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The Effects of Implementation Intentions on Volunteer Firefighter Exercise Behavior: A Randomized Controlled Study

Rodney L. Hammer
Utah State University

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THE EFFECTS OF IMPLEMENTATION INTENTIONS ON VOLUNTEER FIREFIGHTER EXERCISE BEHAVIOR: A RANDOMIZED CONTROLLED STUDY

by

Rodney L. Hammer

A dissertation submitted in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY in Psychology

Approved:

Kerstin E. E. Schroder, Ph.D. Scott Bates, Ph.D.
Major Professor Committee Member

M. Scott DeBerard, Ph.D. Christopher Johnson, Ph.D.
Committee Member Committee Member

Edward M. Heath, Ph.D. Byron R. Burnham, Ed.D.
Committee Member Dean of Graduate Studies

UTAH STATE UNIVERSITY
Logan, Utah

2010
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ABSTRACT

The Effects of Implementation Intentions on Volunteer Firefighter Exercise Behavior:

A Randomized Controlled Study

by

Rodney L. Hammer, Doctor of Philosophy

Utah State University, 2010

Major Professor: Dr. Kerstin E. E. Schroder
Department: Psychology

The current study used a randomized control design to determine if an implementation intention intervention based on the Health Action Process Approach would increase exercise behavior in volunteer firefighters. One hundred forty-seven male and female volunteer firefighters from nine fire departments participated. The treatment group received a survey that prompted them to create exercise implementation intentions by describing “where,” “when,” and “how” they will exercise, while the control group survey included a general exercise message.

We hypothesized that the implementation intervention would increase exercise behavior while the general exercise message would have no effects on exercise, that earlier stage-of-change exercisers would show greater increases in exercise than late-stage exercisers and that there would be an interaction between the intervention and stage membership such that the intervention would be more effective among firefighters in
earlier-stage exercisers. We also hypothesized that the intervention would indirectly decrease sedentary behavior.

Negative binomial regression showed that the intervention \((p = .03)\) was a statistically significant predictor of exercise minutes, supporting the first hypothesis. However, using exercise sessions and leisure time as dependent variables, no significant effects were found for the intervention. Thus, hypothesis one was only partially supported by the results. A stronger group-administered implementation intention formation intervention may be more effective in increasing exercise behavior in volunteer firefighters.

Participants who self-identified as early-stage exercisers were more likely to increase exercise behavior; however, the effects of stage on behavior change were not significant in any of the analyses, leading to the conclusion that hypothesis two had to be rejected. Further, there was no significant stage-by-intervention interaction in any of the analyses, lending no support to hypothesis three. However, a tendency in the expected direction was detected, suggesting that a low-intensity implementation formation intervention may increase exercise time in early-exercise stage volunteer firefighters more than among late-stage members.

In conclusion, this research suggests implementation intention formation influences increased exercise behavior in volunteer firefighters who do not exercise or are not regular exercisers. Future research with a stronger intervention is warranted.
ACKNOWLEDGMENTS

I would like to thank Dr. Kerstin Schroder for her advice, support, and encouragement to complete this research. I would also like to thank my committee members, Drs. Edward Heath, Scott Bates, Scott DeBerard, and Christopher Johnson, for their counsel and advice through this process. I give special thanks to my wife, Colleena, and our children for their encouragement, support, and patience as I try to figure out what I want to be when I grow up. I could not have done it without all of you.

Rodney L. Hammer
CONTENTS

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT.................................................................................................................. iii</td>
</tr>
<tr>
<td>ACKNOWLEDGMENTS ..................................................................................................... v</td>
</tr>
<tr>
<td>LIST OF TABLES......................................................................................................... ix</td>
</tr>
<tr>
<td>LIST OF FIGURES....................................................................................................... x</td>
</tr>
</tbody>
</table>

CHAPTER

I. INTRODUCTION ............................................................................................................. 11

II. LITERATURE REVIEW ................................................................................................. 15

Health Risks, Health Status, and Health Promotion among Volunteer Firefighters .......................................................... 15

Prevalence of Death among Volunteer Firefighters ..................................................... 15
Fitness Levels of Volunteer Firefighters ............................................................... 16
Physical Intensity of Fire Suppressions Activities ..................................................... 17
Exercise promotion for Volunteer Firefighters ....................................................... 19

Theories of Behavior Change ......................................................................................... 21

Theory of Reasoned Behavior ....................................................................................... 21
Self-efficacy Theory ......................................................................................................... 22
Theory of Planned Behavior .......................................................................................... 23
Health Belief Model ........................................................................................................ 25
Transtheoretical Model .................................................................................................. 26
Action Control Theory .................................................................................................... 28
Health Action Process Approach .................................................................................. 29

Summary ......................................................................................................................... 32
Hypothesis ....................................................................................................................... 33

III. METHODOLOGY ........................................................................................................ 34

