga.
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Table 4.1. Participant characteristics in the KPAP yoga study

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<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
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<tr>
<td>Age</td>
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<td>1.42</td>
<td>18 – 24</td>
</tr>
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<td>Body Mass Index</td>
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<td>4.09</td>
<td>17.44 – 34.05</td>
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<td>0.64</td>
<td>2.87 – 4.80</td>
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<td>Satisfaction with Life (SWL)</td>
<td>25.67</td>
<td>6.86</td>
<td>11.00 – 35.00</td>
</tr>
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<td>Yoga experience</td>
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</tr>
<tr>
<td>Novice</td>
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</tr>
<tr>
<td>Months of practice</td>
<td>4.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of experience</td>
<td>19.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year in college</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>4.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td>9.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior</td>
<td>33.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>47.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (female)</td>
<td>81.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>81.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian/Filipino</td>
<td>19.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part-time</td>
<td>42.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>57.1%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.2. Descriptives, intraclass correlations, and correlations of yoga practice (minutes) and relational outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>ICC</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Yoga Practice (minutes)</td>
<td>49.96</td>
<td>13.25</td>
<td>0.14</td>
<td>-</td>
<td>0.14</td>
<td>0.12</td>
<td>0.05</td>
<td>-0.21</td>
</tr>
<tr>
<td>2. Trait Mindfulness</td>
<td>3.82</td>
<td>0.64</td>
<td>-</td>
<td>0.10</td>
<td>-</td>
<td>0.06</td>
<td>0.11</td>
<td>0.42</td>
</tr>
<tr>
<td>3. Self-compassion</td>
<td>35.11</td>
<td>14.98</td>
<td>0.39</td>
<td>-0.02</td>
<td>-0.14</td>
<td>-</td>
<td>0.27</td>
<td>-0.38</td>
</tr>
<tr>
<td>4. Compassion</td>
<td>54.38</td>
<td>22.97</td>
<td>0.59</td>
<td>0.02</td>
<td>-0.06</td>
<td>0.25</td>
<td>-</td>
<td>0.47</td>
</tr>
<tr>
<td>5. Social connectedness</td>
<td>76.95</td>
<td>17.57</td>
<td>0.43</td>
<td>0.05</td>
<td>0.14</td>
<td>0.07</td>
<td>0.47</td>
<td>-</td>
</tr>
</tbody>
</table>

| Level-3 Variance (%)      | 13.57 | - | 39.42 | 59.00 | 42.85 |
| Level-2 Variance (%)      | 6.19 | - | 10.68 | 18.31 | 13.41 |
| Level-1 Variance (%)      | 80.24 | - | 50.00 | 22.69 | 43.74 |

Note. Means and standard deviations represent person-level descriptives. ICC represents the proportion of between-person variability across 3 levels (i.e., across persons, days, and bursts). Coefficients above the diagonal represent between-person correlations, and coefficients below the diagonal reflect within-person, across-day correlations. In the above table, yoga practice represents duration of yoga practice (minutes), and includes only yoga practice days.
Table 4.3. Coefficients from multivariate time-series analyses indicating fixed effects of yoga practice on self-compassion ($\beta_1$), compassion ($\beta_2$), and social connectedness ($\beta_3$) in trait mindfulness subgroups across bursts

<table>
<thead>
<tr>
<th></th>
<th>Low Trait Mindfulness Group ($n=7$)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bursts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>2.71 (2.78)</td>
<td>2.89 (4.69)</td>
<td>-9.26* (3.21)</td>
<td>1.45 (2.87)</td>
<td>0.93 (2.35)</td>
<td>-1.67 (3.63)</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>-2.64 (4.56)</td>
<td>-2.31 (6.05)</td>
<td>6.05 (6.12)</td>
<td>2.39 (5.03)</td>
<td>-2.29 (2.90)</td>
<td>0.56 (3.92)</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>-5.97* (3.58)</td>
<td>-2.42 (4.24)</td>
<td>0.43 (3.89)</td>
<td>0.31 (2.39)</td>
<td>0.77 (2.25)</td>
<td>3.14 (2.67)</td>
</tr>
</tbody>
</table>

