The Role of Executive Functioning on the Intention-Behavior Relationship of Health Behaviors: A Temporal Self-Regulatory Perspective

by

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Abstract

A variety of theories have been used to develop interventions designed to improve health behaviors in college students; however, many people who intend to engage in healthy behaviors still fall short of their goals. While clarifying the relationship between intention and actual behavior has been challenging for researchers, the Temporal Self-Regulation model (TST) has demonstrated promise with its ability to predict health behavior. The TST incorporates a self-regulatory model which has been represented in previous research by varying measures of executive functioning (EF). The current study employed the TST to determine if EF and prepotent behavior moderate the relationship between intention and health behaviors (i.e., safe driving, physical activity, and healthy eating). To address limitations in the previous research, an ecologically valid rating scale of EF and other multi-item assessment measures were used across health behaviors. Consistent with previous research, a link between intent and follow-up behavior was established and EF and prepotent behaviors were positively associated with follow-up behavior. EF had no unique moderation effects on health behaviors, but combinations of different levels of prepotent behavior and EF were able to demonstrate moderation for physical activity and healthy eating. This study demonstrated the utility of the TST in predicting health behavior and emphasized the mutual necessity of EF and prepotent behavior in understanding the intention-behavior relationship. Limitations and future directions for research were discussed.

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List of Abbreviations

ADHD	Attention Deficit/Hyperactivity Disorder
DBS	Driving Behavior Survey
EF	Executive Functioning
IPAQ	International Physical Activity Questionnaire
MET	Metabolic Equivalent
PFC	Prefrontal Cortex
TST	Temporal Self-Regulation Theory

The Role of Executive Functioning on the Intention-Behavior Relationship of Health Behaviors: A Temporal Self-Regulatory Perspective

There is a pressing need to improve health behaviors in the United States. While a variety of interventions and theories have been used to address this challenge, many people who intend to engage in healthy behaviors still fall short of their goals. In fact, a frequently acknowledged problem in the health behavior literature is that we have not been able to determine why some people complete their intended health behaviors, while others with the same knowledge, means, and intentions fail to engage in them. This problem has fueled investigation into how we conceptualize health behavior and the factors that assist us in completing our intended behaviors.

While health-risk behaviors occur at all ages, many adult health behaviors are established by late adolescence (US Department of Health and Human Services, 2010). This pattern is ever present in college students, who engage in a variety of behaviors that put them at risk for serious health problems (Hoban and Leino, 2006). For example, they typically exhibit a distinct decline in nutritional priorities and do not meet dietary guidelines (Freedman, 2010; Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008). These findings are concerning, especially in light of the health-protective benefits of good nutrition. For example, consuming fruits and vegetables can prolong health and well-being (Joung, Kim, Yuan, & Huffman, 2011), is protective against weight gain (Boeing et al., 2012; Kromhout, Bloemberg, Seidell, Nissinen, & Menotti, 2001), and may decrease the risk of various cancers (Gundgaard, Nielsen, Olsen, & Sorensen, 2003; Jansen et al., 2013). Similarly, engaging in physical activity can be considered a health-protective behavior given its physical and psychological benefits (Penedo & Dahn, 2005). Unfortunately, a national NHIS survey found that in 18-24 year olds, less than 40% meet the 2010 Healthy People guidelines for physical activity (Carlson, Fulton, Schoenborn, & Loustalot, 2010). Young adults aged 16-19 are also at the highest risk for motor vehicle crashes among any age group, and are three times more likely than older drivers to be involved in a fatal wreck (Centers for Disease Control and Prevention, 2013a; Insurance Institute for Highway Safety, 2013).

While many college students understand the risks and benefits of these health behaviors and intend to engage in health-protective behaviors, they fail to do so and continue their maladaptive patterns. In fact, bridging the gap between intention and actual behavior is a problem that researchers and clinicians have struggled to solve (Rhodes & Dickau, 2012). Several well-researched models of health behavior change fail to account for the fact that even in individuals with the same attitudes, self-efficacy, or motivation to engage in health behaviors, some complete the behavior while others do not (Adams & White, 2005; Clark & Janevic, 2014). Findings from emerging research suggest that self-regulatory abilities that are necessary to engage in goal-directed behaviors may help to explain the lack of behavioral change. Specifically, a recent meta-analysis concluded that contemporary research exploring constructs that are able to augment intention, such as self-regulation, seemed warranted and may assist in bridging the intention – behavior gap (Rhodes & Bruijn, 2013). The purpose of the current study was to shed light on the relationship between intention and actual behavior in undergraduate students through the use of a self-regulatory model of health behavior.

Self-Regulation and Executive Functioning

The concept of executive functioning (EF) has evolved over the past 50 years and has become one of the most common terms in the neuropsychological literature, with literally dozens of associated functions (Barkley, 2011). For example, initially, EF was conceptualized by four abilities (goal formation, planning, carrying out goal-directed plans, and effective performance) that enable a person to engage successfully in independent, purposive, self-serving behavior (Lezak, 1995). More recently, EF has been described as a multifaceted construct of higher-order cognitive processes involved in reasoning, problem solving, planning, organization, and successful execution of goal directed behavior (Suchy, 2009). Gioia and colleagues (2000) refer to the various set of EF-related capacities as serving as regulatory or management function. Self-regulation, or self-control, is “any response or chain of responses by the individual which serve to alter the probability of their subsequent response to an event and, in doing so, function to alter the probability of a later consequence related to that event” (Barkley, 1997, p. 51). Explicating a theory of EF, Barkley (2011) specified that “(1) EF is self-regulation directed toward the future; (2) that self-regulation is a set of self-directed actions… used by the individual to change his or her subsequent behavior so as to alter the likelihood of some future outcome (attain some goal)” (p. 10) and these self-directed activities include: self-inhibition and interference control, self-awareness over time (hindsight, foresight), working memory, self-planning and problem-solving, and self-monitoring/shifting. EF, therefore, may play a significant role in explaining the intention-behavior gap in the framework of a self-regulatory model of behavior change.

Difficulties Engaging in Health Behavior

An individual’s ability to consistently inhibit health-risk behavior and engage in health-protective behaviors poses considerable challenges for many adults (Hall, Fong, Epp, & Elias, 2008). To engage in a health-protective behavior, individuals must be able to undertake and maintain certain required steps and actions. Although people typically know the proper steps to engage in healthy behaviors and their subsequent benefits, adherence to health-protective behaviors is problematic (Allen & Morey, 2010; Yancy & Voils, 2010). Not undertaking the steps to engage in health-protective behaviors may partly be explained by how immediately reinforcing they are perceived.

A common finding is that individuals tend to engage in behaviors which they feel will have immediate reinforcement value, regardless of negative long-term consequences (Story, Vlaev, Seymour, Darzi, & Dolan, 2014; Zimbardo & Boyd, 1999). Even in situations in which a delayed reward is greater than a more immediate reward, people will often choose a smaller reward that they can immediately access (Loewenstein & Thaler, 1989, McAuley, 2013). Many health-protective behaviors can be perceived as being inconvenient, discomforting, or embarrassing (Fong & Hall, 2003; Stankov, Olds, & Cargo, 2012). Not only might these behaviors be immediately punishing, many health-protective behaviors do not have immediate benefits to counter the negative attributes (Chapman & Coups, 1999; Lo, Smith, Taylor, Good, & von Wagner, 2012). Therefore, for an individual to engage in these health-protective behaviors, one must be able to consider that a larger reward will be gained later, and possess the ability to generate a plan and consciously take steps toward achieving this reward.

For example, to engage in physical activity, individuals face competing demands and environmental obstacles that limit the time and vigor necessary to be physically active (Addy et al., 2004; Salmon, Owen, Crawford, Bauman, & Sallis, 2003). In these moments, the perceived barriers to exercise may be more salient than the long-term benefit of physical or psychological health. The individual may then decide to engage in an immediately reinforcing health-risk behavior such as sedentary behavior. These same temporal considerations are relevant to health-risk behaviors. Although there are long-term detriments associated with unhealthy eating, many people engage in such eating given immediate benefits such as inexpensive cost, ease of accessibility and preparation, and good taste (Glanz, Basil, Maibach, Goldberg, & Snyder, 1998;

Nicklas et al., 2013). In both of these health-protective and health-risk scenarios, the immediately reinforcing behavior is commonly perceived as ideal, whether it is detrimental to one's health or not.

While there are perceived costs of health-protective behaviors and immediate rewards for health-risk behaviors, we know that people engage in healthy behaviors and avoid health-risks every day. In order to inhibit immediately rewarding health-risk behaviors, individuals may be attending to the long-term health contingencies, which motivate them to engage in health-protective behaviors that will be rewarding in the future. To stay motivated and consistently perform these health-protective behaviors, individuals must have active and effortful self-regulation, which allows them to avoid the immediate rewards of health-risk behaviors (Hall & Fong, 2007). One theory that may explain our responsiveness to contingencies and individual differences in health-protective and health-risk behavior according to short- and long-term contingencies is the Temporal Self-Regulation Theory (TST).

Temporal Self-Regulation Theory in Explaining Health Behaviors

The TST acknowledges that temporal factors influence motivation to engage in health behaviors, and might, therefore, help to bridge the intention-behavior gap. Consistent with this notion, studies applying the TST have demonstrated its use in the prediction of healthy lifestyle behaviors, explaining significant amounts of variance in health-protective behavior (Booker & Mullan, 2013; Hall et al., 2008). The TST posits that our ability to engage in a specific behavior emerges from three factors: 1) intention- the behaviors with which we intend to engage, 2) behavioral prepotency- our automatic responses that take precedence over potential reflexes and responses, and 3) self-regulatory capacity (Barkley, 1997; Hall & Fong, 2007; see Figure 1). These factors are developed through complex combinations of biological, cognitive, and social factors that form contingencies and our expected outcomes (Hall & Fong, 2007). Our temporal values and beliefs about these contingencies then structure our intention to engage in a behavior. The strength of intention is then moderated by our behavioral prepotency and self-regulatory capacity. The interaction of these factors is crucial in understanding future behavior.