Human Protection ........................................................................................................... 34
Participants ...................................................................................................................... 35
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Distribution of Exercise Stage for All Participants (n = 147)</td>
</tr>
<tr>
<td>2</td>
<td>Baseline Descriptive Statistics for Quantitative Demographic Variables of All Participants (n = 147)</td>
</tr>
<tr>
<td>3</td>
<td>Detailed Baseline Descriptive Statistics for Categorical Demographic Variables of All Participants (n = 147)</td>
</tr>
<tr>
<td>4</td>
<td>Baseline Descriptive Statistics for Demographic Variables Comparing Those Who Completed the Study to Those Who Dropped Out (n = 147)</td>
</tr>
<tr>
<td>5</td>
<td>Baseline Descriptive Statistics for Categorical Demographic Variables Comparing Those Who Completed the Study to Those Who Dropped Out (n = 147)</td>
</tr>
<tr>
<td>6</td>
<td>Mean and Variance of the Dependent Variables</td>
</tr>
<tr>
<td>7</td>
<td>Summary of Hierarchical Negative Binomial Regression Analysis for Variables Predicting Postexercise Minutes in Volunteer Firefighters (n = 85)</td>
</tr>
<tr>
<td>8</td>
<td>Summary of Hierarchical Negative Binomial Regression Analysis for Variables Predicting Postexercise Sessions in Volunteer Firefighters (n = 85)</td>
</tr>
<tr>
<td>9</td>
<td>Summary of Hierarchical Logistic Regression Analysis for Variables Predicting Dichotomous Postexercise Behavior in Volunteer Firefighters (n = 85)</td>
</tr>
<tr>
<td>10</td>
<td>Summary of Hierarchical Negative Binomial Regression Analysis for Variables Predicting Postintervention Sedentary Behavior in Volunteer Firefighters (n = 85)</td>
</tr>
<tr>
<td>11</td>
<td>Pre- and Posttreatment Statistics and Cohen’s (d) Effect Size for Each Category Subdivision</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Theory of planned behavior</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>Transtheoretical model</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>Health action process approach</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>Flow diagram for participant randomization</td>
<td>56</td>
</tr>
<tr>
<td>5</td>
<td>Data distribution of postintervention exercise minutes</td>
<td>64</td>
</tr>
<tr>
<td>6</td>
<td>Data distribution of postintervention exercise sessions</td>
<td>65</td>
</tr>
<tr>
<td>7</td>
<td>Data distribution of postintervention TV/computer minutes</td>
<td>66</td>
</tr>
<tr>
<td>8</td>
<td>Mean amplitude of pre- and postintervention minutes by group</td>
<td>80</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

The leading cause of death among volunteer firefighters is myocardial infarction due to the high physical demands of firefighting coupled with low physical fitness of volunteer firefighters (Fahy, 2005). Fire suppression activities require intense physical effort for extended periods of time. In many instances, volunteer firefighters are not physically capable of performing these activities safely without risk of myocardial infarction. Volunteer firefighters have higher overweight and obesity rates than the general population indicating low participation in physical activity and eating a healthy diet (Hammer, Heath, & Schroder, 2009).

The American Heart Association identifies overweight and obesity, physical inactivity, smoking, high blood pressure, high cholesterol, and diabetes as controllable risk factors in preventing myocardial infarction (American Heart Association, 2009). Increasing physical activity and adopting a healthy diet has been shown to reduce the risk of myocardial infarction. If volunteer firefighters participate in physical activity, they may reduce their risk of dying from a myocardial infarction while performing fire suppression activities. However, to date no research has been performed to examine the potential of a theory-guided intervention to improve exercise behaviors among volunteer firefighters.

Social cognitive models have been developed to explain exercise behavior in various populations. These models form the foundation for effective behavioral intervention. Ajzen and Fishbein’s (1980) theory of planned behavior (TPB) is one of the most popular models used to predict health behavior. The TPB is a structural model that
explains behavior as a function of motivational factors culminating in an intention.

Research using the TPB has shown that intentions constitute one of the best predictors of behavior. However, as many people have experienced, good intentions do not necessarily lead to changes in behavior.

Kuhl and Atkinson (1986) introduced a theory of action control recognizing the difference between preintentional and postintentional behavior. At the same time, Heckhausen and Gollwitzer (as cited in Heckhausen & Heckhausen, 2008) developed the Rubicon model of action phases distinguishing the difference between the motivational and volitional action phases. The motivational phase occurs in the development of the intention, while the volitional action occurs after the intention is formed. During the postintentional volition phase, planning and initiating behavior occurs.

The Health Action Process Approach (HAPA; Schwarzer & Lusczczynska, 2008) provides an integrative approach that combines features of intentional models such as the TPB with volition theory. Schwarzer and Lusczczynska utilized a model that differentiates between the preintentional motivation that leads to intention and the postintentional volition that leads to actual health behavior. Developing goal intentions requires a different approach than developing behavior. Processes such as action planning to determine the “where, when, and how” play an important role in the volitional stage in order to move from intention to behavior. Based on this background, Gollwitzer (1999) recommended that after people form goal intentions such as “I plan to exercise regularly” they should shift into the action-planning or volitional stage by determining the “when,” “where,” and “how” of behaviors leading to goal attainment, thus forming implementation intentions.
No research has been found that applies action control theory to bridge the intention-behavior gap to increase exercise behavior in volunteer firefighters. Therefore, the purpose of this study was to apply action control theory to predict and enhance exercise behavior among volunteer firefighters who were planning to exercise but had not begun a regular exercise program. An experimental randomized controlled trial was conducted to test the hypothesis that an intervention designed to facilitate the formation of implementation intentions would increase exercise behavior relative to a control group of volunteer firefighters who were equally motivated to exercise but did not receive the action control intervention. Because implementation intentions are theoretically assumed to be particularly beneficial prior to adopting a new behavior, it was further expected that the effects of the intervention would be stronger among volunteer firefighters who were in “earlier stages of change,” that is, who had not yet started an exercise program or not yet adopted exercising as a regular habit.

To test these hypotheses, 147 volunteer firefighters were recruited to take part in the study. The participants were randomly assigned to a treatment or control group. Of the firefighters recruited, 85 returned their weekly exercise log and were included in the comparison of pre- and posttreatment exercise behavior. Because the data distributions of the dependent variables were count data with a positive skew and, thus, did not meet the assumptions of ordinary linear regression, negative binomial regression techniques were applied.

The results were mixed. Both treatment and stage-of-change membership were significant predictors of postintervention exercise behavior. Relative to participants in the control group, those in the treatment group significantly increased the number of minutes
of exercise during the 2-week postintervention period. Further, volunteer firefighters in earlier stages of exercise increased the number of minutes of exercise more than those who were regular exercisers already before the intervention started. However, when analyzing the number of exercise sessions, neither treatment nor stage membership were significant predictors in the regression model. There was not a significant interaction between the treatment and stage membership in any of these analyses.

A secondary hypothesis was that the intervention would have an indirect effect in terms of a reduction of sedentary behavior. To examine this hypothesis, we compared the number of minutes of television and leisure time computer use during the two-week postintervention period compared to the 2-week preintervention period. While the number of minutes of leisure time TV/computer viewing decreased across the entire sample, neither the treatment or stage membership were statistically significant predictors of this behavior. There was also no significant interaction between stage and treatment.

