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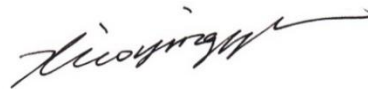
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**Associations Between Implicit Beliefs and Physical Activity Motivation
Among Breast Cancer Survivors**

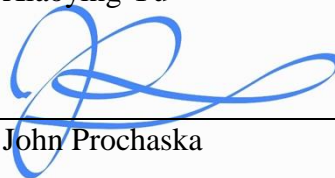
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**Associations Between Implicit Beliefs and Physical Activity Motivation
Among Breast Cancer Survivors**

by

Jason Richard Bentley, M.S.

Dissertation

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Dedication

This dissertation is dedicated to my children, Sarah Pearl and Samuel Joseph. It is my hope that this work will inspire them to pursue their dreams with vigor and optimism and know that they are loved and cherished by their father regardless of where their paths may lead. I also would like to dedicate this to my sister, Carol Annette Westemeier, who passed away on January 17th, 2017 after a courageous battle with cancer. I hope this work will help others embrace their survivorship with the same courage.

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Associations Between Implicit Beliefs and Physical Activity Motivation Among Breast Cancer Survivors

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The University of Texas Medical Branch, 2021

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Breast cancer (BC) survivors may improve their health outcomes by engaging in moderate levels physical activity (PA), but they often lack motivation to be active. Previous research has focused on the use of wearable activity monitors to increase PA; yet sustained use of these tools is problematic. Enhancing activity monitor data with person-relevant motivational feedback may help maintain PA. Currently, little is known regarding the effect personality differences may have on PA behavior, particularly people's implicit beliefs about PA. Research suggests that implicit beliefs differ in two ways: some believe that their ability to perform PA is fixed while others believe that it can change and improve. In the proposed study, we will examine inactive BC survivors' implicit beliefs regarding their PA. In addition, additional psychometric aspects will be examined such as motivation and exercise identity using validated assessment tools. The goals of this research are to understand the themes and concepts that emerge in the reflections of inactive BC survivors participating in a PA study, characterize the implicit beliefs about PA among inactive BC survivors, and examine associations between implicit beliefs and other variables related to PA behavior, specifically exercise identity and motivation. These analyses will identify targets for future PA interventions in BC survivors, hopefully optimizing these interventions to allow sustained routine long-term PA behavior in this population as well as others.

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List of Abbreviations

Apps	Applications
AHA	American Heart Association
BC	Breast Cancer
BMI	Body Mass Index
BREQ—2	Behavioral Regulation in Exercise Questionnaire
CNAAQ	Conceptions of the Nature of Athletic Ability Questionnaire
EMS	Exercise Motivation Scale
ER	Estrogen Receptor
GSBS	Graduate School of Biomedical Science
MI	Motivational Interviewing
NV	Narrative Visualization
PA	Physical Activity
PE	Physical Education
QoL	Quality of Life
RCT	Randomized Controlled Trial
SCT	Social Cognitive Theory
SDT	Self-Determination Theory
UTMB	University of Texas Medical Branch

Chapter 1: Introduction

Breast Cancer Survivorship and Physical Inactivity

According to 2020 data, breast cancer (BC) has surpassed lung cancer as the most commonly diagnosed form of cancer, with approximately 2.3 million new cases reported worldwide.¹ BC now represents 11.7% of all new cancer diagnoses. While the 5-year relative survival rate of BC has increased to 90.6% in the US,² survivors of BC may experience long-term treatment effects (e.g., lymphedema, cardiotoxicity, cognitive dysfunction, cancer-related fatigue) that negatively impact their psychological and physical health and overall quality of life (QoL). Survivors are also faced with common, age-related comorbidities as well as the risk of a potential recurrence or a second new primary BC diagnosis.³⁻⁷

Another independent, yet related risk factor for poor outcomes for women with BC is physical inactivity.⁸ For instance, Leach et al. published on the health profiles of 1500 survivors of various types of cancer included BMI and physical inactivity in their assessments.³ Survivors of BC had the highest number of comorbid conditions during their survivorship compared to other cancers, and BMI and physical inactivity were significant predictors of these comorbidities. Even when controlling for BMI, physical inactivity was significantly correlated to more comorbidities than survivors who were

physically active. Moreover, based on data from the Nurses' Health Study, PA appears to be an independent predictor of survival after breast cancer (i.e., breast-cancer and all-cause mortality).⁹ This prospective observational study reported that those who walked three to five times per week at an average pace experienced the greatest survival benefit and no additional benefit for those showing greater energy expenditure. Similar findings were revealed in a systematic review of 10 prospective cohort studies suggesting that higher levels of physical activity were associated with a reduced risk of cancer-related mortality.¹⁰

Regarding the development of new, primary BC, numerous studies have linked PA to the development of BC. As demonstrated by a 2016 meta-analysis that included 38 cohort studies, women with high levels of PA had a 12-21% lower risk of developing primary BC compared to women who were not physically active.¹¹ Another large meta-analysis of 139 studies found this risk reduction to be significant in pre- and post-menopausal women.¹² Additional evidence of the protective effect of PA was found in the prospective Nurses' Health Study where moderate PA (including brisk walking) significantly reduced the risk of primary BC over the 20 year span of this investigation.¹³ Again, this study and others revealed that even women who become physically active after menopause significantly reduce their risk of BC compared to women who remain sedentary.^{14, 15}

Epidemiological evidence indicates that exercise or PA is protective against morbidity and mortality, but the PA levels of BC survivors is generally low. Boyle et al. reported that older survivors (70+ years) and those with high comorbidities had the lowest levels of PA.¹⁶ Furthermore, results from the 2014 National Health Interview Study revealed that healthy PA behaviors are not widely prevalent in cancer survivors, with fewer than 40% being sufficiently active, and adherence to PA guidelines became even less prevalent with increased age.¹⁷ The American Heart Association (AHA) recommends 150 minutes/week of moderate-level physical activity (PA),¹⁸ yet only 49% of U.S. adults and 39% of those 65 and older meet this recommendation.¹⁹ Even fewer cancer survivors (34-35.6%) achieve this level of activity.¹⁷

Exercise and Physical Activity Interventions

Seeking to increase exercise/PA in BC survivors, clinical investigators have conducted numerous randomized controlled trials (RCTs) of behavioral interventions and found a variety of beneficial outcomes from fatigue reduction to QoL improvements. An RCT comparing a 12-week home-based PA intervention that consisted of telephone counseling calls with a contact control group revealed improved vigor and reduced fatigue in BC survivors.²⁰ A review of 17 RCTs examining home-based exercise programs reported that walking programs were perceived as convenient and increased PA in breast cancer survivors.²¹ Including step pedometers with breast cancer-specific PA

print materials appeared to improve QoL significantly more compared with just a pedometer or printed materials in BC survivors.²² Targeted interventions addressing the specific needs of BC patients can be used to treat various conditions in BC survivors. Dieli-Conwright et al. combined resistance and aerobic exercise in a 12-week intervention to effectively reduce metabolic syndrome, sarcopenic obesity, and relevant biomarkers in a sample of sedentary, overweight, or obese survivors of breast cancer. Similarly, Courneya et al. compared a 12-week aerobic exercise program to usual care in BC survivors with lymphedema.²³ The authors found that the intervention significantly improved patient-rated physical functioning, overall QoL, fatigue, happiness, depression, general health, and cardiovascular fitness. A meta-analysis of 14 rigorous RCTs of exercise interventions in BC survivors indicated that exercise was an effective modality to improve QoL, cardiorespiratory fitness, physical function, and symptoms such as fatigue.²⁴

Motivation and Physical Activity

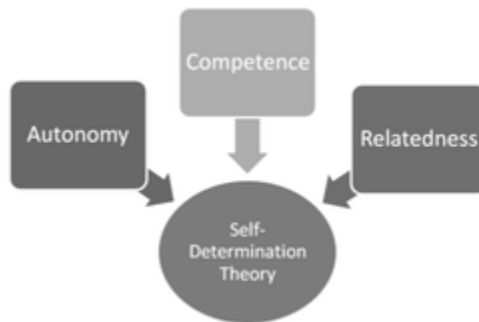
Previous literature has shown that interventions focused on Social Cognitive Theory (SCT) constructs have shown promise in changing PA behavior in cancer survivors.²⁵ Originally postulated by Albert Bandura in 1986, SCT focuses on causal mechanisms that influence behavior.²⁶ In regard to PA, the focus of SCT based interventions have been on using goal setting, self-monitoring, and routine feedback to

influence PA behavior by targeting an individual's belief in their ability to complete a task or achieve a goal (i.e., self-efficacy).²⁷ While these interventions may produce short-term increases in PA,²⁸ rarely do they accomplish long-term behavior change.^{29, 30} One of the possible issues with SCT is that it focuses on external stimuli to elicit behavioral responses. These stimuli may not be sufficient to drive long-term change. Since PA that is maintained over time produces greater effects than short-term increases,³¹ there is a need encourage extended, habitual PA maintenance to improve the health of BC survivors.

Another behavior change theory that focuses on motivation is Self-Determination Theory (SDT).³² SDT offers a multifaceted approach to motivation and looks at what motivates a person at any given time. SDT defines motivation both intrinsically and extrinsically. Extrinsic motivation involves the influence of external factors to change behavior while intrinsic motivation involves the influence of enjoyment and personal value.³³ There are varying degrees by which extrinsic motivation is regulated: external regulation, introjection, identification, and integration. External regulation is when behavior is controlled by an external demand or potential reward and is the least autonomous type of regulation. Introjection is experienced when the external demands are administered by the individual and not another person. Identification is when an individual consciously values the goal of a behavior and considers it personally

important. Integration is the most autonomous type of extrinsic motivation and occurs when an individual accepts and integrates a behavior into their life based on their own perception of their personal values and identity. While integrated motivation resembles intrinsic motivation, it is still considered extrinsic because the goals trying to be achieved are still extrinsic to the self rather than intrinsic enjoyment and value. The transition from extrinsic to intrinsic motivation is achieved via autonomy (desire to be the causal agent of one's own life), competence (seeking to control the outcome via mastery) and relatedness (experiencing interaction, connection and caring for other).³⁴ (Figure 1).

Figure 1: Components of SDT.



A person must feel competent, related, and autonomous to fully integrate a behavior, thus integration leads to self-regulation of this behavior.³⁵ Therefore, integrated regulation makes a logical intervention target for sustaining long-term PA behavior into a sedentary population. Figure 2 has been adapted from Deci and Ryan and shows how all these SDT constructs can be visualized.³⁶

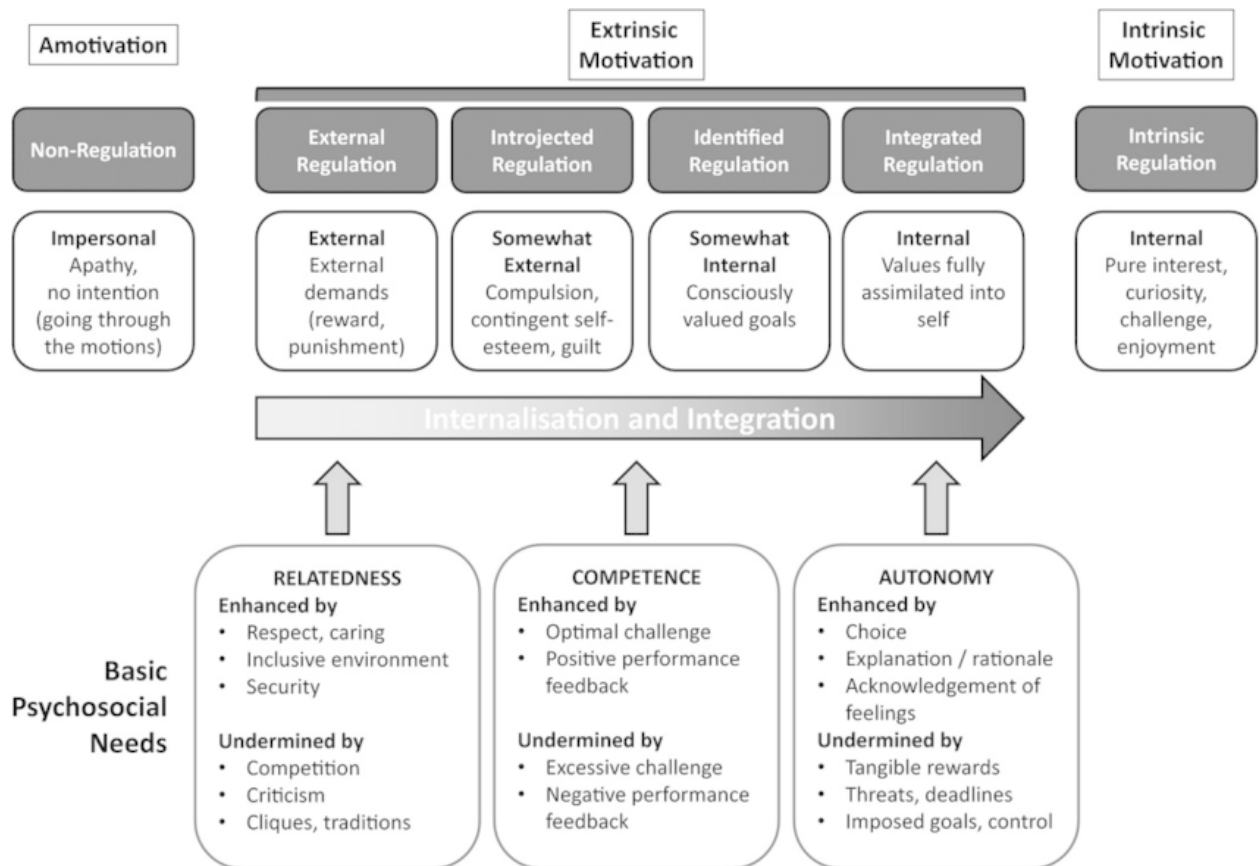


Figure 2: Self-determination Theory.

When it comes to engaging in routine PA, individuals are rarely intrinsically motivated.³⁷ On the contrary, Sherwood and Jeffery found that individuals tend to engage in PA because of the improvements in other personal factors such as health, appearance, social interaction, stress relief, and skill development.³⁷ Therefore, their work suggests that to become a regular exerciser, an individual needs to identify and integrate the value of PA. However, intrinsic regulation is the goal for long-term adherence.³⁸

When it comes to PA behavior in BC survivors, a study in 2008 by Milne et al. examined motivation for PA using SDT constructs using a cross-sectional design.³⁹ The

BC survivors that met PA guidelines demonstrated greater identified and intrinsic motivation, autonomy, and competence than those who did not meet the PA guidelines. Since SDT was found to be a useful intervention paradigm, there have since been several studies conducted warranting systematic reviews that focus on adherence and effectiveness of SDT on PA interventions in BC survivors.^{40, 41} Regarding adherence, Abdin et al. recently reported in their review that despite the lack of negative intervention effects, only 6 of 17 studies showed that PA interventions were maintained and a further lack of long-term adherence.⁴⁰ They also found diverse evidence for intervention effectiveness over a range of outcomes. It was suggested that based on the evidence examined, group interventions may have resulted in more positive results in terms of psychosocial outcomes. Furthermore, Pudkasam et al. compiled a systematic review incorporating several behavioral change strategies including SCT and SDT as well as motivational interviewing (MI) to improve PA behavior in BC survivors.⁴¹ They found issues with adherence due to low motivation and low confidence in the benefits of PA, and suggested that MI might be a good strategy to implement during PA interventions to enhance adherence. However, MI requires an interviewer to deliver the intervention; hence this is not practical for the majority of BC survivors.