Intention. Although intention is a longstanding construct used in health behavior models including the TST, there is limited research examining the role of intention and EF in the TST framework. Using the TST model, one study found that individual differences in EF moderated the association between behavioral intention in both physical activity and dietary behavior (Hall et al., 2008). Other studies have examined the relationship between intention and EF without this model of behavior change. One study examining healthy eating reported that individuals with weak EF ate less fruits/vegetables than they intended, and EF accounted for additional variance in unintentional eating of snacks (Allan, Johnston, & Campbell, 2011). A similar study observing breakfast consumption found that planning, a component of EF, accounted for variance additional to intention (Wong & Mullan, 2009). Contrary to these findings, in a study of binge-drinking, intention was predictive of drinking behavior, while EF did not account for additional variance (Mullan, Wong, Allom, & Pack, 2011).

Behavioral Prepotency. Prepotent responses are often attributed to internal cues such as hunger or thirst, environmental cues that may automatically elicit behavior, or past behavior (Hall & Fong, 2007). In terms of health-risk behavior, sedentary behavior or other behaviors that give immediate reward and no immediate discomfort may represent these prepotent responses. Unless these behavioral tendencies are resisted with persistent effort, they are likely to occur automatically. Consistent with this idea, MRI studies have demonstrated greater prefrontal cortex activation when participants engaged in non-prepotent responses, suggesting a higher level of cognitive effort when abstaining from prepotent responses (Barber & Carter, 2005; Ovaysikia, Tahir, Chan, & DeSouza, 2011). In the TST model, previous behavior is typically used as an objective operationalization of a prepotent response, based on other research which has shown that past behavior is predictive of future behaviors and can become an automatic process, especially in contexts where the behavior is repeatedly practiced (Gardner, de Bruijn, & Lally, 2011; Ouellette & Wood, 1998). To restrain prepotent responses and translate intention into behavior, a strong self-regulatory capacity may be necessary.

Self-regulation. The regulation of one's own behavior is one of the core difficulties with engaging in future-oriented health-protective behaviors, because it requires resisting prepotent responses that would elicit an immediately reinforcing health-risk behavior. Unfortunately, there appears to be a physical limit to one's self-regulation of prepotent responses that is subject to energy depletion (Maranges, Schmeichel, & Baumeister, 2016; Muraven & Baumeister, 2000; Muraven, Tice, & Baumeister, 1998). That is, continued effort to restrain prepotent responses (such as maintenance of healthy behaviors while resisting unhealthy behaviors) demands energy that may be dependent upon one's self-regulatory, or EF, capacity. Consequently, EF is a construct that may help us understand why some individuals are not able to engage in the health-protective behaviors they intend, and why some individuals are more susceptible to engage in health-risk behaviors.

Executive Functioning and Driving Behavior

Driving is a complex goal directed task that involves a variety of cognitive control functions. Specifically, one must be able to have self-regulatory control to shift between activities essential for safe driving such as monitoring and adjusting speed, detecting meaningful information in the driving environment, and responding to sensory information (Anstey, Wood, Lord, Walker, 2005). Research has demonstrated the importance of EF in relation to safe driving. One such study found that adults over 65 years of age with a history of car crashes had significantly worse EF scores on tasks of inhibition and shifting than those with no crashes (Daigneault, Joly, & Frigon, 2002). Similarly, EF was found to be negatively correlated with simulated and on-road driving performance in studies of adults 60 years old and above (Adrian, Postal, Moessinger, Rascle, & Charles, 2011; Alosco, Spitznagel, Cleveland, & Gunstad, 2013). This study found significant relations between driving performance and tasks of shifting and updating, but not inhibition. In studies of adolescents and young adults using a driving simulator, lower scores on tasks of inhibiting, updating, and shifting were associated with greater numbers of driving errors (Mantyla, Karlssen, & Marklund, 2009; Ross et al., 2015). While the aforementioned studies were primarily conducted outside of the United States, studies of American drivers demonstrated that in young adults, EF was negatively related to accident frequency and traffic violations (Barkley, Murphy, DuPaul & Bush, 2002; Pope, Ross, & Stavrinos, 2016). These findings suggest that drivers with lower EF may be at a higher risk for driving accidents and reduced driving safety.

Executive Functioning and Physical Activity

As research has begun to examine why there are not higher rates of physical activity, there has been growing evidence that some individuals may have difficulty engaging in this health behavior due to poor EF. The link between EF and exercise has been demonstrated in several EF components such as task switching, set shifting, selective attention, and inhibitory control. However, research in this area is very limited, and some of our understanding of the relationship between EF and physical activity must be inferred from studies of older adults. In studies examining both younger and older adults, increased physical activity has been associated with shorter latencies and improved error detection during task switching (Hillman, Kramer, Belopolsky, & Smith, 2006; Themanson, Hillman & Curtain, 2006). Positive associations were also found between EF and exercise when measuring task switching and set shifting in adults 55 and older (Albinet, Boucard, Bouquet, & Audiffren, 2010; Barnes, Yaffe, Satariano, & Tager, 2003). Two studies examining older adults age 60-79 determined that higher aerobic fitness was associated with decreased interference and response accuracy on a task of selective attention, even five to ten months later (Prakash et al., 2011; Smiley-Oyen et al., 2008).

Multiple approaches have been employed to operationalize the inhibitory control component of EF. While results have been mixed, research suggests that in healthy adults, higher levels of physical activity associated with better attentional control and higher accuracy rates on flanker tasks (Colcombe et al., 2004). In addition, in a sample of adults aged 60-75 years old, those enrolled in an aerobic exercise group showed significantly greater reaction time in inhibitory control after six months than those in a control group (Kramer et al., 2001). Conversely, a similar study using a 10-month intervention found no improvement (Smily-Oyen et al., 2008).

The findings from this research suggest that intact EF skills may assist people in engaging regularly in physical activity. However, this line of research lacks studies involving college-aged students, who may be at higher risk for decreasing their levels of physical activity and forming sedentary habits.

Executive Functioning and Eating Behaviors

Few studies have examined the associations between fruit and vegetable consumption and EF. In one study of young adults, EF and behavioral intention both predicted fruit and vegetable consumption (Hall et al., 2008). The authors concluded that individual differences in

EF predicted more variance than behavioral intention and moderated the relationship between intention and fruit and vegetable consumption. Other studies have assessed healthy eating in young adults, using saturated fat intake and fruit and vegetable consumption as outcome variables. While these studies found inhibitory control to be predictive of saturated fat intake, one used the Behavior Rating Inventory of Executive Functioning (BRIEF) self-report measure, while the other utilized objective laboratory-based tasks (Allom & Mullan, 2014, Limbers & Young, 2015). In these same studies, fruit and vegetable consumption was also predicted by EF, albeit different components: the Initiation subscale of the BRIEF (Limbers & Young, 2015) and updating (Allom &Mullan, 2014). These findings highlight the inconsistencies in how EF has been measured in the EF literature, and subsequently led to diverse findings.

Similar results have been found in a sample of fourth grade children. In this study, parent ratings of EF were correlated with less snack food intake and greater fruit and vegetable intake (Riggs, Chou, Spruijt-Metz, & Pentz, 2010). At a four month follow-up, EF still predicted greater fruit and vegetable consumption, but not snack food intake. Cross-sectional research has also examined the relationship between eating patterns and EF. In a study of 14-21 year olds, weaker abilities in selective attention and inhibiting responses was associated with difficulty inhibiting responses to eating (Maayan, Hoogendoorn, Sweat, & Convit, 2011). These results are consistent with the framework of the TST, suggesting that strong self-regulatory control may be needed to engage in healthy eating.

The Current Study

There are several limitations in the current literature that merit future research. First, many of the studies examining health behaviors and EF that use elements of the TST have been conducted outside of the United States. Different economic structures and cultural norms in other countries may affect one's opinions of health behaviors and their likelihood to engage in them, thereby limiting generalizability to American samples. Further, few studies investigating the relationship between health behaviors and EF include college students. College enrollment is a period marked by important transitions such as leaving home and increased autonomy in decision-making. During this transition, individuals may begin to establish lifestyle choices towards health-protective and health-risk behaviors (Nelson et al., 2008). Furthermore, the prefrontal cortex PFC, which is involved in EF and goal-directed behavior, does not fully develop until about half way through the second decade of an individual's life (Sowell, Thompson, Holmes, Jernigan, & Toga, 1999). In light of this transition and the association between PFC and self-regulatory behavior, college students would seem to be more prone to health-risk behaviors.

While there are many studies that have examined the relationship between health behaviors and EF, there has been little consistency in how the latter has been measured. Studies have focused on different aspects of EF and have assessed it through a wide range of laboratory-based tasks. The inconsistency with which EF has been measured makes it difficult to integrate findings, especially across different health behaviors. There are also concerns with the use of laboratory tasks to measure EF. For instance, these laboratory tasks were not originally developed to assess specific domains of EF (Burgess et al., 2006) and may hold low ecological validity (Barkley & Fischer, 2011; Chaytor, Schmitter-Edgecombe, & Burr, 2006).

To understand EF deficits in daily goal directed behaviors, researchers have proposed the use of rating scales. Rating scales have many advantages such as the ability to gather information about daily life without intruding into an individual's personal life with direct observations, use multiple but internally consistent items to examine a specific domain, and gather information on actual behaviors across a variety of settings and circumstances that may be impossible to duplicate in a laboratory task (Barkley, 2011). There is a growing body of literature supporting the use of rating scales as an ecologically valid alternative for assessing EF and distinguishing between clinical and non-clinical groups (e.g., Barkley & Murphy, 2011; Biederman et al., 2007; Toplak et al., 2009). Further, rating scales of EF have performed better at predicting psychosocial functioning than laboratory-based tests (Barkley & Murphy, 2011). Using a rating scale of EF, therefore, may prove more advantageous to capture behaviors in daily life and psychosocial functioning.

