2020

Evaluating potential mechanisms of a multiple health behavior change intervention

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Evaluating potential mechanisms of a multiple health behavior change intervention

by

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A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Psychology

Program of Study Committee:
L. Alison Phillips, Major Professor
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The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this thesis. The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

Ames, Iowa

2020

TABLE OF CONTENTS

ABSTRACT

Many Americans are not meeting recommendations for engagement in health promoting and preventative behaviors. Multiple health behavior change (MHBC) interventions target at least two health behaviors to improve at least two health behaviors, and MHBC interventions may be both more economical and effective than single health behavior change (SHBC) interventions. However, the mechanisms through which MHBC (vs. SHBC) interventions may be more effective are unclear. Self-efficacy and identity are known predictors of behavior. The present study seeks to test a novel MHBC intervention and to simultaneously evaluate mediators of behavior change—namely self-efficacy for general health behavior engagement and development of a healthy-person identity. Specifically, participants engaged in one of three interventions: (1) MHBC intervention targeting fruit and vegetable consumption, and yoga practice; (2) SHBC intervention targeting fruit and vegetable consumption; (3) SHBC intervention targeting yoga practice; (4) No intervention control condition. ANOVA-based analyses test the hypotheses that individuals in the MHBC intervention condition will show the highest level in engagement in both target behaviors, compared to those in the SHBC intervention conditions and controls, and this effect will be mediated by differences in self-efficacy for and identity with engaging in health-related behavior. Lastly, Fisher's Z tests the theoretical hypothesis that changes in self-efficacy will precede changes in healthy identity. Mixed results were found, such that individuals in the MHBC intervention condition (vs. control condition) reported greater behavioral engagement in yoga but not fruit and vegetable consumption. The effect of experimental condition on target behaviors was not significantly mediated by general health self-efficacy or development of a general health identity. Finally, Fischer's Z test did not confirm a theoretical hypothesis that changes in self-efficacy will precede

changes in healthy identity, but data appeared to be trending in the predicted direction. Overall, the MHBC intervention did effect greater behavioral engagement compared to the SHBC and control conditions. More research is needed to better understand the mechanisms through which behavior change occurs in the context of MHBC interventions.

CHAPTER 1. INTRODUCTION

Many Americans are failing to engage in sufficient amounts of health-promoting behaviors, thereby increasing risk of poor health or illness. Specifically, in a sample of 153,000 Americans, only 3% met health recommendations for physical activity engagement (PA), fruit and vegetable consumption, maintaining a healthy weight, and not smoking (Reeves & Rafferty, 2005). Although a higher proportion of Americans in this sample sufficiently met any one of these health recommendations in isolation (i.e., 22% were physically active; 23% met fruit and vegetable consumption recommendations; 40% maintained a healthy weight; 76% were non-smokers), there is a clear problem regarding adherence to multiple health-promoting behaviors. Given that several common chronic illnesses (e.g., heart disease, stroke, Type 2 Diabetes, cancer) can be prevented, mitigated, or delayed through better diet, reduced sedentariness and non-smoking (Centers for Disease Control and Prevention, 2019), identifying ways to increase adherence to multiple health behaviors is imperative. One way that this could be accomplished is through the use of multiple health behavior change (MHBC) interventions.

In general, behavior change interventions tend to be expensive and time consuming, making them largely inaccessible, especially for individuals who would require multiple interventions for different behaviors. However, because MHBC interventions bundle multiple health behaviors into a single intervention, they require fewer resources and are consequently more cost-effective, less time-consuming, and more accessible for individuals and thus, could have a greater impact on public health (Prochaska & Prochaska, 2011). Research on MHBC interventions is fairly recent, with the majority of studies investigating MHBC interventions being published since 2005 (King et al., 2015).

MHBC interventions are not only potentially more resource-effective, but existing literature suggests they may be efficacious at promoting behavior change. Positive health behaviors tend to cluster together, as do negative health behaviors; thus engagement in positive or negative health behaviors might rely on similar mechanisms. This incidental co-occurrence of related health behaviors may facilitate the success of MHBC interventions, as promoting change in each of these behaviors may reciprocally encourage change in all of the target behaviors. When individuals change one health behavior, it is not uncommon that natural shifts in related health behaviors also occur. For example, men who were quitting smoking tended to exercise more compared to smokers; and, conversely, exercise levels decreased among those who resumed smoking during a relapse (Nagaya et al., 2007). Similarly, individuals who were smokers were in earlier stages of change (i.e., Transtheoretical Model, TTM; Prochaska & DiClemente, 1983) for PA engagement and diet change than individuals who did not smoke (Emmons, Hammond, & Abrams, 1994), suggesting that engaging in one health behavior (i.e., not smoking) may facilitate engagement in other health behaviors as well (i.e., PA engagement). However, these studies were observational in nature and did not involve any form of intervention. In order to capitalize on these potentially shared mechanisms between health behaviors, we need to understand what these mechanisms are and how they function so that interventions could be tailored to complement these processes (Nielson et al., 2018). For example, the inverse relationship between exercise and smoking may be physiological (e.g., smoking decreases lung capacity required for exercise), psychological (e.g., pursuing better health via one behavior may increase one's motivation to add other health behaviors), and/or social (e.g., if shifting from activities where smoking is the norm leads to activities where physical activity is the norm). In recent years, research regarding MHBC interventions has been

growing; however, many questions regarding the processes that underlie successful MHBC interventions remain unanswered (King et al., 2015; McSharry, Olader, & French, 2015; Prochaska & Prochaska, 2011).

The limited existing research regarding MHBC interventions tends to focus on evaluating the efficacy of interventions that include a variety of health behaviors, as compared to a control condition (McSharry et al., 2015), and such interventions often have promising results. For example, Johnson, Paiva, and Cummins (2008) used a tailored intervention based on the TTM of behavior change (Prochaska & DiClemente, 1983) and found that obese individuals participating in a tailored MHBC intervention targeting PA, healthy diet, and emotional eating (vs. control condition) improved significantly on all three of these health behaviors, with approximately half of participants reaching public health guidelines for each of the behaviors. Further, individuals who adopted changes to meet recommendations for a single behavior were 2.52 to 5.18 times more likely to also improve another health behavior, compared to those in the control condition, who were only 1.24 to 2.63 times more likely to also improve another behavior after adopting changes to a single behavior. A meta-analysis by Sweet and Fortier (2010) also found that although weight loss interventions that only targeted increasing PA engagement or improving diet were associated with higher levels of engagement in PA and better diet, respectively, MHBC interventions that concurrently targeted both PA and diet were associated with more effective weight loss and weight gain prevention.

The majority of research regarding MHBC interventions tends to target the following combinations of target behaviors: (1) diet and PA; (2) smoking and diet, (3) smoking, alcohol, diet, and PA; (4) illicit drug use and sexual-risk behaviors (King et al., 2015). These groupings of behaviors are typically targeted because they are linked to a shared outcome; for example, diet

and PA are instrumental for goals of weight loss and often used in samples with overweight and obesity. Similarly, interventions targeting smoking, alcohol, diet, and PA focus on chronic disease prevention and general health. Developing interventions that facilitate achievement of health-related goals that are beyond simply increasing engagement in a specific behavior (e.g., weight loss, chronic disease prevention) are the types of interventions that will positively impact public health and lower health care costs (Wu & Green, 2000). However, it is challenging to parse out the specific mechanisms through which MHBC interventions actually function when the target behaviors are so closely associated with each other. By better understanding the specific processes through which MHBC interventions function, and through which are potentially more efficacious than single health behaviors change (SHBC) interventions, researchers will be able to develop MHBC interventions that only contain the necessary components and minimize participant burden (Nielson et al., 2018). Conducting systematic studies that focus not only on whether the intervention impacted the behavioral outcome, but also the processes through which the intervention is efficacious, is imperative for proper intervention development (Sheeran, Klein, & Rothman, 2017). Minimizing participant burden is especially important when administering complex interventions because individuals tend to have worse adherence to very complex (vs. simpler) regimens (Osterberg & Blanschke, 2005). Thus, it is important that researchers are able to identify how to capitalize on the processes that make MHBC interventions efficacious (Nielsen et al., 2018), without overburdening participants with procedures that are too taxing and that might impair adherence, instead.

Given that research regarding MHBC is quite recent, there is currently no established theoretical framework used to explain the mechanisms through which MHBC interventions function, and there is little consistency regarding how these interventions are constructed,

measured, and evaluated (Prochaska & Prochaska, 2011). Social Cognitive Theory (Bandura, 1977) and the Transtheoretical Model (TTM; Prochaska & DiClemente, 1983) have been the most commonly used theories in the context of MHBC. Although self-efficacy and stages of change have been assessed in the context of MHBC, studies have focused on these mechanisms in relation to specific behavioral outcomes, rather than mechanisms of the MHBC intervention as a whole (Prochaska et al., 2008; Toobert et al., 2007). It is possible that self-efficacy is both affected by the intervention, but also functions as a mechanism that facilitates more efficient behavior change when multiple (vs. single) behaviors are addressed. Thus, I aim to fill this gap in the literature by examining the predicted mechanism through which MHBC interventions may function, as guided by the integration of two theoretical frameworks: Self-Efficacy Theory and Identity Theory.

Self-Efficacy and Multiple Health Behavior Change

Self-efficacy is a known predictor of behavior, and is important for behavior change and adopting new behaviors, such as exercise (Oman & King, 1998). Specifically, level of self-efficacy influences what types of activities individuals engage in, as well as the frequency of engagement, such that higher engagement tends to be associated with activities for which individuals have higher levels of self-efficacy (Bandura, 1977, 1982; Shunk, 1984). For example, Brod and Hall (1984) found that smokers who elected to join a smoking cessation program had higher self-efficacy for quitting than did those who did not elect to join. Further, when individuals' levels of self-efficacy expectancy for changing an behavior (i.e., smoking cessation) were manipulated, individuals who were in the high self-efficacy condition reported significantly stronger intentions to stop smoking, compared to those in the low self-efficacy condition (Maddux & Rogers, 1983). Similarly, individuals whose self-efficacy for exercise was increased

with an experimental manipulation had significantly better adherence to exercise at a five-month follow-up than the control condition (McAuley, Courneya, & Rudolph, 1994). Higher self-efficacy for a specific task is associated with more effort and higher persistence devoted to that task (Bandura & Schunk, 1981; Brown & Inouye, 1978; Schunk, 1981). Therefore, individuals who have higher self-efficacy for engaging in a specific health behavior (e.g., exercising, eating fruits and vegetables, adhering to medication) are more likely to not only engage in the new behavior, but also exert more effort toward engaging in that health behavior, and continue to engage in that behavior over time. For example, after a self-efficacy manipulation, individuals in the high self-efficacy condition reported less psychological distress and fatigue, as well as higher well-being, after engaging in the same level intensity exercise tasks as those in the low self-efficacy condition (McAuley, Talbot, & Martinez, 1999). In addition, active (and successful) engagement in a behavior tends to strengthen self-efficacy for that behavior. Lastly, individuals who had higher (vs. lower) self-efficacy for exercise were more likely to still be exercising nine and 12 months after participating in an exercise intervention (Neupert, Lachman, & Whitbourne, 2009). Thus, it is clear that self-efficacy is an important predictor for adopting a new health-related behavior such as exercise.

Self-efficacy may be crucial when investigating the mechanisms of MHBC interventions. Although self-efficacy is behavior-specific, self-efficacy may generalize to other behaviors that rely on similar sub-skills (Bandura, 1991). For example, self-efficacy for smoking cessation may be similar to self-efficacy for limiting high fat foods because both behaviors require resisting an appetitive but unhealthy behavior. Interestingly, King (1996) found a positive correlation between self-efficacy for smoking cessation and self-efficacy for PA engagement, suggesting that self-efficacy for health-related behaviors may influence each other, rather than existing in

silos for each specific behavior or specific characteristics of a behavior (e.g., resisting an appetitive behavior). Similarly, Grembowski et al. (1993) found that self-efficacy scores for five health behaviors (i.e., exercise, reducing fat intake, weight loss, smoking cessation, limiting alcohol) were inter-correlated, and that self-efficacy for one behavior correlated with outcome expectancies for the other behaviors. Therefore, it is possible that when an individual begins to change one health behavior and is successful, their self-efficacy increases for that behavior, and also generalizes and increases self-efficacy for other related behaviors. Consequently, in the context of MHBC, increasing self-efficacy for several health behaviors at once may strengthen self-efficacy to engage in health behavior more generally, in addition to improving self-efficacy for the target behaviors alone. This study will evaluate the role of self-efficacy to engage in health-related behaviors as a mechanism for MHBC interventions.

Although MHBC interventions may boost self-efficacy for health behavior engagement and consequently accelerate behavior change, MHBC interventions may also have the opposite effect if individuals fail at the target behaviors and therefore have low self-efficacy. Feeling inefficacious is associated with avoidance of the behavior, which consequently promotes further declines in self-efficacy (Beck, 1976). Therefore, it is important to consider how both successful and unsuccessful attempts to change or maintain a behavior can influence the efficacy of an intervention, and longer-term adherence. For example, when individuals successfully quit smoking, their self-efficacy for smoking cessation increases, and may generalize to self-efficacy for PA engagement (Bandura, 1986; Maddux, 1993). However, during a relapse, self-efficacy for smoking cessation decreases, and this reduction in self-efficacy may also generalize to PA engagement. Feelings of being inefficacious tend to be associated with negative emotion (Beck, 1976), which can interfere with further engagement in the behavior and validate feelings of

inefficacy (Schunk, 1984). Further, low self-efficacy is associated with avoidance of the behavior which can exacerbate feelings of inefficacy. Thus, failing to engage in a desired behavior (e.g., smoking relapse) may not only be detrimental to future engagement in that behavior, but also for self-efficacy of similar behaviors (e.g., PA). Therefore, although self-efficacy can be beneficial for facilitating multiple behavior change, the individual must be successful at actually changing their behavior for self-efficacy to increase and positively impact adherence.

Throughout the process of behavior change and behavior maintenance, individuals will commonly encounter barriers that can interfere with adherence. Encountering such barriers may incite negative emotions, lower self-efficacy, and promote avoidance of the behavior. Therefore, although self-efficacy is an important component of MHBC, more stable factors have to also be considered to be able to account for instances where individuals encounter barriers but persevere instead of abandoning the behavior. Development of a healthy identity may be one such factor.

Identity Theory and Multiple Health Behavior Change

In addition to self-efficacy, identity has been shown to be predictive of engagement in health behaviors (e.g., exercise, Anderson & Cychosz, 1994; healthy eating, Strachan & Brawley, 2008; Teixeria, Carraca, Markland, Silva, & Ryan, 2012). In the context of MHBC interventions, forming an identity around engaging in the target behaviors may be a key factor predicting long-term adherence to the targeted behaviors.

According to Identity Theory, one's self-concept is comprised of a hierarchy of role-identities, with the identities at the top of the hierarchy being the most important to the individual, and the most salient (i.e., most likely to be acted upon; McCall & Simmons, 1978; Stryker, 1980). Each role identity comes with the socially constructed expectations of how

someone with that identity is supposed to behave, and by adopting a role-identity, one incorporates these meanings and expectations of that identity into their self-concept (Stets & Burke, 2000). Role-identities provide meaning for past behavior as well as guide future behavior to be consistent with existing role-identities, suggesting that some engagement in the behavior is prerequisite for developing an identity around that behavior (Anderson & Cychosz, 1994). For example, no one will have an exercise identity until they have actually exercised and developed an identity around exercising to explain their engagement in this behavior. Once an identity is established, individuals are motivated to behave in congruence with their identity. For example, individuals with stronger exercise identities are more likely to regularly engage in exercise and have higher self-efficacy for overcoming barriers to exercising, compared to individuals with weaker exercise identities (Anderson & Cychosz, 1995; Anderson, Cychosz, & Fanke, 1998; Storer, Cychosz, & Anderson, 1997; Strachan & Brawley, 2008). Thus, forming an identity around the target behavior(s) of behavior change interventions could serve as an important maintenance factor, given that individuals use identities to guide future behavior.

