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PREDICTORS OF PAIRED, SINGULAR, AND NO ACTION AMONG MIDDLE SCHOOL STUDENTS WITH BEHAVIOR RISKS

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PREDICTORS OF PAIRED, SINGULAR, AND NO ACTION AMONG MIDDLE SCHOOL STUDENTS WITH BEHAVIOR RISKS

BY

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ABSTRACT

Understanding multiple health risk behavior change may contribute to the prevention of chronic illness. The present study examined drivers of behavior change over time within individuals with health behavior risks who were at risk for two behaviors. Participants were middle school students from a randomized controlled trial conducted across 20 middle schools within the state of Rhode Island using two transtheoretical model-tailored, computer-delivered interventions in the school setting. Participants received an alcohol prevention program or an energy balance program. Analyses were conducted with participants who were at risk for both physical activity and fruit and vegetable intake (N = 1401). A series of chi-square analyses, one-way between subjects ANOVAs, and MANOVA models were conducted to examine whether (1) Treatment (received energy balance intervention), (2) baseline Stage of Change, (3) Effort, and (4) Severity predicted the number of behaviors that an individual changes (no behaviors, one behavior, or two behaviors) at three follow-up time points (12, 24, and 36 months). Additionally, demographic effects were examined in the context of participants at risk for multiple health behaviors. Treatment, Stage of Change, Severity, and Effort at baseline, were all significantly related to the number of behaviors changed at a certain time point over the course of the study- 12, 24, or 36 months, or across multiple time points. Treatment demonstrated the greatest consistency across behaviors and time points, with more participants in the treatment condition being in the paired action group (change on two behaviors) at each time point (12, 24, and 36 months). Furthermore, age, was the only consistent demographic effect across time points. Findings shed light on the mechanisms of multiple behavior change within individuals, providing a deeper

understanding of what impacts the number of behaviors that an individual changes over time.

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The present study is a secondary data analysis of data obtained from a randomized trial involving two multiple health behavior interventions (#DA020112, Principle Investigator, Velicer). As this study was a secondary data analysis, there was no potential risk for the participants of the original study, thus, an exemption was granted by the Institutional Review Board (IRB) for this project.

PREFACE

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Predictors of Paired, Singular, and no Action Among Middle School Students with Behavior Risks

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Abstract

Understanding multiple health risk behavior change may contribute to the prevention of chronic illness. The present study examined drivers of behavior change over time within individuals with health behavior risks who were at risk for two behaviors. Participants were middle school students from a randomized controlled trial conducted across 20 middle schools within the state of Rhode Island using two transtheoretical model-tailored, computer-delivered interventions in the school setting. Participants received an alcohol prevention program or an energy balance program. Analyses were conducted with participants who were at risk for both physical activity and fruit and vegetable intake (N = 1401). A series of chi-square analyses, one-way between subjects ANOVAs, and MANOVA models were conducted to examine whether (1) Treatment (received energy balance intervention), (2) baseline Stage of Change, (3) Effort, and (4) Severity predicted the number of behaviors that an individual changes (no behaviors, one behavior, or two behaviors) at three follow-up time points (12, 24, and 36 months). Additionally, demographic effects were examined in the context of participants at risk for multiple health behaviors. Treatment, Stage of Change, Severity, and Effort at baseline, were all significantly related to the number of behaviors changed at a certain time point over the course of the study- 12, 24, or 36 months, or across multiple time points. Treatment demonstrated the greatest consistency across behaviors and time points, with more participants in the treatment condition being in the paired action group (change on two behaviors) at each time point (12, 24, and 36 months). Furthermore, age, was the only consistent demographic effect across time points. Findings shed light on the mechanisms of multiple behavior change within individuals, providing a deeper

understanding of what impacts the number of behaviors that an individual changes over time.

Predictors of Paired, Singular, and no Action Among Middle School Students with Behavior Risks

Introduction

Multiple Health Behavior Change (MHBC) is critical for health promotion, disease prevention and management (Prochaska, 2008). The aim of the present study is to advance several key questions about the MHBC construct, specifically relating to MHBC with middle school students.

Considerable research has been conducted on the science of single behavior change, but little is known about how multiple behaviors change within individuals. Multiple health risk behaviors have a synergistic negative impact on health leading to higher rates of premature mortality, disability, morbidity, and increased healthcare costs (James et al., 2016). In order to develop more effective MHBC interventions, there is a need to understand the factors that drive change within individuals. Most studies exist on the factors that drive MHBC between groups. However, there is minimal research examining behavior change within individuals and how within individual behavior change may impact and predict between group change.

Several emerging properties of MHBC have been identified through studying individuals with co-occurring behavioral risks and examining whether they change one or more of those behaviors over time. Coaction, for example, is a phenomenon where individuals who change one behavior in a pair are more likely to change the second behavior than individuals who do not change the first behavior. However, coaction is a phenomenon that occurs mostly in treated individuals, demonstrating that it may not be a natural process (Paiva et al., 2012; Johnson et al., 2014).

When examining individuals with pairs of co-occurring health-risk behaviors at baseline and assessing their longitudinal behavioral change, four possible outcome patterns have been identified when examining each assessed behavior pair. The four outcomes are: paired action (when effective action occurs for both co-occurring behaviors within individuals during the same time period), singular action (when effective action occurs only for a single behavior from a pair of co-occurring behaviors within individuals, either behavior A or B), and no change in either behavior in the pair of co-occurring behaviors (Yin et al., 2013). Understanding the drivers of paired action may identify underlying mechanisms of change that could impact on the development of innovative MHBC interventions.

Previous studies have identified the consistency of four effects as predictors of long-term change across separate multiple health risk behaviors, including stage of change, treatment, problem severity, and effort (Blissmer et al., 2010). These effects are dynamic and open to change via interventions.

Taken together, two features constitute the present study's novel contributions to MHBC. This research investigates (1) whether the specific four effects (stage of change, treatment, problem severity, and effort) as well as demographics, are predictors of the number of behaviors changed (no action, singular action, paired action), and (2) this is examined within a population of middle school students.

Significance

While the focus of most research has been a single behavior change paradigm, the contemporary focus has shifted to multiple behavior change and to population based interventions. The Transtheoretical Model (TTM)-based interventions have been applied to large populations. It is an effective framework to intervene on entire populations. TTM generates methods to proactively reach out to populations to generate MHBC.

Transtheoretical Model (TTM) of Behavior Change

The TTM is an effective model for tailoring MHBC interventions. The TTM incorporates process-oriented variables both to predict and to explain how and when individuals change behaviors. It is considered to be an important integrative model of behavior change (Johnson et al., 2008). A central organizing construct in TTM is stage of change. In the TTM, behavior change is conceptualized as a process that unfolds over time and involves progression through a series of five stages of change: Precontemplation (i.e., PC- not intending to take action in the next six months), Contemplation (i.e., C- intending to take action in the next 6 months), Preparation (i.e., PR- intending to take action in the next thirty days), Action (i.e., A- there has been an overt behavior change that has occurred within the past six months), and Maintenance (i.e., M- a behavior change that has been sustained for at least six months). The TTM therefore adapts and tailors its interventions based on additional behavior change constructs including decisional balance, processes of change, and self-efficacy, in addition to its central tenet, stage of change (Johnson et al., 2014). The application of these change constructs are what comprise the effort effect.