|                      | Average Trait Mindfulness Group ($n=7$) |                      |                      |                      |                      |                      |
|                      | Bursts                              |                      |                      |                      |                      |                      |
|                      | 1        | 2        | 3        | 4        | 5        | 6        |
| $\beta_1$            | 1.13 (2.88) | 4.71 (3.26) | -5.53* (3.21) | -4.47 (3.57) | 0.69 (2.16) | 0.27 (2.44) |
| $\beta_2$            | 4.79 (3.20) | -9.14* (4.77) | -7.43* (3.65) | -2.27 (3.62) | 1.66 (3.46) | -1.80 (3.13) |
| $\beta_3$            | 6.02* (3.26) | -4.65 (4.31) | -1.36 (4.15) | -1.41 (3.09) | -0.01 (2.75) | -1.53 (2.87) |

|                      | High Trait Mindfulness Group ($n=7$) |                      |                      |                      |                      |                      |
|                      | Bursts                              |                      |                      |                      |                      |                      |
|                      | 1        | 2        | 3        | 4        | 5        | 6        |
| $\beta_1$            | 3.29 (2.36) | 0.88 (3.29) | 6.55* (2.57) | -3.85 (3.42) | 2.01 (1.72) | 6.55* (2.18) |
| $\beta_2$            | -1.33 (4.64) | 11.39* (5.43) | -7.11 (4.39) | 4.78 (4.34) | 3.64 (3.74) | -4.12 (3.94) |
| $\beta_3$            | -4.04 (2.43) | -1.83 (4.29) | -3.42 (4.29) | 3.66 (4.34) | -3.06 (3.19) | -5.86 (3.33) |

$df = 42$, $t$ values $\geq 1.68$ denote significant results. *$p < .05$
Figure 4.1. CONSORT flow diagram to depict participation in KPAP yoga study
Figure 4.2. Measurement burst design for KPAP yoga study

Recruitment ($n=33$, initial interest) → Consented and complete baseline ($n=24$) → 83 Days Burst = 8 consecutive daily surveys 6 bursts, 7 days between bursts 48 data points per individual → Complete 6 bursts ($n=21$) and post-test ($n=20$) → Spring 2016 Academic Semester
CHAPTER 5. General Discussion

The overarching goal of this dissertation was to examine the influences of yoga practice on the widely neglected “relational” (intra- and interpersonal) outcomes. Through a mixed methods approach, the three studies that comprised this dissertation sought to gather unique perspectives to accumulate pre-experimental evidence for the relational benefits of yoga by addressing a few of the outstanding limitations in the literature. Bolstering the initial stage of the National Center for Complementary and Integrative Health’s conceptual framework (NCCIH, 2017) for testing mind-body interventions is an invaluable step, one which can guide decision making for the development of future yoga-based interventions. This concluding chapter first provides a summary of the objectives and findings from each of the three studies. Major contributions from this work are also highlighted, and recommendations for future research are suggested, to encourage and strengthen this line of inquiry. To close, practical implications are outlined considering yoga is a practice that extends “off” of the mat, and if sustained, can become an *art of living*.

Study 1 was a qualitative study which concerned the ways in which yoga influences practitioners’ relationship to oneself and to others, illuminating how community-dwelling yoga practitioners *perceived and experienced* the relational benefits of yoga practice. From a combination of open-ended questions and in-depth interviews, this study identified four emerging themes, demonstrating and adding to the previous evidence base that yoga practice generates states of calm, mindfulness, (self-)compassion, and social connectedness (Conboy, Wilson, & Braun, 2010; Curtis, Osadchuk, & Katz, 2011; Gard et al., 2012; Kinser, Bourguignon, Taylor, & Steeves, 2013; Ross, Bevans, Friedmann, Williams, & Thomas, 2014; Shelov, Suchday, & Friedberg, 2009). Additionally, a common pattern was detected through the qualitative data such that practitioners voiced yoga leading first to *intrapersonal* changes (e.g., cultivation of a non-reactive and compassionate nature in oneself), which subsequently, positively impacted one’s *interpersonal* domains (corroborating
patterns identified in qualitative studies on meditative movement; Christopher, 2006; Ross et al., 2014). Through these key findings, a conceptual model of yoga focusing on the relational pathways was developed to be fine-tuned and tested in future work.