Although there is evidence of health-related identities being predictors of future engagement in health-related behavior, there is little research regarding the function of identity in health behavior change interventions, particularly regarding MHBC. For example, Strachan and Brawley (2008) found that having a stronger healthy-eater identity significantly predicted fruit and vegetable consumption, as well as consuming fewer foods with low nutritional value. However, the data in this study were self-reported and only collected at one time point. Cardinal and Cardinal (1997) used a longitudinal experimental design to evaluate development of exercise identity among women who participated in an exercise versus non-exercise class. They found that women who were in the aerobic exercise class condition developed stronger exerciser

identities and increased their exercise behavior across time. In contrast, the women who were in the non-exercise class control condition demonstrated no change in exerciser identity and actually decreased exercise engagement across time. West et al. (2010) found that among obese individuals participating in a weight loss intervention, those who were in active treatment conditions (vs. control) reported stronger weight-loser and exerciser identities at every post-treatment assessment point. In addition, stronger weight-loss-maintainer identity and exerciser identity was associated with more weight loss and less weight regain. Thus, participating in an intervention alone fostered natural development of identities associated with the target behaviors, and stronger identities predicted more successful outcomes (e.g., higher weight loss). Importantly, these health-related identities (i.e., exerciser, weight loser, weight maintainer) were maintained for the individuals in the active treatment groups even at follow-up 18 months post intervention. Therefore, it is clear that engaging in an intervention tends to promote development of an identity associated with the target behavior. Additionally, the development of an identity related to the target behavior appears to promote continued engagement in the behavior, in congruence with Identity Theory. There is no study to my knowledge that examines the role of identity in the context of MHBC interventions, thus, I seek to fill this gap in the literature.

In order to understand how forming a health-related identity can be protective of health behavior change, it is important to focus on how the identity may be formed. Simply engaging in the target behavior is not enough to form an identity around that behavior; rather, individuals must view themselves as capable of engaging in the behavior, actually engage in the behavior, and enjoy the behavior enough to want to do it again. Thus, self-efficacy for engaging in the behavior (i.e., action self-efficacy) is important for identity formation, but individuals must also believe that they are able to continue engaging in the behavior across time (i.e., maintenance

self-efficacy) for the intervention to be successful long-term (Schwarzer, 2008). Given that identities are formed in part to explain past behavior, having an identity around a target behavior should be positively associated with both action self-efficacy and maintenance self-efficacy because the identity is formed around the premise that the individual has been engaging in this behavior enough for it to become part of who they are, and will consequently promote continued engagement in the future (Anderson & Cychosz, 1994; Stets & Burke, 2000).

The Current Study

Given the lack of research focusing on the interplay between self-efficacy and identity within MHBC interventions, I aim to fill this gap in the literature. Specifically, I propose that the combined effects of self-efficacy and identity development allow MHBC interventions to be more effective than interventions addressing single health behaviors in isolation. MHBC interventions may have an advantage over SHBC interventions because self-efficacy for each of the target behaviors may generalize to self-efficacy for the other behaviors in the intervention (Bandura, 1977; Bandura, 1986; King et al., 1996), whereas such an opportunity does not exist in the SHBC interventions. Given that self-efficacy is reinforced after successful engagement in the target behavior, successfully engaging in multiple behaviors may not only increase self-efficacy for the specific behaviors, but perhaps also for engagement in health behavior, more generally. Further, given that higher self-efficacy is associated with higher frequency of engagement in that behavior (Bandura, 1977), individuals participating in MHBC (vs. SHBC) interventions may be more likely to develop an identity around the target behaviors (and general health behavior) as a function of increases in self-efficacy through consistent engagement. Moreover, the higher number of successful attempts to engage in a specific behavior should be associated with a stronger identity for that behavior. In addition, the more successful attempts an individual has at

engaging in a wider variety of health-related behaviors, the stronger the individuals' general health identity should be. Therefore, MHBC interventions may provide participants with a unique environment that fosters better longer-term maintenance of the target behaviors through increased self-efficacy (i.e., action and maintenance) and development of a health-related identity.

Much of the existing research regarding MHBC interventions has focused on very specific samples; for example, individuals with overweight or obesity, and individuals who engage in risky behaviors (e.g., smoking, drinking alcohol, using illicit drugs). Although these populations are important to study, prevention is vital for improving public health. According to the Centers for Disease Control and Prevention (2019), many chronic illnesses can be prevented, or at least mitigated, through the engagement in health-promoting behaviors such as exercising regularly, not smoking, and eating sufficient amounts of fruits and vegetables. Therefore, healthy individuals are an overlooked population who would also largely benefit from interventions that could help them engage in more health-promoting behaviors. After all, health care costs can be most dramatically reduced if people aren't becoming ill in the first place; therefore, prevention is key (Gortmaker et al., 2015; Veerman, Sacks, Antonopoulos, & Martin, 2016; Wu & Green, 2000).

Further, as previously mentioned, many of the existing MHBC interventions focus on behaviors that share a common goal; for example, increasing PA and improving diet (e.g., increasing fruit/vegetable intake, reducing fat intake) for weight loss (King et al., 2015). Although combining behaviors with a common goal outcome can be beneficial for facilitating behavior change in the said outcome, this may complicate researchers' ability to discern what the actual mechanisms that make MHBC interventions successful actually are. Additionally,

interventions with common goals that may be attractive and motivating in their own rights, such as weight loss, may function differently than interventions with less concrete or rewarding outcomes (i.e., preventing chronic illness). It is important to evaluate both types of interventions: MHBC interventions that focus on target behaviors sharing a common goal, as well as MHBC interventions that involve target behaviors that are similar, but not as closely related to a tangible common goal. For the purposes of this study, I will be investigating the mechanisms of a MHBC intervention where the two target behaviors do no share an obvious common goal (i.e., practicing yoga, and consuming fruits and vegetables) in order to specifically test whether identity as a healthy person, rather than the motivation to achieve a specific external goal, is a mechanism through which MHBC interventions are particularly effective (as compared to SHBC interventions).

It is well known that fruit and vegetable consumption is associated with favorable health outcomes such as chronic illness prevention and better overall health (Centers for Disease Control and Prevention, 2019). Additionally, practicing yoga has also been shown to provide many health benefits. A review by Ross and Thomas (2010) brought to light that yoga may have comparable, or even stronger, health benefits compared to some forms of exercise. Specifically, practicing yoga has been associated with a wide range of health benefits including reducing fatigue, improving kidney function, reducing pain, mitigating stress and lowering cortisol, improving sleep, improving menopausal symptoms, improving social and occupational functioning, and improving quality of life (Ross & Thomas, 2010). Unlike other forms of exercise that may require equipment or may be strenuous, yoga can be done anywhere and can easily be adapted to any fitness level. Given the health benefits of yoga, coupled with its accessibility, yoga can be a quick and easy, yet effective health behavior that may be important

for both overall well-being, as well as better physical and mental health. In addition, yoga tends to be viewed less as exercise and more of a stretch and relaxation technique, thus, it is less likely that participants focus on weight loss goals in this intervention targeting yoga than if we asked participants to engage in moderate to vigorous PA (MVPA) alongside consuming more fruits and vegetables. Thus, by focusing on yoga (rather than MVPA) and fruit and vegetable consumption, participants may view the intervention as having a relatively ambiguous goal of improving their overall health, which will allow us to more clearly examine our specific hypothesized mechanisms of self-efficacy and identity.

One other limitation of MHBC intervention research is that many studies compare the MHBC intervention condition to only a control condition, or to only a SHBC intervention, but not both, which is problematic (McSharry et al., 2015; Prochaska et al., 2011). Without comparing the MHBC intervention condition, corresponding SHBC intervention conditions, and a control condition, it is impossible to discern which type of intervention is more efficacious, if any. Specifically, only comparing the MHBC condition to a control condition prevents researchers from knowing whether the MHBC intervention is better, worse, or equivalent to a SHBC intervention. Similarly, limiting the comparison to only the MHBC and SHBC interventions disallows being able to conclude whether either of the interventions are better or worse than no intervention at all. Therefore, it is imperative to compare all three types of conditions to be able discern whether the MHBC intervention is actually beneficial to participants. Therefore, I seek to fill this gap in the literature by comparing a MHBC intervention to two SHBC interventions for each of target behaviors in the MHBC intervention (i.e., yoga practice; fruit and vegetable consumption), and to the control condition.

The purpose of this study is to test a MHBC intervention designed to facilitate more frequent yoga practice and higher fruit and vegetable consumption. I predict that the MHBC intervention will be more effective than SHBC interventions or no intervention (control) as a function of general health behavior engagement self-efficacy and health-related identity development. Specifically, I hypothesize the following:

Hypothesis 1a

Individuals in the MHBC intervention condition will have higher levels of both yoga engagement and frequency of filling half of their plate with fruits and vegetables, compared to the SHBC yoga intervention, SHBC fruit and vegetable intervention, and control conditions.

Hypothesis 1b

Individuals in the MHBC intervention condition will have stronger intentions to continue engaging in the target behaviors (i.e., yoga engagement, filling half of their plate with fruits and vegetables) after the intervention, compared to the SHBC yoga intervention, SHBC fruit and vegetable intervention, and control conditions.

Hypothesis 1c

Individuals in the MHBC intervention condition will have highest self-efficacy for general health behavior and most central general health identities, as compared to the SHBC yoga intervention, SHBC fruit and vegetable intervention, and control conditions.

Hypothesis 2a

The effect of experimental condition on individuals' engagement in the target behaviors (i.e., yoga engagement, filling half of one's plate with fruits and vegetables) during the intervention will be mediated by general health self-efficacy and general health identity.

Hypothesis 2b

Individuals' intentions to continue engaging in the target behaviors (i.e., yoga engagement, filling half of one's plate with fruits and vegetables) after the intervention will be mediated by general health self-efficacy and general health identity.

Hypothesis 3

The relationship between individuals' general health self-efficacy at T2 and general health identity at T3 will be stronger than the relationship between individuals' general health identity at T2 and general health self-efficacy at T3, indicating that development of general health self-efficacy precedes development of general health identity.

CHAPTER 2. METHODS

Participants

Participants were a total of 101 female faculty and staff members at Iowa State University (M_{age} = 41.51, SD = 12.71). Of the 101 participants at T1, there was a 22.78% attrition rate for T2 (n = 78), and an additional 29.49% attrition rate from T2 to T3, two weeks later (n = 54). The total attrition rate from T1 to T3 was 46.53%. An additional 21 participants completed the T3 survey weeks or months beyond the one month timeline of the study, thereby lowering total attrition rate from T1 to T3 to 25.74% (n = 75). Participants were compensated for their participation with a $25 Amazon gift card following the baseline session (T1).

Procedure

This study was approved by the Institutional Review Board at Iowa State University (IRB ID: 19-366; see Appendix B). Participants were randomly assigned to one of four conditions: (1) MHBC intervention condition: yoga practice engagement, and fruit and vegetable intake; (2) SHBC intervention condition: yoga; (3) SHBC intervention condition: fruit and vegetable intake; (4) No intervention: control condition. The study was four weeks in duration for all participants, regardless of condition. Data were collected at three time points: baseline (T1), midpoint (T2), and follow-up (T3). Before being admitted to this study, individuals completed a pre-screen questionnaire evaluating whether they are interested in improving their engagement in health behaviors, specifically increasing their fruit and vegetable intake and practicing yoga, and their stage of change for these behaviors. Participants who reported (1) not currently engaging in these behaviors regularly, (2) not be in the maintenance stage of either of these behaviors, (3) that they are interested in increasing their engagement in both of these behaviors, and (4) not vegetarian or vegan, were eligible to participate in this study. All eligible participants completed a baseline

questionnaire during the first session of the study (T1), which included measures of action self-efficacy for health behavior in general, yoga, and fruit and vegetable consumption, identity as a healthy person, yoga identity, fruit- and vegetable-eater identity, and a measure of health behaviors that they currently engage in. Participants also underwent a health behavior intervention during the baselines session if they were in any of the three intervention conditions. The intervention included setting implementation intentions (Gollwitzer, 1999), and action planning (Hagger & Luszczynka, 2014). Individuals in the MHBC condition completed the intervention for both yoga practice engagement and increasing fruit and vegetable intake, whereas participants in the SHBC conditions completed only the intervention for yoga practice engagement or fruit and vegetable intake, if they were assigned to the yoga or fruit and vegetable conditions, respectively. Individuals in the control condition completed the baseline measures but did not participate in any intervention.

The midpoint of the study (T2) took place two weeks after the baseline session, at which point all participants were emailed a survey to complete. This survey included measures of frequency and duration of engagement in a variety of health behaviors (including yoga and fruit and vegetable consumption), maintenance self-efficacy for health behaviors in general, healthy person identity, yoga identity, and fruit and vegetable-eater identity. Participants were asked to complete these surveys at the midpoint of the study (i.e., T2, two weeks post baseline) and immediately following the end of the intervention (i.e., T3, four weeks post baseline).

The participant recruitment and data collection process was slower than anticipated, and due to the emergence of the COVID-19 global pandemic, I was unable to collect my full sample of 200 participants within the planned time frame. Unfortunately, COVID-19 related disruptions prevent me from collecting more data until Fall 2020 at earliest, once the pandemic has cleared

and the data collection procedures can resume as described. Thus, for the purposes of this manuscript, I will be using the data that I currently have available with the intent of collecting more data once possible.

Intervention

Individuals who were randomly assigned to any of the three intervention conditions set implementation intentions and engaged in coping planning for their target behaviors during the baseline session (T1), after completing the preliminary baseline measures listed above. Individuals who were in each of the SHBC conditions completed the intervention only for their respective target behavior (i.e., yoga or fruit and vegetable consumption), whereas those in the MHBC condition completed the intervention for both yoga and fruit and vegetable consumption. Individuals in the control condition completed baseline and survey measures, but did not participate in any form of the intervention.

Participants in the intervention conditions were told that for the purposes of this study, they are to engage in the following behaviors for one month: (1) MHBC condition: practice yoga for 20 minutes, three times per week, or an equivalent of 60 minutes per week; and fill half of their plate with fruits and/or vegetables at least once per day; (2) SHBC Yoga condition: practice yoga for 20 minutes, three times per week, or an equivalent of 60 minutes per week; (3) SHBC Fruits and Vegetable condition: fill half of their plate with fruits and/or vegetables at least once per day. Having autonomy is important for internalizing and having more intrinsic motivation to engage in a behavior (Ryan & Deci, 2000). Therefore, although the goals for yoga and fruit and vegetable consumption were uniform across participants, individuals had choice regarding how they wished to meet those guidelines. Specifically, participants were able to choose at which meal they would aim to fill half of their plate with fruits and vegetables, and what types of fruits

and vegetables they preferred to select. Similarly, for yoga practice, participants received access to a subscription of online yoga classes that contained a wide range of types of yoga classes at varying levels, led by a wide range of instructors. This way, participants were able to self-select the types of yoga and levels of difficulty that they wished to engage in, thereby affording each participant the autonomy of engaging in types of yoga that they enjoy.

Implementation Intentions

Implementation intentions have been shown to facilitate behavior change (Gollwitzer, 1999). Specifically, implementation intentions specify when, where, and how one will engage in the target behavior. Participants were asked to respond to the following prompt: "Think about your daily routines- ones that occur at least on 5 days of the week, but preferably every day of the week (e.g., going to class, leaving class, going to or leaving meals, down time, going to bed, etc.). Brainstorm possible contexts/cues/routines that you could fit your new behavior into (write several possibilities, if you think of them)." Individuals in the MHBC condition completed this prompt twice, once for yoga practice and once for increasing fruit and vegetable intake. Individuals in the SHBC condition for yoga or fruit and vegetable intake only completed this prompt for yoga or fruit and vegetable intake, respectively. Participants were then asked to select a specific cue from their abovementioned routines and to engage in the target behavior to in response to this cue (i.e., incorporate the target behavior into an existing routine). Participants then completed the prompt "Whenever I _____ (specific cue), I will do yoga" (yoga only condition) or "Whenever I _____ (specific meal, such as dinner or lunch), I will fill half of my plate with fruits and/or vegetables," (fruit and vegetable only condition). Individuals in the MHBC condition completed both sets of prompts.