One important finding of this study was that the local volunteer firefighters had higher prevalence of overweight and obesity than the general population. This confirms the need to develop an intervention that will increase healthy behavior. Our intervention showed promise. While the results of the study were mixed, there was a definite trend toward more exercise in the treatment group. This may be due in part to the weakness of the intervention. A more intense and sophisticated intervention strategy involving, for example, refined exercise planning tools, individually tailored feedback on progress, and follow-up sessions addressing barriers may be needed to produce stronger effects.
CHAPTER II
REVIEW OF LITERATURE

The review of literature will begin with an examination of the health risk factors leading to volunteer firefighter deaths during and after fire suppression activities. A discussion of the fitness levels of volunteer firefighters followed by an examination of the intensity of fire suppression activities will help illustrate the danger to volunteer firefighters. Next, exercise behavior change will be examined in the context of established social-cognitive theories leading to the HAPA. This review will guide the creation of an intervention plan to determine if action control theory increases exercise behavior in volunteer firefighters, especially among those with poor pre-existing exercise habits.

Health Risks, Health Status, and Health Promotion among Volunteer Firefighters

Prevalence of Death among Volunteer Firefighters

According to the National Fire Protection Association, which tracks all firefighter fatalities (Fahy, 2005), the leading cause of death among on-duty firefighters is sudden cardiac death. Statistics presented by the Centers for Disease Control and Prevention (CDC) report 610 volunteer firefighter fatalities in the United States between 1994 and 2004. Half of the volunteer firefighter deaths were caused by myocardial infarction. The median age of those who died was 47 years (range 15-81 years). Stress and overexertion were attributed to 98% of volunteer firefighter sudden cardiac arrest deaths (CDC, 2010). Fire suppression activities were associated with the highest risk of death to firefighters.
Kales, Soteriades, Christophi, and Christiani (2007) reported that this risk is approximately 10-100 times as high as that for nonemergency duties of firefighters. They also reported that 45% of all firefighter deaths are due to myocardial infarction precipitated by heart disease. In contrast, 15% of all other occupation “on the job” deaths are caused by cardiovascular events.

**Fitness Levels of Volunteer Firefighters**

In a study examining cause of sudden cardiac death in firefighters, Fahy (2005) found that of the 308 deceased firefighters whose records could be retrieved, 43% had prior known heart-related conditions such as previous myocardial infarction or had undergone bypass surgery or angioplasty/stent placement. Another 31.5% had arteriosclerotic heart disease with occlusion of at least 50% of the coronary arteries.

Three descriptive research articles were located that describe fitness levels of volunteer firefighters. Swank, Adams, Barnard, Berning, and Stamford (2000) found that the mean Body Mass Index (BMI) for rural volunteer firefighters was 27.8 + 4.5 (range 17.9 – 41.9) indicating that the average firefighter was overweight (BMI ≥ 25) and that some were obese (BMI ≥ 30). This could indicate that these firefighters were fairly inactive. An examination of aerobic capacity verifies this. Among firefighters Swank et al. (2000) tested, only 10% had an aerobic capacity (VO\(_{2\text{max}}\)) above 40 ml/kg/min. Aerobic capacity recommendation for firefighters is a VO\(_{2\text{max}}\) greater than 45 ml/kg/min (Gledhill & Jamnik, 1992). Hammer et al. (2009) found that 78% of volunteer firefighters were overweight or obese based on BMI. Hammer et al. (2009) also reported the mean
VO2\text{max} of volunteer firefighters was 39 ml/kg/min, lower than the recommended minimum of 45 ml/kg/min. Again, indicating that the volunteer firefighters were inactive.

A third investigation by Gaetano et al. (2007) reviewed health screening of 1,458 volunteer firefighters and Emergency Medical Service (EMS) personnel (mean age 41.7 years) in rural New York. They found that 34% had one or more abnormal findings. Specifically, they found 29% \((n = 192)\) had abnormal spirometry (pulmonary function), 36% \((n = 238)\) showed instances of hypertension (blood pressure > 140/90), 24% \((n = 159)\) had abnormal electrocardiograms, and 10% \((n = 69)\) displayed abnormal physical exams. Of 315 firefighters age 45 years and over examined for firefighter classification, 17% \((n = 52)\) had substantial risk of coronary heart disease. This screening suggests that a third of volunteer firefighters have potential risk factors for myocardial infarction and that as many as 17% may have substantial risk.

**Physical Intensity of Fire Suppression Activities**

Several descriptive studies were found that examined the work intensity of firefighting. Firefighting has been shown to be physically demanding. Firefighters routinely carry 27.2 kg of self-protection including fire coat, pants, helmet, gloves, self-contained breathing apparatus (SCBA) and a facemask. Gledhill and Jamnik (1992) examined the heart rate and VO2 levels of professional firefighters while performing simulated firefighting tasks including: carrying equipment, advancing charged hoses, forcible entry, raising ladders, pike pole work, rescuing victims, and so forth. They found that 10% of the most demanding firefighting operations required a mean peak VO2 of 41.5 ml/kg/min. Gledhill and Jamnik (1992) recommended a minimum VO2\text{max} of 45
ml/kg/min for all active duty firefighters. Davis, Dotson, and Santa Maria (1992) found that heart rates of firefighters peaked at 97% of age-predicted max heart rate indicating firefighters were working at near maximal physical levels. Lusa, Louhevaara, Smolander, Kivimaki, and Korhonen (1993) reported 22% of firefighters exceeded their age-predicted maximal heart rate when conducting fire ground search and rescue operations.

The American College of Sports Medicine (ACSM; 2009) recommends a physician be present whenever maximal exertion tests are conducted on patients who undergo physical testing to reach their maximum heart rate if the patients have two or more coronary artery disease risk factors including BMI $\geq 30$ and a sedentary lifestyle. If these volunteer firefighters exceed their age-predicted maximal heart rate similar to the 22% in the study by Lusa et al. (1993), they are at serious risk of sudden cardiac death according to the ACSM. They are exerting themselves much more than they should given their physical fitness.