Current Predictors of Behavior Change

Treatment Effect. Treatment effects have been found to be a predictor of successful maintenance of behavior change. It is expected that compared to control groups, significantly more individuals randomly assigned to treatment at baseline will be in the Action and Maintenance Stages at long-term follow-ups. Previous studies have supported treatment effects for single and multiple behaviors. Another important factor is whether or not the individual is receiving a TTM-tailored intervention to aid them in changing their health behaviors. Control groups also typically show change but at lower rates than intervention groups.

Stage Effect. The Stage of Change reflects an individual's readiness to change. Individuals in later SOC, that is those with greater behavioral intentions to change (e.g., Preparation) at baseline have been found more likely to make greater progress to Action and Maintenance at long-term follow-up than individuals in an earlier stage (e.g., Precontemplation; e.g., Prochaska et al., 1994). Stage effects have been found in both treatment and control groups (Prochaska, Velicer, Prochaska, & Johnson, 2004).

Severity Effect. The severity of the behavior at baseline has been found to be a predictor of successful behavior change. The severity of the behavior is how far the current risk behavior is (e.g., 20 minutes of physical activity per day for three days per week) from public health behavior criterion (i.e., 60 minutes of physical activity per day for at least five days a week). The severity of the problem behavior can be seen as a measure of habit strength. On this view, individuals at baseline who need greater amounts of behavioral change to reach public health criterion are in turn predicted to be less likely to be successful (Blissmer et al., 2010).

Effort Effect. Effort is a measurement of how much an individual is working to change their problem behavior. Within the TTM framework, the use of Decisional Balance, Self-Efficacy, and Processes of Change reflect an individual's effort. Decisional Balance is a construct that refers to the pros and cons of behavioral change. Self-Efficacy is the construct that refers to the situation specific confidence an individual has to cope with high risk situations or temptations. Processes of Change constructs refer to the covert and overt strategies and techniques people use to alter their experiences and environment to progress through the various Stages of Change (Velicer, DiClemente, Prochaska & Brandenburg, 1985; Velicer, DiClemente, Rossi & Prochaska 1990; Prochaska, Velicer, DiClemente & Fava, 1988). Individuals making greater efforts on at least one of the TTM dynamic variables at baseline are more likely to progress to a later SOC at follow-up.

Coaction. Coaction refers to the increase in probability that individuals who adopt one health behavior will adopt another health behavior. The vast majority of the population has multiple health risk behaviors. The percentage of people with multiple risk behaviors suggests the importance of looking at coaction (Johnson et al., 2014; Paiva et al., 2012). When examining coaction, coaction Odds Ratios (ORs) do not identify the actual proportion of individuals who changed both behaviors or only one of their co-occurring baseline risk behaviors, and do not permit direct comparison of specific behavior change rates to be made between groups. Thus, focusing on paired action can have implications in better understanding coaction.

Paired and Singular Action. Paired and singular action have been used to describe how individuals change multiple health risk behaviors over time. In paired action, the individual changes both behaviors in the pair over time. In singular action, individuals change only one of the behaviors within the pair over time. In a comparative study of behaviors changed via paired action compared to singular action (Prochaska et al., unpublished study), paired action yielded the highest number of behaviors changed over singular action, but only in treatment groups with positively linked pairs of behavior (e.g., energy balance behaviors–diet, exercise, and emotional eating). With all other groups, there was a prevailing tendency for individuals to change one behavior in a pair, rather than both. The authors found that the TTM may impact this outcome, where the TTM treatment intervention seemed to decrease this singular action trend by 50% compared to controls with negatively linked pairs of behaviors (where observed changes are less than predicted from separate behavior changes). In individuals with positively linked pairs of behaviors, the TTM treatment intervention reversed this pattern (Prochaska et al., unpublished study).

Types of Behaviors

Energy balance behaviors are behaviors that are related in function and include diet, exercise, and emotional eating. When these behaviors are at risk, they may lead to various health consequences including obesity (Johnson et al., 2008). Indeed, they are behaviors that are essential to obesity prevention and healthy weight management. Poor diet and physical inactivity have also been shown to increase risks of diabetes, cardiovascular disease and cancer (USDHHS, 1996). These behaviors have also been found to be positively linked, whereupon observed linked behavior change was greater than what was predicted if behaviors change separately and independently (Prochaska et al., unpublished study; Johnson et al., 2012).

Several researchers have demonstrated that targeting clusters or pairs of behaviors can be potent, for example, multiple health behavior interventions that target dietary intake (including fruit and vegetable intake) and physical activity have been found to be effective, resulting in significant weight loss in the treatment group (Larson, Laska, Story, & Neumark-Sztainer, 2012; Appel et al., 2011). However, the mechanisms underlying change within these pairs are largely unknown. Therefore, an investigation into such mechanisms could reveal the effects that each behavior in the pair may hold, and whether these effects are related to the number of behaviors an individual changes.

Pre-Adolescents and Adolescents

Pre-adolescence and adolescence are a key time to begin prevention, yet these youth remain an understudied population relative to adults. Healthful patterns that can be maintained across a lifespan start early in life. With middle school students it is important to look at the whole population and not just those at risk, as it is a time when young people can start moving from not at risk to at risk (Gordon-Larsen, Adair, Nelson & Popkin, 2004).

Methods

The present study is a secondary data analysis of a randomized trial involving two multiple health behavior interventions (Velicer et al., 2013). One group received treatment for two types of behaviors; smoking and alcohol use. The other group received an intervention for physical activity, fruit and vegetable consumption, and limiting TV time. This research investigated the drivers of paired action. As indicated above, it is novel in that it examined whether the four effects and demographics are *predictors of paired action, crucially, within individual behavior change*. Many previous studies exist on the factors that drive behavior change between groups. Here, the focus is on behavior change within individuals with a special focus on pre-adolescents and adolescents.

Specifically, this study examined treatment, Stage of Change, problem severity, and effort effects, as well as demographic predictors of paired action across three time points (12, 24, and 36 months). Exploring predictors of paired action, and understanding what impacts the number of behaviors that an individual changes can provide important insight into how multiple health behavior changes occur within individuals.

Participants

A sample of 4,158 middle school students [48% female, 65% White, and 15.6% Hispanic] were drawn from 20 middle schools within the state of Rhode Island (Velicer et al., 2013). This sample was randomized in a two-arm comparison trial. One arm was a TTM-tailored tobacco and alcohol prevention program and the other arm a TTM-tailored energy balance program. The sample was subdivided into three groups; those who were in the paired action group, those who were in the singular action group, and those who were in the no action group. Being in the paired action group entailed having changed on both behaviors in the pair (physical activity and fruit and vegetable intake), and being in the singular action group entailed having changed on one behavior in the pair (physical activity or fruit and vegetable intake).

Participants who were in pre-action at baseline for both physical activity and fruit and vegetable intake were identified and used in the following analyses (N=1401). At each time point, people who changed on physical activity (PA) only were classified as being in the singular action group, while those who changed both PA and fruit and vegetable intake (FV) were classified as being in the paired action group. At each time point people who changed on FV only were classified as being in the singular action group, while those who changed both PA and FV were classified as being in the paired action group. In addition, those who did not change on either PA or FV were classified as being in the no action group. The grouping variable at each time point compared those in the paired action group, vs. individuals in the singular action group, vs. those in the no action group (see Figure 1).