Individual Differences and Physical Activity

Furthermore, even MI interventions and those using SDT have had limited success in producing long-term PA behavior change, particularly for older adults.⁴²

Therefore, long-term behavior change might be better approached if we first can understand how individual differences in personality (i.e., personality traits) affect adherence to PA. Understanding these differences might be the key to implementing a values-driven approach to improve motivation to adhere to PA behavior. One such individual difference variable is implicit beliefs.

Carol Dweck originally proposed the concept of implicit beliefs regarding intelligence and defined them as one's beliefs about their potential for change.⁴³ People who hold entity beliefs consider their abilities to be immutable or fixed;⁴⁴ whereas people who hold incremental beliefs consider their abilities to be improvable.⁴⁵ This model describes how an individuals' goals elicit a pattern of response, and these goals are cultivated by the individuals' self-conception. The model identifies individual differences in beliefs which in turn produce individual differences in behavior. For individuals with entity beliefs, if perceived ability to perform a task is high, the perceived possibility for mastery is also high. In turn, if perceived ability is low, there is little perceived possibility of mastery, and people tend to give up. However, those with incremental beliefs consider

their abilities as malleable traits, which can be improved upon through effort and hard work. Thus, implicit beliefs can predict adaptive or maladaptive responses to obstacles.

While Dweck's original work mainly focused on intelligence, several authors have applied the implicit belief framework to other domains. For example, Ehrlinger et al. investigated implicit beliefs in regard to healthy eating behavior.⁴⁶ They developed interventions that encouraged incremental beliefs about body weight which encouraged a healthier diet. Howell et al. studied implicit beliefs of well-being, and that those who possessed incremental beliefs of well-being were predictive of hedonic (i.e., pleasurable) and eudaimonic (i.e., meaningful) well-being activities.⁴⁷ Emile et al. demonstrated that those with an incremental mindset who were exposed to stereotype-inconsistent information boosted their handgrip strength compared to those with an entity mindset.⁴⁸ Finally, longitudinal studies conducted in the school setting have demonstrated that implicit beliefs apply to health among adolescents.⁴⁹ Consequently, individuals' beliefs regarding their ability to change their behavior may have important implications for health behavior including PA adherence.

To investigate implicit beliefs about PA, a modified instrument was needed to assess entity and incremental beliefs in the PA domain. Therefore, Sarrazin et al. developed the Conceptions of the Nature of Athletic Ability Questionnaire (CNAAQ) for children aged 11-12 who adopted different sport and PA goals.⁵⁰ In contrast to the

original work of Dweck, they suggested that entity and incremental beliefs may coexist in the context of PA since both innate abilities (entity) and learned skills (incremental) contribute to improved performance of PA. Therefore, the CNAAQ is a multidimensional assessment of implicit beliefs about PA. Unfortunately, measurements using this instrument were inconsistent,⁵¹⁻⁵³ suggesting that a more rigorous assessment instrument was needed. Therefore, Biddle et al. refined the CNAAQ and improved the empirical and conceptual bases of the instrument to dichotomously measure entity and incremental beliefs about PA.⁵⁴ Their instrument, the CNAAQ-2, was validated with good factorial, convergent, and discriminant validity and internal consistency (Cronbach's $\alpha = 0.80$) via multiple RCTs. The measure has been subsequently used in a variety of experimental research to quantify entity and incremental implicit beliefs about PA.⁵⁵ Importantly, entity mindsets were found to be associated with decreased self-reported PA⁵⁶ and decreased intrinsic motivation to engage in PA.⁵⁷

Several investigators have shown that implicit beliefs are correlated with PA behavior in a large variety of contexts using a large variety of outcome variables.⁵⁵ One interesting cross-sectional study by Emile et al. from 2014 examined how aging stereotypes that have been shown to affect PA behavior are correlated with implicit beliefs.⁵⁸ This study was one of the few that looked at implicit beliefs about PA in older adults, as their sample was a group of healthy older men and women aged 60-93 years

(mean age of 73) in France. They hypothesized that entity beliefs would predict the endorsement of negative aging stereotypes about PA (i.e., risks) and incremental beliefs would predict the endorsement of positive aging stereotypes about PA (i.e., benefits). Using the original CNAAQ instrument,⁵⁰ along with assessments of PA level along with stereotypes about older people and PA, they confirmed their hypothesis. While this study is one of the few that looked at implicit beliefs about PA in an older population and how it affected PA, there were some significant limitations. First, they only examined one personality trait (openness to experience) and examined implicit beliefs as mediators to aging stereotypes. Second, PA behavior was not directly assessed, so whether there is a relationship between implicit beliefs about PA and how entity and incremental mindsets affect healthy PA behavior was not clear. Lastly, the sample was a group of healthy older adults, and not a clinical population whereby engaging in routine PA is considered paramount to improved health. However, this study did show that implicit beliefs about PA among an older population can be reliably assessed.

A study by Stevenson and Lochbaum examined implicit beliefs about PA and leisure-time exercise motivation using cross-sectional analysis in healthy, mostly younger adults (79% were aged 18-24 years and only 0.5% were 65+) and most participants were within normal body weight range (58%) as determined by BMI.⁵⁹ They used a less common instrument to assess autonomy for exercise: the Exercise Motivation Scale

(EMS),⁶⁰ and used the CNAAQ-2 to assess implicit beliefs about PA. They found that entity mindsets were a significant negative predictor of autonomy while incremental mindsets were significant positive predictors of autonomy. One limitation of their study was that they mostly sampled healthy, younger college students; hence, the influence of aging and/or health was not taken into consideration. Another limitation was similar to what Emile et al. discussed in that only PA motivation was assessed and not PA behavior. While these limitations may affect the validity of detailed insights into motivation, they were able to reliably assess the correlation of implicit beliefs about PA using the CNAAQ-2 and exercise motivation among healthy adults.

There is also evidence that implicit beliefs can be manipulated. Moreno Murcia et al. looked at a relatively small group of university students (N = 42, mean age 22 years) and assessed their implicit beliefs about PA using the CNAAQ-2 instrument at baseline and after a 3-month program in motor task learning.⁶¹ Weekly teaching sessions based on autonomy in learning sport-related skills were used, for a total of ten 45-minute classes. Participation in the autonomy-based programs significantly improved incremental mindsets as well as perceptions of competence. However, while increases in intrinsic regulation were found, they were not significant, which is consistent with other studies.⁶² Also, this study focused on individuals who participate in sport activities. Despite these limitations, the results suggest that teaching framework can influence implicit beliefs

about PA in young individuals. Whether this is the case with older populations, whether these results apply to simpler physical tasks like walking, and whether these types of programs have lasting effects on motivation, is yet to be determined.

One of the more prolific investigators of implicit beliefs about PA is C.K. John Wang who has assessed implicit belief mindsets primarily in students, focusing on physical education (PE) and PA participation.⁶³⁻⁷¹ One major finding was that children with high incremental beliefs, competence, and autonomy tended to be more active. Wang et al. also examined the cross-cultural validation of the CNAAQ-2 which was supported using groups of young students from Singapore and the United Kingdom.⁶⁷ However, one of the most cited studies used cluster analysis of a large national sample (n = 2,510) of 12- to 15-year-olds to identify differences in PA participation and perceptions of physical self-worth.⁶³ They used SDT constructs along with the CNAAQ-2 and identified five meaningful clusters reflecting two highly motivated and two less well-motivated clusters, as well as a clearly amotivated cluster. Their results provided valuable insights in promoting PA in young people. However, one of the limitations of their work was that some clusters reflected age and gender differences, even though the age range was relatively narrow. This could be key in interpreting results from studies using these instruments in diverse (e.g., older) populations.

Biddle and Wang later collaborated on a study to examine implicit beliefs about PA behavior, but limited their sample to adolescent girls using a cross-sectional design along with cluster analysis.⁵⁷ Their results revealed five clusters as well but instead found two lowly motivated clusters. In addition, they assessed PA levels using a 7-day recall questionnaire, and interestingly found that differences in motivation and self-perception did not reflect large differences in PA. This could be due to perceptions of PA among this sample of girls, in that the sample was obtained from girls participating in a physical education (PE) course. Hence, if leisure time activities were relatively low, they might have scored their PA higher due to the compulsory nature of the activities involved in the PE course. prospective areas for intervention that may enhance motivation for PA.

An experimental approach was used by Spray et al. to determine whether there is a causal link between implicit beliefs and achievement goals among a sample of secondary school students who performed a sport task (golf putting) where failure of the task was induced by the investigators.⁷² This approach also allowed them to examine differences in affective outcomes and attributions of failure between those high in entity beliefs versus those high in incremental beliefs. Finally, they attempted to manipulate implicit beliefs by reciting coaching instructions that either focused on the gifted nature of ability or the malleable nature of ability. One of the most pertinent findings in their study was that virtually all their participants were initially quite high in incremental

beliefs; however, they were able to manipulate their implicit beliefs and found differences in ability attributions and achievement goals between those with increased entity beliefs and those with incremental beliefs following failure. They did suggest, though, that PA or sport behaviors may not differ very much in individuals high in entity beliefs, particularly if they are also high in incremental beliefs. Further insights into motivational processes and outcomes among this population are needed, in addition to more explicit delineation between implicit beliefs and approach / avoidance forms of achievement goals.

With the exception of Emile et al.,⁵⁸ there is a lack of research examining implicit beliefs about PA in the older adult population,⁵⁵ and there are currently no studies in a clinical population of BC survivors. Therefore, we propose a new intervention that uses a values-driven approach to improve motivation in sedentary BC survivors allowing them to adhere to sustained routine PA behavior. This novel intervention is called narrative visualization and uses scrapbooking activities to promote transformative reflection on PA behavior. Since narrative visualization has never previously been used to promote PA, we wanted to first determine its acceptability in a sample of sedentary BC survivors, and qualitatively evaluate the approach so it can be effectively delivered in future intervention research.

Thus, we examined implicit beliefs about PA among another sample of sedentary BC survivors. Since this individual difference variable has never been measured in this population, we evaluated the reliability of the CNAAQ-2 instrument to characterize their implicit beliefs about PA. Once this was established, we examined the associations between the implicit beliefs and other variables related to PA behavior, specifically exercise beliefs, behavioral regulation in exercise and motivation. The goal of these analyses was to identify targets for PA interventions, such as narrative visualization, in BC survivors to increase reflection, integrated regulation, and ultimately PA maintenance (Figure 3). The effect these individual difference variables have on interventions will be examined in future research, hopefully helping to optimize these interventions to allow sustained routine long-term PA behavior in this population as well as others.



Figure 3: Conceptual model of intervention mechanism and approach.

Chapter 2: Specific Aims

Breast cancer (BC) survivors are at risk for negative physical and psychological health outcomes related to both cancer and its treatment. While these risks can be reduced via sustained routine physical activity (PA), PA levels are generally low among BC survivors. Interventions that use goal setting, self-monitoring, and routine feedback have produced short-term increases in PA, but rarely have they accomplished long-term behavior change.

Previous clinical interventions have focused on improving PA by targeting behavioral self-regulation, which is essentially the ability to act in one's own long-term best interest. However, individual personality traits may impact the efficacy of self-regulation interventions. In particular, a specific trait called implicit personality may influence self-efficacy, or the confidence in one's ability to perform a specific action, which is a strong predictor of PA adherence. Implicit personality theory states that individuals differ in the extent to which they believe a trait is fixed (entity theorist) or incremental (incremental theorist). This theory has been widely studied in the area of intelligence, where implicit theories were shown to predict both behavior and motivation. For entity theorists, if perceived ability to perform a task is high, the perceived possibility for mastery is also high. In turn, if perceived ability is low, there is little perceived possibility of mastery, and people tend to give up. In contrast, incremental theorists

believe that abilities are malleable traits, which can be improved upon through effort and hard work. Implicit beliefs are correlated with PA behavior in cross-sectional studies. Additionally, investigators have used targeted prompts to manipulate implicit beliefs and found a causal link between these beliefs and achievement goals in a sport task. However, implicit theories about PA have not been examined in a clinical setting among breast cancer survivors. Thus, at this point, the role of implicit beliefs about PA and other variables related to PA behavior, specifically exercise beliefs, behavioral regulation in exercise and motivation. are not yet understood in this population.

Addressing these gaps in the literature, the following study, which was part of a larger parent project, was conducted in a two-part process. First, we qualitatively evaluated the reflections that emerged from 20 sedentary BC survivors who participated in an innovative PA intervention that integrated narrative visualization. This motivational strategy used photographs, step graph drawings annotated with stickers, and daily reflection questions aiming to connect participants' daily step data to their personal values. The goal was to understand how participants use these strategies to reflect on their behavior. Then, in a cross-sectional sample of 40 sedentary BC survivors, we examined the role of implicit beliefs regarding their PA behaviors. Assessments of implicit beliefs about PA along with measures of motivation, exercise identity and QoL were acquired.

This novel application of personality theory could lead to a better understanding of PA behavior in this population, ultimately allowing optimization of future PA interventions to improve self-efficacy, PA initiation, and PA adherence among BC survivors.

The specific aims of the project were to:

Aim 1: Understand themes and concepts that emerge in the reflections of inactive BC survivors participating in a narrative visualization intervention.

Aim 2: Characterize the implicit beliefs about PA among inactive BC survivors.

Aim 3: Examine the associations between BC survivors' implicit beliefs and other variables related to PA behavior, specifically exercise beliefs, behavioral regulation in exercise and motivation.

Chapter 3: Acceptability of Narrative Visualization with Physical Activity Monitoring Among Breast Cancer Survivors

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ABSTRACT

Purpose: Physical activity (PA) levels are low among breast cancer survivors. Narrative visualization (NV) is a technique that uses drawings, photographs, and text to contextualize data, which may increase integrated regulation, or motivation for PA by relating it to personal values and identity. The purpose of this study was to determine the acceptability of a NV intervention for older breast cancer survivors.

Methods: Participants completed an NV workbook for 7 days using the provided instant camera, art supplies including a variety of stickers, and a wearable electronic activity monitor. The workbook pages prompted participants to re-draw their daily activity graphs from the monitor's mobile app, then annotate them with text, photographs, stickers, etc. to reflect what the data meant to them. Thematic analysis and content analysis were used to identify emergent themes.