To broaden our understanding of the role of EF in health behaviors and help bridge the gap between intent and behavior, this study examines multiple health behaviors in the context of the Temporal Self-Regulation Theory. The current study uses an empirically-derived self-report measure of EF whose dimensions reflect contemporary theories of EF and has been shown to relate to impairment in psychosocial functioning. This study also attempts to add to the current literature by investigating health behaviors relevant to American college students. In this study, health-protective behaviors will be defined as engaging in physical activity, healthy eating, and safe driving. It was hypothesized that:

H1: Greater deficits in EF are negatively associated with frequencies of health-protective behaviors.

H2: The relationship between intention and actual health behaviors is moderated by EF and prepotent behavior, such that as EF scores decrease and prepotent behavior increases (improves), the relationship between intention and health behavior is stronger.

Method

Participants and Procedure

Participants were undergraduate students enrolled in psychology courses at a public university in the Southeastern United States. Students were recruited via SONA-Systems, a cloud-based participant management software used at universities to integrate research administration processes online. Students who were interested in participating were able to read a description of the study on SONA-Systems and decide if they wanted to participate in the online survey sessions. Students between the ages of 18 and 25 years old were eligible for participation. Exclusionary criteria for data analyses included the participants' self-reported presence of medical conditions, injuries, or disabilities that restrict their dietary consumption or prevent them from engaging in physical activity or driving. Prior to initiating data collection, all research activities were approved by the university's Institutional Review Board (IRB).

After reading the study description on SONA-Systems, interested students were directed to the Qualtrics website (a private research software company used for online data collection). After consenting, students completed online survey measures. These measures assessed EF and participants' health behaviors over the past week and intentions for health behaviors over the upcoming week. This will be referenced as Time 1 data. Students were given 48 hours to complete these measures after beginning the study in Qualtrics. One week after students completed this survey, they completed a second round of surveys, referenced as Time 2. Time 2 surveys again assessed participants' health behaviors over the past week to determine how their actual behavior compared to their intended behavior. This time frame has been demonstrated to yield reliable and valid results involving recall for multiple health behaviors including diet and physical activity (Bennett, Amtmann, Diehr, & Patrick, 2012; Helmerhorst, Brage, Warren, Besson, & Ekelund, 2012; Milton, Bull & Bauman, 2011). To improve participant response rates and decrease attrition, course credit was given to participants completing Time 1 data, and bonus course credit was given to those participants who also completed data at Time 2 within the aforementioned time frame. Course credit was delivered to participants automatically through SONA-systems. Participants who did not complete Time 2 data were not used in data analyses.

Measures

Demographics. Students were asked to provide information pertaining to their age, gender, race/ethnicity, and education level.

Measuring Prepotent Behavior. Consistent with the TST, prepotent behavior was operationalized by previous behavior (Hall & Fong, 2007). At Time 1, participants completed measures assessing their physical activity, eating, and driving habits over the past seven days.

Driving Behavior. To assess risky driving behavior, participants completed The Driving Behavior Survey (DBS) Self-Report Form (Barkley et al., 2002). The DBS is a 26-item measure that assesses potential risk for traffic accidents and citations by having participants rate items on a four-point Likert scale. Items are summed to provide a total score of risk in which higher scores indicate a greater frequency of safe driving behaviors. This scale has demonstrated good internal consistency ($\alpha = .81$; Barkley et al., 2002), and has been significantly associated with number of past traffic citations received and number of motor vehicle crashes by participants (Barkley et al., 2002; Barkley, Guevremont, Anastopoulos, DuPaul, & Shelton, 1993; Knouse, Bagwell, & Barkley, 2005). Internal consistency for the current sample was good to excellent (prepotent $\alpha = .87$; intended $\alpha = .95$; follow-up $\alpha = .91$) and commensurate with previous findings.

Physical Activity. To assess physical activity, students completed the International Physical Activity Questionnaire (IPAQ) short form (Craig, et al., 2003). The IPAQ short form is a 7-item questionnaire assessing physical activity at varying levels of intensity and duration to give a summation of total physical activity. The short form of this measure has demonstrated appropriate test-retest reliability using a seven day interval and concurrent validity with the long form (Craig et al., 2003). Data demonstrating reliability and validity were gathered through a worldwide data collection effort involving 12 countries and men and women age 18-55 years. Consistent with the established use of the IPAQ, scores were treated as both a continuous variable and categorical variable, expressed in metabolic equivalents (METS). Regarding the latter, METS was categorized into Low (0-599 METS), Moderate (600-3000 METS), and High levels of physical activity (3000+ METS), as recommended by the IPAQ's guidelines for data processing and analysis (IPAQ, 2005).

Healthy Eating. Healthy eating was assessed using the National Cancer Institute's All-Day Screener (Thompson & Byers, 1994). This measure computes the frequency and daily serving size of fruits and vegetables that one consumes over the previous month, to generate a total score of healthy eating. This 16-item measure has displayed acceptable reliability and validity, and demonstrated fruit and vegetable recall that was not significantly different from 24-hour recall, which is considered the gold standard for measuring fruit and vegetable consumption (Yaroch et al., 2012). To standardize the length between the measures used in this study and improve recall ability, the items in the All-Day Screener were modified to assess eating behavior over the past seven days rather than past month. This study used this modified seven day measure to balance valid recall with efficiency. The seven day period is frequently used in research involving fruit and vegetable consumption recording, has yielded similar results to 24-hour recalls, and has been shown to be representative of actual fruit and vegetable consumption (Day, Hoelscher, Eastham, & Koers, 2008; Eck et al., 1991; Eck, Klesges, Klesges, 1996). Some research has also reported that over a month period, food intake does not significantly change from one week to another, suggesting there is no real advantage of collecting food intake beyond one week (St Jeor, Guthrie, & Jones, 1983).

Measuring Intent. Behavioral intent was measured by adapting the existing questions for past behavior. During Time 1 data collection, questions were modified to ask the subjects how often they intend to engage in health behaviors over the next seven days rather than their behavior during the past seven days. For example, the IPAQ question "*During the last 7 days, on how many days did you do vigorous-physical activities like heavy lifting, digging, aerobics, or fast bicycling?*" was adapted to read "*During the next 7 days, how many days do you intend to do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?*" A full list of questions measuring intent can be found in Appendix C.

Measuring Follow-Up Behavior. Follow-up was measured at Time 2, one week after Time 1. The questions used for measuring follow-up behavior were identical to those used in measuring prepotent behavior to maintain consistency in responding (see Appendix B).

Executive Functioning. The Barkley Deficits in Executive Functioning Scale (BDEFS) was normed using an adult sample representative of the demographics of the United States in the 2000 U.S. Census. This rating scale has demonstrated satisfactory internal consistency, test-retest reliability, and validity (construct, discriminant, criterion, content; Barkley, 2011). Eighty-nine items, using a Likert scale response format, assess the respondent's experience of problems during the past six months. The BDEFS elicits five subscale scores (e.g., Self-Management to Time, Self-Organization/Problem Solving, Self-Restraining, Self-Motivation, & Self-Regulation of Emotion) as well as a Total EF Summary Score. Higher scores indicate higher levels of dysfunction. Cronbach's alphas were calculated for the BDEFS ($\alpha = .98$) and demonstrated excellent internal consistency, commensurate with previous findings (Barkley, 2011). Consistent with previously published research examining the contributions of EF on outcomes, raw scores were used in all analyses.

Validity Check. To help increase the likelihood of using valid self-report data in this study, three strategies were used. First, three validity questions were dispersed within the BDEFS and DBS. Incorrect answers on these questions suggested invalid survey response patterns (e.g., “I have never brushed my teeth”). Second at the end of the two parts of the study, an honesty question was presented. Students were informed that their answer to the honesty question would not affect their participation or credit, and was only meant for the researcher to know if the data should be used. This question asked participants if their responses were accurate throughout the entire study, only accurate in the first or second half, or inaccurate throughout. Survey responses that were affirmed as accurate throughout the entire study were examined or excluded in conjunction with the three validity questions. Lastly, endorsements of extreme responses were excluded from the study. Extreme responses were defined as scores on any measure that were three standard deviations greater or less than the sample mean.

Data Analytic Strategy

All analyses were conducted using the *Statistical Package for the Social Sciences (SPSS), Version 23* (IBM Corp, 2014). Descriptive statistics were used to characterize the study sample and to identify violations of statistical assumptions. To establish the link between intent and follow-up behavior, bivariate correlations were conducted between these two variables for each health behavior. To test Hypothesis 1, bivariate correlations were also conducted between the total score of the BDEFS and the frequencies for each health behavior.

Hierarchical multiple regressions were conducted to test Hypothesis 2, and to determine the moderation effect of EF and prepotent behavior on the relationship between intent and follow-up behavior. In these analyses, demographic variables (e.g., sex, age, race) were entered into Block 1 and EF and intent were placed in Block 2. The interaction term between intent and EF was then placed in Block 3. A significant interaction term in Block 3 is indicative of a moderation effect. These same analyses were also conducted to determine the moderation effect of prepotent behavior, with prepotent behavior replacing EF in Block 2 of the regressions. Exploratory analyses were conducted using subscales of the BDEFS to represent EF in Block 2 of hierarchical multiple regressions. Only subscales that demonstrated significant correlations with health behaviors were used for these analyses.

In accordance with the scoring of the IPAQ, physical activity was also examined as a categorical variable. To analyze categorical levels of physical activity, Spearman rank-order correlations and Multinomial Logistic Regressions were conducted. Specifically, these regressions were used to determine the impact of EF and prepotent behavior on the likelihood of which level of follow-up physical activity participants would report.