Coping Planning

After setting their implementation intentions, participants were asked to think of possible barriers that may arise and interfere with engaging in the target behaviors (i.e., practicing yoga and/or filling half of their plate with fruits/vegetables). Participants were then asked to describe ways that they could overcome such barriers and make alternate plans for engaging in the target behavior when such barriers arise (Gollwitzer, 1999; Sniehotta, Schwarzer, Scholz, & Schüz, 2005). Participants were asked to respond to the prompt: "Think about things that might get in the way of you [engaging in the target behavior] (i.e., barriers). Please list at least three (3) barriers that could prevent you from [engaging in the target behavior] at any given time." Participants in the yoga or fruit and vegetable conditions only completed this prompt for their given target behavior. Individuals in the MHBC condition completed this prompt twice, once for practicing yoga, and once for consuming fruits and vegetables. Next, participants were asked to identify specific strategies to overcome the barriers listed in the previous prompt. Specifically, participants were asked to complete the following prompts for each of their listed barriers: "Thinking about the barriers you listed above, think about alternative plans that could help you overcome these barriers. Please fill in the following prompt for each of your listed barriers. For example, if your target behavior was running outside every day and a barrier was bad weather, you may complete the prompt like this 'If the weather is not suitable for running outside, then I will not put off running until the next day. Instead, I will go to the gym and run inside.' Using this example as a template, please complete the following prompts: If _____(barrier), then I will not _____ (behavior allowing barrier to interfere with target behavior). Instead, I will _____ (alternate plan facilitating engagement in target behavior)."

Measures

Stages of Change

Individuals' stage of change for the target behaviors was assessed using a five-point scale, adapted from Marcus, Rakowski, & Rossi (1992). Participants were asked to select the option that most accurately represents them for both yoga practice and fruit and vegetable consumption. Practicing yoga is defined as engaging in at least one 20 minute session of yoga, three times per week, or an equivalent of 60 minutes of yoga per week. Eating fruits and vegetables is defined as filling half of one's plate with fruits and/or vegetables during a chosen meal (e.g., dinner, lunch).

The five items evaluating stages of change for practicing yoga are as follows: (1) "I currently do not practice yoga and I do not intent to start practicing yoga in the next six months; (2) I currently do not practice yoga but I am thinking about starting to practice yoga in the next six months; (3) I currently practice yoga some, but not regularly; (4) I currently practice yoga regularly but I have only begun doing so within the last six months; (5) I currently practice yoga and have done so for longer than six months."

The five items evaluating stages of change for eating fruits and vegetables are as follows: (1) "I currently do not eat fruits and vegetables and I do not intent to start eating fruits and vegetables in the next six months; (2) I currently do not eat fruits and vegetables but I am thinking about starting to eat fruits and vegetables in the next six months; (3) I currently eat fruits and vegetables some, but not regularly; (4) I currently eat fruits and vegetables regularly but I have only begun doing so within the last six months; (5) I currently eat fruits and vegetables and have done so for longer than six months."

Action Self-Efficacy

Action self-efficacy was evaluated by four items adapted from Renner and Schwarzer (2007). Participants responded to the stem "I am sure that I can start engaging in health behaviors immediately, even if…" on a four-point Likert scale (1: Not true at all - 4: Exactly true). Items include: (1) I initially have to reconsider my views on being healthy; (2) the planning for this is very laborious; (3) I have to for myself to start immediately; (4) I have to push myself. Responses to the four items were averaged for an index of action self-efficacy for health behavior engagement.

Action self-efficacy was also evaluated for each target behavior. Specifically, the phrase "health behaviors" was replaced by "yoga practice" and "eating fruits and vegetables" to evaluate action self-efficacy for starting to practice yoga and begin eating fruits and vegetables, respectively. Responses were averaged to create one overall score of action self-efficacy for each of the three types of health behavior measured.

Maintenance Self-Efficacy

Maintenance self-efficacy was evaluated with an eleven item measure, adapted from Renner and Schwarzer (2007). Participants responded to the stem "I am sure that I can start engaging in health behaviors immediately, even if…" on a four-point Likert scale (1: Not true at all - 4: Exactly true). Examples of items include: "I am stressed out," "I am tired," and "I have to start all over again several times until I succeed."

Maintenance self-efficacy was also evaluated for each target behavior. Specifically, the phrase "health behaviors" was replaced by "yoga practice" and "eating fruits and vegetables" to evaluate maintenance self-efficacy for continuing to practice yoga and eat fruits and vegetables,

respectively. Responses were averaged to create one overall score of maintenance self-efficacy for each of the three health behaviors measured.

Healthy Person Identity

Health-related identity was assessed using a modified version of the exercise identity scale by Anderson & Cychosz (1994). Participants responded to nine items on a five-point Likert scale (1: Strongly disagree - 5: Strongly agree). The items are as follows: (1) I consider myself a healthy person; (2) When I describe myself to others, I usually include my healthy lifestyle; (3) I have numerous goals related to being healthy; (4) Being a healthy person is a central factor of my self-concept; (5) I need to be healthy to feel good about myself; (6) Other see me as someone who engages in healthy behavior regularly; (7) For me, being a healthy person means more than just engaging in health-related behaviors; (8) I would feel a real loss if I were forced to give up engaging in health-related behaviors; (9) Being a healthy person is something I think about often.

Yoga Identity

Yoga identity was assessed using a modified version of the exercise identity scale by Anderson & Cychosz (1994). Participants responded to nine items on a five-point Likert scale (1: Strongly disagree - 5: Strongly agree). The items are as follows: (1) I consider myself a yogi (i.e., someone who practices yoga); (2) When I describe myself to others, I usually include my involvement in yoga; (3) I have numerous goals related to practicing yoga; (4) Practicing yoga is a central factor of my self-concept; (5) I need to practice yoga to feel good about myself; (6) Other see me as someone who practices yoga regularly; (7) For me, being a yogi means more than just doing yoga; (8) I would feel a real loss if I were forced to give up practicing yoga; (9) Yoga is something I think about often.

Fruit- and Vegetable-Eater Identity

Fruit- and vegetable-eater identity was assessed using a modified version of the exercise identity scale by Anderson & Cychosz (1994). Participants responded to nine items on a five-point Likert scale (1: Strongly disagree - 5: Strongly agree). The items are as follows: (1) "I consider myself as someone who eats fruits and vegetables; (2) When I describe myself to others, I usually include my eating fruits and vegetables; (3) I have numerous goals related to eating fruits and vegetables; (4) Eating fruits and vegetables is a central factor of my self-concept; (5) I need to eat fruits and vegetables to feel good about myself; (6) Other see me as someone who eats fruits and vegetables regularly; (7) For me, being someone who eats fruits and vegetables means more than just eating fruits and vegetables; (8) I would feel a real loss if I were forced to give up eating fruits and vegetables; (9) Eating fruits and vegetables is something I think about often."

Yoga Engagement

Participants indicated the frequency and duration of yoga engagement by responding to four items: (1) "In the past week, on how many days have you practiced yoga?; (2) In the past week, how many times did you practice yoga, total?; (3) Approximately how long were each of these yoga sessions (minutes)?; (4) On average, how many minutes did you spend engaging in yoga last week?"

Fruit and Vegetable Consumption

Participants indicated how often they filled half of their plate with fruits and vegetables. This was assessed by three items: (1) "In the past week, how many times per day did you eat fruits and vegetables?; (2) In the past week, on how many days did you fill half of your plate

with fruits and vegetables?; (3) Approximately how many servings of fruits and vegetables did you consume last week?"

Engagement in Health-Related Behaviors

Participants indicated the frequency and duration of health behavior engagement by responding to four items: (1) "In the past week, on how many days have you engage in health-related behavior?; (2) In the past week, how many times did you engage in health-related behavior, total?; (3) For approximately how long did you engage in each bout of health-related behavior engagement (minutes)?; (4) On average, how many minutes did you spend engaging in health-related behavior last week?"

Specific health behavior engagement. Participants also indicated the types of health-related behaviors that they engaged in, within the past week. Engagement was assessed using three items: (1) "In how many *different* types of health-related behaviors (e.g., swimming, getting enough sleep, eating less fat) did you engage in last week? Please list them below; (2) Please indicate how many times you engaged in each behavior last week; (3) Please indicate for how long (i.e., minutes) you participated in each behavior last week."

Motivation to Engage in Target Behaviors

Participants completed adapted versions of the Behavioral Regulation Exercise Questionnaire (BREQ)-3 (Markland & Tobin, 2004; Wilson, Rodgers, Loitz, & Scime, 2006) to evaluate individuals' motivation for engaging in general health-related behaviors, yoga, and filling half of one's plate with fruits/vegetables.

Motivation to engage in general health behavior. Participants were asked to answer questions regarding their reasons underlying their decisions to engage or not engage in health-related behaviors. The scale consists of 24 items on a five-point Likert scale (0: Not true for me - 4: Very true for me). An example of items are: "I don't see why I should have to engage in health-related behaviors" and "I engage in health-related behaviors because they are consistent with my life goals."

Motivation to practice yoga. Participants were asked to answer questions regarding their reasons underlying their decisions to engage or not engage in yoga practice. The scale consists of 24 items on a five-point Likert scale (0: Not true for me - 4: Very true for me). An example of items are: "I don't see why I should have to engage in yoga" and "I engage in yoga because it is consistent with my life goals."

Motivation to eat fruits and vegetables. Participants were asked to answer questions regarding their reasons underlying their decisions to engage or not engage in filling half of their plate with fruits and/or vegetables. The scale consists of 24 items on a five-point Likert scale (0: Not true for me - 4: Very true for me). An example of items are: "I don't see why I should have to engage in filling half of my plate with fruits and/or vegetables" and "I engage in filling half of my plate with fruits and/or vegetables because it is consistent with my life goals."

Intentions to Continue Engaging in Target Behaviors

Participants were asked whether they intend to engage in the following behaviors in the next month: (1) health-related behaviors in general; (2) practicing yoga; (3) filling half of their plate with fruits/vegetables. Responses will be on a scale from 1(Strongly Disagree) to 5(Strongly Agree).

CHAPTER 3. ANALYSIS PLAN

A power analysis was conducted and a minimum sample size of $n = 200$ is required to have power of at least .80 for all analyses. Descriptive statistics for all variables will be obtained. Levene's test will be used to evaluate whether the assumptions of homoscedasticity have been sufficiently met for analysis. Univariate and multivariate outliers will be assessed. Effect sizes will be emphasized, instead of relying on significance levels alone, given the planned examination of multiple comparisons and problems associated with significance testing.

Hypothesis 1a

A series of eight one-way between subjects ANOVAs will be conducted to test whether there are group differences as a function of experimental condition in behavioral engagement in the target behaviors. Specifically, the independent variable will be experimental condition, and will have four levels: (1) MHBC intervention condition; (2) SHBC intervention: Yoga only condition; (3) SHBC intervention: Fruit/vegetable only condition; (4) Control condition. There will be eight dependent variables, one for each of the ANOVAs: (1) yoga engagement at T2, (2) yoga engagement at T3 including only those who completed T3 measures within the one month of the study, (3) yoga engagement at T3 including all cases with T3 data, (4) yoga engagement at T3 where missing cases were imputed with yoga engagement values at prior to the intervention (i.e., pre-screen values), (5) frequency of filling half of one's plate with fruits and vegetables at T2, (6) frequency of filling half of one's plate with fruits and vegetables at T3 including only those who completed T3 measures within the one month of the study, (7) frequency of filling half of one's plate with fruits and vegetables at T3 including all cases with T3 data, (8) frequency of filling half of one's plate with fruits and vegetables at T3 where missing cases were imputed with yoga engagement values at prior to the intervention (i.e., pre-screen values). In the event of

significant results, post-hoc pairwise comparison tests (e.g., Tukey's HSD) will be conducted. Cohen's d effect sizes will also be reported for all pairwise comparisons.

Hypothesis 1b

A series of four one-way between subjects ANOVAs will be conducted to test whether there are group differences as a function of experimental condition in intentions to continue engagement in the target behaviors beyond the intervention. Specifically, the independent variable will be experimental condition, and will have four levels: (1) MHBC intervention condition; (2) SHBC intervention: Yoga only condition; (3) SHBC intervention: Fruit/vegetable only condition; (4) Control condition. There will be eight dependent variables, one for each of the ANOVAs: (1) intentions to continue yoga engagement at T3 including only those who completed T3 measures within the one month of the study, (2) intentions to continue yoga engagement at T3 including all cases with T3 data, (3) intentions to continue filling half of one's plate with fruits and vegetables at T3 including only those who completed T3 measures within the one month of the study, (4) intentions to continue filling half of one's plate with fruits and vegetables at T3 including all cases with T3 data. In the event of significant results, post-hoc pairwise comparison tests (e.g., Tukey's HSD) will be conducted. Cohen's d effect sizes will also be reported for all pairwise comparisons.

Hypothesis 1c

A series of eight one-way between subjects ANOVAs will be conducted to test whether there are group differences as a function of experimental condition in levels of general health self-efficacy, and general health identity. Specifically, the independent variable will be experimental condition, and will have four levels: (1) MHBC intervention condition; (2) SHBC intervention: Yoga only condition; (3) SHBC intervention: Fruit/vegetable only condition; (4)

Control condition. There will be eight dependent variables, one for each of the ANOVAs: (1) general health SE at T1, (2) general health SE at T2, (3) general health SE at T3 including only those who completed T3 measures within the one month of the study, (4) general health SE at T3 including all cases with T3 data, (5) general health identity at T1, (6) general health identity at T2, (7) general health identity at T3 including only those who completed T3 measures within the one month of the study, (8) general health identity at T3 including all cases with T3 data. In the event of significant results, post-hoc pairwise comparison tests (e.g., Tukey's HSD) will be conducted. Cohen's d effect sizes will also be reported for all pairwise comparisons.

Hypothesis 2a

Hayes' mediation model number four will be run in the SPSS macro Process (Hayes, 2018). Specifically, I will be testing whether the direct effect of experimental condition on engagement in the target behaviors (i.e., yoga engagement, filling half of one's plate with fruits and vegetables) is mediated by general health-related self-efficacy and general health identity. General health self-efficacy and general health identity will be entered as independent simultaneous mediators. The independent variable will be experimental condition, which will be dummy coded such that MHBC intervention condition is the reference group. Thus, each model will produce three mediation models, one with each of the dummy-coded independent variable comparisons: (1) SHBC yoga compared to MHBC, (2) SHBC fruit and vegetable compared to MHBC; (3) control compared to MHBC. I will run this model with six different dependent variables, for a total of 18 analyses: (1) yoga engagement at T2, (2) yoga engagement at T3 including all cases with data for T3, (3) yoga engagement at T3 where missing cases were imputed with yoga engagement values at prior to the intervention (i.e., pre-screen values), (4) frequency of filling half of one's plate with fruits and vegetables at T2, (5) frequency of filling

half of one's plate with fruits and vegetables at T3 including all cases with data for T3, (6) frequency of filling half of one's plate with fruits and vegetables T3 where missing cases were imputed with frequency values prior to the intervention (i.e., pre-screen values).

Hypothesis 2b

Hayes' mediation model number four will be run in the SPSS macro Process (Hayes, 2018). Specifically, I will be testing whether the direct effect of experimental condition on intentions to continue engaging in the target behaviors (i.e., yoga engagement, filling half of one's plate with fruits and vegetables) is mediated by general health-related self-efficacy and general health identity. General health self-efficacy and general health identity will be entered as independent simultaneous mediators. The independent variable will be experimental condition, which will be dummy coded such that MHBC intervention condition is the reference group. Thus, each model will produce three mediation models, one with each of the dummy-coded independent variable comparisons: (1) SHBC yoga compared to MHBC, (2) SHBC fruit and vegetable compared to MHBC; (3) control compared to MHBC. I will run this model with four different dependent variables, for a total of 12 analyses: (1) intentions to continue yoga engagement at T3 including only cases that completed T3 measures within the one month period of the study, (2) intentions to continue yoga engagement at T3 including all cases with data for T3, (3) intentions to continue filling half of one's plate with fruits and vegetables at T3 including only cases that completed T3 measures within the one month period of the study, (4) intentions to continue filling half of one's plate with fruits and vegetables at T3 including all cases with data for T3.