Fifty percent of volunteer firefighter fatalities are the direct result of a heart attack. Of those who died of a myocardial infarction, Kales et al. (2007) reported that 32.1% of on duty firefighter deaths occurred during fire suppression operations. Another 25.9% occurred while responding to or from an alarm. Fahy (2005) stated:

Firefighting activities are strenuous and often require firefighters to work at near maximal heart rates for long periods. The increase in heart rate has been shown to begin with responding to the initial alarm and to persist through the course of fire suppression activities. (p. 2)

Clearly, a combination of poor physical fitness coupled with the strenuous nature of fire suppression is putting the lives of volunteer firefighters at risk as they serve their community.
Exercise Promotion for Volunteer Firefighters

No studies were found that examined exercise promotion for volunteer firefighters. Three research articles were found describing exercise promotion programs for career firefighters using Pubmed electronic database search. Keywords entered were firefighter exercise, and firefighter. All involved professional full time firefighters or new firefighter recruits in fire training (Adams et al., 1986; Elliot et al., 2004; Roberts, O’Dea, Boyce, & Mannix, 2002).

Two of the articles reported using standard physical training practices guided by certified trainers. These programs only reported exercise training guidelines with no report of the fundamental cognitive theory guiding the intervention. Adams et al. (1986) found significant (Cohen’s $d$ ES = 0.17) changes in body weight, aerobic capacity (Cohen’s $d$ ES = 0.44), and exercise time (Cohen’s $d$ ES = 0.10) using a 14-week training program. While the results were statistically significant, the effect size of weight loss and exercise time was small, while the effect size of aerobic capacity was moderate.

One of the studies used a worksite health promotion intervention. Elliot et al. (2004) compared a team-based curriculum, an individual counselor, and a control group. The team approach significantly increased coworker cohesion ($p < 0.05$, Cohen’s $d$ ES = 1.25) and shift exercise habits ($p < 0.001$, Cohen’s $d$ ES = 1.44) when compared to the control group. The counselor strategy significantly increased dietary self-monitoring ($p < 0.01$, Cohen’s $d$ ES = 0.36) and reduced depressed feelings ($p < 0.01$, Cohen’s $d$ ES = 0.94) when compared with the control group. Shift cohesion increased in a group x time
interaction ($p < 0.05$), while shift exercise habits increased in a group x time interaction ($p < 0.01$).

While these variables showed a moderate-to-large effect size, traditional measures of physical fitness improvement including weight loss and BMI were statistically and practically insignificant. This intervention may have been theory based but did not describe it as such. Elliot et al. (2004) did not identify why they chose these methods as a comparison, nor did they describe or measure theoretical constructs shown to be predictors of exercise participation and behavioral change.

None of the preceding studies included volunteer firefighters. There is an important difference between volunteer firefighters and full time professional firefighters. The professional firefighters typically work a 24- to 48-hr shift with at least one hour per day specifically reserved for physical training. The career firefighting culture recognizes the physical nature of the work because they respond to more fire calls than volunteer firefighters. On the other hand, volunteer firefighters attend from one to four 2-hr fire-training drills per month consisting of classroom lecture and some simulation of fire suppression tasks. This may be their only nonemergency contact with other volunteer firefighters. Typically, there is no time mandated to physical training for volunteer firefighters and no time spent during drills for physical exercise to increase physical conditioning. The only contact they have with the fire station and other department personnel is when they are paged out to fight fires.
Theories of Behavior Change

Over the past five decades, researchers have identified several models to describe social-cognitive factors associated with changes in health behavior. Basic features of the most well-known and well-recognized models of health behavior such as the Theory of Planned Behavior (Ajzen & Fishbein, 1980) have been integrated into a comprehensive new model called the Health Action Process Approach (HAPA), which combines both motivational and action control stages of behavior change. In the following section, the models and model features leading to the HAPA approach will be briefly discussed.

Theory of Reasoned Action

The theory of reasoned action (TRA; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) is a “motivational model” of health behavior rooted in traditional expectancy-value theories of motivation. It is “considered to be a deliberative processing model” describing how individuals make behavioral decisions based on “careful consideration of available information” (Conner & Sparks, 1996). According to the TRA, intentions precede behavior. For example, one must first have an intention to exercise prior to the performance of exercise behavior. Intention to perform a behavior is influenced by two components: attitudes toward that behavior and subjective norms related to the behavior. Both attitudes and subjective norms are modeled according to an expectancy-value theory. Attitudes towards exercise behavior are shaped by the individual’s beliefs about the consequences of exercise (anticipated contingencies) and the personal positive or negative values of these consequences (values). Similarly, subjective norms describe a person’s normative beliefs (i.e., how significant others think about how he or she should
be involved in exercise behavior) and the person’s willingness to conform to these expectations. It is an assessment of social pressure (Conner & Sparks, 1996).

An important shortcoming of the TRA was its inability to account for behaviors that may not be fully under personal control and, thus, may be perceived as too difficult to perform, preventing an action even if attitudes and social norms are strongly supporting the behavior. A component such as “self-efficacy beliefs,” accounting for individual differences in perceived behavioral control was missing. The TRA was eventually modified to include such a component, leading to the TPB. The TPB can best be understood on the background of self-efficacy theory, which will be discussed next.

**Self-efficacy Theory**

While not a theoretical model of health behavior, self-efficacy is nevertheless an important construct in understanding behavior change. Bandura (1977) defined self-efficacy as an individual’s belief that he or she can successfully execute the behavior required to produce a certain outcome. This theory is important in the adoption of behavioral change. For example, a firefighter may recognize the risk of death due to heart attack, expect that changing his behavior (i.e., adopting an exercise program) would reduce the risk, and finally, believe that he is capable of successfully executing his planned behavior. This belief in the ability to execute the behavior is a result of performance accomplishments, vicarious experience, verbal persuasion, and psychological states (Bandura, 1977).