Results: Of the 20 consented women (mean age 67 ± 5 years, 45% non-Hispanic White), 17 participants completed all study procedures. Participants showed high levels of engagement (e.g., mean of 9 photos taken; mean of 56 stickers used over 7 days; all workbook questions completed) supporting intervention acceptability. Themes within the photos included family, specific locations, everyday objects, religion, and friends. Themes within the written portions of the workbook included family, chores and obligations, health, personal reflection, hobbies, and shopping. Weight loss was not a major theme.

Conclusions: Breast cancer survivors successfully used NV techniques to reflect on their PA data and behavior. These techniques show promise for promoting integrated regulation in activity monitoring interventions.

Trial Registration: This study was funded by an award from the National Cancer Institute (R21CA218543) beginning July 1, 2018.

Keywords: physical activity behavior, narrative visualization, scrapbooking, breast cancer survivors

BACKGROUND

Breast cancer survivors are at risk for negative health outcomes, including recurrence and developing other comorbidities, such as cardiovascular disease^{73, 74}. Engaging in routine physical activity (PA) can reduce these risks and improve quality of life¹⁰; however, PA levels are low among this population^{17, 75}. Evidence suggests that adherence to PA interventions, particularly long-term adherence (1 year or longer), is inconsistent and is particularly low among older adults⁴². Therefore, there is a need for novel interventions to increase habitual PA integrated into their routine lifestyle to improve the long-term health of older cancer survivors.

Individual characteristics such as self-regulation and self-efficacy may play an important role in PA outcomes including adherence⁷⁶. Self-regulation is the process of guiding one's own behaviors to reach goals, particularly by managing disruptive emotions or impulses⁷⁷. Essentially, this is goal-driven behavior where the long-term goal drives behavioral choices even when feeling fatigued or otherwise tempted to give up.

Similarly, self-efficacy relates to one's beliefs in their own capabilities to successfully engage in a predetermined course of action⁷⁸. So, when these concepts are applied to a PA intervention, it would involve setting PA goals, monitoring PA, and receiving meaningful feedback on progress⁷⁹. With the increasing usage of wearable electronic activity monitors (e.g. FitBit), this feedback most often takes the form of interactive displays showing percentages toward a predetermined goal. The software interface for these devices also typically shows charts of steps per day, comparisons to previous days, as well as weekly and monthly trends⁸⁰.

Interventions that use goal setting, self-monitoring, and routine feedback appear to produce short-term increases in PA, but rarely do they accomplish long-term behavioral change ^{32, 42, 81}. Evidence suggests that these programs are limited by lack of guidance in the use and interpretation of the self-monitoring charts and data, which has been shown to be major reasons why individuals stop using PA monitors ^{82, 83}. Breast cancer survivors have also reported that they reduced adherence to self-regulation behaviors once they were no longer accountable to interventionists ⁸⁴. This population further reports that they want their PA goals to be contextualized as part of their larger, value-based life goals ^{85, 86}. Breast cancer survivors also face unique barriers related to their identities. Changes to the body, particularly body parts associated with femininity, can greatly alter perceptions of identity ^{81, 87}, which may in turn impact PA.

In addition to these basic regulation processes, Self-Determination Theory (SDT) provides a framework for a more motivation-related perspective on behavior change intervention ³². This theory postulates that motivation can range from fully internal or intrinsic (autonomous), which is one's inherent drive to seek out challenges, to fully external or extrinsic (controlled), where motivation comes entirely from external sources. Higher levels of autonomous forms of motivation tend to predict long-term adherence to PA ⁸⁸, and hence it is critical to establish autonomy when PA is being introduced and integrated into routine behavior ⁸⁹. The most autonomous type of extrinsic regulation is called integrated regulation, or self-regulation where motivation relates to personal values and identity. Integrated regulation is associated with engagement in regular PA over time ⁹⁰. While this form of targeted motivation is understudied, several studies suggest that it

may address limitations in current intervention strategies for PA maintenance in this population ^{29, 91, 92}.

A novel way to target this form of motivation is a process of using annotation to help tell a story related to data presentation called narrative visualization ^{93, 94}. Narrative visualization (NV) is a technique that uses drawings, photographs, and annotation to contextualize numerical data. For example, one study used a scrapbook that included photographs and text annotating each photo and found that this process helped individuals find patterns in their daily arousal and relaxation. ⁹⁵ Other investigators used an app that prompted users to regularly look at old photographs and add new annotations. These investigations found that this process led to greater reflection and improved well-being ⁹⁶. The annotation of photographs was also more acceptable and effective at clarifying personal values than written survey methods ⁹⁷. Thus, a growing cross-disciplinary evidence base suggests that adding visuals in the form of photographs and/or drawings can promote engagement with and reflection on data.

Thus, we developed a prototype intervention that built upon self-monitoring techniques using wearable devices, to include narrative visualization techniques that targeted integrated regulation for improving PA. The purpose of this study was to determine the acceptability of scrapbooking activities as an NV strategy along with standard activity monitoring for older (55-79 age range) breast cancer survivors over a 7-day period. We used qualitative analysis to determine themes from reflections from the scrapbooking activities.

METHODS

Study Design and Population

Twenty participants were recruited based on the following eligibility criteria: (1) age between 55 and 79 years, (2) self-identify as female, (3) self-reported diagnosis of breast cancer, (4) report <150 minutes of moderate-vigorous physical activity per week, (5) able to read and understand English, (6) daily access to a smartphone or similar device compatible with the self-monitoring app used, and (7) cleared to participate as determined by the Physical Activity Readiness Questionnaire+. The study protocol was approved by the university's institutional review board, and all participants provided written informed consent.

Procedures

Eligible participants were provided with a wearable activity monitor (Garmin Vivoactive or FitBit Aspire), an instant camera with film (FujiFilm Instax or Kodak Printomatic), a decorative carrying bag, and a workbook containing pages to attach photographs and document their daily activity over the 7-day period. Participants were also provided various art supplies such as stickers, colored pens, photo corner stickers and decorative adhesive tape (Figure 1). Stickers included sheets of various emojis (e.g., smiley faces, food, hearts), positive affirmations, and fitness-themed affirmations. The fitness and affirmation stickers came from standard packs of planner stickers, such as those available

from The Happy Planner (<https://thehappyplanner.com/>) and Avery (<https://www.avery.com/>) companies.



Figure 3: instant camera, activity monitor, and art supplies.

The workbook consisted of two parts: an introductory values clarification exercise and daily logs. The initial values clarification exercise asked participants to take 10 photographs that reflected what they consider important in their everyday life ⁹⁷. They were then asked to write out notes or annotations about what those photographs represented and how they reflect things they value in life and that are important to them. For the daily logs, a blank graph was provided so participants could draw their daily progress in terms of steps taken over the course of the day. They were instructed and encouraged to write notes, indicate times activities started or ended, and use stickers to show what happened throughout the day, how they felt, or anything else they would like to record. Reflection questions were provided each day for participants to reflect on their activity at the end of the day, as well as after the 7 days as shown in Table 1.

Table 1. Reflection prompts.

Timing	Prompt
Daily	How were you active today?
	Why do you think you were (or were not) active today?
	What impacted your decisions about activity today?
After 7 days	Looking back, do you see any patterns in your activity?
	How can you take this knowledge and use it to be more active next week?
	How do you feel about your progress this week? Do you feel closer to your goals?

Participants were given the choice to use or not use whatever materials they preferred over the 7 continuous days. Workbooks were then returned, and the pages subsequently digitized for analysis.

Data Analysis

For the purposes of data analysis, we chose to treat workbook pages in a method similar to the products of photovoice interventions, which also include expressive photographs and text ⁹⁸. Content analysis of stickers was conducted by two independent coders, abstracting information on number of stickers and logging each sticker by an assigned name (e.g., heart eyes smiley, rolling eyes emoticon). The two coders met to assign emojis to the categories of positive (smiles for mouth, hearts for eyes, etc.) or ambivalent/negative (frowns or lines for mouths, etc.). Thematic analysis was used to analyze photographs, drawings, and written content provided by the participants (NVivo 12 Pro, QSR International). Codes were developed by two independent coders by identifying people, places and things that were photographed, and by iteratively reading through the comments made by participants to identify recurring themes (e.g., family, chores, health, etc.). A meeting was held to resolve any differences in coding, and illustrative quotes were selected for each major theme identified. The intervention was deemed acceptable if the participants successfully completed the procedures as instructed and affirmed their acceptance of the procedures during the post-intervention interview.

RESULTS

Of the 20 consented women (mean age 67 ± 5 years, 45% non-Hispanic white), 1 participant was lost to follow-up due to medical complications, 1 did not return phone calls, and 1 was unable to complete the procedures due to cultural barriers (preferred to communicate via spouse). Since the latter participant chose to let her male spouse answer the questions regarding acceptability and preferences, we judged her data not to be consistent with the population of interest for this study. Thus, no data from this individual were included here.

Quantitative results

The NV procedures using both photos and written prose were universally accepted. Participants took a mean of 9 photos over 7 days (range: 4-10) and completed workbook questions regarding current PA and PA goals (Figure 2). All participants completed all of the daily pages, though one printed her own pages that combined the two (so she had 8 pages instead of 15) and one forgot to do the weekly log at the end. Though all the daily pages were completed, not all were completed in the way we intended. For example, some participants wrote numbers of steps at different points of the graph without drawing lines, some pasted photos instead of graphs and wrote about their steps instead of drawing, and some pasted their own stickers and other printouts into the graph space.

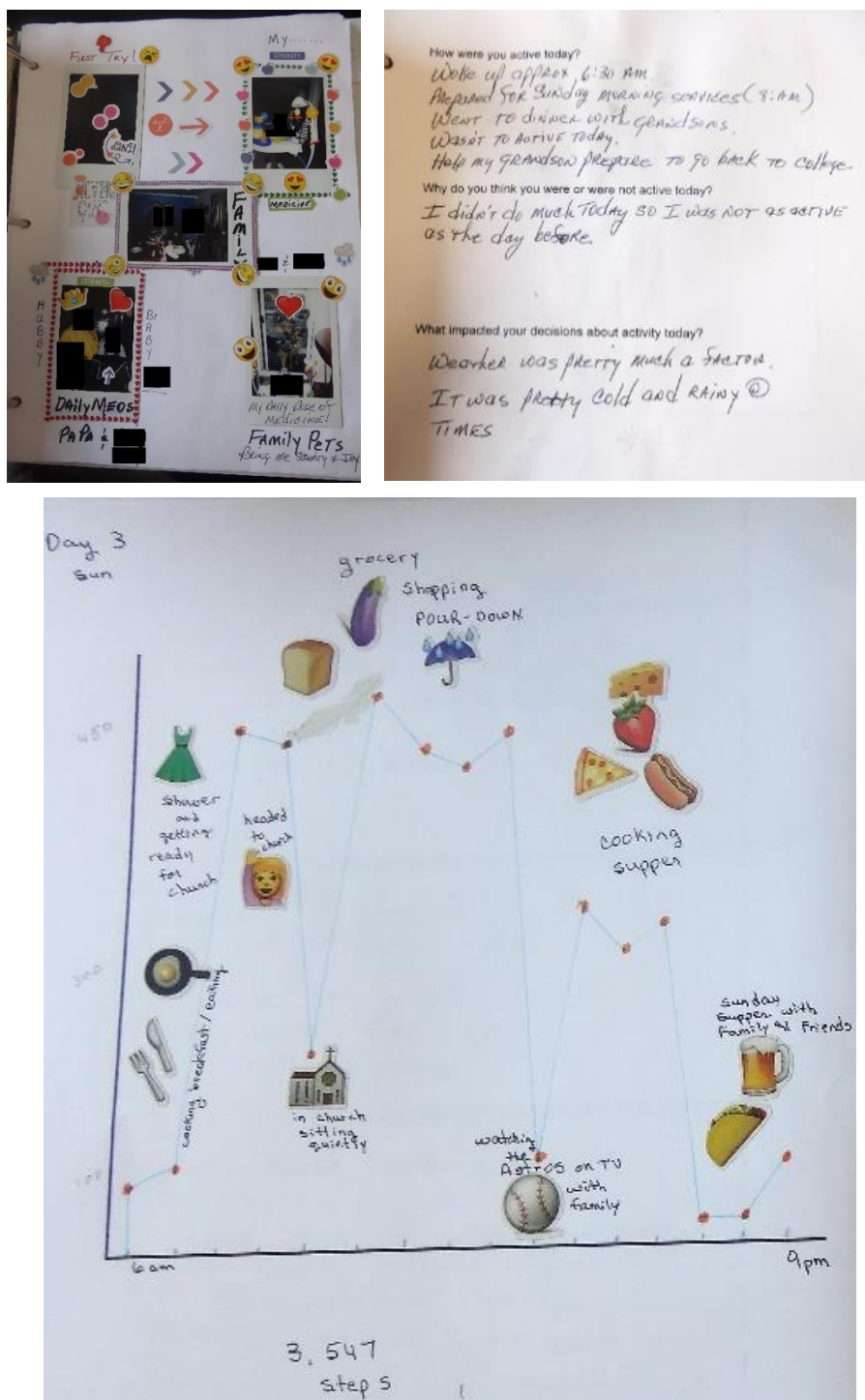


Figure 4: Example workbook pages with faces obscured.

Regarding sticker usage, there were a total of 945 stickers used by all participants (mean \pm SD per participant: 56 ± 49 ; range: 0-180). Almost half of these were emoji stickers (48.6%), most of which were positive themed (smileys, winks, etc.); of the 459 emojis, 136 (29.7%) were negative themed (Figure 3). There were also a substantial amount of stickers used that reflected positive or exercise-related sayings ($n=228$, 24.1% of the total stickers used).

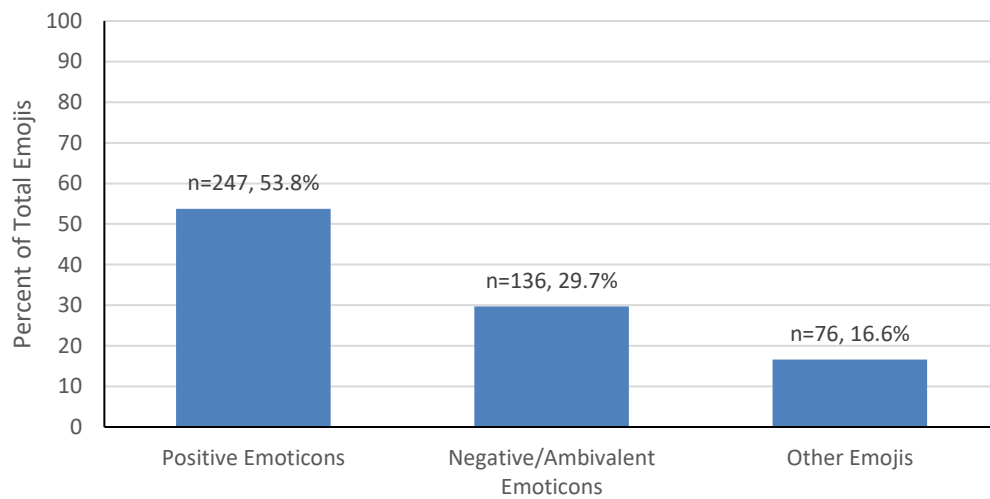


Figure 5: Emoji sticker usage.