Hypothesis 3

I predict that the relationship between general health self-efficacy at midpoint (T2) and general health identity at follow-up (T3) is stronger than the relationship between general health identity at midpoint and general health self-efficacy at follow-up. This pattern of relationships would suggest that development of general health self-efficacy temporally precedes development of general health identity. Fischer's Z test will be used to determine whether the correlation between general health self-efficacy at midpoint (T2) and general health identity at follow-up (T3) is significantly different from the relationship between general health identity at midpoint (T2) and general health self-efficacy at follow-up (T3).

CHAPTER 4. RESULTS

Mahalanobis distance values indicated no multivariate outliers on the tested study variables ($X^2(23) = 25.309$, $p = .335$; see Tabachnik & Fidell, 2007). Cases with *Z*-scores with values of 3.00 or higher, or values of -3.00 or lower were considered univariate outliers. A total of ten univariate outliers were identified on seven different variables. See Table 1. Analyses were conducted with all outliers included, as well as with outliers relevant to the analysis excluded. All results are reported with outliers included in the analyses. Results are also reported for analyses where outliers were excluded when exclusion of outliers meaningfully altered results. The final analytic sample including outliers was $n = 101$, which is below the recommended sample of $n = 200$ for sufficient power. Data were collected at three separate time points: baseline T1 ($n = 101$), midpoint T2 ($n = 78$), and follow-up T3 ($n = 75$). A subset of participants completed the follow-up survey outside of the one month study timeline ($n = 21$), thus analyses using variables from T3 were analyzed with only cases that were collected within the one month study timeframe, and again including the cases that were collected late. Additionally, given the small sample size at T3 due to attrition, data were also analyzed with missing values imputed using pre-screen intervention levels of behavioral engagement for yoga practice and frequency of filling half of one's plate with fruits and vegetables. Attrition was likely due to participants not continuing with the intervention and the target behavior. Therefore, a conservative estimate is that they went back to their initial levels (i.e., pre-screen) of the target behaviors at the point they dropped out. Random assignment was confirmed, as participants did not differ across conditions prior to receiving the intervention on their stages of change for yoga or fruit and vegetable consumption, or on behavioral engagement in yoga or fruit and vegetable consumption. See Table 2. Given the small sample size, significance testing may be unreliable. Thus, Cohen's d

effect sizes were computed for each of the pairwise comparisons between conditions on stages of change for yoga or fruit and vegetable consumption, or on behavioral engagement in yoga or fruit and vegetable consumption. See Tables 3-4. Effects were generally small, indicating no consistent large differences between conditions at pre-screen on these variables. See Tables 5-7 for descriptive statistics.

Experimental Condition Predicting Drop-Out

To determine whether there were differences in attrition as a function of experimental condition, I conducted a one-way ANOVA predicting number of surveys completed (i.e., baseline, midpoint, follow-up) from experimental condition. Participants who completed the follow-up survey after the one-month duration of the intervention were not included in this analysis because they were explicitly emailed post-intervention and asked to complete the final survey. Therefore, these cases are qualitatively different than those who completed the follow-up survey on time at the one month post-baseline interval. Levene's test was not significant, indicating equal error variances, $F(3,83) = .05$, $p = .99$. There was no significant effect of condition on number of surveys completed, suggesting that individuals in any one experimental condition were no more likely to drop out of the study than individuals in any other experimental condition, $F(3,83) = .01$, $p = .99$.

Hypothesis 1a

I predicted that individuals in the MHBC intervention group would have higher levels of both yoga engagement and frequency of filling half of their plate with fruits and vegetables, compared to SHBC intervention groups and the control group. I analyzed the effect of condition on yoga engagement and frequency of filling half of one's plate with fruits and vegetables at T2 and T3. I conducted eight one-way ANOVAs to test this hypothesis, with experimental condition

(i.e., MHBC intervention, SHBC yoga intervention, SHBC fruit and vegetable intervention, control condition) as the independent variable. The dependent variables for each analysis were: (1) yoga engagement at T2, (2) yoga engagement at T3 including only those who completed T3 measures within the one month of the study, (3) yoga engagement at T3 including all cases with T3 data, (4) yoga engagement at T3 where missing cases were imputed with yoga engagement values at prior to the intervention (i.e., pre-screen values), (5) frequency of filling half of one's plate with fruits and vegetables at T2, (6) frequency of filling half of one's plate with fruits and vegetables at T3 including only those who completed T3 measures within the one month of the study, (7) frequency of filling half of one's plate with fruits and vegetables at T3 including all cases with T3 data, (8) frequency of filling half of one's plate with fruits and vegetables at T3 where missing cases were imputed with yoga engagement values at prior to the intervention (i.e., pre-screen values). Although the multiple ways of treating the outcome lead to a larger number of analyses for this and subsequent hypotheses, this approach is consistent with current recommendations to conduct a multiverse analysis (Steegan, Tuerlinckx, Gelman, & Vanpaemel, 2016)—i.e., being transparent about data decisions and reporting results for each possible data decision.

Levene's test was not significant for all analyses predicting frequency of filling half of one's plate with fruits and vegetables and for the analysis predicting yoga engagement at T2, suggesting equal error variances. Levene's test was significant for the remaining analyses predicting yoga engagement, thus violating the assumption of error variance equality; the corrected model was used for these analyses. See Tables 8-15 for F test results and effect sizes of pairwise comparisons.

There was no significant effect of condition on frequency of filling half of one's plate with fruits and vegetables at any time point. However, experimental condition significantly predicted yoga engagement at T2, $F(3,73) = 3.67$, $p = .02$. Post-hoc analyses using Tukey's HSD indicated that individuals in the MHBC intervention ($M = 40.29$) reported engaging in significantly more minutes of yoga in the last week than those in the control condition ($M = 11.36$, $p = .03$, *Cohen's d* = 1.00). Experimental condition also significantly predicted yoga engagement at T3 for those who completed T3 measures within the intervention period, $F(3,48) = 3.51$, $p = .02$. Post-hoc analyses using Tukey's HSD indicated that individuals in the MHBC intervention ($M = 44.23$) reported engaging in significantly more minutes of yoga in the last week than those in the control condition ($M = 3.57$, $p = .02$, *Cohen's d* = .98). Removing two outliers changed the results of this analysis such that the F test was no longer significant, $F(3,46) = 2.27$, $p = .09$, $\eta^2 = .13$. Both outliers were in the MHBC intervention condition, and after their removal, mean yoga engagement decreased from 44.23 to 25.45 minutes per week. The effect size of the difference between MHBC and SHBC yoga conditions on yoga engagement decreased from moderate ($d = .37$) to very small ($d = .04$), the difference between MHBC and SHBC fruit and vegetable conditions on yoga engagement decreased from large ($d = .78$) to moderate ($d = .49$), and the difference between MHBC and control also decreased but remained large (with outliers: $d = .98$, without outliers: $d = .79$). However, the pairwise comparison between MHBC ($M = 25.45$) and control ($M = 8.42$) after outliers were removed was no longer significant, $p = .21$.

Experimental condition significantly predicted yoga engagement at T3 for all cases with T3 data, $F(3,70) = 5.27$, $p = .002$. Post-hoc analyses using Tukey's HSD indicated that individuals in the MHBC intervention ($M = 52.89$) reported engaging in significantly more

minutes of yoga in the last week than those in the SHBC fruit and vegetable condition (M = 8.26, p = .01, *Cohen's d* = .83), and those in the control condition (M = 2.94, p = .004, *Cohen's d* = .95). Lastly, experimental condition significantly predicted yoga engagement at T3 when missing data was imputed with engagement levels prior to the intervention, $F(3,97) = 2.80$, p = .04. Post-hoc analyses using Tukey's HSD indicated that individuals in the MHBC intervention (M = 23.00) reported engaging in significantly more minutes of yoga in the last week than those in the control condition (M = 2.00, p = .05, *Cohen's d* = .63). Removing four outliers changed the results of this analysis such that the F test was no longer significant, $F(3,93) = 1.13$, p = .34, η^2 = .04.

Three of the outliers were in the MHBC intervention condition, and one outlier was removed from the SHBC yoga condition. After their removal, mean yoga engagement decreased from 23.00 to 7.27 minutes per week in the MHBC condition, and from 13.46 to 9.60 minutes per week in the SHBC yoga condition. All of the effect sizes involving MHBC and SHBC yoga conditions decreased substantially. The greatest change in effect size after removing these outliers was between the MHBC and SHBC fruit and vegetable conditions, which decreased from moderate (d = .52) to very small (d = .14). Further, the pairwise comparison between MHBC and control was significant when outliers were included (M_{MHBC} = 23.00, $M_{Control}$ = 2.00, d = .63, p = .05) but no longer significant when outliers were excluded (M_{MHBC} = 7.27, $M_{Control}$ = 2.00, d = .41, p = .64).

Hypothesis 1b

I hypothesized that individuals in the MHBC intervention group would have stronger intentions to continue engaging in the target behaviors (i.e., yoga engagement and filling half of one's plate with fruits and vegetables) post intervention, compared to SHBC intervention groups

and control groups. I analyzed the effect of condition on intentions to continue engaging in yoga and filling half of one's plate with fruits and vegetables post intervention at T3. I conducted four one-way ANOVA to test this hypothesis; with experimental condition as the independent variable. The dependent variables for each analysis were: (1) intentions to continue engaging in yoga post intervention at T3 including only those who completed T3 measures within the one month of the study, (2) yoga engagement at T3 including all cases with T3 data, (3) intentions to continue filling half of one's plate with fruits and vegetables post intervention at T3 including only those who completed T3 measures within the one month of the study, (4) intentions to continue filling half of one's plate with fruits and vegetables at T3 including all cases with T3 data.

Levene's test was not significant for any of the analyses, suggesting equality of error variances. See Tables 8-15 for F test results and effect sizes of pairwise comparisons. Experimental condition did not predict intentions to continue engaging in yoga or filling one's plate with fruits and vegetables post intervention, regardless of whether only timely T3 cases or all cases were included. However, there was a moderate effect size (d = .58) regarding the difference between MHBC (M = 3.85) and SHBC fruit and vegetable (M = 3.18) on yoga engagement (including only cases that completed T3 measures on time), a moderate effect size (d = .68) regarding the difference between MHBC (M = 3.85) and control (M = 3.07) on yoga engagement. Similarly, the difference between MHBC (M = 3.71) and control (M = 2.85) regarding intentions to continue engaging in yoga (including all cases at T3) also had a moderately large effect size (d = .71). Thus, the MHBC intervention may have had an influence on intentions to continue engaging in yoga, despite the non-significant results.

Hypothesis 1c

I hypothesized that individuals in the MHBC intervention group would have the highest self-efficacy for general health behavior and most central general healthy person identities, compared to the non-intervention groups. I analyzed the effect of condition on general self-efficacy and general healthy identity at T1, T2, and T3. I conducted eight one-way ANOVAs to test this hypothesis; with experimental condition as the independent variable. The dependent variables were: (1) general health SE at T1, (2) general health SE at T2, (3) general health SE at T3 including only those who completed T3 measures within the one month of the study, (4) general health SE at T3 including all cases with T3 data, (5) general health identity at T1, (6) general health identity at T2, (7) general health identity at T3 including only those who completed T3 measures within the one month of the study, (8) general health identity at T3 including all cases with T3 data. See Table 16 for F test results, and see Tables 17-20 for effect sizes of pairwise comparisons.

Levene's test was not significant for all but one of the analyses (i.e., predicting general health identity at T2), indicating equality of error variances for those seven analyses. For the analysis predicting healthy identity at T2, the corrected model was used. Experimental condition only significantly predicted general healthy identity at T2, $F(3,75) = 2.91$, $p = .04$. Post-hoc analyses using Tukey's HSD indicated that individuals in the MHBC intervention ($M = 2.81$) reported holding in significantly weaker general health identities than those in the SHBC fruit and vegetable condition ($M = 3.47$, $p = .05$, *Cohen's d* $= .49$). No other group differences in yoga engagement were significant. After two outliers were removed for general health identity at T2, Levene's test became non-significant, suggesting equal error variances, and the F test predicting general health identity at T2 also became non-significant, $F(3,73) = 1.04$, $p = .38$, $\eta^2 =$

.04. Both outliers were in the MHBC condition, and their removal increased the mean general health identity from 2.81 with outliers included, to 3.14 with outliers removed. The significant pairwise comparison between MHBC and SHBC fruit and vegetable was no longer significant after removal of the outliers (p = .38) and the effect size increased, likely due to a reduction in variance within the MHBC condition (outliers included: d = .49, outliers removed: d = .52). Other effect sizes remained relatively similar.

Hypothesis 2a

Next, I evaluated whether the effect of experimental condition on target behavior (i.e., yoga engagement and filling half of one's plate with fruits and vegetables) was mediated by general health self-efficacy and general health identity. I tested six dependent variables: (1) yoga engagement at T2, (2) yoga engagement at T3 including all cases with data for T3, (3) yoga engagement at T3 where missing cases were imputed with yoga engagement values at prior to the intervention (i.e., pre-screen values), (4) frequency of filling half of one's plate with fruits and vegetables at T2, (5) frequency of filling half of one's plate with fruits and vegetables at T3 including all cases with data for T3, (6) frequency of filling half of one's plate with fruits and vegetables T3 where missing cases were imputed with frequency values prior to the intervention (i.e., pre-screen values). The independent variable in each of these models was experimental condition, which was dummy coded such that MHBC intervention condition was the reference group. Thus, for testing each dependent variable, there were three mediation models with the following independent variables: (1) SHBC yoga compared to MHBC, (2) SHBC fruit and vegetable compared to MHBC, (3) control compared to MHBC. General health self-efficacy at T2 and general health identity at T2 were entered into each of the models as independent mediators. Altogether, there were 18 mediation models tested.

When predicting yoga engagement at T2, there was a significant total effect of the SHBC fruit and vegetable condition (vs. MHBC; *Effect* = -24.58, *SE* = 10.19, *t* = -2.41, *p* = .02) and a significant direct effect of the SHBC fruit and vegetable condition (vs. MHBC; *Effect* = -26.13, *SE* = 10.49, *t* = -2.49, *p* = .02). There was also a significant total effect of the control condition (vs. MHBC; *Effect* = -28.93, *SE* = 28.93, *t* = -2.97, *p* = .005) and a significant direct effect of the control condition (vs. MHBC; *Effect* = -29.81, *SE* = 10.28, *t* = -2.90, *p* = .005) on yoga engagement at T2. The total and direct effects of the SHBC yoga (vs. MHBC) condition were not significant (total: *Effect* = -7.59, *SE* = 10.72, *t* = -.71, *p* = .48; direct: *Effect* = -8.92, *SE* = 10. 96, *t* = -.81, *p* = .42). There were no significant indirect effects of general health identity or general health self-efficacy on yoga engagement at T2. See Table 21.

Similarly, when predicting yoga engagement at T3 with all cases included, there was a significant total effect of the SHBC fruit and vegetable condition (vs. MHBC; *Effect* = -29.72, *SE* = 11.38, *t* = -2.61, *p* = .01) and a significant direct effect of the SHBC fruit and vegetable condition (vs. MHBC; *Effect* = -33.73, *SE* = 11.75, *t* = -2.9, *p* = .006). There was a significant total effect of the control condition (vs. MHBC; *Effect* =-35.50, *SE* = 11.541, *t* = -3.08, *p* = .003) and a significant direct effect of the control condition (vs. MHBC; *Effect* = -38.17, *SE* = 11.68, *t* = -3.27, *p* = .002) on yoga engagement at T3 with all cases included. The total and direct effects of the SHBC yoga (vs. MHBC) condition were not significant (total: *Effect* = -11.35, *SE* = 12.65, *t* = -.90, *p* = .37; direct: *Effect* = -14.35, *SE* = 13.01, *t* = -1.10, *p* = .28). There were no significant indirect effects of general health identity or general health self-efficacy on yoga engagement. See Table 22.