Study 2 extended this line of inquiry in a real world setting (i.e., through a 21-day daily diary study) and examined the associations of daily yoga practice on relational outcomes to better understand how relational benefits would unfold in the context of community dwelling yoga practitioners’ day-to-day lives (Bolger, Davis, & Rafaeli, 2003). As the first daily diary study examining relational outcomes within the context of yoga practice, this study showed that yoga, mindfulness, (self-)compassion, and social connectedness all demonstrated substantial day-to-day variation (in fact, in this sample, the variation within-persons was greater than the variation reported between-persons across all variables), providing initial evidence for the value of examining these relational variables as “dynamic” phenomena through intensive longitudinal data (Walls & Schafer, 2012). Secondly, findings from multilevel analyses demonstrated that on days when a practitioner practiced more yoga than their usual, greater mindfulness and self-compassion were reported. Those who practiced more yoga overall also indicated greater compassion overall throughout the 21-days, supporting the notion that interpersonal benefits accumulate through a routine yoga practice.

Further, although no daily effects of yoga (i.e., direct, within-person influences) emerged with respect to the interpersonal domains of compassion and social connectedness, in line with the proposed conceptual model from study 1, multilevel meditation analyses provided preliminary evidence for the intra- to interpersonal pathways through which yoga may operate. That is, the results showed that yoga may enhance compassion and social connectedness indirectly through its’ impact on intrapersonal resources such as mindfulness. Although in need of corroboration through further experimental work; overall, the results support the integral role of mindfulness in yoga practice, in that it can be cultivated acutely (with a day’s yoga practice), lead to long-term change
(i.e., practitioners practicing more yoga overall reported greater mindfulness overall), and mediate (linking the intra- to interpersonal) yoga’s effects on compassion and social connectedness. Hence, raising the question of whether dispositional characteristics such as trait mindfulness may influence benefits derived from meditative movement modalities such as yoga.

Lastly, study 3 through an exploratory approach examined the role of trait mindfulness in impacting the relational benefits of yoga in novice yoga practitioners participating in a semester long yoga course. Multivariate time-series analyses were utilized to shed light on the question of for whom and when yoga brings about relational benefits. For those with low dispositional mindfulness, yoga practice days predicted decreases in relational outcomes across the first half (i.e., bursts 1-3) of the 15-week academic yoga course. Conversely, the high mindfulness group only reported positive influences from yoga practice days (specifically, on self-compassion and compassion) at burst 2 and 3, with effects for self-compassion, lasting to the end of the semester (at burst 6).

Key Contributions to the Yoga Literature

This dissertation provided key contributions to the burgeoning field of yoga research in the following ways. First, the three studies helped accrue pre-experimental evidence for the understudied relational benefits of yoga. In particular, the three studies examined the intra- and interpersonal outcomes that have been considered as key resources derived from contemplative and meditative movement forms (Falb & Pargament, 2012; Gard, Noggle, Park, Vago, & Wilson, 2014; Kabat-Zinn, 1993; Kristeller & Johnson, 2005; Larkey, Jahnke, Etmin, & Gonzalez, 2009), but which have unfortunately, remained understudied. As a whole, the studies specifically linked daily yoga practice with positive relational outcomes; namely, mindfulness, (self-)compassion, and social connectedness; enriching the growing literature that, to date, has placed a strong emphasis in studying the biological and psychological (other than relational) benefits of yoga (McCall, 2014). Considering the fact humans are naturally social (Baumeister & Leary, 1995) and interpersonal relationships constitute a
significant risk factor for health (with risk for mortality comparable to well-established risk factors such as physical inactivity and obesity Holt-Lunstad, Smith, & Layton, 2010), the scarcity of research on relational outcomes is rather disappointing. This research helps fill the gap in the literature on the wide-array of health benefits that have been demonstrated through yoga across different population groups and ages (For example, see: Gothe & McAuley, 2015; Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005; Lin, Hu, Chang, Lin, & Tsauo, 2011; Raub, 2002; Uebelacker et al., 2010), further bolstering the “holistic” nature of yoga as a mind-body practice.