Qualitative results

Photos

All participants successfully took photographs using the instant cameras and pasted at least one photograph into the workbook. Several participants included their failed photographs in addition to later, more successful tries. The most commonly occurring themes in the photographs were family, specific locations, everyday objects that held personal significance, religion, and friends.

Photos of family included spouses, children and grandchildren, other immediate family members, “chosen” family (i.e., individuals not related or legally adopted but unofficially adopted into the family), and pets. A participant wrote next to photographs of her family, “My babies, my loves and who give my life meaning they make me laugh – they have been with me through my cancer fight.” Another participant wrote of her pet dog, “She loves me unconditionally, and reminds me of how much I love animals and how awesome I felt when I could save her. She is saving me now – she doesn’t leave my side. It’s important that while my world is crashing, I remember hers revolves around me, so I have to get my stuff together!”

Specific locations included photos of participants’ home, churches, gardens, the beach, and interesting places they passed. One participant pasted a picture of a tree on her walking path and wrote, “It is old with many branches like me. Older – many branches of my life. Peaceful and quiet. I feel good looking at it – peaceful – I love the shade as if God is covering me.” Another participant wrote, “This is the fountain in front of [name redacted] church. I brought my mom to church everyday, and we loved this fountain. It is peaceful to just sit by it. Mom passed away [date redacted] without ever knowing I have cancer. I sat here today after taking this picture & ‘talked’ to mom about it.”

Everyday objects included beds, books, clothing, flowers, computers, hats for local sports teams, etc. A participant wrote, “These roses are very meaningful to me. I planted them when I was sick on treatment. They blossomed all winter and have given the new hope ‘I can blossom in & out of season.’”

Religious photos often overlapped with other themes, such as specific locations and everyday objects (e.g., churches and Bibles). One participant took a picture of her church

foyer and wrote, “I took this while attending church. My faith is very important to me and a big part of my life, beliefs, values, morals, and salvation!” Another used an image of the inside of her church and wrote, “Religion. My church. Such an important part of my life. Growing in faith connecting with the lost, and helping those in need as we communicate God’s word through education, sacraments, worship, praise, and fellowship.”

While friends were often mentioned along with family, there were some photos where friendships were highlighted. For example, one participant wrote, “Friendship. I look at this picture and see trust, a mentor, a person so different from me, but so like me. Everyone needs a [name redacted]!” Another participant captioned, “One of my oldest friends. I’ve known him since he was 6 years old. Son of my best friend. Love this man! Love remembering the good times we had with him and his wife (and mother and dad when they were alive).”

Written text in values clarification section and daily/weekly activity pages

Thematic analysis of written text in the values clarification section and text and drawings from the daily reflections revealed that participants felt that family had the largest impact on their PA. This was followed by: chores and obligations, health and illness, personal reflection, hobbies or activities, and shopping. These themes were discussed in the context of important aspects of the participants’ lives and also in journal form as things that occurred during the course of their days. For example, a participant might discuss religion as important to her and paste a photo of her Bible in the values clarification section, then mention going to church in her Wednesday and Sunday journal entries. Illustrative quotes of these concepts are provided in Table 2.

Regarding the family theme, grandchildren were repeatedly mentioned in the workbooks as being significant factors for PA. There was also an emphasis among 4 participants on non-related family, or in other words, individuals that were chosen to be family by the participants. Several participants discussed friends that were instrumental in their health goals, and they often discussed the friends in terms of their importance regarding their commitments or obligations.

Hobbies were also frequently mentioned as part of their personal reflection. Activities such as gardening, shopping, or service to community via ministry or volunteering were evident.

Table 2. Major themes found in participants' written workbook text.

Theme	Illustrative quotations
Family	"I walked a bit, stretched a little and also played kickball with family first time ever! Excited to be so active & feel great afterwards."
	"I would love to see all of my grandkids grow up. I keep that as my motivation. Grandbaby on the way and I have GOT to be able to get to know this bundle."
	"My health and family are primary. Stay busy & active will keep me with them and remind of what I'm living for."

Chores and Obligations	“I woke up and fixed breakfast and did the household chores. Sit for a while and then went out with my daughter.”
	“Weekend household chores. Yard work... again.”
	“... ran a few errands, attended a meeting – walked from the garage back and forth.”
Health and illness	“Not very active. Had chemo all day.”
	“Back pain. It’s difficult to know how much walking to do without causing pain elsewhere. Drinking a lot of water forced me to get up and move to go to the bathroom.”
	“Not much activity. I did not feel good on this day. I started taking a new med. Doctor said medicine would make me feel sluggish until it adjust to my body.”
Personal reflection	“Looking through my pictures made me realize how blessed I am to have these wonderful gifts in my life. The actual visualization of these blessings, all together in this notebook make me understand the importance of them in my life and recognize the fact that I don’t tell them (enough) how important they are to me. God

	and family are what's more important to me (fur babies included).”
	“‘Live like you were dying’ – we all have an expiration date, hope with more activity mine is not too soon.”
	“This study has allowed me a way to express my day – my feelings my thoughts. I needed this to show me the way to include a new activity in my life. I need to write and sort my activities and emotions. Help me to discover the me at age 66, a senior elderly. With old memories and making new memories. Building a new chapter. Learning how to live with the fear of cancer, recovering or being a survivor. Taking a closer look at my world – looking a[t] grass, sky, family, friend in a deeper way. Then attempt to put it all down to try and find out who I want to be when I grow up!”
Hobbies or Activities	“The activities of interest are most important – flowers that became a hobby when I needed something, ministry which is at my core and shopping.”
	“My ministry activities are very motivating because if I’m not healthy I cannot serve in ministry.”

	<p>“Family project... Garden. I loved watching my husband teach my grandson how to use tools when they built this garden. So many lessons you can teach children when they don’t even have a clue that it’s a teaching session.”</p>
Shopping	<p>“I still had one more promise to keep. I went to the grocery store to get things for the meal for the Cowboys-Saints game party at my sister’s house. Big pot of chili and all of the fixins! WHEW!”</p>
	<p>“Today I needed a ‘me’ day to shop off the island and also to take care of some business however I was determined to get my steps in by pounding the pavement.”</p>
	<p>“My daughter loves to shop, of course we went to the mall. I walked for a while, going in and out of stores, we started at 3:00 PM and did not get home until 9:00, you know it was busy.”</p>

DISCUSSION

In summary, the NV procedures were accepted by the breast cancer survivors recruited for this study. These survivors understood the workbook instructions and were able to use the provided supplies as intended. Participants took approximately 9 of the expected 10 photos for the week. They also completed all of the expected 15 workbook pages, except for one missed weekly log page, and used an unexpectedly large number of stickers to illustrate their pages.

Regarding the utilization of supplies provided, the use of fitness and motivation stickers was not unexpected given that participants were focused on their PA. However, it was notable that they chose to use near equal numbers of both positively and negatively themed emoji stickers. This may be impacted by widespread use of emojis in modern text communications and a related feeling of comfort using them to express feelings, both good and bad ⁹⁹. For example, if a participant was feeling tired during a day when they had PA goals they wanted to achieve, they would express this feeling with a negative emoji. It has been shown that emoji use is more prevalent among females ¹⁰⁰, and the all-female nature of our sample may have influenced emoji usage. In addition, cancer survivors tend to experience a large range of emotions as they adjust to life after cancer, particularly given the painful treatment process and related negative side effects ¹⁰¹. Therefore, the tendency for the breast cancer survivor population to use both negative and positive emojis to communicate their feelings warrants further study. Interestingly, there was also a participant who chose to use none of the stickers. Her responses were also relatively succinct compared to the rest of the study participants, but she recorded her

daily step counts with accuracy. It may be that this individual was less expressive artistically and preferred numerical journaling.

Several participants experienced a learning curve when using the instant cameras for the values clarification portion of the workbooks; since the cameras were preloaded with 10-packs of film when dispensed, there were usually fewer than 10 photos included in the workbooks. However, all participants expressed how they enjoyed and valued this part of the study. Huldtgren et al. suggested that decision making could be improved by focusing on personal values; similarly, the photographs taken as part of our study inspired the participants to reflect on their values ⁹⁷. In addition, Issacs et al. found their participants to benefit from photojournalism since the images served as reminders of positive experiences ⁹⁶. Therefore, photos of breast cancer survivors' family were often featured, which agrees with the literature showing family to be a significant motivator for physical activity adoption and maintenance ^{102, 103}. These investigators also found friends to be significant motivators as well, again which supports our findings.

While numerical step count data from the electronic activity monitors was not used in our analysis, as our interest was focused on the acceptability of using the measurement device along with the other NV supplies, participants used nearly all the space provided for them to draw their daily step charts and to answer questions about their daily activity. These results are in line with previous findings in the communications and human-computer interaction fields, which showed that individuals who self-monitored wanted options for storytelling and emotional self-expression ^{104, 105} and scaffolding to help them get from receiving new information to acting upon that information ^{106, 107}. Participants used photos, drawings, stickers, and text to reflect on their values as well as their identity,

integrating them with their PA data to tell stories about their lives ¹⁰⁸. This process reflects what has been called the “qualified self,” as opposed to the “quantified self” that is commonly discussed in regard to PA self-monitoring ^{109, 110}. Robertson et al. found that cancer survivors’ preferences differed from current standards used in application development for mobile devices in that they preferred value-based rather than numeric goals ⁸⁶. They also preferred PA data to be interpreted and contextualized rather than delivered numerically. That is, these participants used numerical PA data as one part of a larger set of data to describe their attitudes towards PA and how it fit in with other mundane aspects of their day-to-day lives such as chores and shopping. Further, they discussed these stories in the context of larger issues, such as family obligations, religion, and the impact of illness on their lives. These findings are in line with what is found in this NV acceptability study – the pictures, graphs and themes identified highlight the values in this population.

It was particularly interesting that weight loss was not identified as a major theme, as this is often the primary theme of many physical activity programs and protocols. It seems cancer survivors are more focused on spending time with family, and they recognize that improving their physical health can improve the quality of this time. They also focused on how their health impacted their PA. For example, several participants commented on how going to physician appointments or helping others go to their physician appointments negatively impacted their ability to do PA. In addition, whether they felt good or bad after these appointments also directly impacted their attitude toward their own PA goals.

These findings have several potential implications for future studies. PA interventions among the cancer survivor population should consider how activity monitors are utilized by the participants. Numerical data, particularly those focused on daily/weekly calories used or steps accumulated, may be less meaningful to most participants than visual data such as graphs and progress charts. Fortunately, activity monitor manufacturers provide several types of visual data in their applications, but current research is not focused on these aspects. However, visual data are an essential aspect of a NV intervention, thus emphasizing the promise that this type of intervention offers cancer survivors.

The tactile nature of our visualization procedures also suggests several potential areas of future research. The stickers we provided were extremely popular. It is not clear whether virtual stickers would have a similar impact to the tactile feeling of sticking a physical sticker to a piece of paper. We adopted a hybrid approach to this study, with electronic data collection but hard copies of all scrapbooking materials. As part of this decision process, we opted to use instant cameras with printed out photos rather than digital photos. Future studies may wish to investigate differences between purely digital scrapbooking, for example using an app like Day One (<https://dayoneapp.com>), as opposed to tactile scrapbooking such as was used here.

While the acceptability of this novel NV technique and insights gained from the utilization of the materials as noted above are the strengths of this study, it also had some limitations that should be considered when interpreting the findings. First, this was a formative study focused on the acceptability of a novel intervention and thus, interpretations are limited by the small sample size. Also, since the primary goal was to gain feedback on the intervention equipment and utilization, the duration of usage was

relatively short (7 days). Third, an unexpectedly large proportion of participants (three of the twenty) were lost to follow up despite this being a very short-term study. While this was unexpected and is unusual based on previous studies, we believe that the loss of contact with one participant and the loss of another to an acute health issue were likely chance occurrences. The third lost participant provided important information in that the scrapbooking activities were culturally inappropriate for her, which provided insight for future studies in this population (e.g., exclusion criteria added during recruitment, future tailoring to adapt NV strategies to be culturally acceptable among women uncomfortable with sharing private information with healthcare providers). Finally, since our target population is older breast cancer survivors, our interpretations are limited in both age and gender. Additional research is needed to investigate whether these materials and procedures are acceptable in other populations.

CONCLUSIONS

In conclusion, the materials provided to the breast cancer survivors allowed them to successfully use NV techniques to reflect on their PA data and behavior. These techniques show promise for promoting integrated regulation in activity monitoring interventions, in addition to promoting PA adherence in longitudinal studies, which will be examined in the future.

Chapter 4: Associations of Implicit Beliefs with Exercise Identity and Motivation Among Breast Cancer Survivors

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ABSTRACT

Background: Breast cancer (BC) survivors may improve their health outcomes by engaging in moderate physical activity (PA), but they often lack motivation. Currently, little is known regarding the effect implicit beliefs about PA (e.g., fixed vs. incremental ability to change) have on variables related to motivation.

Purpose: Characterize inactive BC survivors' implicit beliefs regarding their PA and examine associations with exercise identity and motivation.

Methods: Forty inactive breast cancer survivors aged 55-79 completed questionnaires assessing implicit beliefs, exercise identity, motivation, and integrated regulation.

Associations were examined using cross-sectional bivariate correlation analyses.

Results: Participants' implicit beliefs that focused on PA improvement were correlated to exercise beliefs ($r=.34$) and introjected regulation ($r=.39$). Implicit beliefs focused on stability were correlated to integrated regulation ($r=.39$).

Conclusions: These correlations lend insight into the mindsets of BC survivors and their thoughts on routine PA. Understanding these relationships may guide future interventions to elicit long-term PA adherence.

Trial Registration: This study has been registered on ClinicalTrials.gov (NCT03612596) beginning July 1, 2018.

Keywords: implicit beliefs, exercise behavior, motivation, breast cancer survivors

BACKGROUND

Breast cancer survivors are at risk for negative health outcomes, including recurrence and other comorbidities such as cardiovascular disease^{73, 74}. Engaging in routine physical activity (PA) can reduce these risks and improve quality of life; however, PA levels are low among this population^{17, 75}. Therefore, there is a need to increase habitual PA to improve the long-term health of these cancer survivors.