Insert Figure 1 About Here

Measures

In this study the measures were organized around assessing each of the four effects: stage of change, treatment, problem severity, and effort.

Students in each of the arms were assessed for both sets of behaviors and the related TTM constructs.

Demographics. The available demographics for this sample provided information on gender, race/ethnicity, and body mass index (BMI).

Stages of Change. Paired action behavior change was measured by the individual's progression through the Stages of Change on both behaviors in the pair of simultaneously treated at risk behaviors. 1= Precontemplation (PC- no intention to change behavior in the next 6 months), 2= Contemplation (C- intending to change in the next six months), 3= Preparation (PR- intending to change in the next thirty days), 4= Action, (A- individual has modified the problem behavior), 5= Maintenance (M- individual has maintained behavior change for at least 6 months). The stages will be examined for both of the behaviors in the pair (e.g., the individual is in pre-action (PC, C, PR) for both of the behaviors in the pair). For fruit and vegetable intake Stage of Change was assessed regarding readiness to meet criteria of consuming five or more servings of fruits and vegetables each day. For physical activity Stage of Change was determined regarding readiness to meet criteria of engaging in 60 minutes of physical activity a day for at least five days per week (Mauriello et al., 2010).

Treatment. Rather than using a no treatment placebo control, this RCT used a strategy that has been used in previous studies. One set of schools received treatment for energy balance behaviors and the other for alcohol and tobacco use, with the emphasis on preventing acquisition of smoking or drinking (Velicer et al., 2013). Students in the energy balance treatment group engaged in Pro-Change's Health in Motion obesity prevention program (Mauriello et al., 2010). These students received a computer based TTM-tailored intervention for physical activity, fruit and vegetable consumption, and limited TV viewing. The substance use prevention group students received a computer based TTM-tailored intervention aimed primarily at preventing smoking and alcohol use. Each intervention was delivered beginning in the 6^{th} grade and involved five in-class contacts over a three year period with annual assessments conducted through 9^{th} grade (12, 24, and 36 months). The five computerized TTM-tailored intervention sessions were each 30-minutes and were group specific. Participants interacted with the intervention once in sixth grade, three times in seventh grade, and once in eight grade. More information on the treatment can be found in Mauriello et al., 2010. This project will only analyze data from students on physical activity and fruit and vegetable intake.

Problem Severity. Fruit and vegetable severity was measured as the number of servings of fruit and vegetables consumed daily, with the further from consuming five or more servings of fruits and vegetables a day (public health criteria), the greater the severity score. Physical activity severity was measured as the number of minutes per day that participants engaged in exercise in a week relative to public health criterion (the further from engaging in 60 minutes of physical activity a day for at least five days per week, the greater the severity score).

Effort. Decision-making variables (the Pros and Cons of changing behavior) and self-efficacy were used as proxy measures of effort. Two separate eight-item measures (one for fruit and vegetable intake, and one for physical activity) were assessed, with four items assessing the Pros and four items assessing the Cons of behavior change. These measures evaluated the perceived advantages and disadvantages in an individual's decision to change each risk behavior. Participants provided responses on a 5-point Likert scale of importance, ranging from 1 (Not at all important) to 5 (Extremely important). Self-efficacy was assessed by two separate six-item measures for fruit and vegetables and physical activity that measured an individual's confidence to engage in each behavior across various situations. Participants provided responses on a 5-point Likert scale of confidence, ranging from 1 (Not at all confident) to 5 (Completely confident). The higher the score on each construct, the greater is the effort effect score.

Hypotheses and Planned Analyses

H 1: As simultaneous treatment produced more MHBC, it was expected that more participants in the *Health in Motion* program (treatment group) would be in the paired action group rather than the singular or no action group at each follow-up time point (12, 24, 36 months) compared to those students who received the alternative treatment (control group).

Analysis 1: A series of chi-square analyses were conducted to examine the differences in proportions of treatment group participants compared to control group participants within the three distinct behavior change groupings (no action, singular action, paired action).

H2: The second hypothesis related to baseline Stage of Change and behavior change groupings (no action, singular action, paired action) at each follow-up time point (12, 24, 36 months).

H2a: We hypothesized those participants who were in Preparation for FV at baseline would be more likely to be in the paired action group rather than the singular action or no action group at each follow-up time point compared to participants who were in the earlier stages (PC/C) for FV at baseline.

H2b: Additionally, it was predicted that those participants who were in Preparation for PA at baseline would be more likely to be in the paired action group rather than the singular action group, or no action group, at each follow-up than those participants who were in the earlier stages (PC/C) for PA at baseline.

Analysis 2a and 2b: A series of chi-square analyses were conducted to examine the differences in proportions of participants in earlier vs. later stages of change and behavior change groupings (no action, singular action, paired action).

H3: It was predicted that Severity at baseline would be associated with behavior change group membership (no action, singular action, paired action) at each follow-up time point (12, 24, 36 months). Severity is defined as the amount of PA or FV servings reported at baseline with the further away from public health criteria, the greater the severity.

Analysis 3: A series of one-way between subjects ANOVAs were conducted to examine differences in baseline severity of fruit and vegetable intake based on behavior change groupings (no action, singular action, paired action). Similarly, a series of one-way between subjects ANOVAs were conducted to examine differences in baseline severity of physical activity based on behavior change groupings. These ANOVAs were run separately for each time point and contrasts examining differences between group membership were examined using Tukey's HSD.

H4: The fourth hypothesis examined whether there were differences in group membership (no action, singular action, paired action) based on effort (pros of change, cons of change, and self-efficacy related to change) at each of the three follow-up time points (12, 24, and 36 months). We hypothesized that baseline effort would differ based on behavior change group membership.

Analysis 4: A series of multivariate analysis of variance (MANOVA) models were run to examine differences in group membership based on baseline effort.

H5: The fifth hypothesis is related to baseline demographics (gender, ethnicity, age, and BMI) and behavior change groupings (no action, singular action, paired action) at each follow-up time point (12, 24, 36 months). It was predicted that demographics would not be associated with behavior change group membership.

Analysis 5: A series of chi-square analyses were conducted to examine the differences in proportions of participants' baseline demographics (gender, ethnicity, age, and BMI) and distinct behavior change groupings (no action, singular action, paired action).

Data analyses were conducted using the IBM Statistical Package for the Social Sciences, version 25 (IBM SPSS 25, Armonk, New York).

Results

Baseline demographics are presented in Table 1.

[Table 1 near here.]

H 1: As simultaneous treatment produced more MHBC, it was expected that more participants in the *Health in Motion* program (treatment group) were in the paired action group rather than the singular or no action group at each follow-up time point (12, 24, 36 months) compared to those students who received the alternative treatment (control group).

[Table 2 near here.]

Treatment effect at 12 months. A chi-square test was performed to examine the relationship between participants who received the *Health in Motion* program (treatment) and behavior change groupings (no action, singular action, paired action). More participants in the treatment group (14.1%) were in the paired action group compared to participants in the control group (8.7%), χ^2 (2, N = 1141) = 8.35, $p < .05$ (see table 2).