Performance accomplishments are those activities successfully completed by the individual and are the most influential developers of self-efficacy. Self-efficacy may also
be gained through vicarious experience, or watching others perform. If a firefighter sees others regularly exercise, he might be more inclined to believe that he can do the same thing. A third source of self-efficacy perceptions is through verbal persuasion. While somewhat weaker than personal or vicarious experience, individuals can nonetheless become more convinced in their ability to complete a task through persuasion. However, self-efficacy developed through this method can easily be altered through unsuccessful experiences. Finally, Bandura (1977) has suggested that self-efficacy may be influenced through emotional arousal, specifically avoidance behavior. These are typically destructive actions, leading to a reduction in self-efficacy beliefs.

Perceived self-efficacy has been found to be a major force in adopting and maintaining an exercise program (Schwarzer & Fuchs, 1996). Berger, Pargman, and Weinberg (2002) provided summaries of several research projects using the self-efficacy construct. They assert “self-efficacy was the most consistent predictor of changes in exercise behavior over time despite the fact that many variables were used to predict exercise changes.” Holden (1991) found in a meta-analysis that subject ratings of self-efficacy were found to consistently predict subsequent health-related outcomes including exercise behavior (ES = 0.34).

The Theory of Planned Behavior

The TPB (see Figure 1) was developed by Ajzen and Fishbein (1980), Ajzen and Madden (1986) as an extension of the TRA with the aim to better account for behaviors that may not be fully under a person’s control. The goal was to address factors that an individual might perceive to be out of their control. Perceived behavioral control or the
individual’s perception of the ease or difficulty of the performance of the behavior (Conner & Sparks, 1996) was added as a fourth predictor. Perceived behavioral control has been compared to self-efficacy. Of importance is the fact that perceived behavioral control and self-efficacy not only influence the formation of intentions, but directly influence behavior as well. The more a firefighter believes that he can exercise, the more likely he is to engage in that behavior.

Some researchers have considered self-efficacy and the perceived behavioral control construct of the TPB to be equivalent. Berger et al. (2002) summarized research where self-efficacy has been the equivalent of perceived behavioral control with the results that self-efficacy was predictive of exercise intentions and exercise behavior. At
the same time, Bandura (1977) argued that the two constructs are not the same and that self-efficacy must be measured independently of the TPB. The solution to this controversy is beyond the scope of this paper.

In a meta-analysis of the TPB, Hausenblas, Carron, and Mack (1997) found 31 studies based on 10,621 participants yielding 162 effect sizes (reported as Hedges & Olkin $d$), which indicate that the TPB is superior to the TRA in accounting for intention to exercise. Hausenblas et al. (1997) reported that the direct determinant of exercise behavior is intention (Hedges & Olkin; $d$ ES = 1.09, $r$ = .47) in the TRA. While reducing the effect of intention on exercise behavior, the TPB showed that perceived behavioral control had a large relationship with exercise behavior (Hedges & Olkin, $d$ ES = 1.01, $r$ = .45) and intention (Hedges & Olkin, $d$ ES = 0.97, $r$ = 43).

**Health Belief Model**

The health belief model (HBM) is an expectancy-value model that explains health behavior as a function of threat perception and behavioral evaluation. Threat perception is defined as the individual’s susceptibility to an illness and the severity of the consequences of that illness. Behavioral evaluation refers to the benefits and barriers of enacting a behavior (Sheeran & Abraham, 1996). The HBM was important to the development of later theories of health behavior in pointing out the relevance of health risk perceptions in changing health (risk) behaviors. Several later theories adopted perceived vulnerability and perceived severity of health risks as predictors of health behavior, thus featuring a perceived risk component.
As applied to this study, a firefighter will be less likely to implement intentions to exercise if he perceives a heart attack as either a low risk or a low severity incident. He may be more inclined to exercise if he perceives the risk to be low and the severity high or the risk to be high but the severity low. He will be most inclined to exercise if he perceives the risk and severity to be high.

**Transtheoretical Model**

The transtheoretical model (TTM; see Figure 2) is a stage model developed by Prochaska and DiClemente (1983) that argues that an individual progresses through a series of stages of change in a cyclical pattern. The stages include precontemplation, contemplation, preparation, action, and maintenance. Precontemplation describes the state of individuals who have either no desire to change, or do not feel any need to change. Contemplation describes those who intend to change their behavior (begin to exercise) within the next six months. Preparation includes those who seriously intend to take action within the next month. These individuals may have taken some action in the recent past towards exercise behavior but have not regularly participated. By definition, these early stages reflect nonexercisers or nonregular exercisers. Precontemplators do not feel any desire or need to exercise, contemplators intend to exercise within the next six months, and those in preparation seriously intend to take action within the next month. However, none are regular exercisers and all have room for improvement.

The action stage describes those who are actively engaged in the desired behavior but have done so for less than six months, and finally, the maintenance period begins
The transtheoretical model describes a five-stage behavioral change process: precontemplation, contemplation, preparation, action, and maintenance. The model was adapted from Prochaska and diClemente’s work and has been widely applied to understand and intervene in various health behaviors, including exercise. The stages are progressive, with each stage building on the previous one.

### Figure 2. Transtheoretical model.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Precontemplation</td>
<td>Individuals have not considered the behavior or seen the benefits.</td>
</tr>
<tr>
<td>Contemplation</td>
<td>Individuals are thinking about the behavior and its benefits.</td>
</tr>
<tr>
<td>Preparation</td>
<td>Individuals are actively preparing to perform the behavior.</td>
</tr>
<tr>
<td>Action</td>
<td>Individuals have performed the behavior at least once.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Individuals have performed the behavior regularly for at least six months.</td>
</tr>
</tbody>
</table>

In the most simplistic form, an individual would progress through each stage to achieve the goal of regular physical activity. However, this is rare. Most people move up and down throughout the stages of the model over time (Velicer, Prochaska, Fava, Norman, & Redding, 1998). The transtheoretical model has been applied to the study of exercise behavior. Marcus and Simkin (1994) reviewed several research studies showing...
that interventions tailored to specific stages have been effective in changing exercise behavior. The reliability of the stages of change instrument over a 2-week period had a Kappa index of .78 (Marcus, Rossi, Selby, Niaura, & Abrams, 1992).