Interventions that use goal setting, self-monitoring, and feedback can produce short-term increases in PA, but rarely do they accomplish long-term behavior change¹¹¹. Various barriers to long-term adherence have been reported in breast cancer survivors including reduced adherence to self-regulation behaviors once no longer accountable to interventionists⁸⁴. This population reports that they prefer their PA goals to be contextualized as part of their larger, value-based life goals^{85, 86}. Moreover, individual difference variables may also be related to one's PA engagement and adherence. In fact, implicit beliefs regarding one's ability to change inherent characteristics may be of particular interest¹¹². Unlike self-efficacy, which assesses beliefs about current capabilities, implicit beliefs are focused on one's beliefs about their likelihood for change. Implicit personality theory states that individuals differ in the extent to which

they believe a trait is fixed (entity theorist) or incremental (incremental theorist) ⁴⁵. This theory has been widely studied in the area of intelligence, where implicit theories were shown to predict both behavior and motivation ⁴³. For instance, for entity theorists, if perceived ability to perform a task is high, the perceived possibility for mastery is also high. In turn, if perceived ability is low, there is little perceived possibility of mastery, and people tend to give up. In contrast, incremental theorists believe that abilities are malleable traits, which can be improved upon through effort and hard work.

While the original work on implicit beliefs mainly focused on intelligence, others have applied this framework to other domains including exercise and PA. Studies have revealed that this individual difference variable applies to exercise behavior such that incremental mindsets are associated with increased self-reported PA in female collegiate athletes ⁵⁶ and motivation to engage in PA in youth ⁵⁴. However, while ample studies have been conducted on youth and young adults in regard to exercise and PA behavior ⁵⁵, implicit theories about PA have not been studied in a clinical and/or older adult populations to our knowledge.

BC survivors' beliefs regarding their ability to change their behavior may play an important role in their motivation to engage in PA. Motivation towards exercise has been extensively studied, and, while various theories have been postulated, most modern conceptualizations argue that motivation falls on a continuum from to external (peer or external pressures) to introjected (internal pressures), identified (outcome-based), integrated (values and identity-based), and finally to intrinsic (pleasurable) exercise regulation. ^{92, 113}. Targeting the more autonomous forms of motivation may improve PA maintenance, and motivation related to values may be particularly important for BC

survivors⁸⁶. In addition, another self-report measure known as exercise identity may provide insight into motivation as it is associated with self-regulation¹¹⁴ and PA¹¹⁵.

This exploratory study sought to explore how implicit beliefs were associated with exercise motivation in BC survivors as mindset may serve as a target of future interventions seeking to increase motivation towards PA adherence. These findings may help guide development of future intervention materials to promote autonomous motivation among individuals with different implicit beliefs, particularly those who are older and/or engaging in PA for clinical improvement.

PURPOSE

The goal of the study was to characterize implicit beliefs about PA among inactive BC survivors, and examine the associations between their implicit beliefs and exercise identity, motivation, and integrated regulation.

METHODS

Participants

Forty participants were recruited for a 24-week randomized controlled trial to improve PA behavior; this report is focused on the baseline measures of this population. Participants qualified for this study based on the following eligibility criteria: (1) age between 55 and 79 years, (2) self-identified as female, (3) self-reported diagnosis of breast cancer, (4) reported <150 minutes of moderate-vigorous physical activity per week, (5) able to read and understand English, (6) daily access to a smartphone or similar device compatible with the self-monitoring app used, and (7) cleared to participate as determined by the Physical Activity Readiness Questionnaire+. Ineligibility criteria included currently engaged in PA over 150 minutes per week, surgery within the past 6

months, current evidence of cancer, or current use of a wearable electronic activity monitor. The study was funded by an award from the National Cancer Institute (NCT03612596), the protocol was approved by the university's institutional review board, and all participants provided written informed consent.

Measures

Participants completed basic demographic items (age, race/ethnicity). Medical information (e.g., stage at diagnosis, time since diagnosis) was self-reported. For the purpose of the current report, *Implicit beliefs about PA* was assessed with the Conceptions of the Nature of Athletic Ability Questionnaire-2 (CNAAQ-2), a 12-item scale comprised for four subscales (3-items each) including stable and gifts (entity) and improvement and learning (incremental) ⁵⁴. Previous studies reported Cronbach alphas from .77-.91. *Exercise Identity* was assessed with the Exercise identity which includes two subscales: exercise role identity and exercise beliefs ^{115, 116} with alphas ranging from .81-.94. *Exercise Motivation* with the Behavioral Regulation in Exercise Questionnaire (BREQ)-2 assessing amotivation; external, introjected, identified, and intrinsic regulation ¹¹⁷ (alphas= .73-.86) which was complemented with the Integrated Regulation Scale ⁹¹ (alpha=.93). We report on the subscales of these instruments.

Data Analysis

We calculated means and standard deviations to describe the sample as well as the distributions of study variables. Then, we examined the associations between the CNAAQ-2 subscales and exercise identity, motivation, and integrated regulation with cross-sectional bivariate correlation analyses. Because this is an exploratory study, we focused on effect sizes to guide future research and did not control for multiple

comparisons. P values are reported but should be interpreted with caution as this analysis was not a priori powered.

RESULTS

Forty female BC survivors (age 62 ± 5.4 years; BMI 31.2 ± 6.3 , 72.5% Non-Hispanic White) completed the assessments. Table 1 shows the descriptive results of the CNAAQ-2 subscales including mean scores. While stability and gifts (entity subscales) and learning and improvement (growth subscales) were expected to be directly associated with each other (here, $r=.32$ and $r=.31$, both $P<.05$, respectively), learning was also associated with gifts ($r=.39$, $P<.05$). Moreover, Cronbach's alpha for stability, gifts, and improvement showed acceptable to good reliability, learning was not a reliable measure within this sample. Therefore, we excluded the learning subscale from the primary correlation analyses.

Table 1. Means, standard deviations and Cronbach alphas for the CNAAQ-2 subscales.

CNAAQ-2 Subscale	Mean	SD	Possible Range	Range	Reliability Coefficient
Stability	7.08	2.401	3-15	3-12	0.662
Gift	6.08	2.165	3-15	3-14	0.759
Improvement	11.88	2.078	3-15	7-15	0.837
Learning	11.55	1.853	3-15	8-15	0.383

Bivariate correlations revealed that the stability mindset was directly associated with exercise role identity ($r=.39$, $P=.02$), and improvement mindset was directly correlated with exercise beliefs ($r=.34$, $P=.03$) Moreover, the improvement mindset was found to be directly correlated to the introjected regulation subscale ($r=.39$, $P=.01$) and

the stability mindset was directly correlated to integrated regulation ($r=.39$, $P=.01$). We also found a direct association between the gifts mindset and external regulation ($r=.40$, $P=.01$). Table 2 portrays the mean scores and bivariate associations of study variables with CNAAQ-2 subscales.

Table 2. Bivariate correlations between the CNAAQ-2 subscales and the subscales of the BREQ-2 along with integrated regulation.

Variables	Mean \pm SD (Range)	Correlation Coefficient		
		Stability	Gifts	Improvement
Amotivation	1.3 \pm 2.3 (0-10)	.24	.27	-.29
External Reg	3.8 \pm 3.7 (0-16)	.16	.40**	.18
Introjected Reg	5.7 \pm 3.8 (0-12)	-.10	.15	.37*
Identified Reg	10.4 \pm 3.8 (2-16)	.18	-.05	.17
Intrinsic Reg	8.2 \pm 4.8 (0-16)	.21	.10	.18
Integrated Reg	6.9 \pm 4.2 (0-16)	.39*	.15	.05
Role Identity	7.2 \pm 4.5 (3-19)	.38*	0.01	0.02
Exercise Beliefs	20.9 \pm 8.8 (6-39)	.09	0.09	0.34*

Note, *, $P<.05$; **, $P<.01$;

Abbreviations: Reg, Regulation.

CONCLUSIONS

This pilot study sought to explore the role of implicit beliefs about PA in the motivation of BC survivors who enrolled in a PA intervention study. We found that survivors were more likely to endorse a growth rather than entity mindset as observed by

their mean scores (Table 1). Regarding internal reliability of the CNAAQ-2 in the current sample, the subscales of stability and gifts (entity beliefs) revealed adequate to strong reliability coefficients. For the incremental beliefs, only the improvement but not the learning mindset ($\alpha=.38$) subscale was reliable. In our sample of BC survivors, the stability subscale which is part of an entity mindset was significantly associated with the exercise role identity subscale so that those believing that PA behavior is a stable trait, the more they identify with exercise as a role identity. Similarly, stability was positively associated with integrated regulation meaning that the more stable one's PA mindset the more one derives motivation to exercise from one's identity and personal values. Moreover, the gifts subscale was directly associated with external regulation so that the more a person believes that PA behavior is an inherent trait, the more they are prone to external regulation such as peer pressure to exercise. In contrast, the improvement subscale which is part of the growth mindset was directly associated with the exercise beliefs subscale of exercise identity and introjected regulation in our sample of BC survivors. Here, the more individuals believe that they can improve upon their current ability to perform PA, the more they cognitively engage in PA and the more internal pressure they experience to exercise.

Based on these findings, implicit beliefs appear to be significantly associated with exercise motivation; however, the direction of the effects do not map on to the previous literature which suggested that a growth mindset is associated with more autonomous forms of motivation. Here, we observed the opposite: those endorsing an entity mindset were more likely to report more autonomous forms of regulations whereas those with a growth mindset were more likely to be motivated by extrinsic regulation.

It is important to point out that unlike previous implicit belief studies focusing on youth and young adults, the underlying motives for relatively inactive BC survivors to engage in PA may be vastly different. In fact, among BC survivors, the improvement mindset in this context may have less to do with improvement in PA behavior but more with prevention of negative health outcomes, i.e., avoiding recurrence, leading to improved health. Moreover, this population tends to be encouraged by their oncological caregivers to integrate routine walking as a form of health maintenance, and they may have been convinced by their family members that these behaviors are integral for their health. They are not necessarily focused on improving their PA skills, which would be more in line with growth beliefs; however, they may simply be convinced that they can use their current walking skills in a stable and consistent fashion to reduce their chance of BC recurrence. This is perhaps evident in the correlation between stability beliefs and exercise role identity. Longitudinal and experimental designs including larger samples are necessary to shed light on specific associations in clinical and older populations as developmental processes may account for this incongruence with previous findings from healthy, young people.

In conclusion, this pilot cross-sectional study laid the foundation that implicit beliefs are associated with motivational processes in sedentary BC survivors seeking to improve their PA. Future research is warranted as implicit beliefs may serve as a target of future intervention research seeking to improve PA behavior in clinical populations.

Chapter 5: Implications of findings and future directions for research

As specified in Chapter 2, the goals of this project were to: understand themes and concepts that emerged in the reflections of inactive BC survivors participating in a narrative visualization intervention, characterize the implicit beliefs about PA among this sample population, and begin to examine associations between implicit beliefs and other psychosocial variables related to PA behavior. Results were presented from both a qualitative study that found narrative visualization (NV) techniques acceptable as a novel PA intervention strategy (Chapter 3), and a cross sectional analysis that found significant correlations between implicit beliefs about PA and exercise beliefs, introjected regulation, and integrated regulation (Chapter 4). This chapter will summarize the key results and discuss the implications of each study.

Study 1: Acceptability of Narrative Visualization with Physical Activity

Monitoring Among Breast Cancer Survivors

- Over 7 days, participants (N = 17) completed a workbook using an instant camera, art supplies including a variety of stickers, and a wearable electronic activity monitor.
- Participants showed high levels of engagement (e.g., mean of 9 photos taken of a goal of 10; mean of 56 stickers used; all workbook questions completed) supporting intervention acceptability.
- Themes within the photos included family, specific locations, everyday objects, religion, and friends.
- Themes within the written portions of the workbook included family, chores and obligations, health, personal reflection, hobbies, and shopping.

- Weight loss was not a major theme.
- BC survivors successfully used NV techniques to reflect on their PA data and behavior.
- These techniques show promise for promoting integrated regulation in activity monitoring interventions.

IMPLICATIONS FOR STUDY 1

We have highlighted the potential that this type of novel intervention offers BC survivors when used in the context of improving PA behavior. By incorporating photographs, reflection, and written thoughts about progress in achieving PA goals, BC survivors have the resources to contextualize their PA behavior. This will hopefully help foster positive PA adaptations and may ultimately lead to improved quality of life for this population.

One of the other intriguing findings is that weight loss was not a major theme for BC survivors. While obesity does correlate to negative health outcomes, this population was more focused on their family, friends, and hobbies as potential motivating factors in their desire to improve their health. One reason this is significant is that many PA and health-related protocols for otherwise healthy populations tend to focus on weight loss as a primary outcome. Perhaps this approach needs to be adjusted for clinical populations such as cancer survivors.

It was also evident that BC survivors enthusiastically accepted the concept of using reflection materials. Given the technological developments in wearable fitness devices, manufacturers have improved and added to their smartphone software interfaces such that users may better reflect on their PA data. Perhaps these interfaces could be

explored in terms of their capability to provide users with a narrative visualization experience, thus giving them tools and resources to contextualize their PA experience. For example, if the software provides journaling capabilities, digital photos, virtual stickers, etc., this could enhance reflection. These findings provide evidence for future intervention research with this approach in mind.

This study also supported the next phase of my research: testing whether BC survivors' implicit beliefs about PA may be related to motivation in BC survivors' ability to sustain routine PA behavior. This individual difference variable may be the key to unlocking long-term PA behavior change that will ultimately improve long-term health for BC survivors. In addition, while this approach is being examined in BC survivors, there is abundant potential for the generalization of this approach to other clinical populations. Given the importance of PA behavior in rehabilitation from several conditions (e.g., cardiovascular disease, musculoskeletal injury, arthritis, other cancers, etc.), there is promise that this approach could be the key to enhancing adherence to long-term PA behavior.

Study 2: Associations of Implicit Beliefs with Exercise Identity and Motivation Among Breast Cancer Survivors

- Forty inactive BC survivors (age 62 ± 5.4 years; BMI 31.2 ± 6.3) enrolled in a 24-week randomized controlled trial.
- Questionnaires were given at baseline assessing implicit beliefs about PA, exercise identity, motivation, and integrated regulation.

- Associations between these baseline assessments were examined using cross-sectional bivariate correlation analyses.
- Incremental beliefs regarding PA improvement were correlated to exercise beliefs and introjected regulation.
- Entity beliefs focused on stability of PA behavior were correlated to integrated regulation.
- Implicit beliefs about PA appeared to be associated with motivational processes in sedentary BC survivors seeking to improve their PA.
- These relationships provided insight into the mindsets of sedentary BC survivors which will in turn provide insights in the potential effectiveness a novel intervention approach to increase PA behaviors.