Another contribution worth highlighting from this dissertation was the use of a mixed methods approach, which strengthened the evidence base for the relational benefits of yoga through varying perspectives. By allowing participants to elaborate on their own perceived experiences of yoga focusing on the intra- and interpersonal domains, the qualitative work facilitated the development of a conceptual model. To elaborate, the hypothesized pathways in the model first delineated intrapersonal improvements from yoga (i.e., yoga practice increasing mindfulness and self-compassion), which subsequently led to interpersonal enhancements in compassion and social connectedness. These pathways were then, tested in the second study, which provided initial evidence for: (1) the direct enhancements in mindfulness (daily and overall) and self-compassion (daily) that can be gained through yoga, and (2) the indirect pathways to improved interpersonal outcomes, first, through the positive gains observed in intrapersonal resources (i.e., mindfulness and self-compassion). The proposed model also illustrates a direct path to social connectedness (as talked about by participants); although no direct influences emerged with the multilevel models predicting social connectedness. Importantly, study 2 also helped provide preliminary empirical evidence base on the mechanisms of how yoga works, which has thus far been a void in yoga research. These pathways should be subjected to further corroboration through diverse methodological approaches, including experimental studies.
It is important to acknowledge the yoga literature to date has relied on piecemealed evidence from diverse fields and literatures in the construction of previous frameworks (McCall, 2013; Gard, Noggle, Park, Vago, & Wilson, 2014; Riley & Park, 2015; Schmalzl, Powers, & Henje Blom, 2015), which have been, to a large extent, theoretical and abstract. Hence, it remains rather difficult to synthesize the information in a coherent way, in the near absence of empirical testing of the various hypotheses proposed in the literature. To address this shortcoming, study 1 sought to generate a more specific model, presenting testable hypotheses for future research and building solid foundation for future studies examining relational outcomes. The incorporation of qualitative methodology to affirm perceived relational benefits is also noteworthy in the context of the limitations that currently exist in the assessment of relational outcomes more broadly, and with respect to obtaining intensive longitudinal data, in particular. Given the reliability and validity of existing brief measures of relational outcomes have yet to be determined, obtaining qualitative data on the perceived benefits in the relational domain through a case-oriented approach (Creswell & Clark, 2011) lowered the risk that palpable relational benefits would be missed due to lack of or weak measures.

In addition, through the use of intensive longitudinal methods, this dissertation (specifically, studies 2 and 3) also helped to characterize the “dynamics” of yoga practice with respect to relational domains, providing a snapshot of the variability that is often missed in traditional experimental designs. Utilizing intensive longitudinal methods helped to answer questions that cannot be addressed through traditional between-person designs, specifically targeting the within-person level of analyses. Moreover, the majority of previous research on yoga has been conducted in controlled experimental settings (Riley & Park, 2015). To our knowledge, study 2 was the first daily diary study conducted in the context of daily yoga practice, shedding light on ways in which daily yoga practice impacts relational outcomes in a real world setting and among practitioners with diverse yoga
experience. Given this was one of the first attempts at collecting intensive longitudinal data in the context of yoga practice, these studies can serve as a “starting point”, helping to provide guidance on study design for future work incorporating repeated assessments. Drawing from a community-dwelling sample of yoga practitioners (i.e., those who regularly practice yoga in a non-experimental setting) was another prominent strength, as it gave insight into the shared, \textit{style invariant} influences of yoga.

Lastly, utilizing a specific type of intensive longitudinal design, the single-case research design (SCDs; Dallery & Raiff, 2014; Molenaar & Campbell, 2009) in study 3 helped to better understand \textit{for whom} and \textit{when} yoga works, providing clues for future intervention development. Specifically, this study provided a means to identify and scrutinize differences between low and high responders among novice yoga practitioners enrolled in a yoga program. Due to the divergent influences from yoga practice that were observed across the trait mindfulness subgroups, we concluded future yoga programs and interventions may benefit from obtaining an initial assessment of dispositional mindfulness in order to identify individuals or subgroups who may need additional support at the start of one’s yoga practice. It would also seem plausible to slightly restructure the existing yoga curricula in a way that may facilitate the enhancement of mindfulness skills prior to introducing more advanced and varied yoga practices, as a means to minimize negative influences on relational outcomes. Along the same lines, future rigorous RCTs could consider approaches such as the SMART design (Collins, Murphy, Nair, & Strecher, 2005; Collins, Murphy, & Strecher, 2007) to appropriately adapt interventions to (non-)responders and to address predisposing characteristics that may be linked to nonresponse to optimize intervention outcomes.

\textbf{Future Directions for Strengthening Research on Yoga in the Relational Domain}

Given the overarching aim of yoga and contemplative practices is to promote health and wellbeing in the individual but also in how we relate to others (in our interpersonal relationships)
and the nascent research on relational outcomes, more research is warranted to help bolster the initial evidence base in this area. While not explicitly modeled in the conceptual framework in Study 1, of particular interest is the question of “time” (i.e., not limited to the day-to-day influences) and the intriguing inquiry of how long it may take for the relational benefits to transfer off of the mat. Additionally, there is a need to better understand how the relational benefits (e.g., increased self-compassion, social connectedness) are associated to other distal health and wellbeing outcomes (as depicted in the conceptual framework but not a focus of the dissertation); specifically, as it pertains to yoga practice. Future research is also encouraged to determine the far reaching consequences of the relational benefits of yoga, not just in enhancing the health and wellbeing of the individual, but in fostering more compassionate and connected interpersonal relationships, which may also expand to impact the health and wellbeing of others (i.e., going from micro- to macro-level influences).