Treatment effect at 24 months. A chi-square test was performed to examine the relationship between participants who received the *Health in Motion* program (treatment) and behavior change groupings (no action, singular action, paired action). More participants in the treatment group (14.5%) were in the paired action group compared to participants in the control group (7.9%), χ^2 (2, N = 1069) = 19.40, $p < 0.01$ (see table 2).

Treatment effect at 36 months. A chi-square test was performed to examine the relationship between participants who received the *Health in Motion* program (treatment) and behavior change groupings (no action, singular action, paired action). More participants in the treatment group (13.8%) were in the paired action group compared to participants in the control group (6.5%), χ^2 (2, N = 1009) = 22.90, $p < 0.01$ (see table 2).

H2: The second hypothesis related to baseline Stage of Change and behavior change groupings (no action, singular action, paired action) at each follow-up time point (12, 24, 36 months).

[Table 3 near here.]

H2a: We hypothesized those participants who were in Preparation for FV at baseline would be more likely to be in the paired action group rather than the singular action or no action group at each follow-up time point compared to participants who were in the earlier stages (PC/C) for FV at baseline.

Baseline Stage of Change Fruit and Vegetable Intake

H2a: **Stage of Change effect at 12 months.** A chi-square test revealed no significant differences between participants in the later stage of change for FV at baseline (Preparation) and those who were in the earlier stages for FV at baseline (PC/C) and group membership (no action, singular action, paired action) at 12 months, χ^2 (2, N = 1141) = 2.33, $p > .05$ (see table 3).

Stage of Change effect at 24 months. A chi-square test revealed a significant difference between baseline Stage of Change for FV and group membership (no action, singular action, paired action) with 13.4% of those in Preparation and 9.3% of those in PC/C being in the paired action group, χ^2 (2, N = 1069) = 6.55, $p < .05$ (see table 3).

Stage of Change effect at 36 months. A chi-square test revealed a significant difference between baseline Stage of Change for FV and group membership (no action, singular action, paired action) with 13.1% of those in Preparation and 7.7% of those in PC/C being in the paired action group, χ^2 (2, N = 1009) = 8.07, $p < .05$ (see table 3).

H2b: Additionally, it was predicted that those participants who were in Preparation for PA at baseline would be more likely to be in the paired action group rather than the singular action group, or no action group, at each follow-up than those participants who were in the earlier stages (PC/C) for PA at baseline (see table 3).

Baseline Stage of Change Physical Activity

H2b: **Stage of Change effect at 12 months.** A chi-square test revealed no significant differences between participants in the later stage of change for PA at baseline (Preparation) and those who were in the earlier stages for PA at baseline (PC/C) and group membership (no action, singular action, paired action) at 12 months, χ^2 (2, N = 1141) = 2.33, $p > .05$ (see table 3).

Stage of Change effect at 24 months. A chi-square test revealed no significant differences between participants in the later stage of change for PA at baseline (Preparation) and those who were in the earlier stages for PA at baseline (PC/C) and group membership (no action, singular action, paired action) at 24 months, χ^2 (2, N = 1069) = 5.00, $p > .05$ (see table 3).

Stage of Change effect at 36 months. A chi-square test revealed a significant difference between baseline Stage of Change for PA and group membership (no action, singular action, paired action) with 12.6% of those in Preparation and 7.9% of those in PC/C being in the paired action group, χ^2 (2, N = 1009) = 6.97, $p < .05$ (see table 3).

H3: It was predicted that Severity at baseline would be associated with behavior change group membership (no action, singular action, paired action) at each follow-up time point (12, 24, 36 months). Severity is defined as the amount of PA or FV servings reported at baseline with the further away from public health criteria, the greater the severity.

[Table 4 near here.]

Baseline Fruit and Vegetable Severity

Severity effect at 12 months- FV. A one-way between subjects ANOVA revealed a significant difference in servings of FV at baseline based on group membership (no action, singular action, paired action), $F(2, 1138) = 19.44$, $p < 0.001$ at the 12 month follow-up. A Tukey post hoc test revealed that participants in the no action group consumed the least FV at baseline (2.36 servings) followed by those in the singular action group (2.55 servings). The paired action group consumed the most FV at baseline (2.99 servings; see table 4).

Severity effect at 24 months- FV. A one-way between subjects ANOVA revealed a significant difference in baseline FV severity based on group membership (no action, singular action, paired action), $F(2, 1066) = 14.63$, $p < 0.001$ at the 24 month follow-up. A Tukey post hoc test revealed that participants in the paired action group consumed significantly more FV (2.99 servings) than the no action (2.43 servings) and singular action group (2.45 servings; see table 4).

Severity effect at 36 months- FV. A one-way between subjects ANOVA revealed a significant difference in baseline FV severity based on group membership (no action, singular action, paired action), $F(2, 1006) = 13.04$, $p < 0.001$ at the 36 month follow-up. A Tukey post hoc test revealed that participants in the no action group consumed the least FV at baseline (2.32 servings) followed by those in the singular action group (2.54 servings). The paired action group consumed the most FV at baseline (2.87 servings; see table 4).

Baseline Physical Activity Severity

Severity effect at 12 months- PA. A one-way between subjects ANOVA revealed no significant difference in baseline PA severity based on group membership (no action, singular action, paired action), $F(2, 1138) = 2.04$, $p = 0.13$ at the 12 month follow-up (see table 4).

Severity effect at 24 months- PA. A one-way between subjects ANOVA revealed a significant difference in baseline PA severity based on group membership (no action, singular action, paired action), $F(2, 1066) = 6.21$, $p < 0.05$ at the 24 month follow-up. A Tukey post hoc test revealed that participants in the no action group engaged in significantly less PA at baseline (98.48 minutes) than those in the singular action group (109.98 minutes; see table 4).

Severity effect at 36 months- PA. A one-way between subjects ANOVA revealed no significant difference in baseline PA severity based on group membership (no action, singular action, paired action), $F(2, 1006) = 2.69$, $p = 0.07$ at the 36 month follow-up (see table 4).

H4: The fourth hypothesis examined whether there were differences in group membership (no action, singular action, paired action) based on effort (pros of change, cons of change, and self-efficacy related to change) at each of the three follow-up time points (12, 24, and 36 months). We hypothesized that baseline effort would differ based on behavior change group membership.

[Table 5 near here.]

Baseline Fruit and Vegetable Effort

Effort effect at 12 months- FV. A MANOVA revealed a significant difference of group membership (no action, singular action, paired action) on baseline FV effort (self-efficacy, and pros and cons of behavior change), F (6, 2114) = 3.32, $p < .01$; Wilk's $\Lambda = 0.98$, partial $\eta^2 = .01$ at the 12 month follow-up. Univariate testing indicated that there was a significant difference in baseline FV self-efficacy based on group membership, F (2, 1059) = 7.65; $p < .01$; partial $\eta^2 = .01$. Post hoc testing using Tukey's HSD revealed that participants in the paired action group had FV self-efficacy ratings at baseline that were 2.52 points higher than the no action group ($p < 0.001$). Similarly, the paired action group had FV self-efficacy ratings 1.85 points higher than the singular action group at baseline ($p < 0.05$). Univariate testing found no differences in group membership based on pros (F [2, 1059] = 2.68, p = 0.07) or cons (F [2, 1059] = 0.02, p = 0.98) of behavior change (see table 5).