The same pattern of results was found when predicting yoga engagement at T3 but imputing all missing cases with pre-screen levels of yoga engagement, such that there was a

significant total effect of the SHBC fruit and vegetable condition (vs. MHBC; *Effect* = -19.33, *SE* = 9.03, *t* = -2.14, *p* = .04) and a significant direct effect of the SHBC fruit and vegetable condition (vs. MHBC; *Effect* = -22.32, *SE* = 9.32, *t* = -2.39, *p* = .02). The total and direct effects of the SHBC yoga (vs. MHBC) condition were not significant (total: *Effect* = -15.28, *SE* = 9.50, *t* = -1.61, *p* = .11; direct: *Effect* = -18.28, *SE* = 9.75, *t* = -1.87, *p* = .07). There were no significant indirect effects of general health identity or general health self-efficacy on yoga engagement. See Table 23.

When predicting frequency of filling's one's plate with fruits and vegetables at T2, there were no significant total effects, direct effects of condition, and no significant indirect effects in any of the three mediation models. Similarly, when predicting frequency of filling's one's plate with fruits and vegetables at T3 including all cases with data, there were no significant total effects, direct effects of condition, and no significant indirect effects in any of the three mediation models. Lastly, when predicting frequency of filling's one's plate with fruits and vegetables at T3 imputing all missing cases with pre-screen values of fruit and vegetable consumption, there were no significant total effects, or direct effects of condition, and no significant indirect effects in any of the three mediation models. See Tables 24-26.

Hypothesis 2b

I also evaluated whether the effect of experimental condition on intentions to continue engaging in the target behavior (i.e., yoga engagement and filling half of one's plate with fruits and vegetables) was mediated by general health self-efficacy and general health identity. I tested four dependent variables: (1) intentions to continue yoga engagement at T3 including only cases that completed T3 measures within the one month period of the study, (2) intentions to continue yoga engagement at T3 including all cases with data for T3, (3) intentions to continue filling half

of one's plate with fruits and vegetables at T3 including only cases that completed T3 measures within the one month period of the study, (4) intentions to continue filling half of one's plate with fruits and vegetables at T3 including all cases with data for T3. The independent variable in each of these models was experimental condition, which was dummy coded such that MHBC intervention condition was the reference group. Thus, for testing each dependent variable, there were three mediation models with the following independent variables: (1) SHBC yoga compared to MHBC, (2) SHBC fruit and vegetable compared to MHBC, (3) control compared to MHBC. General health self-efficacy at T2 and general health identity at T2 were entered into each of the models as independent mediators. Altogether, I tested 12 mediation models.

When predicting intentions to continue engaging in yoga at T3 including only cases that completed T3 measures within the study period, there were no significant total effects or direct effects of condition, and no significant indirect effects in any of the three mediation models. See Table 27. Further, when predicting intentions to continue engaging in yoga at T3 including all cases with T3 data, there were no significant total effects or direct effects of condition, and no significant indirect effects in any of the three mediation models. See Table 28.

When predicting intentions to continue filling half of one's plate with fruits and vegetables at T3 including only cases that completed T3 measures within the study period, there were no significant total effects or direct effects of condition, and no significant indirect effects in any of the three mediation models. See Table 29. Similarly, when predicting intentions to continue filling half of one's plate with fruits and vegetables at T3 including all cases with T3 data, there were no significant total effects or direct effects of condition, and no significant indirect effects in any of the three mediation models. See Table 30.

Hypothesis 3

I predicted that the relationship between general health self-efficacy at midpoint (T2) and general health identity at follow-up (T3) would be stronger than the relationship between general health identity at midpoint and general health self-efficacy at follow-up. This pattern of relationships would suggest that development of general health self-efficacy temporally precedes development of general health identity. General health self-efficacy and general health identity at T3 included all cases with available data at T3. The correlation between general health self-efficacy (T2) and general health identity (T3) was strong ($r = .50$, $p < .001$, $n = 65$). The correlation between general health identity (T2) and general health self-efficacy (T3) was moderate ($r = .29$, $p = .02$, $n = 65$). Fischer's Z test indicated that these correlations were not significantly different from each other ($Z = -1.37$, $p_{two\text{-}tailed} = .17$).

When the two outliers are removed, the correlation between general health self-efficacy (T2) and general health identity (T3) increased slightly in magnitude ($r = .52$, $p < .001$, $n = 64$). The correlation between general health identity (T2) and general health self-efficacy (T3) also increased ($r = .38$, $p = .002$, $n = 63$). Fischer's Z test indicated that these correlations were not significantly different from each other ($Z = -0.97$, $p_{two\text{-}tailed} = .33$).

CHAPTER 5. DISCUSSION

This study evaluated a MHBC intervention aimed at increasing levels of yoga engagement, and levels fruit and vegetable consumption. I predicted that the MHBC intervention would be most effective for facilitating increased levels of yoga engagement and fruit and vegetable consumption, though the process of increasing general health self-efficacy and general health identity.

Individuals in the MHBC intervention were more likely to engage in more yoga than those in the SHBC fruit and vegetable and control conditions, which supports my hypothesis that the MHBC intervention will be more effective for facilitating behavior change. However, significance of these effects dissipated when outliers were removed from analyses. These outliers reported engaging in substantially more yoga compared to other participants (i.e., Z scores > |3| on yoga engagement), thus, it is plausible that the intervention was successful for these individuals in the MHBC condition. It is also possible that these individuals may have been qualitatively different from the rest of the sample on some other characteristic and artificially inflated the results of the intervention. More data collection is needed to increase the limited sample size and determine whether the outliers are an artifact of having a small sample, or whether they are indeed different from other participants. Given that there were no multivariate outliers, it is plausible that the intervention simply worked well for the individuals with high levels of yoga engagement, and that with a larger sample, these cases may no longer be univariate outliers.

Another reason for the lack of effects of the MHBC intervention is that the intervention targeting increased fruit and vegetable consumption may not have been effective. Individuals who received the intervention for increasing fruit and vegetable consumption (i.e., MHBC

intervention, SHBC fruit and vegetable intervention) did not differ in frequency of filling half of their plates with fruits and vegetables from those who did not receive an intervention targeting fruit and vegetable consumption (i.e., SHBC yoga intervention, control). Although previous studies have successfully increased fruit and vegetable intake through implementation intentions, impulsivity has been shown to dampen the effectiveness of implementation intentions for fruit and vegetable intake (Churchill & Jessop, 2008; De Nooijer, de Vet, Brug, & de Vries, 2006; Guillaumie, Godin, Manderscheild, Spitz, & Muller, 2012). I did not collect measures of impulsivity, however, in future research, it would be useful to examine whether impulsivity, as well as other individual difference factors such as conscientiousness, impact the extent to which MHBC interventions are effective at facilitating behavior change. If the SHBC fruit and vegetable intervention was, indeed, less effective than expected in the current study, the effect of the MHBC intervention may not have been as powerful as intended, either. For this reason, individuals in the MHBC intervention may have differed from the SHBC yoga condition less than expected.

There were no significant differences between the effects of the MHBC intervention or SHBC yoga intervention on yoga engagement (regardless of whether outliers were included or excluded), suggesting that undergoing an intervention for both behaviors did not affect yoga engagement differently than intervening on yoga only. Individuals in the MHBC intervention condition did engage in significantly more yoga than those in the control condition or in the SHBC fruit and vegetable intervention condition. Given that the SHBC fruit and vegetable intervention did not appear to influence behavior, it is likely that the MHBC intervention was not uniquely impactful given only one of the two interventions were successful. In other words, the MHBC condition was more similar to the SHBC yoga condition because only the yoga

intervention was effective. I proposed that MHBC interventions may be more effective than SHBC interventions because MHBC intervention would provide more opportunities for individuals to successfully engage in the target behaviors, which would more drastically boost general health self-efficacy through transference of self-efficacy across the two behaviors. However, if individuals are only successfully changing one behavior, the transference of increased self-efficacy will likely occur to a much lesser degree, more similarly to those who only received a SHBC intervention (Bandura, 1991). In fact, not improving on one of the two target behaviors may have the opposite effect and dampen self-efficacy for the successful behavior. In future studies, I plan to further explore the processes through which MHBC interventions influence both behavior-specific and general health self-efficacy, and the impact of these changes on behavior.

Moreover, experimental condition did significantly predict yoga engagement at T2 and T3 with individuals in the MHBC intervention engaging in 21 to 44 more minutes of yoga engagement per week, than the control condition. These effects were dampened when two outliers were removed, suggesting that those individuals may have been driving the effect. Given that there were no significant differences between conditions at pre-screen regarding stages of change for yoga engagement or minutes of yoga practice per week, these results shouldn't be discounted. Increased yoga engagement by 30 minutes per week may make a noticeable difference in individuals' health, especially if yoga engagement is a source of moderate or vigorous physical activity. Current recommended guidelines for physical activity engagement for American suggest engagement in 150 minutes of moderate physical activity per week for physical activity (Office of Disease Prevention and Health Promotion, 2019). Thus, 30 minutes of yoga engagement at moderate intensity could account for approximately one fifth of the

weekly physical activity recommendation, which could make a considerable difference in individuals' health, especially if they were not meeting physical activity recommendations previously (Office of Disease Prevention and Health Promotion, 2019). Therefore, even if the intervention facilitated small increases in yoga engagement, such increases could still have notable impacts on individuals' health.

Next, I predicted that individuals in the MHBC intervention condition would report stronger intentions to continue engaging in yoga and filling half of their plates with fruits and vegetables after the conclusion of the study than those in the SHBC or control conditions. Experimental condition had no significant effect on intentions to continue engaging in yoga at T3 including only those who completed T3 measures within the study timeframe, or when all participants with data at T3 were included. Similarly, experimental condition had no significant effect on intentions to continue filling half of one's plate with fruits and vegetables at T3 including only those who completed T3 measures within the study timeframe, or when including all cases with data at T3. It is important to note that intentions to engage in a behavior are different than actual engagement (Sheeran & Webb, 2016). Individuals can report having strong intentions, but that does not mean that these intentions will translate to behavior because more resources are needed to exact behavioral engagement than simply having intentions to engage. Considering that people are generally aware that engagement in health behaviors is beneficial for health and well-being, it is not surprising that participants reported high intentions (i.e., above the midpoint of the 5-point scale) for both yoga (M_{ALL} = 3.39, M_{ONTIME} = 3.43) and filling half of their plates with fruit and vegetables (M_{ALL} = 4.42, M_{ONTIME} = 4.41). In addition, participants were aware that health-promoting behavior engagement is the focus of this study and may have been even more motivated to report strong behavioral intentions for this reason. The lack of

differences across conditions suggests that the intervention did not affect the extent to which individuals intended to engage in health behavior. Thus, in subsequent studies, it may be more useful to measure actual engagement at post-intervention follow-up (e.g., one month after the conclusion of the intervention) rather than assessing intentions to continue the target behaviors, given the ceiling effects found here.

To assess the potential mechanisms through which the MHBC intervention affects behavior, I examined whether experimental condition predicted general self-efficacy and general health identity. There were no differences between groups on general health self-efficacy. Given that higher levels of self-efficacy tend to predict higher levels of behavioral engagement, it is surprising that although individuals in the MHBC intervention reported engaging in more yoga than those in the control condition, there were no differences in general health self-efficacy as a function of condition at T2 or T3 (Bandura, 1977, 1982; Shunk, 1984). Perhaps other mechanisms, other than self-efficacy, were being used to facilitate increased behavioral engagement. In a study that used implementation intentions to increase fruit and vegetable consumption, Guillaumie et al. (2011) found that action planning alone predicted fruit and vegetable intake, regardless of self-efficacy. Thus, it is possible that individuals used more reflexive strategies, such as habits, as mechanisms for behavioral engagement, rather than cognitive strategies more directly related to self-efficacy.

Experimental condition only significantly predicted general health identity at T2 such that those in the MHBC condition (M = 2.81) had significantly weaker general health identities than those in the SHBC fruit and vegetable condition (M = 3.47, p = .05, *Cohen's d* = .49). This finding was counter to my prediction that those in the MHBC intervention would have the strongest general health identities. Even with the removal of outliers, individuals in the MHBC

conditions reported lower weaker general health identities (M = 2.18) at T2 than those in the SHBC fruit and vegetable condition (M = 3.14, p = .38, d = .52), though the difference was smaller and non-significant, but had a larger effect size. It is possible that given the SHBC fruit and vegetable intervention did not affect behavior, individuals in the MHBC intervention experienced dissonance such that they were only successful at increasing yoga engagement, but not fruit and vegetable consumption. Individuals may have perceived being successful at only one of their two target behaviors as being incongruent with a strong healthy person identity because they were not improving the frequency of filling half of their plate with fruits and vegetables. Fruit and vegetable consumption tends to be relatively salient health behavior. This experience of dissonance from succeeding at one health behavior but not another may have dampened the extent to which these participants were able to develop general healthy person identities (Warin, Maddock, Pell, & Hargreaves, 2007). It is interesting that participants in the SHBC fruit and vegetable condition reported stronger general health identities despite there being no differences in behavioral engagement for fruit and vegetable consumption (see Hypothesis 1a). Individuals in the SHBC fruit and vegetable conditions may be less likely to experience such dissonance because any progress toward eating more fruits and vegetables would be viewed positively, given this was their only goal. In contrast, those in the MHBC intervention may have struggled to find a balance between engaging in yoga and eating more fruits and vegetables. Perhaps if the fruit and vegetable intervention was, indeed, weaker than the yoga intervention, individuals in the MHBC intervention may have been more frustrated by perceiving insufficient progress towards eating more fruits and vegetables relative to yoga engagement. Consequently, individuals in the MHBC intervention may have experienced a decline in general health identity relative to the other conditions, as a result of being frustrated

and experiencing dissonance. Measures of dissonance were not included in this study, thus I can only speculate. Future studies should include affective assessments and evaluate whether differences exist between conditions regarding levels of positive and negative affect.

It is also surprising that the MHBC condition reported weaker general health identities than the SHBC fruit and vegetable condition at T2 but not T3. Identity tends to be relatively stable across time, thus, it is unusual for someone to develop a healthy person identity over the course of two weeks, only for it to disappear two weeks later (Hogg, Terry, & White, 1995; Stryker, 1987). Thus, individuals in the MHBC condition may have experienced reductions in general health identity at T2, but after successfully engaging in yoga over the second half of the study, general health identity for the MHBC condition increased slightly to be equivalent with levels of identity for the other conditions. People use self-identities to explain past behavior, and as a guide for future behavior, thus behavioral engagement is necessary before an identity related to that behavior can develop (Anderson & Cychosz, 1994). If individuals perceived the extent of their engagement in health-related insufficient for being considered a generally healthy person, a strong general health identity would likely not develop. To address this, assessments of ideal levels of behavioral engagement, as well as qualitative assessments of individuals' perceptions of what it means to be a healthy person should be collected in future studies.

Further, I predicted that increases in general self-efficacy and development of a stronger general health identity would be the mechanisms through which the MHBC intervention would affect greater behavior change, compared to the other conditions. Thus, I assessed whether the effect of condition on behavioral engagement would be mediated by general health self-efficacy and general health identity. See Figure 1.

For mediation models predicting yoga engagement, total effects and direct effects were only significant in the SHBC fruit and vegetable and control conditions when compared to the MHBC condition at all time points (T2, T3 with all cases, T3 with missing cases imputed with pre-screen values). There were no significant indirect effects of general health self-efficacy or general health identity; Hypothesis 2a was not supported. This pattern of findings is congruent with findings from Hypothesis 1 such that the MHBC intervention was related to increased yoga engagement, but not general health self-efficacy or general health identity.

For mediation models predicting frequency of filling half of one's plate with fruits and vegetables, there were no significant total effects, direct effects, or indirect effects at any of the timepoints (T2, T3 with all cases, T3 with missing values imputed with pre-screen values); further confirming Hypothesis 2a being not supported. Interestingly, in the models predicting fruit and vegetable consumption at T3 with all cases included, the effects of general health identity (*Effect* = 1.98, p = .001) and general health self-efficacy (*Effect* = -.81, p = .01) on frequency of filling one's plate with fruits and vegetables were significant. This is interesting because this suggests a negative effect of general health self-efficacy on fruit and vegetable consumption at T3. Given that self-efficacy is an important predictor of behavioral engagement, it would be expected that self-efficacy and engagement are positively related (Bandura, 1977, 1982; Shunk, 1984); however, lower general health-self-efficacy predicted greater engagement. Perhaps individuals struggled with engaging in this behavior, but knowing they were participating in a health behavior study, they tried harder to fill half of their plate with fruits and vegetables daily, despite their doubts about actually being able to complete the behavior. Alternatively, it is possible that the participants who ate the most vegetables had the highest

standards for themselves regarding how much they believed they should be eating. Not believing that they could meet these thresholds could have dampened their health self-efficacy further.