In addition to Hierarchical Multiple Regressions, the SPSS PROCESS macro (Hayes, 2013) was conducted to extend our understanding of the moderating relationships in the TST model (Hypothesis 2; see Figure 2). Similar to Hierarchical Multiple Regression, PROCESS used multiple regression analyses, with the addition of nonparametric bootstrap procedures, to give an overall fit of the TST model on the data. While giving corresponding information about which variables or interactions predicted follow-up behavior, and if there was a moderating effect, PROCESS also generated slopes for the moderating effects of each combination of high, medium, and low EF and prepotent behavior for each health behavior. For each of the models conducted in PROCESS, the respective health behavior was used as the dependent variable, intention as the independent variable, and EF and prepotent behaviors as moderators, while statistically controlling for age, race and sex.

Results

Demographics

Of the approximately 434 students who completed the first part of the study, 260 students returned after one week to complete the follow-up portion. No significant or meaningful group differences in demographics or study variables were found between students who completed only Time 1 of the study and those who completed both parts of the study for any of the health behaviors or executive functioning.

Although 260 students participated in both parts of the study, 26 surveys could not be used because participants did not use a codename or used a codename that did not match in both surveys, and 14 surveys were removed from analysis due to invalid responding (see Measures), leaving 220 participants. Age of the 220 students who completed both parts of the study ranged from 18 - 25 years ($M = 19.37$, $SD = 1.4$). Approximately 50.9% identified themselves as freshmen, 26.4% as sophomores, 8.2% as juniors, 14.5% of participants as seniors, and 83.2% as female. The majority of students in this study described themselves as European American descent (88.2%), while 4.1% of other students described themselves as African American, 3.6% as Asian, 0.9% as Bi-racial, 0.5% as Latino, and 2.7% as Other.

Preliminary Data Analyses

Bivariate correlations between prepotent behavior, intention, and actual health behaviors were all significant, and the relationship between intent and follow-up behavior was established for each health behavior (Table 1). Means and standard deviation values for EF, driving, physical activity, and healthy eating are presented in Table 2. The majority of participants in this study endorsed high levels (i.e., METS) of physical activity in their previous (62.3%), intended (68.6%), and follow-up (60.3%) behaviors, but did not endorse eating the recommended 4.5 cups of fruits and vegetables each day in their previous (93.6%), intended (88.2%), and follow-up (97.1%) behaviors (U.S. Department of Health and Human Services, 2005).

Driving Behavior. Correlations between prepotent, intended, and follow-up driving behaviors were all significant at the $p < .001$ level (Table 1). Partially consistent with study hypotheses, total EF was significantly and negatively related to prepotent ($p < .001$) and follow-up driving behaviors ($p = .019$), indicating that an increase in EF skills is associated with increases in prepotent and safe driving behavior. EF was not significantly associated with intended driving ($p = .063$; Table 2).

Physical Activity. When examining physical activity (METS) as a continuous score, all correlations between prepotent, intended, and follow-up physical activity were significant at the $p < .001$ level (Table 1). Consistent with study hypotheses, the BDEFS total score was significantly and negatively correlated with prepotent ($p = .012$), intended ($p < .001$), and follow-up ($p = .002$) physical activity (Table 2).

Similarly, when METS were analyzed as a categorical variable, the BDEFS total score was significantly and negatively correlated with follow-up ($p < .001$) physical activity. Thus, results indicated that increases in EF are associated with increases in physical activity.

Healthy Eating. Correlations between prepotent, intended, and follow-up healthy eating behaviors were all significant at the $p < .001$ level (Table 2). Consistent with study hypotheses, the BDEFS total score was significantly and negatively associated with prepotent ($p = .021$) and follow-up behaviors (p = .036). Indicating that increases in EF were associated with increases in fruit and vegetable consumption.

Regression Analyses

Driving Behavior. When demographic variables (e.g., sex, race, age) were placed into Block 1 of the regression model, they did not predict follow-up driving behavior (p = .538) and accounted for1% of the variance (Table 3). When EF and intent were added to Block 2, the overall model improved to a significant level, $F(5, 211) = 16.08$, $p < .001$. However, intent was the only variable to uniquely predict follow up behavior ($\beta = .51$, p < .001). Inconsistent with the study hypothesis, when the interaction term between EF and driving intent was added (Block 3), no variables produced a significant relationship. The addition of the interaction term did not improve model fit, and no moderation effect was found.

Prepotent driving was then examined in a regression model predicting follow-up driving behavior. When prepotent behavior and intent were added into Block 2 of the model holding demographics constant, $F(5, 211) = 37.20$, $p < .001$, $R^2 = .47$, only prepotent driving uniquely predicted follow-up driving (*beta* = .61, $p < .001$; Intent *beta* = .10, $p = .15$; Table 4). The overall model did not improve when the prepotent driving and intent interaction term was added (Block 3), no variables predicted follow-up driving, and no moderation effect was found.

Physical Activity. Physical activity was first assessed as a continuous variable. Demographic variables were entered into Block 1 of the regression model and explained approximately 4% of the variance in follow-up physical activity (Table 5). When EF and intent were added into Block 2, the overall model became significant $F(5, 198) = 30.50$, $p < .001$, $R^2 = .44$, and only intent significantly and uniquely predicted follow-up physical activity (*beta* = .64, $p < .001$; EF *beta* -.05, $p = .44$). When the interaction between EF and physical activity was added into Block 3, the overall model did not improve and no variables in this model produced a significant relationship. Contrary to the study hypothesis, no moderation effect was found.

A separate regression was used to assess the ability of prepotent physical activity and intent to predict follow-up physical activity. After entering prepotent behavior and intent into Block 2, the model demonstrated significance, and explained an additional 43% of the variance from Block 1, $F(5, 198) = 35.24$, $p < .001$, $R^2 = .47$ (Table 6). Both intent and prepotent behavior significantly and uniquely predicted follow-up behavior, with intent recording a higher beta value (*beta* = .44, $p < .001$) than prepotent behavior (*beta* = .29, $p < .001$). When an interaction term between intent and prepotent behavior was added to Block 3 of the model, the overall model demonstrated no change in explained variance ($R^2 = .47$), and the interaction term did not predict follow-up behavior, suggesting no moderation affect.

When physical activity was analyzed through the PROCESS macro as a continuous variable, an error was encountered due to multicollinearity, and the analysis would not run. This problem suggested that two or more of the predictor variables were constant or in a highly correlated linear combination together.

Multinomial Logistic Regressions were conducted to further explore the role of EF on the likelihood of which category of follow-up physical activity participants would report. In this analysis, the full model containing all predictors was significant, χ^2 (16, N = 204) = 134.83, $p < .001$, indicating that the model was able to distinguish between levels of follow-up physical activity. Likelihood ratio tests indicated that the intended physical activity ($p < .001$), prepotent physical activity ($p < .001$), and EF ($p = .022$) variables made a uniquely and statistically significant contribution to the model. Goodness-of-Fit models gave discrepant results that the model did (Deviance $p = .1.00$) and did not (Pearson $p < .001$) fit the data well. The model as a whole explained between 39% (McFadden R-square) and 59% (Nagelkerke R-square) of the variance in follow-up physical activity.

When examining statistically significant odds ratios for outcomes in the High physical activity category at follow-up, it was determined that as intended physical activity changed from the High to Low level, the odds of being in the Low physical activity level as compared to the High level were three times more likely (Table 7). Similarly, as intent changed from High to Moderate level, the odds of being in the Low level at follow-up were 19.8 times more likely. When examining odds ratios with EF, it was determined that for each one-unit increase in BDEFS scores (indicating more difficulties with EF), the odds of being in the Low physical activity level as compared to the High level increased by 2.6% ($p = .013$). Prepotent behavior had no significant relationships with the Low level of physical activity at follow-up.

When examining the odds of being in the Moderate physical activity level at follow-up, Moderate intended physical activity and Moderate prepotent behavior demonstrated significant relationships, with a change from High to Moderate intended physical activity to increase the odds of Moderate level follow-up physical activity by 12.4 times, and a change from High prepotent to Moderate levels of prepotent physical activity to increase the odds of Moderate levels of follow-up physical activity by about 3.6 times. EF also demonstrated a significant relationship, with a one-unit increase in BDEFS score being associated with a 1% increase in the odds of being at the Moderate physical activity level as comparted to High physical activity level at follow-up.

When physical activity was analyzed as a categorical variable by the PROCESS macro, the overall model was significant and explained 53% of the variance $F(10, 193) = 49.7$, $p < .001$. Of the variables in this model, only intention significantly and uniquely predicted follow-up behavior (*b* = .53, *t* (193) = 5.3, $p < .0001$). When examining the moderating effect of prepotent behavior and EF on the relationship between intent and follow-up behavior, all combinations of low, medium, and high prepotent behavior with low, medium, and high BDEFS scores demonstrated a significant relationship (Table 8).

Healthy Eating. When demographic variables were entered into Block 1 of the regression model, 2% of the variance in follow-up healthy eating was explained (Table 9). Next, EF and intent were added into Block 2, and the overall model changed to significant $F(5, 185) = 23.44$, $p < .001$, $R^2 = .39$. In this model, only intent significantly and uniquely predicted follow up behavior (*beta* = .61, $p < .001$; EF *beta* = -.08, $p = .22$). Inconsistent with the study hypothesis, when the interaction term between EF and intended healthy eating was added to the next block of this regression, only intended healthy eating produced a significant relationship (*beta* = .66, $p = .002$) and there was no significant change in variance accounted for by the model. No moderation effect was found.