**Action Control Theory**

Building on motivation psychology, Heckhausen and Gollwitzer (as cited in Heckhausen & Heckhausen, 2008), Gollwitzer (1996), Kuhl and Atkinson (1986), Sniehotta, Scholz, and Schwarzer (2006), and others identified action control strategies that would lead to successful goal attainment. These strategies recognized the difference between goal setting (motivation) and goal striving (volition). Their model also recognized the commonality of these two actions. Similar to the TTM stage theory, it divides the emergence, maturation, and fading of motivation into four distinct phases separated by clear transition points.

The predecisional first phase includes deliberating the positive and negative consequences of action alternatives (Heckhausen & Heckhausen, 2008). The end of this phase is marked by the formation of intentions. The next phase (preactional) includes planning strategies to achieve the predetermined goal. The third stage (action) begins with intention initiation and involves the enacting of strategies. This action phase of the model ends with intention deactivation. Finally, an evaluation (postactional) phase comes into play where results of their action are measured against goals set in the predecisional phase.

It becomes apparent that the predecisional phase leads to the formation of intentions. As shown in the TPB, intention is a predictor of behavior, but the TPB does
not address the intention-behavior gap. Action control theory (ACT) does so in such a way as to explain goal setting (intention development) and goal attainment through action control, including implementation intentions as a major action planning strategy.

**Health Action Process Approach**

Schwarzer developed the HAPA (see Figure 3) in the late 1980s by integrating Bandura’s social cognitive theory, Fishbein and Ajzen’s TRA, and Heckhausen and Gollwitzer’s volition theories and applied them to health behavior change (Schwarzer & Luszczynska, 2008). He expanded on the work of Kuhl, Hechhausen, and Gollwitzer and applied the difference between the preintentional motivation processes that lead to an intention and the postintentional volition process that bridges the intention behavior gap to the theory of health behavior. As suggested in ACT, Schwarzer and Luszcynska’s model utilizes preintentional motivation derived from risk perception, outcome expectancies, and perceived self-efficacy. Schwarzer and Luszcynska identified people in this stage as preintenders. The preintentional phase is identified as Time 1 in the HAPA model.

After an intention is formed, Schwarzer and Luszcynska (2008) recommended action planning to bridge the gap between intention and behavior. Individuals in this stage are considered intenders. Action plans may include mental simulation, appeals based on fear combined with specific instruction, or implementation planning where specific parameters of action including the “where,” “when,” and “how” are addressed. Implementation planning or implementation intentions are practical, automatic processes
that are called up when encountering problems in translating goals to actions. Rather than focusing on goals “I intend to exercise regularly,” implementation intentions focus on the “where, when, and how” aspects of goal attainment. This phase is identified as “Time 2” by Schwarzer and Luszczynska (2008).

Another important factor in Time 2 is maintenance self-efficacy. Individuals need to have optimistic beliefs that they are capable of dealing with barriers that may arise as they begin a new behavior. In general, self-efficacy beliefs play a specific role in the HAPA model in that different types of self-efficacy beliefs (preaction, maintenance, recovery self-efficacy) are believed to influence the process of behavior change during the three time points (see Figure 3). However, compared to the TPB (Ajzen & Madden,
1986), self-efficacy beliefs (or perceived behavioral control) and intentions are not sufficient to explain health behavior change. Usually, action planning is required for successful behavior change. In this context, implementation intentions (as the result of a successful planning stage, identifying the “when,” “where,” and “how”) facilitate entry into behavior as identified in Time 3.

Implementation intentions have been found to be successful in compliance with exercise programs (Milne, Orbell, & Sheeran, 2002). Milne et al. (2002) reported that exercisers completed 91% of prescribed sessions using implementation intentions, while the control group only completed 29% of their prescribed exercise sessions. Sniehotta, Scholz, and Schwarzer (2005) found that by adding planning as a mediating variable between intention and exercise behavior that intention was no longer significant. Comparing regression models with and without volitional planning and maintenance self-efficacy showed that intentions are fully mediated by planning. The model without planning explained 11% of the variance in exercise behavior, while the model including planning explained 24% of the variance in exercise behavior (Sniehotta et al., 2005).

Several other researchers have used implementation intention interventions and have shown increased adherence in various health behaviors in studies comparing implementation intention participants with a control group including exercise adherence in rehabilitation (Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008), and general exercise (Cohen’s $d$ ES = .50; Prestwich, Lawton, & Conner, 2003). In a meta-analysis of implementation intentions and goal achievement, Gollwitzer and Sheeran (2006) found that the impact of forming implementation intentions on goal achievement was Hedges and Olkin’s $d$ ES= 0.65. According to Cohen (2001) this reflects a medium-
to large-effect size. Clearly, the formation of implementation intentions increases exercise behavior by bridging the intention-behavior bridge.

**Summary**

The preceding discussion outlines several accepted models that attempt to identify constructs predicting specific behavior. Those reviewed include the TPB, the HBM, TTM, ACT, and the HAPA. The HAPA combines the structural models of the TRA and TPB while incorporating volitional theory to address the gap between intention and behavior. It also integrates the motivational and volitional stages distinguished in the ACT, which explain intention formation and enactment of an intention as two distinct processes. One method identified in the HAPA to bridge the intention-behavior gap is the use of implementation planning or the development of implementation intentions.

Theoretical models such as the TRA and the TPB identify intention as a predictor of exercise. Research in the HAPA using implementation intentions to bridge the intention-behavior gap identified intention as a nonsignificant variable when mediated by planning (Sniehotta et al., 2005). Further research using implementation intentions shows that exercise behavior is increased dramatically by using implementation intentions (Milne et al., 2002). There is sufficient evidence that an implementation intention intervention may prove to be effective in increasing exercise behavior in volunteer firefighters beyond interventions aimed at increasing self-efficacy or forming intentions. Firefighters are constantly reminded to exercise, yet there is still a lack of physical fitness in volunteer firefighters. Therefore, the purpose of this study was to develop an
implementation intention intervention to determine if such an intervention would increase exercise behavior better than a general exercise promotion message.

**Hypothesis**

To address the purpose of this study, the following hypotheses were tested:

Hypothesis One. An implementation intention intervention will increase exercise behavior over time in volunteer firefighters while a general exercise message will have no effects on exercise.