Effort effect at 24 months- FV. A MANOVA revealed a significant difference of group membership (no action, singular action, paired action) based on baseline FV effort (self-efficacy, and pros and cons of behavior change), F (6, 1984) = 2.29, $p < .05$; Wilk's $\Lambda = 0.99$, partial $\eta^2 = .01$ at the 24 month follow-up. Univariate testing indicated that there was a significant difference in baseline FV self-efficacy based on group membership, F (2, 994) = 5.77; $p < .01$; partial $\eta^2 = .01$. Post hoc testing using Tukey's HSD revealed that participants in the paired action group had FV self-efficacy ratings at baseline that were 2.24 points higher than in the no action group ($p < .001$). Similarly, the paired action group had FV self-efficacy ratings 1.96 points higher than in the singular action group at baseline ($p < .01$). Univariate testing found no differences in group membership based on pros (F [2, 994] = 0.16, p > 0.05) or cons (F [2, 994] = 0.42, p > 0.05) of behavior change (see table 5).

Effort effect at 36 months- FV. A MANOVA revealed no significant difference of group membership (no action, singular action, paired action) based on baseline FV effort (self-efficacy, and pros and cons of behavior change), F (6, 1864) = 1.80, $p > .05$ at the 36 month follow-up.

Baseline Physical Activity Effort

Effort effect at 12 months- PA. A MANOVA revealed a significant difference of group membership (no action, singular action, paired action) based on baseline PA effort (self-efficacy, and pros and cons of behavior change), F (6, 2140) = 4.72, $p < .001$; Wilk's $\Lambda = 0.97$, partial $\eta^2 = .01$ at the 12 month follow-up. Univariate testing indicated that there was a significant difference in baseline PA self-efficacy based on group membership, F (2, 1072) = 9.28; $p < .01$; partial $\eta^2 = .02$. Post hoc testing using Tukey's HSD revealed that participants in the paired action group had PA self-efficacy ratings at baseline that were 2.17 points higher than the no action group ($p < 0.001$). Similarly, the singular action group had PA self-efficacy ratings 0.90 points higher than the no action group at baseline (p < 0.05). Additionally, the paired action group had PA self-efficacy ratings 1.27 points higher than the singular action group at baseline ($p = .05$). Univariate testing found no differences in group membership based on pros (F [2, 1072] = 2.70; $p > .05$) or cons (F [2, 1072] = 1.52; $p > .05$) of behavior change (see table 5).

Effort effect at 24 months- PA. A MANOVA revealed no significant difference of group membership (no action, singular action, paired action) based on baseline PA effort (self-efficacy, and pros and cons of behavior change), F (6, 2022) = 1.75, $p < .05$ at the 24 month follow-up.

Effort effect at 36 months- PA. A MANOVA revealed a significant difference of group membership (no action, singular action, paired action) on baseline PA effort (self-efficacy, and pros and cons of behavior change),), F (6, 1902) = 6.26, $p < .001$; Wilk's $\Lambda = 0.96$, partial $\eta^2 = .02$ at the 36 month follow-up. Univariate testing indicated that there was a significant difference in baseline PA self-efficacy based on group membership, F (2, 953) = 11.69; $p < .001$; partial $\eta^2 = .02$, and in PA cons of behavior change sum score based on group membership F (2, 953) = 5.19; $p < .01$; partial $\eta^2 = .01$. Post hoc testing using Tukey's HSD revealed that participants in the singular action group had PA self-efficacy ratings at baseline that were 1.15 points higher than the no action group ($p = 0.01$). Similarly, the paired action group had PA self-efficacy ratings 1.43 points higher than the singular action group at baseline (p < 0.05). Additionally, the paired action group had PA self-efficacy ratings 2.58 points higher than the no action group at baseline ($p < 0.001$). Furthermore, participants in the no action group had PA behavior change cons at baseline that were 0.67 points higher than the singular action group ($p < .05$). Similarly, the paired action group had PA behavior change cons that were 0.86 points higher than the singular action group at baseline (p = 0.05). Univariate testing found no differences in group membership based on pros of behavior change F (2, 953) = 2.22; $p > .05$ (see table 5).

H5: The fifth hypothesis is related to baseline demographics (gender, ethnicity, age, and BMI) and behavior change groupings (no action, singular action, paired action) at each follow-up time point (12, 24, 36 months). It was predicted that demographics would not be associated with behavior change group membership.

[Table 6 near here.]

Gender

Demographic effect at 12 months- gender. A chi-square test was performed to examine the relationship between gender (male, female) and behavior change groupings (no action, singular action, paired action). More participants who identified as male (13.4%) were in the paired action group compared to participants who identified as female (9.9%), χ^2 (2, N = 1140) = 10.27, $p < 0.01$ (see table 6).

Demographic effect at 24 months- gender. A chi-square test was performed to examine the relationship between gender (male, female) and behavior change groupings (no action, singular action, paired action). More participants who identified as male (13.5%) were in the paired action group compared to participants who identified as female (9.6%), χ^2 (2, N = 1068) = 36.53, $p < 0.01$ (see table 6).

Demographic effect at 36 months- gender. A chi-square test was performed to examine the relationship between gender (male, female) and behavior change groupings (no action, singular action, paired action). More participants who identified as male (12.3%) were in the paired action group compared to participants who identified as female (8.5%), χ^2 (2, N = 1009) = 17.19, $p < 0.01$ (see table 6).

Ethnicity

Demographic effect at 12 months- ethnicity. A chi-square test revealed no significant differences between ethnicity (White, not Hispanic, Combination, Unknown/not Reported, Black, not Hispanic, Asian, American Indian/Alaskan Native, Pacific Islander) and behavior change groupings (no action, singular action, paired action), χ^2 (12, N = 1140) = 13.47, $p > .05$ (see table 6).

Demographic effect at 24 months- ethnicity. A chi-square test revealed no significant differences between ethnicity (White, not Hispanic, Combination, Unknown/not Reported, Black, not Hispanic, Asian, American Indian/Alaskan Native, Pacific Islander) and behavior change groupings (no action, singular action, paired action), χ^2 (12, N = 1068) = 7.75, $p > .05$ (see table 6).

Demographic effect at 36 months- ethnicity. A chi-square test revealed no significant differences between ethnicity (White, not Hispanic, Combination, Unknown/not Reported, Black, not Hispanic, Asian, American Indian/Alaskan Native, Pacific Islander) and behavior change groupings (no action, singular action, paired action), χ^2 (12, N = 1008) = 8.05, $p > .05$ (see table 6).

Age

Demographic effect at 12 months- age. A one-way between subjects ANOVA revealed no significant difference in age of participant at baseline (10-14 years) based on group membership (no action, singular action, paired action), $F(2, 1117) = 1.55$, $p = .21$ at the 12 month follow-up (see table 6).

Demographic effect at 24 months- age. A one-way between subjects ANOVA revealed no significant difference in age of participant at baseline (10-14 years) based on group membership (no action, singular action, paired action), χ^2 (8, N = 1053) = 7.75, $p > .05$ at the 24 month follow-up (see table 6).

Demographic effect at 36 months- age. A one-way between subjects ANOVA revealed a significant difference in baseline age of participant (10-15 years) based on group membership (no action, singular action, paired action), $F(2, 990) = 3.69$, $p < .05$ at the 36 month follow-up. A Tukey post hoc test revealed that participants in the singular action group (11.32) were significantly younger than those in the no action group (11.43; see table 6).