On the other hand, there was a significant positive relationship between general health identity and frequency of filling half of one's plate with fruits and vegetables at T3 (all cases included), regardless of condition. According to identity theory, individuals use identities to explain their past behavior, and as a guide for future behavior (Anderson & Cychosz, 1994). Thus, individuals who ate more fruits and vegetables may have justified this consistent engagement in a new behavior through identifying as a healthy person. Subsequently, identifying as a healthy person may have further propagated increased fruit and vegetable consumption.

Further, I evaluated whether the effect of condition on behavioral intentions to continue engaging in each of the target behaviors (e.g., yoga engagement, fruit and vegetable consumption) was mediated by general health self-efficacy and general health identity. There were no significant total effects, direct effects, or indirect effects for mediation models predicting intentions to continue engaging in yoga (i.e., when including only cases completed on time at T3, or including all cases with data at T3), or intentions to continue filling half of one's plate with fruits and vegetables (i.e., when including only cases completed on time at T3, or including all cases with data at T3). Thus, Hypothesis 2b was not supported. Similar to the analyses for behavioral engagement, general health self-efficacy (*Effect* = -.20, p = .001) and general health identity (*Effect* = .74, p = .02) significantly predicted intentions to continue filling half of one's plate with fruits and vegetables when only participants who completed T3 measures on time were included. When all cases with T3 data were included, only general health identity significantly predicted intentions to continue filling half of one's plate with fruits and vegetables when all cases with data at T3 were included (*Effect* = .37, p = .02). Thus, there seems to be

some congruence between predictors of individuals' intentions to eat fruits and vegetables and actual behavior. It is promising to discover that development of a stronger health identity is associated with increased intentions to continue filling half of one's plate with fruits and vegetables. However, these effects did not differ by condition, thus, it could be possible that mere participation in the study, rather than specific processes of the MHBC intervention, facilitated increases in participants' fruits and vegetable intake.

Lastly, I predicted that individuals in the MHBC condition would first develop increased general health self-efficacy as a function of successfully engaging in two new health-related behaviors. This increase in general health self-efficacy, coupled with increased engagement in new health behaviors would facilitate development of a general health identity. Although the difference between the correlations was not significant, the correlation between general self-efficacy at T2 and general health identity at T3 appears to be strong, whereas the correlation between general health identity at T2 and general health self-efficacy at T3 appears to be moderate. Even when outliers were removed, the trend remained consistent. Given my small sample size, especially at T3 due to attrition, it is likely that the non-significant difference could be a function of being underpowered. It is possible that if the data continue this trend, the difference between these correlations may reach significance with a larger sample and higher power, thereby supporting my hypothesis that general health self-efficacy develops before general health identity in the context of MHBC interventions. Nonetheless, more research is needed before such conclusions can be made.

Limitations

One large limitation of this study is the small sample size. Ability to be able to detect small effects at power of .80 requires a sample of at least 200 participants. My final sample only

consisted of 101 cases, thus my analyses were underpowered even when all 101 participants are included in analyses. Unfortunately, there were only 101 participants with data at T1, whereas by T3, only 51 participants had full data at the end of the intervention period. Although 21 more participants completed T3 measures weeks or months after the conclusion of the intervention period, a sample size of 75 at T3 is still not acceptable, and the late responders may be qualitatively different from the rest of the sample who completed the measures on time. Resultantly, it is important to interpret these results with caution, until more data can be collected.

Another limitation is that the intervention may not have had good fidelity, or in other words, the intervention was not executed or did not function as it was meant to (Murphy & Gutman, 2012). Given that experimental condition did not affect fruit and vegetable consumption, and that there were no differences between the MHBC intervention condition and the SHBC yoga condition suggests that the SHBC fruit and vegetable may not have been as effective as the SHBC yoga intervention. As such, the MHBC intervention would be compromised because the process through which MHBC interventions may be effective requires intervening upon, and subsequently changing, two or more health behaviors. Thus, if the SHBC fruit and vegetable intervention was not effective, then the MHBC intervention was also not effective. It is possible that the intervention was not strong enough, that participants did not fully understand the intervention, or a combination of the two. It is also plausible that there was nothing wrong with the intervention component but the study is simply underpowered.

Further, a one month long intervention may not have been long enough to be able to detect changes in general health identity or general health self-efficacy as a function of experimental condition. There is no literature, to my knowledge, that provides insight to how

long identity development in the context of health behavior change may take to occur. For the purposes of this study, a one month intervention timeline was used, as is common in health behavior intervention research. However, this may not have been long enough. More research regarding the development of health related identity, as well as health related self-efficacy, in the context of behavior change is needed before the intervention can be optimized to detect changes in identity and self-efficacy.

Lastly, approximately the final 25% of my sample was collected during the onset of the COVID-19 global pandemic. Thus, the individuals who completed my study between February and March 2020 have been impacted by this global event in unprecedented ways. In the face of a global pandemic and severe disruptions of daily routines, it is quite likely that individuals' cognitions, beliefs, and behaviors have changed relative to life before the emergence of COVID-19. Therefore, it is important to consider that about one quarter of my sample have been impacted by this global event while participating in this study, and because of this, results need to be interpreted with caution.

Future Directions

First and foremost, more data must be collected to obtain sufficient power to verify whether the current results reported in this manuscript are artifacts of having a small sample size or are representative of female faculty and staff at Iowa State University.

Second, further analyses investigating the formation of general health identity and general health self-efficacy in the context of a MHBC intervention are warranted. Although results were mixed regarding the influence of the MHBC intervention on increases in general health self-efficacy and general health identity, examining changes in self-efficacy and identity related to the target behaviors may provide valuable insight regarding the process through which

the intervention may affect health self-efficacy and health identity more generally. I made a theoretical assumption that general health self-efficacy (and subsequently general health identity) would be more likely to form in the MHBC intervention condition as a function of behavior-specific self-efficacy generalizing to a higher order self-efficacy for general health behavior. It is possible that the lack of consistent findings regarding general health self-efficacy in this study could be due to failure to increase behavior-specific health self-efficacy, or failure to generalize increased in behavior-specific self-efficacy to self-efficacy for general health behavior (Bandura, 1977; Bandura, 1986; King et al., 1996). Investigating these issues regarding generalization of self-efficacy to higher-order behaviors would provide insight regarding the potential mechanisms of this MHBC intervention.

Finally, little is known regarding how to best administer a MHBC intervention: do the multiple behaviors need to be changed simultaneously, or could they be addressed sequentially but within the same intervention? Vandelanotte, Reeves, Brug, and De Bourdeaudhujj (2007) examined a MHBC intervention focused on increasing physical activity and decreasing fat, and found that success in changing multiple behaviors did not differ as a function of changing behaviors simultaneously or sequentially. However, there are very few studies examining how to most effectively execute MHBC interventions. It is possible that approaching MHBC simultaneously could be overwhelming for participants in particular contexts. However, it is unknown whether engaging in a sequential MHBC intervention is any different than engaging in two SHBC interventions one after another. Given these unknown parameters, I plan to assess whether, and under which conditions, simultaneous versus sequential MHBC interventions differ in efficacy.

Conclusion

In this study, I evaluated the efficacy of a MHBC intervention targeting yoga engagement and fruit and vegetable consumption. Results were mixed. Individuals in the MHBC intervention engaged in more minutes of yoga per week compared to those in the control condition, however, individuals did not differ regarding fruit and vegetable intake regardless of condition. There was no effect of condition on intentions to continue engaging in the target behaviors beyond the intervention period, but effect sizes suggested that individuals in the MHBC condition were more likely to have stronger intentions to continue yoga practice than those in the control condition. Experimental condition did not systematically predict general health self-efficacy or development of a general health identity, which did not support my hypothesis. Further, the effect of experimental condition on behavior was not significantly mediated by general health self-efficacy or general health identity. Although not significant, results hinted that individuals may be experiencing boosts in general health self-efficacy before developing general health identities, which is congruent with my prediction. This study served as an exciting first step for unpacking how MHBC interventions may influence beliefs and behavior. Overall, there may be promise for utilizing MHBC interventions to effect behavior change in an economical fashion, however much more research is needed before the processes and parameters of MHBC interventions are sufficiently understood.

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APPENDIX A: TABLES AND FIGURES.

Table 1. *Univariate outliers.*

Variable	ID number	Z score
Health ID T2	103	-4.05
Health ID T2	222	-4.05
Health SE T2	222	-3.64
Yoga Engagement T3 (Imputed)	160	4.97
Yoga Engagement T3 (Imputed)	115	4.46
Yoga Engagement T3 (Imputed)	143	3.77
Yoga Engagement T3 (Imputed)	161	3.41
Yoga Engagement T3 (All cases)	184	5.35
Yoga Engagement T3 (On time)	160	3.55
Yoga Engagement T3 (On time)	115	3.13
Fruit Veg Intention T3 (On time)	208	-3.53
Health SE T1	212	-3.21
Health SE T1	180	-3.21

Note: T1 = baseline; T2 = midpoint; T3 = follow-up; On time = only cases that completed T3 measures within the one-month timeframe of the study included; All cases = all cases with T3 data included; Imputed = values missing at T3 imputed with pre-screen values; SE = self-efficacy; ID = identity.

Table 2. *Descriptive statistics and one-way ANOVA results testing the differences between conditions on levels of stages of change and behavioral engagement at pre-screen.*

	Stage of Change Yoga	Stage of Change Fruit Veg	Yoga Engagement	Fruit Veg Consumption
Levene's Test	$F(3,97) = 2.70$, $p = .05$	$F(3,97) = .653$, $p = .58$	$F(3,97) = 10.08$, $p < .001$	$F(3,97) = 1.82$, $p = .15$
ANOVA Result	$F(3,97) = 1.92$, $p = .130$, $\eta^2 = .06$	$F(3,97) = .45$, $p = .707$, $\eta^2 = .01$	$F(3,97) = 2.11$, $p = .105$, $\eta^2 = .06$	$F(3,97) = .75$, $p = .526$, $\eta^2 = .02$
Total *M (SD)*	1.69 (.47)	2.45 (.52)	.86 (5.67)	1.07 (1.33)
MHBC *M (SD)*	2.14 (.36)	2.43 (.51)	3.57 (11.30)	.86 (1.11)
SHBC Yoga *M (SD)*	1.94 (.42)	2.33 (.49)	.00 (.00)	.97 (1.19)
SHBC Fruit Veg *M (SD)*	1.83 (.58)	2.43 (.51)	.00 (.00)	1.00 (1.13)
Control *M (SD)*	2.04 (.46)	2.56 (.58)	.00 (.00)	1.38 (1.74)

Table 3. *Cohen's d values for pairwise comparisons between experimental conditions on stage of change for yoga engagement and fruit and vegetable consumption at pre-screen.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Yoga		*M*	*SD*	*n*			
	1. MHBC	2.12	.33	25	-		
	2. SHBC Yoga	1.96	.34	26	.47	-	
	3. SHBC Fruit Veg	1.83	.58	25	.62	.22	-
	4. Control	2.04	.46	25	.20	.22	.40
Fruit and Veg							
	1. MHBC	2.40	.50	25	-		
	2. SHBC Yoga	2.42	.50	26	.04	-	
	3. SHBC Fruit Veg	2.44	.51	25	.08	.04	-
	4. Control	2.56	.58	25	.30	.26	.22

*Note: *p < .05*

Table 4. *Cohen's d values for pairwise comparisons between experimental conditions on yoga engagement and fruit and vegetable consumption at pre-screen.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Yoga		*M*	*SD*	*n*			
	1. MHBC	3.00	10.41	25	-		
	2. SHBC Yoga	.00	.00	26	.41	-	
	3. SHBC Fruit Veg	.00	.00	25	.41	.00	-
	4. Control	.00	.00	25	.41	.00	.00
Fruit and Veg							
	1. MHBC	.84	1.14	25	-		
	2. SHBC Yoga	1.17	1.27	26	.54	-	
	3. SHBC Fruit Veg	1.00	1.12	25	.14	.14	-
	4. Control	1.38	1.74	25	.36	.14	.26

*Note: *p < .05*

Table 5. *Descriptive statistics for yoga engagement and intentions to continue yoga across experimental conditions.*

Variable	Total		MHBC		SHBC Yoga		SHBC Fruit Veg		Control	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Yoga Engagement T2	23.48	32.91	40.29	33.51	34.75	39.18	13.50	28.84	11.36	23.16
Yoga Engagement T3 (On time)	17.78	36.39	37.92	55.55	21.25	38.35	11.36	22.15	3.57	8.42
Yoga Engagement T3 (All cases)	17.82	35.53	37.00	53.88	27.08	39.11	9.24	19.01	2.94	7.72
Yoga Engagement T3 (Imputed)	9.20	27.52	21.67	45.45	9.44	26.89	5.43	16.02	2.00	6.45
Yoga Intention T3 (On time)	3.30	1.29	3.75	.97	3.35	1.75	3.05	1.32	3.07	1.30
Yoga Intention T3 (All cases)	3.26	1.27	3.50	1.02	3.55	1.46	3.28	1.26	2.85	1.37

Note: T1 = baseline; T2 = midpoint; T3 = follow-up; On time = only cases that completed T3 measures within the one-month timeframe of the study included; All cases = all cases with T3 data included; Imputed = values missing at T3 imputed with pre-screen values.

Table 6. *Descriptive statistics for fruit and vegetable consumption and intentions to continue fruit and vegetable consumption across experimental conditions.*

Variable	Total		MHBC		SHBC Yoga		SHBC Fruit Veg		Control	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Fruit Veg Consumption T2	4.46	2.34	4.94	2.22	4.47	1.91	4.80	2.40	3.77	2.636
Fruit Veg Consumption T3 (On time)	3.91	2.55	4.00	2.45	3.50	2.39	4.64	2.29	3.50	3.01
Fruit Veg Consumption T3 (All cases)	4.12	2.72	4.63	3.24	3.67	2.30	4.29	2.49	3.82	2.86
Fruit Veg Consumption T3 (Imputed)	2.52	2.53	2.57	2.54	2.00	2.22	2.65	2.60	2.72	2.76
Fruit Veg Intention T3 (On time)	4.35	.71	4.50	.43	4.43	.73	4.25	.92	4.27	.78
Fruit Veg Intention T3 (All cases)	4.37	.69	4.33	.65	4.45	.65	4.38	.76	4.34	.72

Note: T1 = baseline; T2 = midpoint; T3 = follow-up; On time = only cases that completed T3 measures within the one-month timeframe of the study included; All cases = all cases with T3 data included; Imputed = values missing at T3 imputed with pre-screen values.

Table 7. *Descriptive statistics for general health identity and general health self-efficacy across experimental conditions.*

Variable	Total		MHBC		SHBC Yoga		SHBC Fruit Veg		Control	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Health SE T1	5.00	1.64	4.67	2.04	5.74	1.43	5.04	1.59	4.71	1.36
Health ID T1	3.32	.59	3.26	.59	3.41	.67	3.34	.53	3.28	.59
Health SE T2	5.27	1.32	5.15	1.16	5.53	1.09	5.37	1.53	5.09	1.45
Health ID T2	3.32	.62	3.14	.67	3.42	.55	3.44	.61	3.30	.63
Health SE T3 (On time)	5.75	1.41	5.67	1.29	6.19	1.65	5.67	1.41	5.62	1.46
Health ID T3 (On time)	3.42	.61	3.38	.63	3.72	.63	3.31	.42	3.39	.72
Health SE T3 (All cases)	5.61	1.34	5.70	1.20	5.77	1.60	5.46	1.29	5.59	1.43
Health ID T3 (All cases)	3.44	.59	3.35	.60	3.69	.64	3.40	.45	3.37	.66

Note: T1 = baseline; T2 = midpoint; T3 = follow-up; On time = only cases that completed T3 measures within the one-month timeframe of the study included; All cases = all cases with T3 data included; SE = self-efficacy; ID = identity.