Hypothesis Two. Those in the earlier stages of change as defined by the TTM will show greater increases in exercise behavior than those in later stages because those in early stages have more room for growth compared to those in late stages.

Hypothesis Three. There will be an interaction between the implementation intention intervention and stage membership in that the intervention is expected to be more effective among firefighters in the earlier stages of change compared to its effects among firefighters in later stages of change.

Hypothesis Four. The intervention will indirectly decrease sedentary behavior by reducing the amount of time spent in leisure activities such as watching television or recreational computer use.
CHAPTER III
METHODOLOGY

The purpose of this study was to determine if an implementation intention intervention would increase exercise behavior in volunteer firefighters better than a general exercise promotion instruction message. The present study featured a pre-post randomized experimental design using a treatment and control group to understand the effects of implementation intention on exercise adherence compared to a control group.

Human Protection

Approval for this study was given through the Utah State University Institutional Review Board (IRB). This approval was presented to the participants in the form of a “Letter of Information” rather than the typical “Informed Consent” document due to the minimal risk to participants. The researcher in this study is employed as the local county fire chief, thus raising the question of potential perceived coercion among participants. However, the fire chief does not supervise any of the fire department personnel or officers contacted for this research. Two of the fire departments were located outside of the local county. Each of the remaining fire departments within the county is funded and administered by their own respective city government without any oversight by the county fire chief or county government. Several additional measures were taken to eliminate potential coercion experienced by the participant including (a) explicit voluntary nature of participation as identified in the letter of consent (see Recruitment, page 36), (b) anonymous nature of data collection.
Prior to beginning the study, participants were informed about the purpose of the study, procedures, risks, benefits, and participant’s rights. The particular focus of this study on the effects of implementation intentions and the fact that the study involves participation in an intervention was not disclosed to participants because disclosure of this fact would compromise the study goals, potentially leading to contamination (exchange of information between study participants) and efforts to counter-balance among control subjects.

To protect confidentiality of participant, no names were recorded on the questionnaires. Instead, an anonymous number reference was used to combine pretest information and posttest data for analysis. Participants were guided to create their own personalized ID number using a method that has proven useful in former studies. The six-character code asked for the first two letters of their mother’s maiden name, (e.g., JO for Johnson) or XX if this information is not available, the day of birth of the participant (e.g., 24), and the first two letters of the father’s first name (e.g., DO for Doug), or XX if this information is not available. This code was easy to re-create without the need to memorize.

Participants

The participants were members of local volunteer fire departments who currently attended weekly fire training drills in their respective departments. All those who attended the drill on the night that the research took place were invited to attend.
Sample Size

A priori sample size was based on power analysis at the desired significance level, power, and anticipated effect sizes. An a priori alpha level of 0.05 was selected. Desired minimum power was set at 0.80. Previous research using the implementation intentions has resulted in effect sizes of 0.65 (Gollwitzer & Sheeran, 2006). Using an effect size of 0.65 results in a sample size of 24 per group. However, a larger sample size was warranted in this sample, because exercise is not easy to implement in the busy lives of volunteer firefighters with a short-term intervention based on written materials (see below). Previous research employing implementation intentions on exercise behavior has been done with sample sizes of $n = 88$, $n = 248$, and $n = 58$ (Gollwitzer & Sheeran, 2006). Using this as a guideline and estimating a smaller effect size of 0.15, preliminary analysis performed with Gpower for the between-within interaction term of a 2-group repeated-measures analysis of variance (ANOVA) suggested a sample size of 45 individuals per group for a total of 90 participants. With the possibility of dropouts, an initial sample of 150 recruits was targeted.

Recruitment

The researcher asked the local fire chiefs for their cooperation in allowing their firefighters to take part in this research and to provide a few minutes of time in a weekly meeting for the applicant to recruit volunteers. All nine fire chiefs who were approached agreed to take part. Recruitment took place at their respective fire stations. Criteria for inclusion required that the individual had to be a volunteer firefighter. If an individual was also a career firefighter, he was not included in the study. The local fire chief
assured the participants that participation was voluntary and would not effect the status of the firefighter should they elect to participate/not participate.

The researcher addressed the fire department personnel and asked for participants to help with a study to better understand the current attitudes of volunteer firefighter towards exercise. Those who wished to participate were asked to remain in the classroom. None of the participants left the classroom during the course of the survey completion; however, one participant each from two different stations did not return the survey they were given during the initial session. All other firefighters appeared to return both of the initial surveys.

**Measurements**

**Demographics.** Demographic variables collected include age, height, weight, sex, number of years in the fire service, marital status, ethnicity, household income level, number of adults working outside the home, and years of education. These variables were collected on a single demographic sheet (see Appendix A). Income level was determined by asking the participant to identify current household annual income as a range: Less than $10,000, $10,000-$20,000, $20,000-$30,000, $30,000-$40,000, $40,000-$50,000, and so forth, up to greater than $90,000. Education level was determined by asking the participant to indicate their highest level of education completed: Less than high school, GRE, high school diploma, vocational/technical training, some college work, associate’s degree, bachelor’s degree, some graduate work, master’s degree, and Ph.D.

**Exercise behavior.** Exercise behavior served as the primary dependent variable. Two measures were used to assess change in exercise behavior: (a) minutes exercised,
and (b) the number of exercise sessions performed. Preintervention exercise behavior was assessed through a timeline follow-back (TLFB) procedure spanning a retrospective self-reporting period of two weeks (see Appendix C). The TLFB is a calendar-aided retrospective self-reporting method in which a participant is asked to report the target behavior for each day of a defined retrospective time interval separately, going backwards in time. Participants were instructed to recall exercise behavior for the past two weeks. The TLFB procedure was modeled after Sobell and Sobell (1992). Use of the TLFB has been shown to be useful in group settings as well as individual council sessions (LaBrie, Pedersen, & Earleywine, 2005; Pedersen & LaBrie, 2006). The participants were given a calendar with blanks for each day in the past 2 weeks and an example with the instructions for completing the TLFB. They were asked to write down holidays, vacation days, birthdays, fire responses, and any other activity that could be used to create a structure to identify past exercise and leisure time behavior. They recorded both the number and length of exercise sessions during the previous 2 weeks. Both the minutes and the number of sessions exercised were added up to represent preintervention exercise behavior.