A separate regression was used to assess the ability of prepotent healthy eating and intent to predict follow-up healthy eating, after controlling for the influence of demographic variables. After entering prepotent behavior and intent into Block 2 the model explained an additional 37% of the variance from Block 1 $F(5, 185) = 23.76$, $p < .001$, $R^2 = .39$ (Table 10). In this model, intent significantly and uniquely predicted follow up healthy eating (*beta* = .52, $p < .001$) while prepotent behavior did not (*beta* = .13, $p = .11$). To test the moderating effect of prepotent behavior on the relationship between intent and follow-up behavior, the interaction term between prepotent behavior and intent was added to Block 3. In this model $F(6, 184) = 21.17$, $p < .001$, $R^2 = .41$, prepotent behavior, (beta = .33 $p = .006$), and intent (beta = .73, $p < .001$) both significantly and uniquely predicted follow-up healthy eating, and the model was significantly improved. The interaction term between prepotent behavior (beta = -.41, $p = .02$) was also significant, suggesting a moderation effect and confirming the study hypothesis.

When the PROCESS macro was conducted with healthy eating, the overall model was significant and explained 42% of the variance $F(10, 180) = 11.57$, $p < .001$. Of the variables in this model, only intention significantly and uniquely predicted follow-up behavior ($b = .39$, $t(180) = 3.75$, $p < .001$). When examining the moderating effect of prepotent behavior and EF on the relationship between intent and follow-up behavior, all combinations of low, medium, and high prepotent behavior with low and medium BDEFS scores demonstrated a significant relationship. There were no significant interactions with high BDEFS scores, indicating no relationships at low levels of EF (Table 11).

Discussion

While researchers have examined many models of behavior change with a wide range of age groups to understand this problem, the current study was designed to help bridge the gap in understanding the relationship between intention to engage in health behaviors and the actual behavior that occurs in undergraduate students. Specifically, the Temporal Self-Regulation model was employed, given its ability to predict health behavior and its emphasis on executive functioning (Hall & Fong, 2007). To address limitations in the previous research, an ecologically valid rating scale of EF and other multi-item assessment measures were used across health behaviors. The primary goal of this study was to determine if EF had a moderating effect on the relationship between intent and follow-up behavior, and could help explain the intention-behavior gap in the context of the TST.

Intention. An integral component of the TST model is the intention to engage in future behavior. In fact, it is a variable repeatedly investigated in the health behavior literature. In the current study, significant predictive utility of intent for follow-up behaviors was demonstrated for each health behavior. Given this study's goal of examining variables that affect the intention – behavior relationship, we inherently expected this relationship to be significant. However, research appears to convey that while intent is an important variable, there are other mechanisms involved in predicting future behavior (Hall et al., 2008; Sheeran, 2002; Wong & Mullan, 2009). The current study demonstrated how EF and prepotent behavior interact with intent to assist in the prediction of health behaviors.

Driving behavior. When examining the relationship between follow-up driving behavior and EF, the first study hypothesis was confirmed. Stronger EF was associated with safer driving behaviors. While EF demonstrated significant correlations, the total EF score was not able to predict follow-up driving behavior. Prepotent driving behavior was also positively correlated with and uniquely predicted follow-up driving behavior. This finding is consistent with previous research in which past driving behavior predicted future driving behaviors (De Pelsmacker & Janssens, 2007; Elliott, Armitage, & Baughan, 2003).

Although prepotent behavior predicted follow-up behavior, no moderation effects were found and the second study hypothesis was not supported. Given these results, it would appear that for driving behavior, prepotent behavior has direct contributions that increase the likelihood of future behavior, rather than moderating the relationship between intentions and behavior. The undergraduate sample examined in this study may have impacted our results. While college students represent an age range that is associated with increased levels of risky driving (Hill et al., 2015), the average participant in this study responded between “Often” to “Very Often” for safe driving behaviors on the Driving Behavior Survey. This suggests that the current sample may be unique in that participants reported driving at a safer level than expected for college students. Further investigation into more specific aspects of EF (e.g., self-restraint (inhibition), self-motivation (effort allocation)) may also elucidate why EF did not predict driving behavior in this sample. Specifically, self-restraint may play an important role in safe driving when participants are tempted by immediately rewarding risky behaviors such as speeding or being distracted by phones or other media. This perspective is supported by research in behavioral economics, which indicates that distracted driving, such as texting while driving, is fundamentally an impulsive choice (Hayashi, Russo, & Wirth, 2015).

While the current study focused on safe driving behaviors, previous studies have used behaviors such as accidents and traffic violations to represent driving behavior (Barkley et al., 2002; Daigneault, Joly, & Frigon, 2002). These objective data may give us a more accurate understanding of participant driving behaviors than self-report measures. Links with EF have been demonstrated in other research using objective measures of driving behavior (Adrian et al., 2011; Barkley et al., 2002; Daigneault et al., 2002). Future research should continue to employ objective driving data when examining the relationship between EF and future behavior, and further investigate the role of self-restraint and impulsivity in identifying the decision making process in driving behaviors.

Physical activity. When examining the relationship between physical activity (IPAC) and EF, the first study hypothesis was confirmed. The BDEFS total score showed a significant and negative association with physical activity at follow-up. This finding is interpreted as higher EF capacities being associated with higher levels of physical activity. Consistent with previous literature, prepotent behavior uniquely predicted follow-up behavior (Ajzen, 2002). Total EF significantly contributed to the prediction of physical activity group at follow-up, and demonstrated that the odds of being in the Low to Moderate group increased with less developed EF. This finding may be due to the categorical nature of the analysis, but highlights the importance of EF in the prediction of follow-up physical activity. These findings are consistent with a body of literature suggesting positive associations and predictive links between executive functions and physical activity (Albinet et al., 2010; Sabia et al., 2009; Themanson et al., 2006). While previous studies have primarily been conducted in older adults, the current study demonstrates that we continue to see this pattern in a younger, college-age sample.

The hypothesis that EF and prepotent behavior would moderate the relationship between intent and follow-up behavior was partially confirmed. When examined independently, neither variable had a moderation effect on the intention – follow-up behavior relationship. However, moderation was demonstrated when the study sample was examined at all combinations of Low, Moderate, and High levels between the two variables. Additionally, at each level of prepotent behavior (Low, Moderate, or High), as EF abilities increased, the relationship between intent and follow-up physical activity improved. This finding demonstrates a three-way interaction between prepotent behavior, EF, and intent, and suggests that rather than acting independently, the combination of prepotent behavior and EF moderates the intent – follow-up behavior relationship for physical activity.

These results are similar to findings by Hall and colleagues (2008), in which EF predicted physical activity and moderated the intent – behavior relationship. Their study differed in that physical activity was measured by using an interview question that asked the number of hours and days participants had engaged in vigorous physical activity to measure physical activity, and used the results of a Go/NoGo task to form Low and High EF capacity groups, that were used in analyses. While in the current study, EF did not independently demonstrate predictive value, however, when EF was separated into Low, Medium, and High groups, we began to see its moderating effect. Indeed, it could be posited that rather than seeing effects in a continuous, linear manner, the role of EF in physical activity is most vividly displayed when examined between low and high EF capacities. As a caveat to this assumption, the Low EF capacity groups in both the current and Hall and colleagues' (2008) did not indicate that participants had a clinical level of EF deficits. For now, these findings serve as an argument that EF, in the context of the TST, plays a role in the prediction of follow-up behavior. Given the paucity of studies using EF as a predictor of health behavior, especially within the TST framework, future research using EF to help understand the intention – behavior relationship is warranted.

Healthy eating. When examining the relationship between follow-up healthy eating behavior and EF, the first hypothesis was confirmed. A significant negative association between total EF scores and eating suggested that higher EF capacities were associated with increased fruit and vegetable consumption. These findings are consistent with studies that linked EF difficulties with poorer eating habits (Maayan et al., 2011; Riggs et al., 2010). However, follow-up healthy eating was not predicted by total EF. Similarly, prepotent healthy eating was positively associated with follow-up behavior, but did not independently predict follow-up healthy eating. These results are not consistent with the study hypothesis or recent literature suggesting the predictive utility of EF on healthy eating (Allom & Mullan, 2014; Sabia et al., 2009). Interestingly, while not uniquely predictive, prepotent behavior demonstrated a moderating role in the intent – follow-up behavior relationship for healthy eating. The moderating role of prepotent behavior is consistent with its conceptual role in the TST, posed by Hall and Fong (2007), and is consistent with our hypotheses.

Similar to the results from the physical activity variable, the hypothesis that EF and prepotent behavior would moderate the relationship between intent and follow-up healthy eating behavior was partially confirmed. As previously mentioned, when prepotent healthy eating was examined as an individual moderator, there was a moderation effect. This moderation effect was not demonstrated when EF was the sole moderator. However, when examining the complete TST there was a significant conditional effect on the relationship between intent and follow-up healthy eating at Moderate and High levels of EF with Low, Moderate, and High levels of prepotent physical activity. As hypothesized, at each level of prepotent behavior (Low, Moderate, or High), as EF abilities increased, the relationship between intent and follow-up healthy eating improved. Unexpectedly, there were no moderation effects at Low levels of EF with any level of prepotent behavior. This finding suggests that regardless of what level participants had previously consumed fruits and vegetables, Low EF skills did not moderate the intent – follow-up behavior relationship. Our methodology can be most directly compared to that of Hall et al. (2008), in which the same measure of healthy eating was given and modified in a consistent manner. The studies differ in that Hall et al. (2008) split EF into a Low and High group and determined that EF predicted healthy eating and moderated the intent – behavior relationship. Although the varying methods of EF may account for some of the discrepancies between the two studies, another rationale is the difference in consumption of fruits and vegetables. In the study by Hall et al. (2008), participants consumed a daily average of 4.56 (prepotent), 5.44 (intended), and 4.41 (follow-up) fruits and vegetables, while the current study consumed 1.79, 2.26, and 1.64, respectively. The higher rates of consumption in the Hall et al. (2008) sample are not surprising given that between 38% and 41% of adults aged 20-34 in Canada consume 5 or more servings of fruits and vegetables each day (Statistics Canada, 2016), compared to the U.S., where the median daily fruit and vegetable consumption for adults is less than three a day (Centers for Disease Control, 2013b). It may be that effects at lower EF capacities were not observed due to the low base rate of fruit and vegetable consumption in this study. Perhaps, a sample with higher levels of fruit and vegetable consumption may have contributed to a more complete understanding of the moderating role of EF at levels of low capacity, and generated results more commensurate with Hall et al. (2008). Another explanation of this finding may be that those with lower EF abilities are consuming too few fruits and vegetables to demonstrate a significant difference among varying levels of prepotent behavior. Instead, this group may be consuming a negligible amount of fruits and vegetables across the board. As mentioned before, this group did not reflect a clinical deficit in EF. Future studies may incorporate clinical and non-clinical samples to more fully examine potential differences between consumption and predictive utility.