Table 8. *Effects of experimental condition on yoga engagement and intentions to continue yoga engagement.*

Variable	Time	Levene's Test	ANOVA Result
Yoga Engagement	T2	$F(3,73) = 2.00$, $p = .12$	$F(3,73) = 3.67$, $p = .02$*, $\eta^2 = .13$
Yoga Engagement	T3 (O)	$F(3,48) = 9.93$, $p < .001$	$F(3,48) = 3.51$, $p = .02$*, $\eta^2 = .18$
Yoga Engagement (outliers removed)	T3 (O)	$F(3,46) = 5.03$, $p = .004$	$F(3,46) = 2.27$, $p = .09$, $\eta^2 = .13$
Yoga Engagement	T3 (A)	$F(3,70) = 13.44$, $p < .001$	$F(3,70) = 5.27$, $p = .002$*, $\eta^2 = .18$
Yoga Engagement	T3 (I)	$F(3,97) = 11.90$, $p < .001$	$F(3,97) = 2.80$, $p = .04$*, $\eta^2 = .08$
Yoga Engagement (outliers removed)	T3 (I)	$F(3,93) = 4.78$, $p = .004$	$F(3,93) = 1.13$, $p = .34$, $\eta^2 = .04$
Yoga Intentions	T3 (O)	$F(3,46) = 1.46$, $p = .24$	$F(3,46) = 1.00$, $p = .06$, $\eta^2 = .06$
Yoga Intentions	T3 (A)	$F(3,69) = 1.05$, $p = .38$	$F(3,69) = 1.77$, $p = .16$, $\eta^2 = .07$

Note: T1 = baseline; T2 = midpoint; T3 = follow-up; O = only cases that completed T3 measures within the one-month timeframe of the study included; A = all cases with T3 data included; I = values missing at T3 imputed with pre-screen values.
*$p < .05$

Table 9. *Effects of experimental condition on frequency of filling one's plate with fruits and vegetables, and intentions to continue fruit and vegetable consumption.*

Variable	Time	Levene's Test	ANOVA Result
Fruit and Vegetable Consumption	T2	$F(3,73) = 1.31$, $p = .28$	$F(3,73) = .97$, $p = .41$, $\eta^2 = .04$
Fruit and Vegetable Consumption	T3 (O)	$F(3,48) = .638$, $p = .59$	$F(3,48) = .63$, $p = .60$, $\eta^2 = .04$
Fruit and Vegetable Consumption	T3 (A)	$F(3,68) = 1.24$, $p = .30$	$F(3,68) = .37$, $p = .78$, $\eta^2 = .02$
Fruit and Vegetable Consumption	T3 (I)	$F(3,97) = .09$, $p = .97$	$F(3,97) = .10$, $p = .96$, $\eta^2 = .003$
Fruit and Vegetable Intentions	T3 (O)	$F(3,45) = .90$, $p = .45$	$F(3,45) = .62$, $p = .61$, $\eta^2 = .04$
Fruit and Vegetable Intentions	T3 (A)	$F(3,68) = .18$, $p = .91$	$F(3,68) = .39$, $p = .76$, $\eta^2 = .02$

Note: T1 = baseline; T2 = midpoint; T3 = follow-up; O = only cases that completed T3 measures within the one-month timeframe of the study included; A = all cases with T3 data included; I = values missing at T3 imputed with pre-screen values.
*$p < .05$

Table 10. *Cohen's d values for pairwise comparisons between experimental conditions on yoga engagement, and fruit and vegetable consumption at T2.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Yoga		*M*	*SD*	*n*			
	1. MHBC	40.29	33.52	17	-		
	2. SHBC Yoga	31.71	38.86	17	.24	-	
	3. SHBC Fruit Veg	15.71	29.89	21	.40	.46	-
	4. Control	11.36	23.16	22	1.00*	.64	.16
Fruit and Veg							
	1. MHBC	4.94	2.22	17	-		
	2. SHBC Yoga	4.44	1.85	17	.25	-	
	3. SHBC Fruit Veg	4.71	2.37	21	.10	.13	-
	4. Control	3.77	2.64	22	.48	.29	.38

Note: $*p < .05$

Table 11. *Cohen's d values for pairwise comparisons between experimental conditions on yoga engagement (with outliers included and outliers removed), and fruit and vegetable consumption at T3, including only cases that completed T3 measures within the one-month study timeline.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Yoga		*M*	*SD*	*n*			
(Outliers removed)	1. MHBC	44.23 (25.45)	57.84 (38.50)	13 (11)	-		
	2. SHBC Yoga	26.92	33.51	13	.37 (.04)	-	
	3. SHBC Fruit Veg	10.42	21.40	12	.78 (.48)	.59	-
	4. Control	3.57	8.42	14	.98* (.79)	.96	.44
Fruit and Veg							
	1. MHBC	4.15	2.41	13	-		
	2. SHBC Yoga	4.38	2.93	13	.05	-	
	3. SHBC Fruit Veg	4.83	2.29	12	.14	.17	-
	4. Control	3.50	3.01	14	.37	.30	.50

Note: $*p < .05$

Table 12. *Cohen's d values for pairwise comparisons between experimental conditions on yoga engagement, and fruit and vegetable consumption at T3, including all cases with T3 data.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Yoga		*M*	*SD*	*n*			
	1. MHBC	52.89	74.13	19	-		
	2. SHBC Yoga	28.68	33.82	19	.42	-	
	3. SHBC Fruit Veg	8.26	18.15	19	.83*	.75	-
	4. Control	2.94	7.72	17	.95*	1.05	.38
Fruit and Veg							
	1. MHBC	4.75	3.04	18	-		
	2. SHBC Yoga	4.39	2.23	18	.14	-	
	3. SHBC Fruit Veg	4.42	2.43	19	.12	.01	-
	4. Control	3.82	2.86	17	.32	.22	.23

Note: $*p < .05$

Table 13. *Cohen's d values for pairwise comparisons between experimental conditions on yoga engagement at T3 (with outliers included and outliers removed), and fruit and vegetable consumption at T3, where missing values were imputed with pre-screen values.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Yoga		*M*	*SD*	*n*			
(Outliers removed)	1. MHBC	23.00 (7.27)	46.70 (17.22)	25 (22)	-		
	2. SHBC Yoga	13.46 (9.60)	26.97 (18.81)	26 (25)	.25 (.13)	-	
	3. SHBC Fruit Veg	5.00	15.41	25	.52 (.14)	.39 (.27)	-
	4. Control	2.00	6.45	25	.63* (.41)	.58 (.54)	.25
Fruit and Veg							
	1. MHBC	2.40	2.58	25	-		
	2. SHBC Yoga	2.73	2.49	26	.13	-	
	3. SHBC Fruit Veg	2.72	2.70	25	.13	.004	-
	4. Control	2.72	2.76	25	.12	.004	.00

Note: $*p < .05$

Table 14. *Cohen's d values for pairwise comparisons between experimental conditions on yoga intentions, and intentions for fruit and vegetable consumption at T3, including only cases that completed T3 measures within the one-month study timeline.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Yoga		*M*	*SD*	*n*			
	1. MHBC	3.85	.987	13	-		
	2. SHBC Yoga	3.63	1.60	12	.17	-	
	3. SHBC Fruit Veg	3.18	1.32	11	.58	.31	-
	4. Control	3.07	1.30	14	.68	.38	.08
Fruit and Veg							
	1. MHBC	4.54	.431	13	-		
	2. SHBC Yoga	4.54	.620	12	.00	-	
	3. SHBC Fruit Veg	4.27	.876	11	.39	.36	-
	4. Control	4.27	.780	13	.43	.38	.00

Note: $*p < .05$

Table 15. *Cohen's d values for pairwise comparisons between experimental conditions on yoga intentions, and intentions for fruit and vegetable consumption at T3, including all cases with T3 data.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Yoga		*M*	*SD*	*n*			
	1. MHBC	3.71	1.02	19	-		
	2. SHBC Yoga	3.66	1.37	19	.04	-	
	3. SHBC Fruit Veg	3.28	1.26	18	.38	.29	-
	4. Control	2.85	1.37	17	.71	.59	.33
Fruit and Veg							
	1. MHBC	4.39	.614	19	-		
	2. SHBC Yoga	4.55	.550	19	.27	-	
	3. SHBC Fruit Veg	4.36	.724	18	.05	.26	-
	4. Control	4.34	.724	16	.07	.33	.03

Note: $^{*}p < .05$

Table 16. *Effects of experimental condition on general health self-efficacy and general health identity.*

Variable	Time	Levene's Test	ANOVA Result
General health SE	T1	$F(3,97) = 1.08$, $p = .36$	$F(3,97) = 2.15$, $p = .10$, $\eta^2 = .06$
General health ID	T1	$F(3,97) = .56$, $p = .64$	$F(3,97) = .48$, $p = .70$, $\eta^2 = .02$
General health SE	T2	$F(3,75) = .64$, $p = .59$	$F(3,75) = .85$, $p = .47$, $\eta^2 = .03$
General health ID	T2	$F(3,75) = 3.09$, $p = .03$	$F(3,75) = 2.91$, $p = .04$*, $\eta^2 = .10$
General health ID (outliers removed)	T2	$F(3,73) = .54$, $p = .66$	$F(3,73) = 1.04$, $p = .38$, $\eta^2 = .04$
General health SE	T3 (O)	$F(3,47) = .19$, $p = .90$	$F(3,47) = .41$, $p = .75$, $\eta^2 = .02$
General health ID	T3 (O)	$F(3,48) = 1.09$, $p = .36$	$F(3,48) = .31$, $p = .82$, $\eta^2 = .02$
General health SE	T3 (A)	$F(3,71) = .18$, $p = .91$	$F(3,71) = .18$, $p = .91$, $\eta^2 = .01$
General health ID	T3 (A)	$F(3,72) = .69$, $p = .56$	$F(3,72) = .78$, $p = .51$, $\eta^2 = .03$

Note: T1 = baseline; T2 = midpoint; T3 = follow-up; O = only cases that completed T3 measures within the one-month timeframe of the study included; A = all cases with T3 data included; I = values missing at T3 imputed with pre-screen values; SE = self-efficacy; ID = identity.

Table 17. *Cohen's d values for pairwise comparisons between experimental conditions on general health self-efficacy and general health identity at T1.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Health Self-efficacy		*M*	*SD*	*n*			
	1. MHBC	4.89	1.98	25	-		
	2. SHBC Yoga	5.76	1.26	26	.53	-	
	3. SHBC Fruit Veg	5.17	1.62	25	.16	.41	-
	4. Control	4.71	1.36	25	.12	.80	.31
Health Identity							
	1. MHBC	3.34	.62	25	-		
	2. SHBC Yoga	3.48	.66	26	.22	-	
	3. SHBC Fruit Veg	3.40	.55	25	.10	.13	-
	4. Control	3.28	.60	25	.10	.32	.21

*Note: *p < .05*

Table 18. *Cohen's d values for pairwise comparisons between experimental conditions on general health self-efficacy and general health identity (with outliers included and outliers removed) at T2.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Health Self-efficacy		*M*	*SD*	*n*			
	1. MHBC	4.88	1.64	19	-		
	2. SHBC Yoga	5.55	1.05	17	.49	-	
	3. SHBC Fruit Veg	5.41	1.50	21	.49	.11	-
	4. Control	5.09	1.45	22	.14	.36	.22
Health Identity							
(Outliers removed)	1. MHBC	2.81 (3.14)	1.18 (.67)	19 (17)	-		
	2. SHBC Yoga	3.43	.54	17	.46 (.48)	-	
	3. SHBC Fruit Veg	3.47	.61	21	.49* (.52)	.07	-
	4. Control	3.30	.64	22	.36 (.24)	.22	.27

*Note: *p < .05*

Table 19. *Cohen's d values for pairwise comparisons between experimental conditions on general health self-efficacy and general health identity at T3, including only cases that completed T3 measures within the one-month study timeline.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Health Self-efficacy		*M*	*SD*	*n*			
	1. MHBC	5.68	1.24	13	-		
	2. SHBC Yoga	6.14	1.24	14	.37	-	
	3. SHBC Fruit Veg	5.81	1.43	12	.10	.25	-
	4. Control	5.62	1.46	14	.04	.38	.13
Health Identity							
	1. MHBC	3.38	.60	13	-		
	2. SHBC Yoga	3.58	.60	14	.34	-	
	3. SHBC Fruit Veg	3.41	.55	13	.05	.31	-
	4. Control	3.39	.72	14	.06	.29	.03

*Note: *p < .05*

Table 20. *Cohen's d values for pairwise comparisons between experimental conditions on general health self-efficacy and general health identity at T3, including all cases with T3 data.*

Variable	Condition				1. MHBC	2. SHBC Yoga	3. SHBC Fruit veg
Health Self-efficacy		*M*	*SD*	*n*			
	1. MHBC	5.69	1.21	19	-		
	2. SHBC Yoga	5.87	1.27	20	.15	-	
	3. SHBC Fruit Veg	5.63	1.31	19	.05	.19	-
	4. Control	5.59	1.43	17	.08	.21	.03
Health Identity							
	1. MHBC	3.39	.57	18	-		
	2. SHBC Yoga	3.63	.59	20	.41	-	
	3. SHBC Fruit Veg	3.49	.52	20	.18	.25	-
	4. Control	3.37	.66	17	.03	.42	.20

*Note: *p < .05*

Table 21. *Mediation models testing the direct effect of condition on yoga engagement at T2 and the indirect effects of general health identity and general health self-efficacy.*

Condition	Effect	Coefficient	*SE*	*t*	*p*	95% CI
SHBC Yoga (vs. MHBC)	Total Effect	-7.59	10.72	-.71	.48	[-28.19, 13.77]
	Direct Effect	-8.92	10.96	-.81	.42	[-30.78, 12.94]
	Indirect Effect ID	1.53	2.29			[-2.38, 6.97]
	Indirect Effect SE	-.19	1.31			[-2.56, 3.23]
SHBC Fruit Veg (vs. MHBC)	Total Effect	-24.58	10.19	-2.41	.02	[-44.90, -4.27]
	Direct Effect	-26.13	10.49	-2.49	.02	[-47.04, -5.22]
	Indirect Effect ID	1.67	2.38			[-2.82, 6.90]
	Indirect Effect SE	-.12	1.18			[-2.53, 2.73]
Control (vs. MHBC)	Total Effect	-28.93	28.93	-2.97	.01	[-49.04, -8.82]
	Direct Effect	-29.81	10.28	-2.91	.01	[-50.29, -9.32]
	Indirect Effect ID	.83	1.81			[-2.64, 4.87]
	Indirect Effect SE	.05	1.07			[-1.56, 2.94]

Table 22. *Mediation models testing the direct effect of condition on yoga engagement at T3 (including all cases with T3 data) and the indirect effects of general health identity and general health self-efficacy.*

Condition	Effect	Coefficient	*SE*	*t*	*p*	95% CI
SHBC Yoga (vs. MHBC)	Total Effect	-11.35	12.65	-.90	.37	[-36.67, 13.97]
	Direct Effect	-14.35	13.01	-1.10	.28	[-40.39, 11.70]
	Indirect Effect ID	5.89	5.33			[-2.13, 18.74]
	Indirect Effect SE	-2.90	3.76			[-12.30, .2.66]
SHBC Fruit Veg (vs. MHBC)	Total Effect	-29.72	11.38	-2.61	.01	[-52.50, -6.94]
	Direct Effect	-33.73	11.75	-2.87	.006	[-57.25, -10.21]
	Indirect Effect ID	5.48	4.83			[-2.84, 16.06]
	Indirect Effect SE	-1.47	2.94			[-8.99, 3.05]
Control (vs. MHBC)	Total Effect	-35.50	11.54	-3.08	.003	[-58.59, -12.40]
	Direct Effect	-38.17	11.68	-3.27	.002	[-61.56, 14.78]
	Indirect Effect ID	3.45	4.22			[-3.92, 13.09]
	Indirect Effect SE	-.78	2.76			[-8.18, 3.72]