BMI

Demographic effect at 12 months- BMI. A one-way between subjects ANOVA revealed no significant difference in BMI at baseline based on group membership (no action, singular action, paired action), $F(2, 1098) = 1.27$, $p = .28$ at the 12 month follow-up (see table 6).

Demographic effect at 24 months- BMI. A one-way between subjects ANOVA revealed no significant difference in BMI at baseline based on group membership (no action, singular action, paired action), $F(2, 1036) = .66$, $p = .52$ at the 24 month follow-up (see table 6).

Demographic effect at 36 months- BMI. A one-way between subjects ANOVA revealed a significant difference in BMI at baseline based on group membership (no action, singular action, paired action), $F(2, 974) = 6.09$, $p < .05$ at the 36 month follow-up. A Tukey post hoc test revealed that participants in the singular action group (19.57) had a significantly lower BMI than those in the no action group (20.73; see table 6).

Discussion

This study shed light on the mechanisms of multiple behavior change within individuals, providing a deeper understanding of what impacts the number of behaviors that an individual changes over time. This study also helps us to understand how different phenomena related to behavior change, specifically, the transtheoretical model may impact longitudinal behavior change. In particular, these results reveal that the four effects of behavior change- Treatment, Stage of Change, Severity, and Effort at baseline, were all significantly related to the number of behaviors changed at a certain time point over the course of the study- 12, 24, or 36 months, or across multiple time points. Furthermore, age, was the only consistent demographic effect across time points.

Treatment vs. Control Group. Overall, treatment effect demonstrated the greatest consistency across behaviors and time points, with significantly more participants in the treatment condition being in the paired action group at each time point (12, 24, and 36 months). This is consistent with prior research examining individuals with pairs of at risk behaviors, that found that the TTM treatment effects produced strong effects in paired action, where treatment was able to change pairs of behavior, yet not individual behaviors (Blissmer et al., 2010). In the present study, the treatment effect is associated with greater numbers of behaviors changed at each time point, which supports the literature that simultaneous treatment produces more MHBC. Behavior change principles learned for one behavior, might be generalized across behaviors, thus facilitating change on another behavior.

Applying TTM can produce synergy by changing multiple behaviors when most models rely on specificity. The classic meta-analysis of Hall and Rossi (2008) examined two fundamental principles of change, namely increasing the Pros of changing from Precontemplation to Action and decreasing the Cons from Contemplation to Action. They found that the Pros of changing increased 1.00 standard deviations and the Cons decreased 0.52 standard deviations. What was striking was that these principles held for

48 behaviors from 10 different countries with eight different languages. These dramatic results support the view that TTM is a universal theory.

Stage of Change. It was hypothesized that participants who were in preparation for FV at baseline would be more likely to be in the paired action group rather than the singular action or no action group at each follow-up time point compared to participants who were in the earlier stages (PC/C) for FV at baseline, and vice versa for those in preparation for PA at baseline. These results demonstrated that the stage effect is seen most consistently among those later in the stages of change for FV at baseline than those later in the stages of change for PA at baseline. Among individuals in later stages of change for FV at baseline, more individuals were in the paired action group at 24, and 36 months, however, this was not significant at 12 months. Among individuals in later stages of change for PA at baseline, more individuals were in the paired action group at 36 months, however, this was not significant at 12 or 24 months. There are various ways that people can take action on multiple behaviors, and this study demonstrates that the stage effect might not be seen until further out in time. These findings build off of a study examining individuals with health behavior risks who changed two behaviors at the final follow up time point (behavior change assessed at 12 and 24 months), where it was found that significantly more individuals changed behaviors sequentially than simultaneously (Dunbar et al., unpublished study). Here, the stage effect is delayed, which is revealed by the 36 month time point. These results also show that the stage effect might impact different behaviors in different manners, where those who are ready to change on one behavior (e.g., FV), are not necessarily more likely to change another behavior (e.g., PA), at earlier points in time.

Severity. It was predicted that baseline severity would be associated with the number of behaviors changed at each time point, with those with lower baseline behavior severity changing more behaviors at each time point. As predicted, participants in the paired action group had less FV severity at baseline at each of the three follow-up time points (12, 24, and 36 months). Surprisingly, baseline PA severity was only significant at 24 months, and this difference was only seen between the no action and singular action group. Here, this might reflect that changing physical activity might be more challenging than changing fruit and vegetable intake.

Effort. When examining the effort effect, which includes decision-making variables (the Pros and Cons of changing behavior) and self-efficacy, higher baseline self-efficacy was most consistently related to being in the paired action group. There was a significant difference in group membership based on baseline FV effort at 12, and 24 months, with participants in the paired action group having the highest self-efficacy ratings at baseline. In contrast, baseline PA effort was significant at 12 and 36 months and not at 24 months. At 12 and 36 months, more participants in the paired action group had higher self-efficacy ratings at baseline. At 36 months, in addition to baseline self-efficacy for PA, significantly more participants in the paired action group had higher cons of behavior change at baseline. These results demonstrate that behavior change mechanisms may both be applicable across behaviors and at the same time, be unique to each behavior. Additionally, among effort variables, self-efficacy might be the greatest predictor of movement through the Stages of Change for energy balanced behaviors, such as fruit and vegetable intake and physical activity.

Demographics. The only consistent demographic effect found was related to gender with significantly more males than females in the paired action group at each follow-up time point. With regard to age and BMI, a significant difference based on participant age and group membership, and BMI and group membership, was only found at 36 months. This significant difference was solely seen between participants in the singular and no action group, with more younger participants in the singular action group and with lower BMIs in the singular action group than in the no action group. Furthermore, ethnicity was not related to number of behaviors changed at any of the follow-up time points. This supports prior research that demonstrates that although demographics may relate to health behavior risk prevalence, they do not appear to differentially predict successful behavior change maintenance (Blissmer et al., 2010).

The results of the present study are not clear cut, yet they provide key evidence that the four effects are related to the number of behaviors that an individual changes. The difference among the relationships found between the four effects and FV and PA and number of behaviors changed might suggest that different effects might be more impactful for different behaviors. Another explanation might be that stage, effort, and severity effects that are impacting one behavior (without the behavior changing), are leading to change on the other behavior. For example, an individual might be further along in the Stages of Change for FV at baseline, thus facilitating change on PA at follow-up time points, with the individual still not changing FV. This further highlighting the similarity and uniqueness of behavior change pathways.

To build on the present findings, further questions for future studies would include the use of other kinds of treatment interventions, as one kind of treatment was used here (TTM-tailored intervention). This secondary data analysis is limited to analyses examining individuals who were in pre-action at baseline for both physical activity and fruit and vegetable intake, which included only a small percentage of the original study participants. However, these findings build upon prior research examining pairs of energy balance behaviors. Achievement of larger and more comparable sample sizes among individuals with additional health risk behaviors would expand the present findings. Furthermore, the behaviors included in this study are positively linked energy balanced behaviors, thus examining the patterns found in the current study among dissimilar behavior pairs (heterogeneous; e.g., smoking, sun exposure, and unhealthy diet) might add to the current program of research. Future research should also examine the combination of all four effects (Treatment, Stages of Change, Severity, and Effort effects) as a predictor of being in the no action, singular action, or paired action group. Additionally, future studies may compare singular action to paired action, paired action to no action, and singular action to no action. This study included the variable BMI as a demographic variable, as it was considered as reflecting participants' health status. Future research would examine BMI as a measure of severity.