Importantly, other relational outcomes (e.g., empathy, altruism), including prosocial emotions such as gratitude and awe, that were not a focus of this dissertation could also enrich future studies (Condon, 2017; Loizzo, 2014) and contribute meaningfully to better understanding the relational pathways in which yoga works; and more broadly, to the contemplative sciences, which, as a field has begun to rigorously assess these relational variables through dyadic work and in real world settings (Kok & Singer, 2017; Lim, Condon, & De Steno, 2015). Research carefully scrutinizing the interpersonal context (i.e., where people spend the majority of their lives) in which these relational variables operate will be crucial, especially given this has been acknowledged as a limitation in the behavioral sciences in the study of psychological processes, health, and wellbeing more generally (Fincham & Beach, 2010; McNulty & Fincham, 2012). For instance, a potential avenue for future research would be to better elucidate, in depth, whether observed positive interpersonal influences are confined to certain social contexts (e.g., within close relationships or in the yoga community) or whether influences can extend to broader social contexts, including
strangers, and even to one’s enemies (included as a practice in a specific kind of meditation, loving-kindness meditation, which focuses on increasing feelings of warmth and care for self and others; Salzberg, 2004).

Additional studies are also warranted to corroborate findings from the three studies in diverse samples to determine the generalizability across population subgroups. Despite the fact this dissertation included both yoga-naïve (young, undergraduate students) and experienced (wide age range of individuals) yoga practitioners, and studies 1 and 2 drew from community-dwelling yoga practitioners across a wide array of styles and experiences, both samples were homogeneous (White, non-Hispanic, female, high socioeconomic status). This skew is reflective of the characteristics of yoga practitioners in the general population (as yoga still remains practiced by narrow segments in the general population; Birdee et al., 2008; Ross, Friedmann, Bevans, & Thomas, 2013). Yet, considering the promise this practice holds (both with respect to accessibility and the multitude of health benefits associated with practice), it is evident more studies are needed to study males, minority ethnic groups, as well as older adults with respect to relational outcomes of yoga. For example, the literature has demonstrated gender differences in the way in which females respond to stress utilizing social resources (i.e., Tend and Befriend Theory; Taylor et al., 2000). It could therefore be speculated there may be biological mechanisms that are ingrained (a bottom-up physiological pathway; Gard et al., 2014) and impact yoga’s relational pathways differently for males. Considering the fact that all studies in this work drew from a predominantly female sample (community-dwelling sample, 92.3%; college sample, 81%), researchers should make an effort to include both sexes, or oversample males in future work, especially as the percentage of male yoga practitioners continues to grow (a rise to 10 million in 2016 from the 4 million male practitioners in 2012; Yoga in America Study).
Similarly, yoga’s acceptability as a mind-body modality and its’ effectiveness to enhance health and wellbeing outcomes in ethnic minority populations provides another fruitful avenue for future research, considering ethnic minorities (as well as individuals of lower socioeconomic status) are less likely to receive conventional mental health treatment, and may thus be more likely to opt for complementary and alternative medicine (CAM) approaches such as yoga. Of note, CAM use varies across racial and ethnic groups, and also depends on one’s health and cultural beliefs (Hsiao et al., 2006). This line of research, thus, comes with additional challenges such as the need to develop culturally-tailored interventions (Castro, Barrera, & Holleran Steiker, 2010). Although feasibility studies have been conducted taking careful measures such as mixing West African dance lexicons with yoga postures (Johnson, Taylor, Anderson, Jones, & Whaley, 2014), and not calling the movement form “yoga” (Mama, 2016), it would be meaningful to further investigate whether racial/ethnic groups may specifically resonate with the relational aspects (e.g., community, social support) of yoga practice (which has been demonstrated through other physical activity interventions; Mama et al., 2015; Mama, McNeill, Soltero, Edwards, & Lee, 2016).