Implications

Beyond the hypotheses that were confirmed, this study presented several implications to the literature. First, this is one of few studies that have examined the intention – behavior gap in the context of the TST. The other known studies have been conducted by research associated with the developers of the TST at sites in Canada. The results of this study help to apply the TST framework to another geographical location that may have different norms regarding health behaviors, and to address the generalizability of the model. While many studies examining the intention – behavior gap have examined one or two health behaviors at a time, the current study examined three behaviors, and provided the advantage of using well validated measures rather than determining behavior through short interview style questions used in much of the previous research. The current study also focused on college-age students, who are often in a developmental period where health behaviors are found lacking. One of the major implications of the current study was the consistent measurement of self-regulatory ability across health behaviors. In the health behavior literature there are several measures of EF that have been used as measures of self-regulatory abilities, albeit without consistency between studies or health behaviors. The utilization of the BDEFS in this study gave a broad and consistent view of how EF presents in the intention – behavior relationship, while also giving the added benefit of an ecologically valid measure. Most importantly, this study demonstrated the utility of the TST. One of the core features of the TST is its belief that both self-regulatory processes and prepotent behaviors moderate the relationship between intention and future behavior. While independently neither of these variables consistently moderated that relationship, combinations of different levels of prepotent behavior and EF were able to demonstrate moderation. This combination may give even more credence to the TST, by suggesting that both variables are mutually necessary to understand the intention – behavior relationship.

Limitations and Future Directions

Some limitations in this study are recognized. First, the study relies on self-reported behaviors rather than recording actual behavior. While there is some concern that self-reporting may be influenced by socially desirable responding and inaccurate recall of behaviors, there is a body of research supporting the use of self-reports as reliable and valid representations of behavior (Sallis, Buono, Roby, Micale, & Nelson, 1993). Additionally, the measures being used in this study have also been correlated highly with actual behavior (Craig et al., 2003; Thompson & Byers, 1994). While the psychometric integrity of the study measures have been demonstrated, future studies may consider adding objective measures of health behavior to assist in determining concurrent validity. Future studies may also examine the relationship between self-regulatory abilities and health behavior by assessing subscales of the BDEFS rather than the total score. Previous research has demonstrated that prediction of healthy eating may be domain-specific to EF, and predicted by separate domains across health-protective and health-risk behaviors (Allom & Mullan, 2014; Limbers & Young, 2015). Another potential limitation is that the generalizability of findings from this study may be somewhat constrained given that recruitment focused on students enrolled in psychology courses at one southeast university. Given the promising results from the study, it is hoped that further research incorporating the TST is carried out in more diverse areas where analyses can investigate demographics such as sex or race. The current sample was unique in that the vast majority of students endorsed high rates of safe driving behaviors and levels of physical activity, and low rates of healthy eating. Larger studies may yield rates of behavior that reflect what we would expect nationally. Contrarily, there is also utility in honing in on samples that may be smaller or less diverse, but shed light on specific behaviors such as college alcohol use. With future studies expanding the TST model to other behaviors, it is our hope that these findings will lead to the examination of how executive functions can be improved in the context of facilitating health behaviors.

In conclusion, there is still much research needed in bridging the gap between intended health behaviors and actual behavior. The TST model introduced by Hall and Fong (2007) has provided a framework that appears promising in accomplishing this goal. In the present study, the TST model was utilized to examine three health behaviors that can be problematic for college-age adults. While the moderating role of EF varied between health behaviors, its ability to help predict follow-up health behavior in this study warrants a more rigorous investigation into our understanding of its role, and suggests that health behavior models should incorporate a self-regulatory perspective. Likewise, researchers and clinicians may use this information to formulate studies and interventions addressing how environmental and policy-level changes may make it easier for people with low self-regulatory abilities to engage in health-protective behaviors while increasing the difficulty of engaging in health-risk behavior. In fact, there is a growing body of research highlighting the effectiveness of changing policy and environmental cues for both physical activity and healthy eating (Belansky et al., 2013; Boutelle, Jeffery, Murray, & Schmitz, 2001; Brownson, Baker, Housemann, Brennan & Bacak, 2001; Prinsen, de Ridder, & de Vet, 2013; Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008; Story, Nanney, & Schwartz, 2009). Adapting environmental contexts and convenience of healthy foods school systems has already been successfully implemented in school systems, increasing fruit and vegetable consumption (Hanks, Just, & Wansink, 2013). Similarly, studies on health-risk behavior have demonstrated that changes in environmental contexts that make smoking more difficult (e.g., increasing tobacco taxes, smoke-free campus policies) are highly effective at reducing smoking behavior (Chaloupka, Cummings, Morley, & Horan, 2002; Seo, Macy, Torabi, & Middlestadt, 2011). These studies compliment the TST's notion of temporal dimensions in health behaviors. Specifically, these studies acknowledge that barriers to health behaviors are often perceived more salient than benefits in the long term, requiring greater levels of self-regulation to plan, organize, and carry out health-protective behaviors. In accordance with the TST, removing barriers to health-protective behaviors or adding barriers to health-risk behaviors should decrease or increase the self-regulatory capacity needed to engage in health behaviors, respectively. The removal or addition of barriers in the aforementioned studies, demonstrates how aspects of the TST may be applied to improve a variety of health behavior and may be a crucial and effective next step in population-wide or university-based health behavior change. It is our hope that as future studies and interventions are conducted, researchers and clinicians will consider EF and the TST model as part of their conceptual framework when attempting to predict and improve future health behavior and bridge the intent – behavior gap.

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Table 1

Bivariate Correlations between Prepotent Behavior, Intent, and Follow-up Behavior

	Prepotent	Intended
Driving		
Intended	0.68**	-
Follow up	0.68**	0.51**
Physical Activity		
Intended	0.74**	-
Follow-up	0.62**	0.66**
Healthy Eating		
Intended	0.72**	-
Follow-up	0.49**	0.61**

*p < .05, ** p < .001

Table 2

Bivariate Correlations between BDEFS and Health Behaviors

Measure	Total EF	Mean	SD	Range
BDEFS				
Total EF	-	146.13	39.80	87-286
Driving (DBS)				
Prepotent	-.25**	86.56	9.76	48-104
Intended	-.10	95.52	8.90	67-104
Follow-up	-.14*	89.80	10.67	52-104
Physical Activity				
Prepotent	-.16*	4786.55	3647.38	0-16530
Intended	-.23**	5513.39	4077.00	0-21252
Follow-up	-.20**	4517.53	3580.39	0-16506
Healthy eating				
Prepotent	-.15*	1.79	1.03	0.16-6.3
Intended	-.08	2.26	1.36	0.30-8.51
Follow-up	-.13*	1.64	0.88	0.21-4.70

*$p < .05$, ** $p < .001$

Table 3

Hierarchical Regression Analysis of EF Predicting Follow-up Driving Behavior

Variable	Block 1			Block 2			Block 3		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*B*
Age	0.00	0.53	0.53	0.03	0.45	0.00	0.02	0.46	0.00
Race	-1.45	2.28	-0.04	0.57	2.06	0.02	0.43	2.09	0.02
Sex	-2.65	1.94	-0.09	-2.35	1.71	-0.08	-2.39	1.72	-0.09
Total EF				-0.02	0.02	-0.08	-0.09	0.17	-0.33
Intended				0.61	0.07	0.51**	0.49	0.17	0.41
Intention x total EF							0.00	0.00	0.27
R^2		.01			.28			.28	
F		0.73			16.08**			13.38**	
F for change in R^2		0.73			38.73**			0.17	

Note. * $p < .05$. ** $p < .001$

Table 4

Hierarchical Regression Analysis of Prepotent Driving Predicting Follow-up Driving Behavior

Variable	Block 1			Block 2			Block 3		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*B*
Age	0.00	0.53	0.00	0.01	0.39	0.00	0.04	0.39	0.01
Race	-1.45	2.28	-0.04	0.52	1.68	0.02	0.58	1.68	0.02
Sex	-2.65	1.94	-0.09	-1.11	1.44	-0.04	-1.06	1.44	-0.04
Prepotent				0.67	0.08	0.61**	0.08	0.59	0.08
Intended				0.12	0.08	0.10	-0.37	0.50	-0.31
Intention x prepotent							0.01	0.01	0.87
R^2		.01			.47			.47	
F		0.73			37.20**			31.17**	
F for change in R^2		0.73			91.00**			1.01	

Note. * $p < .05$. ** $p < .001$

Table 5

Hierarchical Regression Analysis of EF Predicting Follow-up Physical Activity

Variable	Block 1			Block 2			Block 3		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*Β*
Age	-65.30	179.62	-0.03	59.30	139.22	0.02	48.33	138.65	0.02
Race	-1621.15	759.69	-0.15*	39.64	620.17	0.00	300.60	634.89	0.03
Sex	-1147.92	653.39	-0.12	-418.78	516.36	-0.05	-467.40	514.48	-0.05
Total EF				-4.07	5.24	-0.05	-14.10	7.76	-0.16
Intended				0.57	0.05	0.64**	0.27	0.18	0.31
Intention x total EF							0.00	0.00	0.34
R^2		.04			.44			.44	
F		2.40			30.50**			26.18**	
F for change in R^2		2.40			70.15**			3.04	