IMPLICATIONS FOR STUDY 2

Overall, by using the CNAAQ-2 instrument to assess implicit beliefs about PA, we found that BC survivors were more likely to endorse a growth rather than entity mindset. This is encouraging for a sample of BC survivors who are about to participate in an intervention study to improve PA behaviors. However, we also found that those with entity or gift-oriented mindsets about PA were more likely to report more autonomous forms of PA regulation, and those with incremental or growth mindsets were more likely to be motivated by extrinsic regulation. This is different than other investigators have found in samples of young, active populations. It is important to note, however, that the underlying motives for older BC survivors to engage in PA may be vastly different than younger or non-clinical populations. Specifically, the sample in this study were patients who had been referred to us by their oncological caregivers, as they communicated to

them how important incorporating moderate PA (e.g., routine walking) may be to their current and future health. They are not necessarily trying to improve their PA skills for the sake of gaining more fitness or even getting healthier; instead, they may be convinced that by using their current PA skills more consistently will reduce their chance of a negative consequence, namely BC recurrence. The longitudinal study will hopefully provide further insights at 12- and 24-weeks from when the baseline measures were assessed. It should be noted that the COVID-19 pandemic resulted in the loss of follow up data after this study began; hence, the longitudinal study was significantly delayed. However, while some data will be lost, additional data are currently being acquired and will hopefully mitigate the loss.

Another factor that may have contributed to these findings is that the assessment instrument, the CNAAQ-2, was originally created for and validated in young athletes who participated in sport activities. As with other investigators who investigated general PA rather than sport-specific activity, we modified the CNAAQ-2 items to clarify their intent. While this didn't pose reliability issues in other studies, we did find some issues with the reliability of one of the subscales of the CNAAQ-2, specifically the learning mindset which is associated with entity beliefs. Perhaps it would be prudent to reconsider how the CNAAQ-2 was modified for this clinical population, and potentially improve the reliability of the learning subscale.

One final point of implication is that this study emphasized walking as the modality for PA. This may impact how participants perceived this form of exercise since both motor skills and the time required for walking exercise are limited in terms of

growth. Hence, this type of PA may favor an entity mindset whereas other forms of PA tend to map onto growth mindsets.

FUTURE DIRECTIONS

Continuation of Implicit Belief Research in Randomized Controlled Trial

The sample of BC survivors tested in this study are enrolled in a randomized controlled trial that is testing the efficacy of a novel values-based PA intervention (narrative visualization) in promoting PA behavior changes beyond 12-weeks. Therefore, we will observe whether there are changes in either their implicit beliefs about PA or other psychometric variables related to PA behavior at both 12-weeks and 24-weeks after the intervention was introduced. We will also be able to assess if there were differences between the intervention and control group, who are receiving a standard self-regulation intervention. The qualitative study that we first conducted provided confidence in the intervention, and therefore we expect differences in mindsets as these previously sedentary BC survivors engage in routine PA. We suspect that there may be a connection between the values-based intervention and their integrated regulation, which may emphasize their growth mindset. We also suspect that the self-regulation group may result in more stable mindsets, as this intervention emphasizes more extrinsic regulation.

Refinement of CNAAQ-2 Instrument for Clinical Populations

Since reliability issues were found via factor analysis in one of the subscales of the CNAAQ-2 data provided by the BC survivors in our study, the first goal will be to examine the responses for these items from each participant, and check if there are any patterns or common inconsistencies. Furthermore, perhaps a qualitative study could help

refine the instrument for this (and other) clinical populations. I suggest recruiting a similar sample of 20 BC survivors as our first study and getting feedback on each item on the questionnaire. This would allow us to directly assess whether BC survivors interpreted the question within the appropriate framework for the subscale. Like the first study, we could then examine this feedback and look for themes to better understand their interpretation of the 12 items. Using this data, we could revise any item that was interpreted differently than intended to provide a more appropriate scale for this population. We could then provide the revised CNAAQ-2 to a larger sample of BC survivors, and perform another factor analysis to examine reliability of the subscale measures. This approach would be similar to how Biddle et al. validated the CNAAQ-2 instrument and compared it to the original CNAAQ instrument.⁵⁴ While I don't believe we would need to change the first-order and second-order subscale approach, we could simply examine the residual estimates to determine whether the revised scale improves the fit in the root mean square error margin. Essentially, we would look for low root means square errors, perhaps using Hu and Bentler's cut-off recommendation of .06.¹¹⁸

Testing wearable technology systems as possible values-based intervention mechanism

Another interesting connection with implicit beliefs about PA might come from the wearable activity monitors. These devices come with software interfaces that not only inform the wearers of their PA data, but also allow them to creatively reflect on it. In addition, there are several ways to socialize within the context of the data, by forming groups and allowing different users to encourage each other. This might allow those with similar mindsets to work together and increase the likelihood of PA adherence and long-

term PA behavior change. Kumar et al. recently published a systematic review examining mobile and wearable sensing frameworks for mHealth studies.¹¹⁹ They provided an excellent overview of modern applications that are used with wearable activity monitors, and would be a helpful resource in examining opportunities for deployment in future intervention studies.

Bentvelzen et al. developed the Technology-Supported Reflection Inventory (TSRI), which provides a valid scale to evaluate how effectively a mobile application supports reflection.¹²⁰ This would allow further testing of whether this reflection measure may be correlated to integrated regulation of PA as well as implicit beliefs about PA. This additional insight would help reveal how the mindsets of clinical populations, such as BC survivors, might benefit from specific applications. Perhaps different applications would produce more positive adaptations in entity mindsets than for those with incremental mindsets.

Dissemination to a wide variety of clinical participants

Recent research has indicated that providing wearable activity trackers to cancer patients had positive results in terms of usage and health benefits.¹²¹ Given this recent development, it would seem feasible to integrate implicit belief assessments as well as narrative visualization materials along with these large-scale programs to potentially increase both their adoption and effectiveness. This would provide clinical populations from a variety of backgrounds the opportunity for assessments of implicit beliefs, motivation, and reflection to be obtained. This would also allow testing of refined interventions in more diverse populations, and indiscriminately allow for continuation of this line of research.

CONCLUSION

Regardless of the changes we may observe in mindsets or whether implicit beliefs about PA remain stable in this population, these individual difference variables may serve as a target of future PA intervention research in cancer survivors. They may also inspire customized interventions that take implicit beliefs into account, thereby promoting routine PA behavior based on whether they target growth or stability mindsets. For example, for people with entity mindsets, by emphasizing how simple it is for otherwise healthy people to perform walking exercise, and if it is stably maintained, it doesn't need to be improved to reduce the possibility of cancer or disease recurrence. Hence, we may positively benefit their survivorship by using a strategy that would be less effective for others with a different mindset. For those with incremental mindsets, based on current literature, they may be more motivated using standard protocols where improvement in PA behavior is fostered and regulation moves from extrinsic to more intrinsic motivation. This mindset-focused approach shows promise for long-term behavioral change, which has been elusive via incentive-based approaches. Using a mindset assessment instrument like the CNAAQ-2 to provide insight into beliefs about PA could be a valuable tool for anyone trying to design an intervention to motivate long-term PA behavior change.

Appendix A: Informed consent for Study 1

The University of Texas Medical Branch at Galveston Minimal Risk Consent Form

Protocol Title: Narrative visualization for breast cancer survivors' physical activity

IRB Number: 17-0310

Sponsor: National Cancer Institute

Principal Investigator: Elizabeth J. Lyons, PhD, MPH
301 University Blvd, Galveston, TX, 77555-1124
Phone: 409-772-2575 Fax: 409-772-2577 Email:
ellyons@utmb.edu

Why am I being asked to take part in this research study?

You are being asked to take part in this study because you are a breast cancer survivor between the ages of 55 – 79 who is interested in increasing your physical activity. Your participation in this study is completely voluntary. You may refuse to participate or stop your participation in this research study at any time without penalty or loss of benefits and without jeopardizing your medical care at UTMB.

What is the purpose of this research study?

The purpose of this study is to test some of the materials we plan to use in a physical activity intervention. The intervention uses a wearable activity monitor, mobile application, and a workbook for logging your activity information.

How many people will take part in this study?

About 20 people will take part in this study at UTMB.

What procedures are involved as part of this research study?

If you agree to take part, you will be asked to sign this consent form and have the following tests and procedures. Some of the procedures may be part of your standard medical care, but others are being done only because you are taking part in this research study. If you participate you will have a total of two study visits over about 2-3 weeks.

Session 1: Initial meeting (this meeting, approximately 1 hour)

Today we will explain the study procedures to you. If you agree to participate, we will give you a bag of materials to use for the next week. These materials will include an activity monitor (like a Fitbit), an instant camera, a workbook, and art supplies. We will go over each material and show you how to use it.

We will also ask you some questions about how well you understand our instructions. We will audio record your answers.

Session 2: Follow-up (about 1 week later, approximately 2 hours)

At this session, we will collect all of the study materials from you. We ask that you bring back everything, whether you used it or not. We will go over each page of the workbook, asking you about how you filled it out. We will also ask you about how you felt about each of the materials. We will again audio record your answers.

What extra tests and procedures will I have if I take part in this study?

There are no extra tests that you will need to have if you take part in this study.

What are the possible risks for choosing to participate in this research study?

Because of your participation in this study, you are at risk for the following side effects. You should discuss these with the researchers and your regular health care provider.

General Risk

You may experience minor discomfort in your joints, muscles, or other parts of your body as you become more active. There is also a low risk of cardiac events during exercise.

Loss of Confidentiality

Any time information is collected, there is a potential risk for loss of confidentiality. Every effort will be made to keep your information confidential; however, this cannot be guaranteed.

What are the potential benefits for participating in this research study?

If you agree to take part in this study, there may be direct benefits to you. We hope the information learned from this study will benefit others with breast cancer in the future. You may also experience improved mood and potentially modest improvements in physical activity.

Will I be reimbursed for participating in this research study?

You will receive a gift card in the amount of \$50 for your study participation.

Is there an alternative treatment/procedure?

This is not a treatment study. You do not have to be part of it to get treatment for your condition.

If I agree to take part in this research study, can I be removed from the study without my consent?

Yes. The researchers may decide to take you off this study if:

- The researchers believe that participation in the research is no longer safe for you.
- The researchers believe that other treatment may be more helpful.

- The sponsor stops the research for the safety of the participants.
- The sponsor cancels the research.
- You are unable to keep appointments or to follow the researcher's instructions.

Will my insurance provider or I be charged for the costs of any part of this research study?

No. Neither you, nor your insurance provider, will be charged for anything done only for this research study (i.e., the Screening Procedures, Experimental Procedures, or Monitoring/Follow-up Procedures described above).

However, the standard medical care for your condition (care you would have received whether or not you were in this study) is your responsibility (or the responsibility of your insurance provider or governmental program). You will be charged, in the standard manner, for any procedures performed for your standard medical care.

What will happen if I am harmed as a result of taking part in this study?

It is important that you report any illness or injury to the research team listed at the top of this form immediately. Compensation for an injury resulting from your participation in this research is not available from the University of Texas Medical Branch at Galveston.

You or your insurance company or health care plan will be billed and you will be responsible for any charges.

How will my information be protected?

All results obtained in this study will be kept confidential and only available to the research study team. Your individual information will not be reported, only the results of all participants as a group.

A description of this clinical trial will be available on www.clinicaltrials.gov, as required by U.S. Law. This website will not include information that can identify you. At most, the website will include a summary of the results. You can search this website at any time.

How will my privacy be protected?

We have rules to protect information about you. Federal and state laws and the federal medical Privacy Rule also protect your privacy. By signing this form you provide your permission, called your "authorization," for the use and disclosure of information protected by the Privacy Rule.

The research team working on the study will collect information about you. This includes things learned from the procedures described in this consent form. They may also collect other information including your name, address, date of birth, and information from your medical records. This could include information about HIV and genetic testing, or treatment for drug or alcohol abuse or mental health problems.

The research team will know your identity and that you are in the research study. Other people at UTMB, particularly your doctors, may also see or give out your information.

We make this information available to your doctors for your safety. If you think this study might affect your clinical care, please inform your doctor.

People outside of UTMB may need to see or receive your information for this study. Examples include government agencies (such as the Food and Drug Administration), safety monitors, other sites in the study and companies that sponsor the study.

We cannot do this study without your authorization to use and give out your information. You do not have to give us this authorization. If you do not, then you may not join this study.

We will use and disclose your information only as described in this form; however, people outside UTMB who receive your information may not be covered by this promise or by the federal Privacy Rule. We try to make sure that everyone who needs to see your information keeps it confidential – but we cannot guarantee that your information will not be re-disclosed.

The use and disclosure of your information has no time limit. You may revoke (cancel) your permission to use and disclose your information at any time by notifying the Principal Investigator of this study by phone or in writing. If you contact the Principal Investigator by phone, you must follow-up with a written request that includes the study number and your contact information. The Principal Investigator's name, address, phone and information are on page one of this consent form.

If you do cancel your authorization to use and disclose your information, your part in this study will end and no further information about you will be collected. Your revocation (cancellation) would not affect information already collected in the study, or information we disclosed before you wrote to the Principal Investigator to cancel your authorization.

Finally, please specifically authorize the use of your private health information relating substance abuse, psychiatric information, or HIV/AIDS, if applicable, for the above-described purposes.

Initial: _____

Who can I contact with questions about this Research study?

If you have any questions, concerns or complaints before, during or after the research study, or if you need to report a research related injury or bad side effect, you should immediately contact Elizabeth Lyons at 409-772-2575 or Eloisa Martinez at 409-266-9643.

This study has been approved by the Institutional Review Board. If you have any complaints, concerns, input or questions regarding your rights as a subject participating in this research study or you would like more information about the protection of human subjects in research, you may contact the Institutional Review Board Office, at (409) 266-9400 or irb@utmb.edu.

CONSENT TO PARTICIPATE:

The purpose of this research study, procedures to be followed, risks and benefits have been explained to you. You have been given the opportunity to ask questions, and your questions have been answered to your satisfaction. You have been told who to contact if you have additional questions. By signing this form, you are confirming that you have read this consent form and voluntarily agree to participate as a subject in this study.

Signature of Subject

Date

Using language that is understandable and appropriate, I have discussed this project and the items listed above with the subject

Signature of Person Obtaining Consent

Date and Time Consent
Obtained

Printed Name of Person Obtaining Consent

Appendix B: Informed consent for Study 2

The University of Texas Medical Branch at Galveston Minimal Risk Consent Form

Protocol Title: Narrative visualization for breast cancer survivors' physical activity

IRB Number: 17-0310

Sponsor: National Cancer Institute

Principal Investigator: Elizabeth J. Lyons, PhD, MPH
301 University Blvd, Galveston, TX, 77555-1124
Phone: 409-772-2575 Fax: 409-772-2577 Email: ellyons@utmb.edu

Why am I being asked to take part in this research study?

You are being asked to take part in this study because you are a breast cancer survivor between the ages of 55 – 79 who is interested in increasing your physical activity. Your participation in this study is completely voluntary. You may refuse to participate or stop your participation in this research study at any time without penalty or loss of benefits and without jeopardizing your medical care at UTMB.

What is the purpose of this research study?

The purpose of this study is to investigate the feasibility of two different interventions related to increasing physical activity. The interventions use an activity monitor, mobile application, and a workbook for logging your activity information.

How many people will take part in this study?

About 40 people will take part in this study at UTMB.

What procedures are involved as part of this research study?