Previous research has looked at action vs. no action in health behavior change, whereas this study is novel because it examined what factors impact the different amounts of health behavior change made by individuals. We especially focused on what predicts the number of behaviors that individuals change. Additionally, this study is unique because it tracks individuals over a longer period of time, thus allowing for additional patterns of behavior change to be examined.

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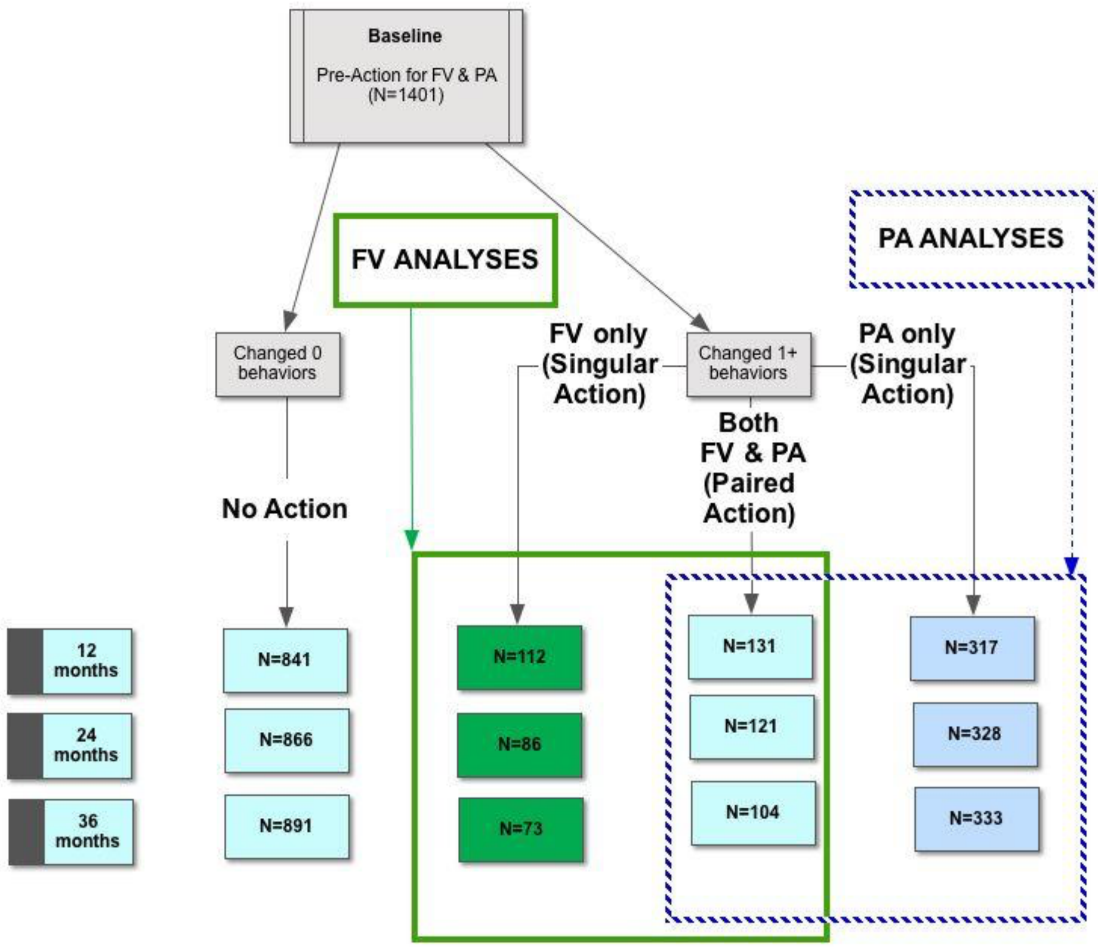
Figure

Figure 1.

Number of Participants in the Paired Action, Singular Action, and No Action Groups at each Time Point for Fruit and Vegetable Consumption and Physical Activity



Tables

Table 1.

Baseline Demographics

Variables	M (SD)	N (%)
1. Age (range from 10-15)	11.42 (0.69)	
2. Gender		
Male		651 (46.6%)
Female		747 (53.4%)
2. Race/ethnicity		
White, not Hispanic		918 (65.7%)
Combination		216 (15.5%)
Unknown/not Reported		131 (9.4%)
Black, not Hispanic		50 (3.6%)
Asian		44 (3.1%)
American Indian/Alaskan Native		28 (2.0%)
Pacific Islander		11 (.8%)
3.Body Mass Index (BMI)*		
Male	20.58 (5.11)	
Female	20.12 (4.84)	
4. Servings of fruits and vegetables/day	2.49 (1.11)	
5. Weekly minutes of physical activity	104.20 (57.02)	

**Note.* Normal Weight BMI (kg/m^2) Range 18.5 to 24.9

Table 2.

Treatment Effect and Behavior Change Groupings at Follow-up Time Points

	No Action % (N)	Singular Action % (N)	Paired Action % (N)	Chi-Square
12 Months				
Treatment	50.2 (296)	35.8 (211)	14.1 (83)	8.35 (df=2)*
Control	51.7 (285)	39.6 (218)	8.7 (48)	
24 Months				
Treatment	44.3 (244)	41.2 (227)	14.5 (80)	19.40 (df=2)**
Control	56.0 (290)	36.1 (187)	7.9 (41)	
36 Months				
Treatment	43.5 (230)	42.7 (226)	13.8 (73)	22.90 (df=2)**
Control	56.0 (269)	37.5 (180)	6.5 (31)	

Note. All percentages are row percentages.
* $p < .05$
** $p < .01$

Table 3.

Baseline Stage of Change Effect and Behavior Change Groupings at Follow-up Time Points

		No Action % (N)	Singular Action % (N)	Paired Action % (N)	Chi-Square
12 Months					
	PR for FV	49.4 (281)	37.8 (215)	12.8 (73)	2.33 (df=2)
	PC/C for FV	52.4 (300)	37.4 (214)	10.1 (58)	
	PR for PA	48.3 (293)	40.3 (244)	11.4 (69)	4.13 (df=2)
	PC/C for PA	53.8 (288)	34.6 (185)	11.6 (62)	
24 Months					
	PR for FV	46.7 (248)	39.9 (212)	13.4 (71)	6.55* (df=2)
	PC/C for FV	53.2 (286)	37.5 (202)	9.3 (50)	
	PR for PA	46.8 (267)	41.2 (235)	12.1 (69)	5.00 (df=2)
	PC/C for PA	53.6 (267)	35.9 (179)	10.4 (52)	
36 Months					
	PR for FV	47.7 (233)	39.1 (191)	13.1 (64)	8.07* (df=2)
	PC/C for FV	51.1 (266)	41.3 (215)	7.7 (40)	
	PR for PA	46.9 (246)	40.6 (213)	12.6 (66)	6.97* (df=2)
	PC/C for PA	52.3 (253)	39.9 (193)	7.9 (38)	

Note. All percentages are row percentages.
*Significant at $p < .05$

Table 4.