Considering the aging demographic trends of the society at large (CDC, 2007; Ortman, Velkoff, & Hogan, 2014), studies that specifically focus on the effects of yoga in older adults are also relevant, perhaps, especially as it applies to aging with wisdom (i.e., beyond successful aging; Ardelt, 2003; Glück et al., 2013; Staudinger & Glück, 2011). Although this was not an emphasis of the dissertation, comments from the in-depth interviews did raise the importance of the sense of community and connectedness in the context of retirement and living alone. And practitioners in committed domestic relationships touched on how their yoga practice has helped to maintain a compassionate relationship with their partner and/or children with age. Importantly, regardless of one’s gender, race, age, or education level, yoga practitioners have held similar beliefs about the potential of yoga to be beneficial for one’s health (Ross, Friedmann, Bevans, & Thomas, 2013).
Hence, it is imperative for future yoga-based research to expand the sample pool to include a diversity of healthy and clinical populations, in order to take incremental steps forward in making yoga a more accessible practice for all.

While the qualitative data collected enriched understanding of the perceived and experienced relational benefits of yoga, with respect to quantitative assessments, this dissertation relied on self-report measures of both yoga practice and the relational domains of interest. Throughout the past few decades, the physical activity literature has substantially benefited from objective monitoring of (in)activity levels through ambulatory assessments such as accelerometers (Troiano, McClain, Brychta, & Chen, 2014). Although one’s yoga practice may be easier to recall in comparison to habitual physical activity (i.e., in that there is generally an intentional start and end to yoga practice), future work could consider the incorporation of ambulatory devices, which aligns with the rising utility of mHealth tools in research (Fiordelli, Diviani, & Schulz, 2013). For instance, utilizing HeartMath to provide heart rate variability feedback during yoga practice (Lehrer et al., 2006; Edwards, 2015), or adding vagal tone as an indicator of connectedness (Kok & Fredrickson, 2010) in which yoga practice can be monitored, or validated, through objective assessments will be an exciting avenue to pursue in future studies.

Further, there are specific methodological and study design issues that could be strengthened as it pertains to studies utilizing intensive longitudinal methods. As recognized in both studies 1 and 2, the frequency of assessments and research design (e.g., how many time points a day, the duration of the study) as well as item selection of the intensive longitudinal assessments deserves careful consideration, especially as it relates to the research questions and phenomena of interest. For instance, in Study 2, it was found that the four relational outcomes (mindfulness, (self-)compassion, and social connectedness) were moderately correlated at the within- and between-person levels. While the literature has acknowledged the similarities (as well as differences) of these relational
outcomes (e.g., mindfulness and self-compassion, Neff, 2015), perhaps a subsequent step would be to explore factor analytic approaches to determine whether four distinct phenomena were appropriately captured. Additionally, although it is clear systematic measurement work is warranted to enhance reliability and validity of instruments to assess relational outcomes through repeated assessments, the quality of future research examining interpersonal domains can also be enhanced by incorporating a wide-array of methods (i.e., not limited to intensive longitudinal data) such as second person reports, computer-based games requiring the use of these relational skills (Leiberg, Klimecki, & Singer, 2011; Weng et al., 2013), or even real time person-to-person interactions that can capture compassionate behaviors in a social context (Condon, Desbordes, Miller, & DeSteno, 2013).

Utilizing a multicomponent assessment of outcomes will not only strengthen the work on relational outcomes (e.g., in Study 2, there was a possibility of a “ceiling effect” for social connectedness which could be overcome in future research through diverse assessments), it also holds potential in helping to tease out the time course of these effects, which could not be specifically pinpointed from the observational and retrospective nature of the three studies.

Most importantly, a critical direction for future research is to conduct experimental research (ultimately, large scale, sufficiently powered RCTs) building off from the accumulated pre-experimental evidence for the relational benefits of yoga practice. Study 1 and 2 were observational in nature, and study 3, while within a context of a yoga program, had no control or comparison group. Hence, in this dissertation, causality of associations could not be established (Stone-Romero & Rosopa, 2008). Although the qualitative reports provided perspective with respect to both the acute and long-term (i.e., years of practice) influences of yoga practice, it was retrospective in nature. Longitudinal studies and intervention/experimental designs examining the relational benefits of yoga in novice practitioners would help to delineate sequencing and pinpoint “timing” of change. Moreover, considering the divergent findings that were observed with how yoga impacted the
relational outcomes depending on the study design and data collected, incorporating intensive assessments within an experimental trial (i.e., multicomponent assessments to assure coverage on potentially meaningful trajectories of change) could also help to better understand the dynamics of yoga practice and relational outcomes as the intervention unfolds. In fact, it is encouraging to note that methodological approaches such as dynamics systems modeling (Walls & Schafer, 2012), or specifically, the time-varying effects model (Tan, Shiyko, Li, Li, & Dierker, 2012), which allows for the scrutiny of how relations may (or may not) shift with time throughout the intervention period are available, and could further aid researchers in analyzing these types of data in a meaningful manner.