Note. * $p < .05$. ** $p < .001$

Table 6

Hierarchical Regression Analysis of Prepotent Physical Activity Predicting Follow-up Physical Activity

Variable	Block 1			Block 2			Block 3		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Age	-65.30	179.62	-0.03	66.02	134.12	0.03	63.03	134.39	0.02
Race	-1621.15	759.69	-0.15*	82.41	580.87	0.01	114.10	583.64	0.01
Sex	-1147.92	653.39	-0.12	-441.06	489.35	-0.05	-453.69	490.41	-0.05
Prepotent				0.28	0.08	0.29**	0.34	0.10	0.34**
Intended				0.39	0.07	0.44**	0.43	0.10	0.49**
Intention x prepotent							-7.16	0.00	-0.10
R^2		.04			.47			.47	
F		2.40			35.24**			29.35**	
F for change in R^2		2.40			81.59**			0.44	

Note. * $p < .05$. ** $p < .001$

Table 7

Multinomial Logistical Regression for Physical Activity Categories

Variable	Low follow-up physical activity			High follow-up physical activity		
	B	*SE*	Odds Ratio	*B*	*SE*	Odds Ratio
Demographics						
Age	0.19	0.32	1.21	0.14	0.13	1.15
Sex	0.78	1.52	2.18	-0.63	0.55	0.53
Race	-0.17	1.26	0.84	-0.04	0.64	0.97
EF	0.03	0.01	1.03*	0.01	0.01	1.01
Intended MET level						
Low	24.15	1.62	3.07**	-	-	-
Moderate	2.99	1.08	19.7*	2.52	0.52	12.42**
Prepotent MET level						
Low	1.64	1.41	5.16	0.21	0.98	1.24
Moderate	1.16	1.08	3.18	1.28	0.48	3.60*

Note. Reference Category is High MET Level. * $p < .05$. ** $p < .001$

Table 8

Conditional Effect of Intended Physical Activity on Follow-up Physical Activity with the Moderators Prepotent Physical Activity and Executive Functioning

Physical Activity	BDEFS	Effect (*b*)	se	*t*	*p*	*LLCI*	*ULCI*
-.64 (Low)	-39.42 (Low)	.64	.14	4.70	< .001**	.38	.92
-.64 (Low)	.000 (Mod)	.61	.09	6.95	< .001**	.44	.79
-.64 (Low)	39.42 (High)	.58	.17	3.47	< .001**	.25	.91
.000 (Mod)	-39.42 (Low)	.57	.16	3.52	< .001**	.25	.88
.000 (Mod)	.000 (Mod)	.53	.10	5.35	< .001**	.33	.72
.000 (Mod	39.42 (High)	.48	.16	3.03	.003**	.17	.80
.46 (High)	-39.42 (Low)	.51	.22	2.34	.020*	.08	.94
.46 (High)	.000 (Mod)	.46	.14	3.35	.001**	.19	.74
.46 (High)	39.42 (High)	.41	.19	2.20	.029*	.04	.79

Note. Values for Low, Mod, High are -1SD, Mean, +1SD, respectively. High for prepotent driving is replaced by the maximum because +1SD is outside the range of the data. *LLCI = lower limit 95% confidence interval. ULCI = upper limit 95% confidence interval.*

Table 9

Hierarchical Regression Analysis of EF Predicting Follow-up Healthy Eating

Variable	Block 1			Block 2			Block 3		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Age	0.04	0.05	0.06	-0.03	0.04	-0.05	-0.03	0.04	-0.05
Race	-0.06	0.20	-0.02	0.05	0.17	0.02	0.05	0.17	0.02
Sex	-0.33	0.17	-0.14	-0.19	0.14	-0.08	-0.18	0.14	-0.08
Total EF				-0.00	0.00	-0.08	-0.00	0.00	-0.06
Intended				0.39	0.04	0.61**	0.43	0.14	0.66*
Intention x Total EF							0.00	0.00	0.17
R^2		.02			.39			.39	
F		1.53			23.45**			19.44**	
F for change in R^2		1.53			.06**			0.81	

Note. * *p* < .05. ** *p* < .001

Table 10

Hierarchical Regression Analysis of Prepotent Healthy Eating Predicting Follow-up Healthy Eating

Variable	Block 1			Block 2			Block 3		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Age	0.04	0.05	0.06	-0.03	0.04	-0.05	-0.03	0.04	-0.04
Race	-0.06	0.20	-0.02	-0.00	0.16	-0.00	-0.01	0.16	-0.00
Sex	-0.26	0.17	-0.14	-0.26	0.14	-0.11	-0.28	0.14	-0.12*
Prepotent				0.11	0.07	0.13	0.28	0.10	0.33*
Intended				0.33	0.05	0.52**	0.48	0.08	0.73**
Intention x Prepotent							-0.06	0.03	-0.41*
R^2	.02			.39			.41		
F	1.53			23.76**			21.17**		
F for change in R^2	1.53			55.77**			5.38*		

Note. * $p < .05$. ** $p < .001$

Table 11

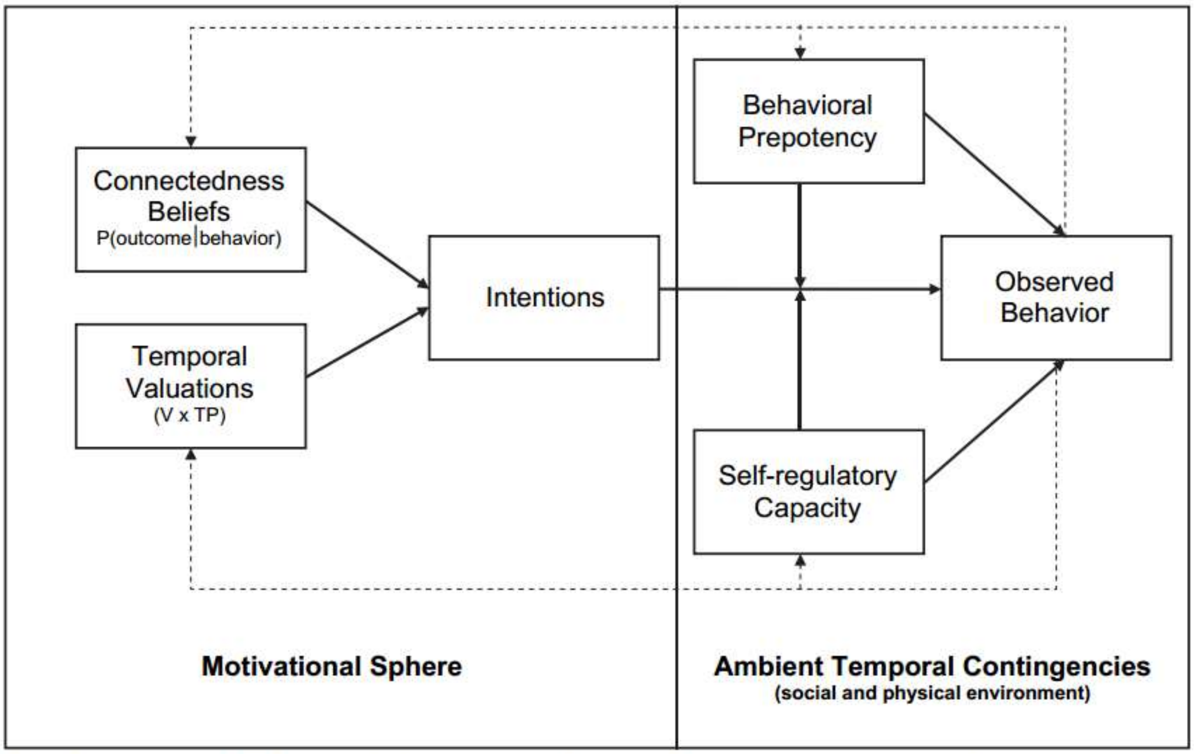
Conditional Effect of Intended Healthy Eating on Follow-up Healthy Eating of the Moderators Prepotent Healthy Eating and Executive Functioning

Healthy Eating	BDEFS	Effect (*b*)	*se*	*t*	*p*	*LLCI*	*ULCI*
-1.03 (Low)	-39.47 (Low)	.56	.15	3.70	< .001**	.26	.86
-1.03 (Low)	.000 (Mod)	.45	.14	3.24	.001**	.17	.72
-1.03 (Low)	39.47 (High)	.33	.23	1.41	.16	-.13	.79
.000 (Mod)	-39.47 (Low)	.45	.10	4.33	< .001**	.25	.66
.000 (Mod)	.000 (Mod)	.39	.10	3.75	< .001**	.18	.59
.000 (Mod	39.47 (High)	.32	.17	1.89	.06	-.01	.66
1.03 (High)	-39.47 (Low)	.34	.09	3.63	< .001**	.16	.53
1.03 (High)	.000 (Mod)	.33	.11	2.92	.004**	.11	.55
1.03 (High)	39.47 (High)	.32	.21	1.51	.13	-.10	.74

Note. Values for Low, Mod, High are -1SD, M, +1SD, respectively. *LLCI* = lower limit 95% confidence interval. *ULCI* = upper limit 95% confidence interval.