Table 23. *Mediation models testing the direct effect of condition on yoga engagement at T3 (where missing cases were imputed with pre-screen values of yoga engagement) and the indirect effects of general health identity and general health self-efficacy.*

Condition	Effect	Coefficient	*SE*	*t*	*p*	95% CI
SHBC Yoga (vs. MHBC)	Total Effect	-15.28	9.50	-1.61	.11	[-34.22, 3.66]
	Direct Effect	-18.28	9.75	-1.87	.07	[-37.71, 1.16]
	Indirect Effect ID	2.32	2.98			[-2.36, 9.32]
	Indirect Effect SE	.68	2.18			[-3.04, 6.04]
SHBC Fruit Veg (vs. MHBC)	Total Effect	-19.33	9.03	-2.14	.04	[-37.31, -1.34]
	Direct Effect	-22.32	9.32	-2.39	.02	[-40.90, -3.73]
	Indirect Effect ID	2.46	3.14			[-2.51, 9.99]
	Indirect Effect SE	.53	1.93			[-2.69, 5.34]
Control (vs. MHBC)	Total Effect	-23.01	8.93	-2.58	.01	[-40.80, -5.21]
	Direct Effect	-24.86	.09	-2.73	.01	[-42.99, -6.73]
	Indirect Effect ID	1.65	2.57			[-1.90, 8.09]
	Indirect Effect SE	.20	1.48			[-2.54, 3.83]

Table 24. *Mediation models testing the direct effect of condition on fruit and vegetable consumption at T2 and the indirect effects of general health identity and general health self-efficacy.*

Condition	Effect	Coefficient	*SE*	*t*	*p*	95% CI
SHBC Yoga (vs. MHBC)	Total Effect	-.50	.80	-.63	.53	[-2.08, 1.08]
	Direct Effect	-.61	.81	-.76	.45	[-2.22, 1.00]
	Indirect Effect ID	.19	.23			[-.13, .76]
	Indirect Effect SE	-.08	.17			[-.47, .26]
SHBC Fruit Veg (vs. MHBC)	Total Effect	-.23	.76	-.30	.77	[-1.73, 1.28]
	Direct Effect	-.38	.77	-.50	.62	[-1.93, 1.16]
	Indirect Effect ID	.21	.24			[-.18, 77]
	Indirect Effect SE	-.05	.17			[-.46, .24]
Control (vs. MHBC)	Total Effect	-1.27	.75	-1.56	.12	[-2.66, .32]
	Direct Effect	-1.29	.76	-1.70	.09	[-2.80, .22]
	Indirect Effect ID	.10	.18			[-.24, .53]
	Indirect Effect SE	.02	.15			[-.27, .36]

Table 25. *Mediation models testing the direct effect of condition on fruit and vegetable consumption at T3 (including all cases with T3 data) and the indirect effects of general health identity and general health self-efficacy.*

Condition	Effect	Coefficient	*SE*	*t*	*p*	95% CI
SHBC Yoga (vs. MHBC)	Total Effect	-.87	1.04	-.83	.41	[-2.95, 1.22]
	Direct Effect	-1.26	.99	-1.28	.21	[-3.25, .72]
	Indirect Effect ID	1.04	.65			[-.05, 2.41]
	Indirect Effect SE	-.64	.49			[-1.80, .07]
SHBC Fruit Veg (vs. MHBC)	Total Effect	-.25	.94	-.27	.79	[-2.13, 1.62]
	Direct Effect	-.90	.89	-1.00	.32	[-2.69, .89]
	Indirect Effect ID	.96	.62			[-.12, 2.30]
	Indirect Effect SE	-.33	.49			[-1.51, .45]
Control (vs. MHBC)	Total Effect	-.71	.95	-.75	.46	[-2.61, 1.19]
	Direct Effect	-1.15	.89	-1.29	.20	[-2.93, .64]
	Indirect Effect ID	.61	.60			[-.49, 1.86]
	Indirect Effect SE	-.17	.46			[-1.28, .58]

Table 26. *Mediation models testing the direct effect of condition on fruit and vegetable consumption at T3 (where missing cases were imputed with pre-screen values of fruit and vegetable consumption) and the indirect effects of general health identity and general health self-efficacy.*

Condition	Effect	Coefficient	*SE*	*t*	*p*	95% CI
SHBC Yoga (vs. MHBC)	Total Effect	-.65	.88	-.75	.46	[-2.40, 1.09]
	Direct Effect	-.94	.90	-1.05	.30	[-2.27, .85]
	Indirect Effect ID	.32	.34			[-.20, 1.09]
	Indirect Effect SE	-.04	.23			[-.55, .447]
SHBC Fruit Veg (vs. MHBC)	Total Effect	-.08	.83	-.10	.92	[-1.74, 1.58]
	Direct Effect	-.39	.86	-.46	.65	[-2.10, 1.32]
	Indirect Effect ID	.34	.37			[-.21, 1.24]
	Indirect Effect SE	-.03	.20			[-.50, .39]
Control (vs. MHBC)	Total Effect	-.25	.82	-.31	.76	[-1.89, 1.39]
	Direct Effect	-.47	.84	-.57	.57	[-2.14, 1.20]
	Indirect Effect ID	.23	.30			[-.20, .94]
	Indirect Effect SE	-.01	.15			[-.41, .26]

Table 27. *Mediation models testing the direct effect of condition on intentions for yoga engagement at T3 (including only cases that completed T3 measures within the one month period of the study) and the indirect effects of general health identity and general health self-efficacy.*

Condition	Effect	Coefficient	*SE*	*t*	*p*	95% CI
SHBC Yoga (vs. MHBC)	Total Effect	-.39	.62	-.63	.53	[-1.65, .86]
	Direct Effect	-.50	.64	-.77	.45	[-1.80, .81]
	Indirect Effect ID	.12	.21			[-.11, .71]
	Indirect Effect SE	-.03	.20			[-.41, .44]
SHBC Fruit Veg (vs. MHBC)	Total Effect	-.70	.56	-1.25	.53	[-1.83, .43]
	Direct Effect	-.80	.58	-1.38	.18	[-1.98, .37]
	Indirect Effect ID	.10	.17			[-.15, .52]
	Indirect Effect SE	.01	.15			[-.40, .24]
Control (vs. MHBC)	Total Effect	-.68	.51	-1.32	.19	[-1.72, .36]
	Direct Effect	-.75	.53	-1.44	.16	[-1.82, .31]
	Indirect Effect ID	.08	.17			[-.13, .54]
	Indirect Effect SE	-.01	.11			[-.22, .25]

Table 28. *Mediation models testing the direct effect of condition on intentions for yoga engagement at T3 (including all cases with T3 data) and the indirect effects of general health identity and general health self-efficacy.*

Condition	Effect	Coefficient	*SE*	*t*	*p*	95% CI
SHBC Yoga (vs. MHBC)	Total Effect	.05	.48	.11	.91	[-.91, 1.01]
	Direct Effect	-.09	.50	-.18	.86	[-1.08, .91]
	Indirect Effect ID	.18	.21			[-.11, .70]
	Indirect Effect SE	-.10	.16			[-.43, .26]
SHBC Fruit Veg (vs. MHBC)	Total Effect	-.33	.44	-.74	.46	[-1.20, .55]
	Direct Effect	-.46	.45	-1.02	.31	[-1.37, .44]
	Indirect Effect ID	.16	.18			[-.11, .61]
	Indirect Effect SE	-.02	.11			[-.34, .15]
Control (vs. MHBC)	Total Effect	-.68	.44	-1.55	.13	[-1.55, .20]
	Direct Effect	-.77	.45	-1.73	.09	[-1.66, .12]
	Indirect Effect ID	.10	.15			[-.11, .49]
	Indirect Effect SE	-.01	.10			[-.24, .18]

Table 29. *Mediation models testing the direct effect of condition on intentions for fruit and vegetable consumption at T3 (including only cases that completed T3 measures within the one month period of the study) and the indirect effects of general health identity and general health self-efficacy.*

Condition	Effect	Coefficient	*SE*	*t*	*p*	95% CI
SHBC Yoga (vs. MHBC)	Total Effect	-.07	.35	-.21	.84	[-.77, .63]
	Direct Effect	-.16	.31	-.54	.60	[-.79, .46]
	Indirect Effect ID	.25	.23			[-.14, .78]
	Indirect Effect SE	-.15	.17			[-.57, .09]
SHBC Fruit Veg (vs. MHBC)	Total Effect	-.25	.31	-.80	.43	[-.88, .38]
	Direct Effect	-.48	.28	-1.74	.09	[-1.05, .08]
	Indirect Effect ID	.18	.20			[-.17, .62]
	Indirect Effect SE	.05	.14			[-.31, .27]
Control (vs. MHBC)	Total Effect	-.23	.29	-.79	.43	[-.82, .36]
	Direct Effect	-.36	.26	-1.41	.17	[-.88, .16]
	Indirect Effect ID	.16	.20			[-.24, .56]
	Indirect Effect SE	-.03	.11			[-.31, .19]

Table 30. *Mediation models testing the direct effect of condition on intentions for fruit and vegetable consumption at T3 (including all cases with T3 data) and the indirect effects of general health identity and general health self-efficacy.*

Condition	Effect	Coefficient	*SE*	*t*	*p*	95% CI
SHBC Yoga (vs. MHBC)	Total Effect	.12	.26	.44	.66	[-.41, .64]
	Direct Effect	.03	.26	.11	.92	[-.49, .55]
	Indirect Effect ID	.20	.16			[-.03, .60]
	Indirect Effect SE	-.12	.13			[-.43, .06]
SHBC Fruit Veg (vs. MHBC)	Total Effect	.01	.24	.04	.97	[-.47, .49]
	Direct Effect	-.12	.24	-.50	.62	[-.60, .36]
	Indirect Effect ID	.18	.15			[-.05, .54]
	Indirect Effect SE	-.05	.12			[-.37, .09]
Control (vs. MHBC)	Total Effect	< .001	.24	< .001	1.00	[-.49, .49]
	Direct Effect	-.09	.24	-.38	.70	[-.57, .39]
	Indirect Effect ID	.11	.14			[-.11, .43]
	Indirect Effect SE	-.02	.100			[-.269, .152]

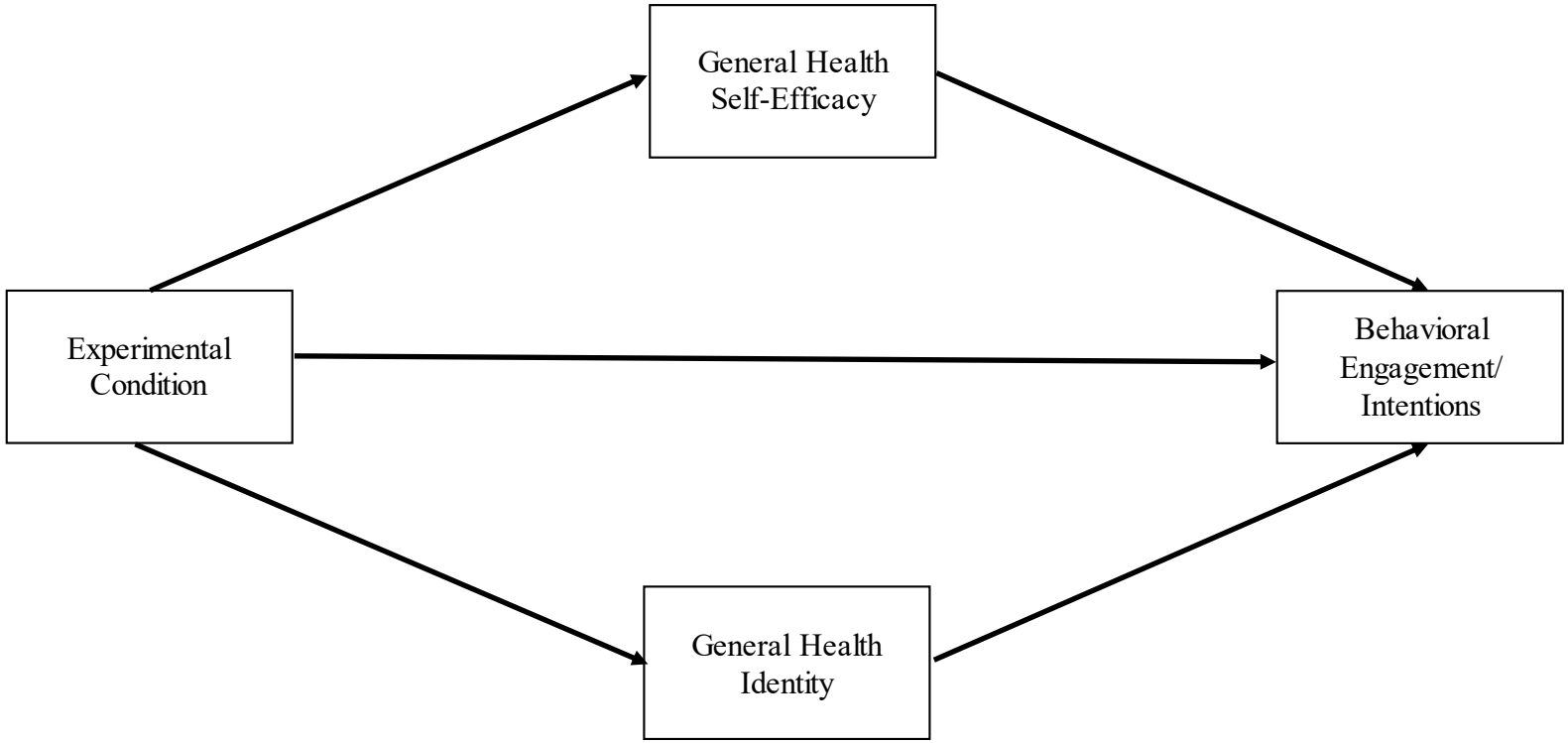

Figure 1. Mediation model testing the direct effects of experimental condition (i.e., MHBC, SHBC yoga, SHBC fruit and vegetable, control) on behavior (i.e., yoga engagement, fruit and vegetable consumption) and intentions (i.e., to continue yoga engagement, to continue fruit and vegetable consumption), and the indirect effects of general health identity and general health self-efficacy.

APPENDIX B: IRB APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research Vice President for Research
2420 Lincoln Way, Suite 202 Ames, Iowa 50014
515 294-4566

Date: 01/09/2020

To: Kathryn Bunda Leigh A Phillips

From: Office for Responsible Research

Title: **Evaluating Potential Mechanisms of a Multiple Health Behavior Change Intervention**

IRB ID: **19-366**

Submission Type: Modification **Review Type:** Expedited

Approval Date: 01/09/2020 **Approval Expiration Date: N/A**

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, including **the recruitment materials and informed consent documents that have the IRB approval stamp.**
- **Retain signed informed consent documents for 3 years after the close of the study,** when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study or study materials.
- **Promptly inform the IRB of any addition of or change in federal funding for this study.** Approval of the protocol referenced above applies only to funding sources that are specifically identified in the corresponding IRB application.

- **Inform the IRB if the Principal Investigator and/or Supervising Investigator end their role or involvement with the project** with sufficient time to allow an alternate PI/Supervising Investigator to assume oversight responsibility. Projects must have an eligible PI to remain open.

- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.

- IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of Institutional Review Board Office for Responsible Research Vice President for Research 2420 Lincoln Way, Suite 202 Ames, Iowa 50014 515 294-4566 FAX 515-294-4267 IRB 01/2019 those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies**. IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

- Your research study may be subject to **post-approval monitoring by Iowa State University's Office for Responsible Research.** In some cases, it may also be subject to formal audit or inspection by federal agencies and study sponsors.

- Upon completion of the project, transfer of IRB oversight to another IRB, or departure of the PI and/or Supervising Investigator, please initiate a Project Closure to officially close the project. For information on instances when a study may be closed, please refer to the IRB Study Closure Policy.

If your study requires continuing review, indicated by a specific Approval Expiration Date above, you should:

- **Stop all human subjects research activity if IRB approval lapses**, unless continuation is necessary to prevent harm to research participants. Human subjects research activity can resume once IRB approval is re-established.

- **Submit an application for Continuing Review** at least three to four weeks prior to the **Approval Expiration Date** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.