**Practical and Societal Implications**

Collectively, the three studies which comprised this dissertation revealed that “relational” benefits can be garnered through one’s yoga practice, providing empirical evidence that yoga is a practice which extends not just to oneself, but to one’s family, and one’s community (as claimed through the philosophy and teachings of yoga; Garfinkel & Schumacher, 2000; Iyengar, 1982). While the majority of yoga practitioners in Western societies initiate yoga practice for exercise and stress management purposes (Park, Riley, Bedesin, & Stewart, 2014), the relational benefits may serve as an “added” value to this mind-body practice, which, with time, may become one of the reasons for a sustained practice. In particular, it appears that those with a regular yoga practice (considered, practicing once a week; Yoga in America Study) can reap positive intra- and interpersonal benefits that importantly, extend “off” of the mat, into the real world. Indeed, the ways in which one’s practice (i.e., of being mindful and compassionate to oneself on the mat) translated off of the mat was a clear message that arose through practitioners’ perceived perceptions and experiences of yoga practice. Not only did yoga act as a self-awareness and powerful self-care technique, practitioners were able to extend this mindful, non-reactive nature and kindness to oneself and to others,
especially in the context of one’s close relationships (as articulated in the qualitative interviews).

Furthermore, it is encouraging to note these findings were shared experiences across diverse styles of yoga in community-based yoga practitioners. Accordingly, despite the heterogeneity that exists across yoga practices, individuals can select their preferred style or variation of yoga and are still likely to benefit in terms of relational outcomes.

Importantly, the impact of dispositional mindfulness on yoga practice, which was demonstrated with the novice yoga practitioners, brings forth pressing questions for the design of future yoga programs targeted towards yoga naïve individuals. That is, appropriate strategies in which low mindful individuals could be protected from the potential discomfort or mind wandering that could be experienced (which can lead to negative consequences; Killingsworth & Gilbert, 2010) should be carefully considered. Perhaps, this may be one of the reasons why MBSR has received attention as a strikingly successful program (Grossman, Niemann, Schmidt, & Walach, 2004), in that it provides a gradual progression of the acquisition of mindful awareness (mindfulness) with instruction on three formal techniques of mindfulness meditation, body scan, and simple yoga practices. While it is clear additional research is warranted to corroborate our findings, careful sequencing and monitoring during this vulnerable time window (i.e., during the initial phases of a program) may work to optimize outcomes in future yoga-based interventions.

Finally, placing this dissertation in the context of broader societal implications, these findings also raise the question of whether yoga has the potential to, to some extent, serve as an antidote to the disconnect (i.e., social isolation) and distrust that have been purported as prevalent in today’s society, partially as a consequence of the social and technological changes that are occurring (McPherson, Smith-Lovin, & Brashears, 2006). Perhaps, when considering the central role of mindfulness that emerged across all three studies, yoga-based interventions targeting relational, as
well as health and wellbeing outcomes in general, may benefit from placing more emphasis on the mindfulness techniques (e.g., awareness, nonjudgmental attitude, and openness) that are cultivated through practice. In particular, considering the majority of yoga classes in the West (especially in the context of gyms and fitness centers) are place a heavy emphasis on the physical aspects of practice (De Michelis, 2005), with little attention on the other major components of yoga practice (i.e., breath, meditation, and ethics of yoga), assuring certain dosage of mindfulness could be an initial step in priming relational benefits in yoga-based programs.

In closing, the mind-body practice of yoga holds promise as a holistic, integrative practice, which promotes a “wholesome life” through the cultivation of not just physical and psychological health, but also, through the enhancement of relational health and wellbeing. Human beings have an inherent need to feel connected, and build meaningful relationships with others (Baumeister & Leary, 1995). Yoga practice, if sustained, can have a meaningful impact on preserving and strengthening these intra- and interpersonal connections; perhaps, through the cultivation of an open heart (i.e., characterized with qualities of greater awareness and kindness).
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