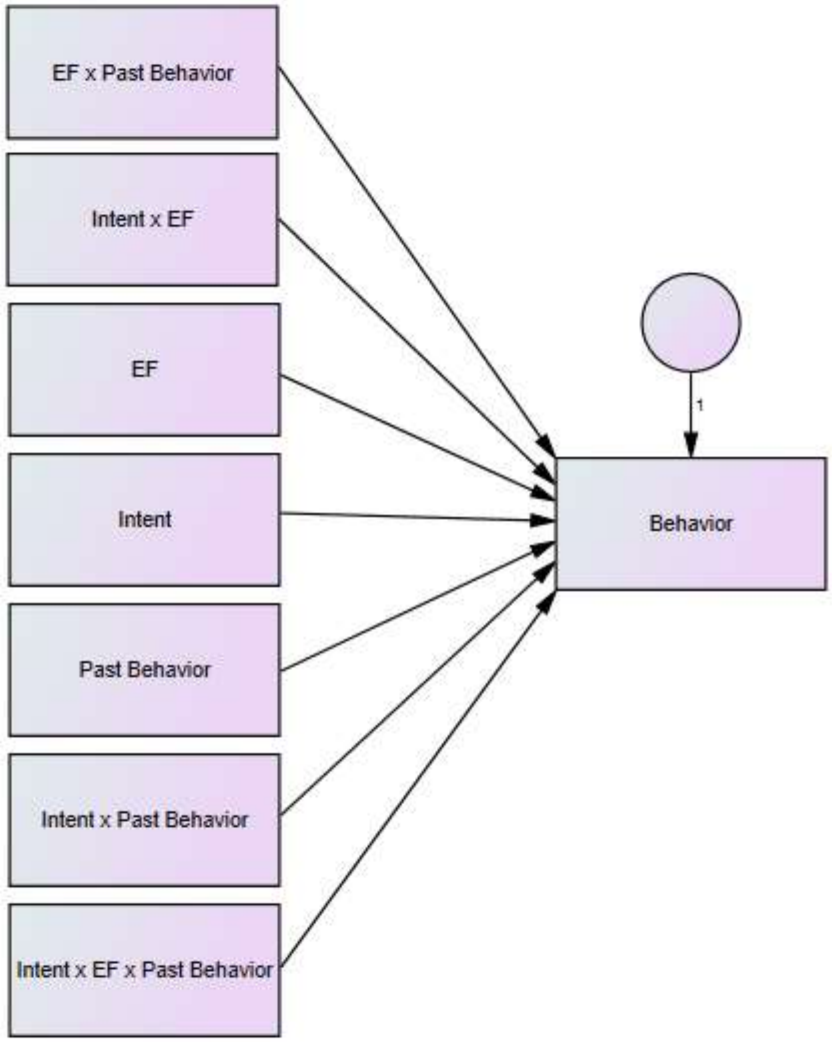
Appendix A

Figure 1. Temporal Self-Regulation Model. Adapted from "Temporal Self-Regulation Theory: A Model for Individual Health Behavior," by P. A. Hall and G. T. Fong, 2007, *Health Psychology Review*, *1*, p. 14. Copyright 2007 by Taylor & Francis.



Note: Arrows between Behavioral Prepotency and Self-regulatory Capacity to the Intentions-Behavior arrow implies moderation; V = value; TP = perceived temporal proximity. Broken arrows denote weaker (i.e., secondary) hypothesized effects.

Figure 2: Statistical Model of Analyses in PROCESS



Appendix B

Measuring Prepotent and Follow-Up

Physical Activity

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Healthy Eating

Think about what you usually eat each week.
Please think about all the fruits and vegetables that you ate last week.

Include those that were:
-raw and cooked,
-eaten as snacks and at meals,
-eaten at home and away from home (restaurants, friends, take-out), and
-eaten alone and mixed with other foods.
Report how many times per week or day you ate each food, and if you ate it, how much you usually had.

Over the last week, how many times per week or day did you drink **100% juice** such as orange, apple, grape or grapefruit juice? **Do not count** fruit drinks like Kool-Aid, lemonade, Hi-C, cranberry juice drink, Tang, and Twister. Include juice you drank at all mealtimes and between meals.

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you drank 100% juice, how much did you usually drink?

Less than ¾ cup (less than 6 ounces)
¾ to 1 ¼ cup (6-10 ounces)
1 ¼ to 2 cups (10-16 ounces)
More than 2 cups (more than 16 ounces)

Over the last week, how many times per week or day did you eat fruit? Count any kind of fruit - fresh, canned, and frozen. Do not count juices. Include fruit you ate at all mealtimes and for snacks.

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you ate fruit, how much did you usually eat?

Less than 1 medium fruit (Less than ½ cup)
1 medium fruit (About ½ cup)
2 medium fruits (About 1 cup)
More than 2 medium fruits (More than 1 cup)

Over the past week, how often did you eat lettuce salad (with or without other vegetables)?

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you ate lettuce salad, how much did you usually eat?

About ½ cup
About 1 cup
About 2 cups
More than 2 cups

Over the last week, how often did you eat French fries or fried potatoes?

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you ate French fries or fried potatoes, how much did you usually eat?

Small order or less (About 1 cup)
Medium order
About 1 ½ cups
Large order (About 2 cups)
Super size order or more (About 3 cups or more)

Over the last week, how often did you eat other white potatoes? Count baked, boiled, and mashed potatoes, potato salad, and white potatoes that were not fried.

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you ate these potatoes, how much did you usually eat?

1 small potato or less (1/2 cup or less)
1 medium potato (1/2 to 1 cup)
1 large potato (1 to 1 ½ cups)
2 medium potatoes or more (1 ½ cups or more)

Over the last week, how often did you eat cooked dried beans? Count baked beans, bean soup, refried beans, pork and beans, and other bean dishes.

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you ate these beans, how much did you usually eat?

Less than ½ cup
½ to 1 cup
1 to 1 ½ cups
More than 1 ½ cups

Over the last week, how often did you eat **other vegetables**?

DO NOT COUNT:

- Lettuce salads
- White potatoes
- Cooked dried beans

- Vegetables in mixtures, such as in sandwiches, omelets, casseroles, Mexican dishes, stews, stir-fry, soups, etc
- Rice

Count:

- All other vegetables - raw, cooked, canned, and frozen.

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each of these times that you ate other vegetables, how much did you usually eat?

Less than ½ cup
½ to 1 cup
1 to 2 cups
More than 2 cups

Over the last week, how often did you eat tomato sauce? Include tomato sauce on pasta or macaroni, rice, pizza, and other dishes.

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you ate tomato sauce, how much did you usually eat?

About ¼ cup
About ½ cup
About 1 cup
More than 1 cup

Appendix C

Measuring Intent

Physical Activity

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you intend to spend being physically active in the **next 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you intend to do in the **next 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you intend to do for at least 10 minutes at a time.

During the **next 7 days**, on how many days do you intend to do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**
_____ **minutes per day**

☐ Don’t know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

☐

No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**
_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

8. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**
_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

9. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**
_____ **minutes per day**

☐ Don't know/Not sure

Healthy Eating

Please think about all the fruits and vegetables that you intend to eat next week.
Include those that are:
-raw and cooked,
-eaten as snacks and at meals,
-eaten at home and away from home (restaurants, friends, take-out), and

-eaten alone and mixed with other foods.

Report how many times per week or day you intend to each food, and how much you intend to have.

Over the next week, how many times per week or day do you intend to drink **100% juice** such as orange, apple, grape or grapefruit juice? **Do not count** fruit drinks like Kool-Aid, lemonade, Hi-C, cranberry juice drink, Tang, and Twister. Include juice you intend to drink at all mealtimes and between meals.

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you drink 100% juice, how much do you intend to drink?

Less than ¾ cup (less than 6 ounces)
¾ to 1 ¼ cup (6-10 ounces)
1 ¼ to 2 cups (10-16 ounces)
More than 2 cups (more than 16 ounces)

Over the next week, how many times per week or day do you intend to eat fruit? Count any kind of fruit - fresh, canned, and frozen. Do not count juices. Include fruit you intend to eat at all mealtimes and for snacks.

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you eat fruit, how much do you intend to eat?

Less than 1 medium fruit (Less than ½ cup)
1 medium fruit (About ½ cup)
2 medium fruits (About 1 cup)

More than 2 medium fruits (More than 1 cup)

Over the next week, how often do you intend to eat lettuce salad (with or without other vegetables)?

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you eat lettuce salad, how much do you intend to eat?

About ½ cup
About 1 cup
About 2 cups
More than 2 cups

Over the next week, how often do you intend to eat French fries or fried potatoes?

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you eat French fries or fried potatoes, how much do you intend to eat?

Small order or less (About 1 cup)
Medium order
About 1 ½ cups
Large order (About 2 cups)
Super size order or more (About 3 cups or more)

Over the next week, how often do you intend to eat other white potatoes? Count baked, boiled, and mashed potatoes, potato salad, and white potatoes that were not fried.

Never

1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you eat these potatoes, how much do you intend to eat?

1 small potato or less (1/2 cup or less)
1 medium potato (1/2 to 1 cup)
1 large potato (1 to 1 ½ cups)
2 medium potatoes or more (1 ½ cups or more)

Over the next week, how often do you intend to eat cooked dried beans? Count baked beans, bean soup, refried beans, pork and beans, and other bean dishes.

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you eat these beans, how much do you intend to eat?

Less than ½ cup
½ to 1 cup
1 to 1 ½ cups
More than 1 ½ cups

Over the next week, how often do you intend to eat **other vegetables**?

DO NOT COUNT:

- Lettuce salads
- White potatoes
- Cooked dried beans
- Vegetables in mixtures, such as in sandwiches, omelets, casseroles, Mexican dishes, stews, stir-fry, soups, etc
- Rice

Count:

- All other vegetables - raw, cooked, canned, and frozen.

  Never
  1-2 times per week
  3-4 times per week
  5-6 times per week
  1 time per day
  2 times per day
  3 times per day
  4 times per day
  5 or more times per day

Each of these times that you eat other vegetables, how much do you intend to eat?

Less than ½ cup
½ to 1 cup
1 to 2 cups
More than 2 cups

Over the next week, how often do you intend to eat tomato sauce? Include tomato sauce on pasta or macaroni, rice, pizza, and other dishes.

Never
1-2 times per week
3-4 times per week
5-6 times per week
1 time per day
2 times per day
3 times per day
4 times per day
5 or more times per day

Each time you eat tomato sauce, how much do you intend to eat?

About ¼ cup
About ½ cup
About 1 cup
More than 1 cup