Baseline Severity Effect and Behavior Change Groupings at Follow-up Time Points

		No Action M *(sd)*	Singular Action M *(sd)*	Paired Action M *(sd)*	ANOVA	Tukey
12 Months						
	FV servings	2.36 *(1.08)*	2.55 *(1.07)*	2.99 *(1.03)*	$F(2, 1138) = 19.44$, $p < 0.001$	No action<singular<paired
	PE mins	102.75 *(54.48)*	109.70 *(57.90)*	108.51 *(57.00)*	$F(2, 1138) = 2.04$, $p = 0.13$	Not significant
24 Months						
	FV servings	2.43 *(1.08)*	2.45 *(1.08)*	2.99 *(0.98)*	$F(2, 1066) = 14.63$, $p < 0.001$	No action, singular<paired
	PE mins	98.48 *(53.99)*	109.98 *(55.20)*	110.91 *(53.15)*	$F(2, 1066) = 6.21$, $p < 0.05$	No action<singular action
36 Months						
	FV servings	2.32 *(1.11)*	2.54 *(1.06)*	2.87 *(0.91)*	$F(2, 1006) = 13.04$, $p < 0.001$	No action<singular<paired
	PE mins	100.93 *(53.18)*	108.20 *(55.09)*	111.01 *(60.79)*	$F(2, 1006) = 2.69$, $p = 0.07$	Not Significant

Note. All percentages are row percentages.
* $p < .05$
** $p < .01$

Table 5.

Baseline Effort Effect and Behavior Change Groupings at Follow-up Time Points

		No Action M *(sd)*	Singular Action M *(sd)*	Paired Action M *(sd)*	MANOVA	Tukey
12 Months						
	FV Pros	16.27 *(3.82)*	16.84 *(3.68)*	16.7 *(3.97)*	2.68 (df=2)	
	FV Cons	9.78 *(4.68)*	9.82 *(4.94)*	9.71 *(5.21)*	0.02 (df=2)	
	FV Self-efficacy	17.49 *(6.31)*	18.15 *(6.55)*	20 *(6.76)*	7.65** (df=2)	Paired action> no action and singular action
	PA Pros	16.72 *(3.41)*	17.23 *(3.11)*	17.01 *(3.96)*	2.70 (df=2)	
	PA Cons	9.76 *(3.23)*	9.37 *(3.38)*	9.57 *(3.36)*	1.52 (df=2)	
	PA Self-efficacy	16.78 *(5.24)*	17.68 *(5.35)*	18.94 *(5.95)*	9.28** (df=2)	Paired action>singular action>no action
24 Months						
	FV Pros	16.43 *(3.72)*	16.32 *(3.79)*	16.52 *(4.02)*	0.16 (df=2)	
	FV Cons	9.80 *(4.70)*	9.51 *(4.66)*	9.60 *(5.23)*	0.42 (df=2)	
	FV Self-efficacy	17.60 *(6.29)*	17.87 *(6.47)*	19.84 *(6.59)*	5.77** (df=2)	Paired action and singular action>no action
	PA				NS	
36 Months						
	FV				NS	
	PA Pros	16.62 *(3.50)*	16.99 *(3.44)*	17.30 *(3.38)*	2.22 (df=2)	
	PA Cons	9.78 *(3.31)*	9.11 *(3.40)*	9.97 *(3.19)*	5.19** (df=2)	No action and paired

						action>singular action
	PA Self-efficacy	16.54 *(5.14)*	17.69 *(5.41)*	19.11 *(5.46)*	11.69** (df=2)	Paired action>singular action>no action

** $p < .01$

Table 6.

Baseline Demographic Effect and Behavior Change Groupings at Follow-up Time Points

			No Action % (N)	Singular Action % (N)	Paired Action % (N)	Chi-Square
12 Months	Gender	Male	45.9 (239)	40.7 (212)	13.4 (70)	10.27**
		Female	55.1 (341)	35.1 (217)	9.9 (131)	
	Ethnicity	White, not Hispanic	51.4 (402)	37.7 (295)	10.9 (85)	13.47
		Combination	47.3 (78)	39.4 (65)	13.3 (22)	
		Unknown/not Reported	53.8 (49)	30.8 (28)	15.4 (14)	
		Black, not Hispanic	57.9 (22)	34.2 (13)	7.9 (3)	
		Asian	52.9 (18)	35.3 (12)	11.8 (4)	
		American Indian/Alaskan	50.0 (11)	36.4 (8)	13.6 (3)	
		Pacific Islander	12.5 (1)	87.5 (7)	0.0 (0)	
24 Months	Gender	Male	39.6 (188)	46.9 (223)	13.5 (64)	36.53**
		Female	58.2 (345)	32.2 (191)	9.6 (57)	
	Ethnicity	White, not Hispanic	50.5 (369)	37.6 (275)	11.9 (87)	7.75
		Combination	47.4 (72)	41.4 (63)	11.2 (17)	
		Unknown/not Reported	44.4 (40)	45.6 (41)	10.0 (9)	
		Black, not Hispanic	52.9 (18)	44.1 (15)	2.9 (1)	
		Asian	57.1 (20)	28.6 (10)	14.3 (5)	
		American Indian/Alaskan	55.0 (11)	40.0 (8)	5.0 (1)	
		Pacific Islander	50.0 (3)	33.3 (2)	16.7 (1)	
36 Months	Gender	Male	42.6 (200)	45.1 (212)	12.3 (58)	17.19**
		Female	55.5 (299)	36.0 (194)	8.5 (46)	
	Ethnicity	White, not Hispanic	47.6 (332)	42.2 (294)	10.2 (71)	8.05
		Combination	44.8 (80)	33.6 (49)	11.6 (17)	
		Unknown/not Reported	52.9 (45)	36.5 (31)	10.6 (9)	

Black, not Hispanic	60.7 (17)	32.1 (9)	7.1 (2)
Asian	44.8 (13)	44.8 (13)	10.3 (3)
American Indian/Alaskan	47.1 (8)	47.1 (8)	5.9 (1)
Pacific Islander	66.7 (4)	16.7 (1)	16.7 (1)

		No Action M *(sd)*	Singular Action M *(sd)*	Paired Action M *(sd)*	ANOVA	Tukey
12 Months						
	Age	11.30 *(.55)*	11.25 *(.49)*	11.23 *(.51)*	$F(2, 1117) = 1.55, p = .21$	Not Significant
	BMI	20.33 *(4.85)*	19.91 *(4.80)*	19.78 *(3.99)*	$F(2, 1098) = 1.27, p = .28$	Not Significant
24 Months						
	Age	11.3 *(.61)*	11.37 *(.62)*	11.28 *(.61)*	$F(2, 1050) = 1.05, p = .35$	Not Significant
	BMI	20.35 *(5.32)*	20.11 *(4.40)*	19.84 *(4.12)*	$F(2, 1036) = .66, p = .52$	Not Significant
36 Months						
	Age	11.43 *(.72)*	11.32 *(.60)*	11.29 *(.62)*	$F(2 ,990) = 3.69, p < .05$	Singular<no action
	BMI	19.57 *(4.42)*	20.05 *(4.95)*	20.20 *(4.93)*	$F(2, 974) = 6.09, p < .05$	Singular<no action

Note. All percentages are row percentages.
*Significant at $p < .05$
**Significant at $p < .01$