If you agree to take part, you will be asked to sign this consent form and have the following tests and procedures. Some of the procedures may be part of your standard medical care, but others are being done only because you are taking part in this research study. If you participate you will have a total of four study visits over about 6 months.

Session 1: Initial meeting (this meeting, approximately 30 minutes)

Today we will give you information about the study. We will talk about study procedures, assessments, and materials. If you agree to participate, we will measure your height and weight and fit you with a small device that is worn around your waist, called an accelerometer. This accelerometer device will measure your physical activity. You will wear this device for seven days, then return it to us when you come in for your next session.

Session 2: First assessment and orientation (about 1 week later, approximately 2.5 hours)

We consider this the start of intervention week 1 (though it will be your second week in the study). At this session we will measure your height and weight again. We will collect the accelerometer you wore around your waist. You will also fill out some questionnaires that will ask about your motivation for exercise, your feelings about exercise, and your quality of life.

Then, you will be randomly assigned (like flipping a coin) to one of two groups. Depending on the group you are in, your intervention will be different.

Participants in both group will receive a Garmin activity monitor, which is very similar to a Fitbit, to wear on your wrist and a mobile app downloaded on your mobile device. These Garmin monitors are different from the ones you wore for research measurements. These are for you to keep and wear during the study. You will wear them every day and use both the display on your wrist and the information in the mobile app to learn more about your physical activity patterns.

Participants in group 1: You will receive the activity monitor, a mobile app downloaded to your mobile device, and a workbook. We will ask you to wear the monitor daily and look at the app to see your steps. You will be asked record your steps each night in the workbook during the 24 week study period.

Participants in group 2: You will receive the activity monitor, a mobile app downloaded to your mobile device, a workbook, and art materials. The art materials will include an instant camera, markers, and stickers. We will ask you to wear the monitor daily and look at the app to see your steps. You will use an instant camera to take pictures of things related to your personal values. You will also write and draw in the workbook each night. Workbooks will include questions about activity and space for drawing, writing, and pasting pictures. You will be asked to record your steps and answer reflection questions each night in the workbook during the 24 week study period.

Please note that participants in group 1 will not receive the additional art materials during the intervention period. We will give participants in this group the art materials after the last assessment, to ensure that all participants get materials of equal value.

Session 3: 12 week follow-up (about 12 weeks later, approximately 1.5 hours)

You will repeat the assessments from the first assessment session. We will mail the accelerometer device about two weeks prior to this visit and call to confirm that you received it. Please wear the device around your waist for at least one full week (seven days). You will wear this accelerometer on your waist AND your Garmin activity monitor on your wrist. It is important that we gather information from both devices, because they measure your activity differently.

We will also ask you questions about your feelings about the study in a brief interview. Topics will include how you felt about the activity monitor, parts of the workbook that were motivating to you, etc. The interview will be audio recorded. We will ask you to bring your workbook with you to this visit so that we can ask you questions about how you used it. We will also keep scanned images of the workbook pages for our records. You will take it with you when you leave and continue writing in it each night for the rest of the intervention.

Session 4: 24 week follow-up (about 12 weeks after session 3, approximately 1.5 hours)

You will repeat the assessments from the first assessment session. We will mail the physical activity measurement device to you about two weeks prior to this visit and call to confirm that you received it. Please wear the device for at least one full week (seven days). We will again ask you to bring your workbook with you to this visit so that we can scan images of the workbook pages for our records. Once we have finished, you will be free to keep all of the intervention materials and use them as you wish.

What extra tests and procedures will I have if I take part in this study?

There are some extra tests that you will need to have if you take part in this study.

You will have the following extra tests:

Height

Weight

Physical activity measurement

Questionnaire measures

The research study will pay for all the extra tests.

What are the possible risks for choosing to participate in this research study?

Because of your participation in this study, you are at risk for the following side effects. You should discuss these with the researchers and your regular health care provider.

General risk

You may experience minor discomfort in your joints, muscles, or other parts of your body as you become more active. There is also a low risk of cardiac events during exercise.

Loss of Confidentiality

Any time information is collected, there is a potential risk for loss of confidentiality. Every effort will be made to keep your information confidential; however, this cannot be guaranteed.

Psychological Stress

Some of the questions we will ask you as part of this study may make you feel uncomfortable. You may refuse to answer any of the questions, take a break or stop your participation in this study at any time.

What are the potential benefits for participating in this research study?

If you agree to take part in this study, there may be direct benefits to you. We hope the information learned from this study will benefit others with breast cancer in the future. You may also experience improved mood and potentially modest improvements in physical activity.

Will I be reimbursed for participating in this research study?

You will receive a gift card in the amount of \$25 for your study participation at the 12 week and 24 week visits, for a total of \$50.

Is there an alternative treatment/procedure?

This is not a treatment study. You do not have to be part of it to get treatment for your condition.

If I agree to take part in this research study, can I be removed from the study without my consent?

Yes. The researchers may decide to take you off this study if:

- The researchers believe that participation in the research is no longer safe for you.
- The researchers believe that other treatment may be more helpful.
- The sponsor stops the research for the safety of the participants.
- The sponsor cancels the research.
- You are unable to keep appointments or to follow the researcher's instructions.

Will my insurance provider or I be charged for the costs of any part of this research study?

No. Neither you, nor your insurance provider, will be charged for anything done only for this research study (i.e., the Screening Procedures, Experimental Procedures, or Monitoring/Follow-up Procedures described above).

However, the standard medical care for your condition (care you would have received whether or not you were in this study) is your responsibility (or the responsibility of your insurance provider or governmental program). You will be charged, in the standard manner, for any procedures performed for your standard medical care.

What will happen if I am harmed as a result of taking part in this study?

It is important that you report any illness or injury to the research team listed at the top of this form immediately.

Compensation for an injury resulting from your participation in this research is not available from the University of Texas Medical Branch at Galveston.

You or your insurance company or health care plan will be billed and you will be responsible for any charges.

How will my information be protected?

All results obtained in this study will be kept confidential and only available to the research study team. Your individual information will not be reported, only the results of all participants as a group.

A description of this clinical trial will be available on www.clinicaltrials.gov, as required by U.S. Law. This website will not include information that can identify you. At most, the website will include a summary of the results. You can search this website at any time.

How will my privacy be protected?

We have rules to protect information about you. Federal and state laws and the federal medical Privacy Rule also protect your privacy. By signing this form you provide your permission, called your “authorization,” for the use and disclosure of information protected by the Privacy Rule.

The research team working on the study will collect information about you. This includes things learned from the procedures described in this consent form. They may also collect other information including your name, address, date of birth, and information from your medical records. This could include information about HIV and genetic testing, or treatment for drug or alcohol abuse or mental health problems.

The research team will know your identity and that you are in the research study. Other people at UTMB, particularly your doctors, may also see or give out your information. We make this information available to your doctors for your safety. If you think this study might affect your clinical care, please inform your doctor.

People outside of UTMB may need to see or receive your information for this study. Examples include government agencies (such as the Food and Drug Administration), safety monitors, other sites in the study and companies that sponsor the study.

We cannot do this study without your authorization to use and give out your information. You do not have to give us this authorization. If you do not, then you may not join this study.

We will use and disclose your information only as described in this form; however, people outside UTMB who receive your information may not be covered by this promise or by the federal Privacy Rule. We try to make sure that everyone who needs to see your information keeps it confidential – but we cannot guarantee that your information will not be re-disclosed.

The use and disclosure of your information has no time limit. You may revoke (cancel) your permission to use and disclose your information at any time by notifying the

Principal Investigator of this study by phone or in writing. If you contact the Principal Investigator by phone, you must follow-up with a written request that includes the study number and your contact information. The Principal Investigator's name, address, phone and information are on page one of this consent form.

If you do cancel your authorization to use and disclose your information, your part in this study will end and no further information about you will be collected. Your revocation (cancellation) would not affect information already collected in the study, or information we disclosed before you wrote to the Principal Investigator to cancel your authorization.

Finally, please specifically authorize the use of your private health information relating substance abuse, psychiatric information, or HIV/AIDS, if applicable, for the above-described purposes.

Initial: _____

Who can I contact with questions about this Research study?

If you have any questions, concerns or complaints before, during or after the research study, or if you need to report a research related injury or bad side effect, you should immediately contact Elizabeth Lyons at 409-772-2575 or Eloisa Martinez at 409-266-9643.

This study has been approved by the Institutional Review Board. If you have any complaints, concerns, input or questions regarding your rights as a subject participating in this research study or you would like more information about the protection of human subjects in research, you may contact the Institutional Review Board Office, at (409) 266-9400 or irb@utmb.edu.

CONSENT TO PARTICIPATE:

The purpose of this research study, procedures to be followed, risks and benefits have been explained to you. You have been given the opportunity to ask questions, and your questions have been answered to your satisfaction. You have been told who to contact if you have additional questions. By signing this form, you are confirming that you have read this consent form and voluntarily agree to participate as a subject in this study.

Signature of Subject

Date

Using language that is understandable and appropriate, I have discussed this project and the items listed above with the subject

Signature of Person Obtaining Consent

Date and Time Consent
Obtained

Printed Name of Person Obtaining Consent

Appendix C: Questionnaires for Study 2

ID _____

Date/Time _____

Group _____

Exercise identity

		Strongly disagree Strongly agree						
1	I consider myself an exerciser.	1	2	3	4	5	6	7
2	When I describe myself to others, I usually include my involvement in exercise.	1	2	3	4	5	6	7
3	I have numerous goals related to exercising.	1	2	3	4	5	6	7
4	Physical exercise is a central factor to my self-concept.	1	2	3	4	5	6	7
5	I need to exercise to feel good about myself.	1	2	3	4	5	6	7
6	Others see me as someone who exercises regularly.	1	2	3	4	5	6	7
7	For me, being an exerciser means more than just exercising.	1	2	3	4	5	6	7
8	I would feel a real loss if I were forced to give up exercise.	1	2	3	4	5	6	7
9	Exercising is something I think about often.	1	2	3	4	5	6	7

Decisions to engage in physical activity (BREQ-2 with Intrinsic Motivation)

		Not true for me		Some-times true for me		Very true for me
1.	I exercise because other people say I should	0	1	2	3	4
2.	I feel guilty when I don't exercise	0	1	2	3	4
3.	I value the benefits of exercise	0	1	2	3	4

4.	I exercise because it's fun	0	1	2	3	4
5.	I don't see why I should have to exercise	0	1	2	3	4
6.	I take part in exercise because my friends/family/partner say I should	0	1	2	3	4
7.	I feel ashamed when I miss an exercise session	0	1	2	3	4
8.	It's important to me to exercise regularly	0	1	2	3	4
9.	I can't see why I should bother exercising	0	1	2	3	4
10.	I enjoy my exercise sessions	0	1	2	3	4

		Not true for me		Some-times true for me		Very true for me
11.	I exercise because others will not be pleased with me if I don't	0	1	2	3	4
12.	I don't see the point in exercising	0	1	2	3	4
13.	I feel like a failure when I haven't exercised in a while	0	1	2	3	4
14.	I think it is important to make the effort to exercise regularly	0	1	2	3	4
15.	I find exercise a pleasurable activity	0	1	2	3	4
16.	I feel under pressure from my friends/family to exercise	0	1	2	3	4
17.	I get restless if I don't exercise regularly	0	1	2	3	4
18.	I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
19.	I think exercising is a waste of time	0	1	2	3	4

Intrinsic Motivation

		Not true for me		Some- times true for me		Very true for me
1.	I exercise because it is consistent with life goals.	0	1	2	3	4
2.	I consider exercise to be part of my identity.	0	1	2	3	4
3.	I consider exercise a fundamental part of who I am.	0	1	2	3	4
4.	I consider exercise consistent with my values.	0	1	2	3	4

Conceptions of the Nature of Athletic Ability

The following questions concern your beliefs about your ability to perform physical activity.

		Com- pletely disagree	Disagree	Neutral	Agree	Com- pletely agree
1.	You have a certain level of ability to perform physical activity and you cannot really do much to change that level	1	2	3	4	5
2.	To be successful in performing physical activity, you need to learn techniques and skills and practice them regularly	1	2	3	4	5
3.	Even if you try, the level of physical activity you reach will change very little	1	2	3	4	5
4.	You need to have certain 'gifts' to be good at performing physical activity	1	2	3	4	5
5.	You need to learn and to work hard to be good at performing physical activity	1	2	3	4	5
6.	In performing physical activity, if you work hard at it, you will <i>a/ways</i> get better	1	2	3	4	5
7.	To be good at performing physical activity, you need to be born with the basic qualities which allow you success	1	2	3	4	5
8.	To reach a high level of performance in physical activity, you must go through periods of learning and training	1	2	3	4	5
9.	How good you are at performing physical activity will <i>a/ways</i> improve if you work at it	1	2	3	4	5
10.	It is difficult to change how good you are at performing physical activity	1	2	3	4	5
11.	To be good at performing physical activity you need to be naturally gifted	1	2	3	4	5
12.	If you put enough effort into it, you will <i>a/ways</i> get better at performing physical activity	1	2	3	4	5

Background questions

Please write in your answer or check the box that describes you best.

1. What is your age?

_____ years old

2. What is your date of birth?

_____/_____/_____

3. Are you

☐ Male

☐ Female

4. Are you Hispanic or Latino?

☐ Yes

☐ No

5. Which one or more of the following would you say is your race?

American Indian or Alaska Native ☐

Asian ☐

Black or African American ☐

Native Hawaiian or Other Pacific
Islander ☐

White ☐

Other race ☐

6. What is the highest grade of school you have completed?

Some high school ☐

High school graduate or GED ☐

Some college or technical school ☐

College graduate ☐

Graduate or professional school ☐

7. What was your age at diagnosis of your breast cancer?

_____ years old

8. When were you first diagnosed with breast cancer (please give the month and year)?

_____/____

9. What was your primary diagnosis?

10. What was your primary diagnosis stage?

Ductal carcinoma in situ (stage 0) ☐

Stage 1 ☐

Stage 2 ☐

Stage 3 ☐

Stage 4 ☐

11. Have you had a secondary cancer diagnosis or a recurrence?

☐ Yes

☐ No

If so, how many secondary diagnoses or recurrences have you had? _____

What was/were the secondary diagnosis? _____

12. What type of surgery, if any, did you undergo?

- | | |
|----------------------------------------|--------------------------|
| Lumpectomy | <input type="checkbox"/> |
| Lumpectomy with node dissection | <input type="checkbox"/> |
| Mastectomy, simple and node dissection | <input type="checkbox"/> |
| Breast-conserving | <input type="checkbox"/> |
| Breast-conserving, then mastectomy | <input type="checkbox"/> |
| No surgery | <input type="checkbox"/> |

13. What kind of adjuvant treatment, if any, did you undergo?

- | | |
|-----------------------------------------------|--------------------------|
| Radiation only | <input type="checkbox"/> |
| Chemotherapy only | <input type="checkbox"/> |
| Hormonal therapy only | <input type="checkbox"/> |
| Radiation and chemotherapy | <input type="checkbox"/> |
| Radiation and hormonal therapy | <input type="checkbox"/> |
| Radiation, chemotherapy, and hormonal therapy | <input type="checkbox"/> |

14. Have you ever been on hormonal therapy?

- | | |
|------------------------------|----------------------------------------------------------------------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No (If no, you do not need to answer the following questions) |
|------------------------------|----------------------------------------------------------------------------------------|

15. If you have ever been on hormonal therapy, please answer the following questions as well:

a. Are you currently on hormonal therapy?

- | | |
|------------------------------|-----------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|------------------------------|-----------------------------|

b. What type of hormonal therapy are/were you on?

- | | |
|------------------------------------------------------|----------------------------------------------|
| <input type="checkbox"/> Estrogen receptor modulator | <input type="checkbox"/> Aromatase inhibitor |
|------------------------------------------------------|----------------------------------------------|

c. How long did your hormonal therapy last?

- | | |
|---------------------------------------------|-------------------------------------------|
| <input type="checkbox"/> Less than one year | <input type="checkbox"/> One year or more |
|---------------------------------------------|-------------------------------------------|

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CURRICULUM VITAE

Jason R. Bentley

Doctoral Candidate (Ph.D.), Rehabilitation Sciences, expected graduation 8/2021, University of Texas Medical Branch, Galveston, TX

- Dissertation title: “Associations Between Implicit Beliefs and Physical Activity Motivation Among Breast Cancer Survivors”

M.S. Physiology, 5/2001, Medical College of Wisconsin, Milwaukee, WI

- Thesis title: “Pulmonary Arterial Dilation by Inhaled NO: Arterial Diameter, NO Concentration Relationship”

B.S. Biomedical Engineering, 5/1996, Milwaukee School of Engineering, Milwaukee, WI

RESEARCH EXPERIENCE

Lecturer, University of Houston – Clear Lake, Houston, TX

Aug

2014 – present

- Provide biomedical engineering expertise for the Health and Human Performance Institute (HHPI).
- Assisted with NASA-funded project evaluating a virtual environment software application for potential use by astronauts aboard the International Space Station.
- Investigated the effect of heart rate variability (HRV) while performing treadmill exercise.

Research Assistant, University of Texas Medical Branch, Galveston, TX

Aug

2017 – present

- National Cancer Institute study “Narrative Visualization for Breast Cancer Survivors’ Physical Activity” (NCT03612596); PI: Elizabeth Lyons, PhD, MPH
- National Institute on Aging study “A Social Media Game to Increase Physical Activity Among Older Adult Women (CHALLENGE)” (NCT04095923); PI: Elizabeth Lyons, PhD, MPH
- Applied for American Heart Association Pre-Doctoral Fellowship, Effect of Implicit Beliefs on Adherence to Physical Activity, August 2019.

Research Associate III, University of Texas Medical Branch, Galveston, TX

Oct

2009 – Jan 2010

- Planning, designing, and executing physiological research studies relating to imaging of reproductive and digestive tracts before and after microbicide interventions.

Scientist/Engineer, Wyle Integrated Science and Engineering, Houston, TX
1999 – Jan 2009

Sept

- Planning, designing, and executing research studies relating to exercise countermeasures for spaceflight induced physiological deconditioning.
- Mentoring student interns in exercise-related research projects.
- Writing test plans; protocols; outlined budgetary requirements; performing data collection, reduction, and analysis; writing and publishing reports for peer-reviewed journals.
- Developing grant proposals and project requirement definitions.

Research Assistant, Medical College of Wisconsin, Milwaukee, WI
1996 – Sept 1999

May

- Planning and executing biomedical research as directed by principal investigators.
- Presenting progress reports, drafting manuscripts, and presenting research at conferences.

TEACHING EXPERIENCE

Lecturer, University of Houston – Clear Lake, Houston, TX
2014 – present

Aug

- Average over 1000 undergraduate Semester Credit Hours (SCH's) annually, one of the highest numbers of SCH production in the College of Human Sciences and Humanities.
- All courses instructed are part of the core curriculum for undergraduates in the Fitness and Human Performance (FHP) program within the Department of Clinical Health and Applied Sciences (CHAS):
 - HLTH-2301 Introduction to Exercise Science (Fall and Spring semesters, 2015-2017)
 - HLTH-3304 Principles of Physical Fitness (Fall, Spring, and 2 Summer semesters, 2014-Present)
 - HLTH-3316 Applied Kinesiology (Fall semesters, 2014-Present)
 - HLTH-4301 Physiology of Exercise (Fall and Spring semesters, 2014-Present)
 - HLTH-4302 Biomechanics (Spring semesters, 2014-Present)
- Developed the HLTH-2301 course to introduce students to exercise science, which became a core course in our program.
- Consistently score between 'High' and 'Very High' on all my course evaluations for overall teaching capability and course quality.
- Consistently rated 'Very Good' or better on my annual review by my department chair for both teaching and research/service.
- Acquire and monitor internships for students enrolled in the FHP program (2014-2015)

Adjunct Instructor, University of Houston – Clear Lake, Houston, TX Aug
2013 – Aug 2014

- Teaching HLTH-4301 Physiology of Exercise and HLTH-3304 Principles of Physical Fitness to undergraduate students.

Adjunct Instructor, College of the Mainland, Texas City, TX Jan
2011 – Dec 2011

- Teaching sophomore-level Anatomy & Physiology to students enrolled in healthcare programs.

Teaching Assistant, Medical College of Wisconsin, Milwaukee, WI May
1996 – Sept 1999

- Teaching the laboratory portion of Human Physiology to first-year medical students.

PROFESSIONAL EXPERIENCE

Exercise Specialist, Fitness Solutions / RPM Sports, Houston, TX Mar
2010 – Aug 2014

- Designing and presenting educational seminars and training plans to competitive cyclists.
- Fitting cyclists to their equipment using a dynamic 3D motion capture system.

HONORS

Awarded the Bohdan Nechay Endowment, University of Texas Medical Branch, 2020

Awarded the Ann and John Hamilton Endowed Scholarship, University of Texas Medical Branch, 2019

Awarded the Charles F. Otis Clinical Research Award, University of Texas Medical Branch, 2017, 2019

Granted U.S. patent for a horizontal exercise apparatus (number 7125370), 2006

Outstanding Achievement Award, Wyle Laboratories, 2004

Space flight Special Achievement Team Award, NASA-Johnson Space Center, 2002

Space flight Special Achievement Individual Award, NASA-Johnson Space Center, 2000

ARTICLES IN PEER-REVIEWED JOURNALS

Bentley JR, Prochaska J, Downer B, Yu X, Karmarkar A, Lyons EJ. (2021). Associations of Implicit Beliefs with Exercise Identity and Motivation Among Breast Cancer Survivors. *Annals of Behavioral Medicine*. Submission in Progress.

Bentley JR, Prochaska J, Downer B, Yu X, Karmarkar A, Lyons EJ. (2021). Acceptability of Narrative Visualization with Physical Activity Monitoring Among Breast Cancer Survivors. *Supportive Care in Cancer*. Under Peer Review.

Bentley JR, Amonette WE, De Witt JK, Hagan RD. Effects of different lifting cadences on ground reaction forces during the squat exercise. *J Strength Cond Res*. 2010 May;24(5):1414-20.

Bentley J, Rickaby D, Haworth ST, Hanger CC, Dawson CA. Pulmonary arterial dilation by inhaled NO: arterial diameter, NO concentration relationship. *J Appl Physiol*. 2001 Nov;91(5):1948-54.

Spiering BA, Lee SMC, Mulavara AP, **Bentley JR**, Buxton RE, Lawrence EL, Sinka J, Williams ME, Ploutz-Snyder LL, Bloomberg JJ. Test battery designed to quickly and safely assess diverse indices of neuromuscular function after unweighting. *J Strength Cond Res*. 2011 Feb;25(2):545-55.

Schneider SM, Amonette WE, Blazine K, **Bentley J**, Lee SM, Loehr JA, Moore AD Jr, Rapley M, Mulder ER, Smith SM. Training with the International Space Station interim resistive exercise device. *Med Sci Sports Exerc*. 2003 Nov;35(11):1935-45.

ARTICLES IN PEER-REVIEWED GOVERNMENT PUBLICATIONS

Bentley JR et al. (2006). Advanced Resistive Exercise Device (ARED) Man-In-The-Loop Test (MILT). NASA Technical Report TP-2006-213717.

Amonette WE, **Bentley JR** et al. (2009). Evaluation of the Horizontal Exercise Fixture in Conjunction with the Interim Resistive Exercise Device (iRED) for use in Bed Rest Research. NASA Technical Publication JSC-CN-18762.

Schaffner G and **Bentley J** (2008). Determining Exercise Strength Requirements for Astronaut Critical Mission Tasks: Reaching Under G-Load. NASA Technical Report TP-2008-0012559.

Norcross J, **Bentley JR** et al. (2007). Comparison of the US and Russian Cycle Ergometers. NASA Technical Report TP- 2007-214760.

De Witt JK, Perusek GP, **Bentley JR** et al. (2008). Kinematic and electromyographical evaluation of locomotion on the enhanced zero-gravity locomotion simulator: A comparison of external loading mechanisms. NASA Technical Report TM-2007-214751.

De Witt JK, **Bentley JR** et al. (2007). Locomotion kinematics in microgravity. C-9 and Other Microgravity Simulations Summary Report, NASA Technical Report TM-2007-21476, 76-83.

De Witt JK, **Bentley JR** et al. (2007). Evaluation of the effectiveness of overhead suspension reduced-gravity analogs in a microgravity environment. C-9 and Other Microgravity Simulations Summary Report, NASA Technical Report TM-2006-213727, 161-171.

De Witt JK, Schaffner G, **Bentley JR** et al. (2006). Biomechanical evaluation of locomotion on the Russian BD-1 treadmill in a weightless environment (KC-135). NASA Technical Report TM-2006-213718.

Schaffner G, De Witt JK, **Bentley JR** et al. (2005). Effect of load levels of subject loading device on gait, ground reaction force, and kinematics during human treadmill locomotion in a weightless environment. NASA Technical Report TM-2005-213169.

Amonette WE, **Bentley JR** et al. (2004). Evaluation of the international space station resistive exercise device using the modified Schwinn Flexpack with human subjects. NASA Technical Report TM-2004-212071.

Amonette WE, **Bentley JR** et al. Ground Reaction Force and Mechanical Differences Between the Interim Resistive Exercise Device (iRED) and Smith Machine While Performing a Squat. NASA TP-2004-212063.

Moore AD, Amonette WE, **Bentley JR** et al. International Space Station Interim Resistance Exercise Device Man in the Loop Test Results. NASA TP-2004-212062.

SELECTED ABSTRACTS

Bentley JR, Schroeder A, Baumbach L, Lyons EJ. (2019). Acceptability of Narrative Visualization Techniques Along with Monitoring Physical Activity Data Among Breast Cancer Survivors. Presented virtually at the 2020 Society of Behavioral Medicine Annual Meeting, San Francisco, CA.

Bentley JR, Lewis ZH, Swartz MC, Lyons EJ. (2019). Acceptability of a Walking Intervention Among Inactive Adults Using a Smartphone-Based Gaming Application. Presented at the 2019 American College of Sports Medicine Annual Meeting, Orlando, FL.

Bentley JR, Lewis ZH, Swartz MC, Lyons EJ. (2018). Wearable Electronic Activity Monitors Produced Greater Self-Regulation and Psychological Need Satisfaction Than Pedometers in a Randomized Trial. Presented at the 2018 American Society of Preventive Oncology Annual Meeting, New York, NY.

Bentley JR, Amonette WE, English KL, Hansen A, Patrick R, Keener K, Fullmer P, Barrera J, Arcemant D, Perera J. (2017). Feasibility of an intense daily treadmill protocol to assess a virtual environment software application. Presented at the 2017 National Strength and Conditioning Association Annual Meeting, Las Vegas, NV.

Bentley JR, Loehr JA, De Witt JK, Lee SMC, English KL, Nash RE, Leach MA, Hagan RD. (2008). Correlation of ground reaction force variables with peak vertical jump height. Presented at the 2008 National Strength and Conditioning Association Annual Meeting, Las Vegas, NV.

Bentley JR, Amonette WE, De Witt JK, Garcia Y, Twine CA, Casperson S, Hagan RD. (2005). Measurement of power output during leg press using a linear encoder and customized software program. Presented at the 2005 National Strength and Conditioning Association Annual Meeting, Atlanta, GA.

Bentley JR, Amonette WE, De Witt JK et al. (2003). Total inertial force and peak power cannot be accurately calculated from bar motion during a loaded squat. Presented at the 2003 National Strength and Conditioning Association Annual Meeting, Indianapolis, IN.

Loehr JA, Lee SMC, English KL, Leach MA, **Bentley J** et al. (2008). 16 weeks of training with the International Space Station advanced Resistive Exercise Device (aRED) is not different than training with free weights. Presented at the 2008 National Strength and Conditioning Association Annual Meeting, Las Vegas, NV.

De Witt JK, **Bentley JR** et al. (2006). Kinematic Differences Between Motorized and Nonmotorized Treadmill Locomotion. Presented at the 2006 Annual Meeting of the American Society of Biomechanics, Blacksburg, VA.

De Witt JK, **Bentley JR** et al. (2005). The Effect of Speed upon Ground Reaction Forces During Locomotion in Weightlessness. Presented at the International Society of Biomechanics XXth Congress, Cleveland OH.

Casperson S, Amonette WE, **Bentley JR** et al. (2005). Accuracy of a commercial linear encoder system to predict leg press 1-RM and measure mechanical power. Presented at the 2005 National Strength and Conditioning Association Annual Meeting, Atlanta, GA.

Schaffner, G, De Witt JK, **Bentley JR** et al. (2004). Effect of bungee loading on ground reaction force during treadmill locomotion in weightlessness. Presented at the 75th Annual Scientific Meeting of the Aerospace Medical Association, Anchorage, Alaska.

Rudner LJ, Amonette WE, **Bentley JR** et al. (2003). Squat exercise load affects bar trajectory. Presented at the Texas American College of Sports Medicine Annual Meeting, Houston, TX.

Amonette WE, **Bentley JR** et al. (2002). Cadence affects on ground reaction forces during a squat. Presented at the Second International Conference on Weightlifting and Strength Training, Budapest, Hungary.

MEMBERSHIP IN SCIENTIFIC SOCIETIES/PROFESSIONAL ORGANIZATIONS:

Certified Strength & Conditioning Specialist (CSCS), National Strength and Conditioning Association (NSCA)

Member of the American College of Sports Medicine (ACSM)

USA Cycling Level III Coach

USA Weightlifting Club Coach

USA Track and Field Level I Coach

PROFESSIONAL SERVICE

Journal Reviewer for the Journal of Strength and Conditioning Research (JSCR); submitted 29 reviews since 2013