Postintervention exercise behavior was assessed with a diary form calendar asking participants to record their exercise and TV/computer viewing behavior daily during the two weeks following the intervention (see Appendix F). The total number of exercise minutes, exercise sessions, and TV/computer viewing behavior over the two-week postintervention period was used for the data analysis.

In addition (because the TLFB can lead to underestimation of behaviors), exercise behavior during the past 2 weeks was assessed with two general questions asking about
the number of 20-min exercise sessions participants usually completed during 1 week, 
and the overall amount of time (hours, minutes) usually spent exercising during a 1-week 
time period.

Current action stage. Next to experimental group, participant’s location on the 
Stages of Change measure defined the second primary predictor of exercise behavior. 
The firefighter’s current action stage was identified using a five-item survey representing 
the five stages of the transtheoretical model (TTM). The five stage questions are:

1. I presently do not exercise and do not plan to start exercising in the next 6 
   months.

2. I presently do not exercise, but I have been thinking about starting to exercise 
   within the next 6 months.

3. I presently get some exercise, but not regularly.

4. I presently exercise on a regular basis, but I have only begun doing so within the 
   past 6 months.

5. I presently exercise on a regular basis and have been doing so for longer than 6 
   months.

Participants were asked to mark the one statement that was most accurately 
describing their current status. Thus, the measure of stage-of-change ranged from 1 
(precontemplation stage) to 5 (maintenance stage). Although, originally, the study 
focused on participants in Stage 2 of the TTM, this plan had to be modified due to the 
limited number of participants self-identified as “Stage 2.” Instead, participants in stages 
1-3 were identified as “early stage” while those who self-identified in stages 4-5 were 
identified as “late stage.” In consequence, each stage group (early vs. late stage) was 
composed of a quite heterogeneous subsample, with the early stage group involving 
precontemplators, contemplators, and poor/irregular exercisers, and the late stage group
comprising both short-term regular exercisers and those in the maintenance stage. Because we grouped early-stage exercisers and late-stage exercisers, stage membership was not the same as stage membership identified in the TTM and cannot be regarded as an attempt to test this model.

**TV / Computer time.** The leisure time spent at TV or computer served as a secondary dependent variable used to test Hypothesis Four. Pre- and postintervention TV/computer time was assessed with the same method used to assess exercise and spanning the same time frame of two weeks. Measurement of TV/Computer activity was also collected with the aim to increase the participants recall activity, especially in the case that no exercise activity existed. It decreased the likelihood that a participant would not turn in their calendar because there was no activity to report. Both preintervention TLFB reports and postintervention diary reports were summed up, representing the number of minutes of inactive leisure time spent before and following the intervention.

**Cardiovascular health risk profile.** The Health Screening Questionnaire (United States Fire Administration, 2000; HSQ; see Appendix B) used by the U.S. Forest Service identifies risk factors for cardiovascular disease. This survey is used to determine a firefighter’s cardiovascular risk profile with regards to a prework fitness test where the firefighter attempts to walk 3 miles with a 45-lb backpack in under 45 min. A “yes” answer to any of these questions requires a physician’s release to participate in the Forest Service Work Capacity Test. This information was used in this study to help quantify the physical health of the volunteer firefighters and to perform randomization checks and comparisons between study completers and drop-outs.
The HSQ is presented in a yes/no checklist format. Participants were asked to answer 10 questions including:

1. During the past 12 months have you at any time (during physical activity or while resting) experienced pain, discomfort, or pressure in your chest?
2. During the past 12 months have you experienced difficulty breathing or shortness of breath, dizziness, fainting, or blackout?
3. Do you have a blood pressure with systolic (top #) greater than 140 or diastolic (bottom #) greater than 90?
4. Have you ever been diagnosed or treated for any heart disease, heart murmur, chest pain (angina), palpitations, (irregular beat), or heart attack?
5. Have you ever had heart surgery, angioplasty, or a pace maker, valve replacement, or heart transplant?
6. Do you have a resting pulse greater than 100 beats per minute?
7. Do you have any arthritis, back trouble, hip/knee/joint pain, or any other bone or joint condition that could be aggravated or made worse by the Work Capacity Test?
8. Do you have personal experience or doctor’s advice of any other medical or physical reason that would prohibit you from taking the Work Capacity Test?
9. Has your personal physician recommended against taking the Work Capacity Test because of asthma, diabetes, epilepsy or elevated cholesterol, or a hernia?
10. In the past year, have you been advised by a physician to refrain from exercising? If yes, please follow your doctor’s advice.

Questions 1, 2, 7, 8, 9, 10 were judged by the researchers to indicate physical disabilities that might cause an individual to decline to participate in exercise due to discomfort or pain. The sum score (6 points possible with 6 = most likely to resist exercise due to physical reasons) of these questions for each individual was compared at baseline across treatment groups to assure randomization was not biased on this variable.
**Exercise attitudes.** Attitude scores were calculated by finding the mean of questions three-eight of the attitudes towards exercise survey (Appendices D and E). Questions 3-8 specifically identified attitudes towards aerobic and anaerobic exercise, while questions 1 and 2 addressed perceived risk of heart attack and calculation of heart rate, respectively. Individual questions were scored from 0-10 with 0 (hate it) to 10 (love it). This measure was used to check for differences between groups both at baseline and between completers and drop-outs. Each question had a maximum value of 10 points for a total of 60 points possible. Each individual was compared in a pre- and postintervention manner to determine if there was a significant difference between the treatment and control group on this variable.

**Exercise Instruction and Intervention Materials**

The preintervention assessment instrument featured a combination of exercise instruction and data collection. This assures that the educational materials were read and that the participant immediately assessed to what degree he/she adheres to the recommended guidelines. Further, the survey included the intervention materials as described below.

**Educational materials.** Both groups were given advice on cardiovascular exercise following the frequency, intensity, time, and type (FITT) principle promoted by the ACSM (1998). This principle recommends exercise prescription including:

- **Frequency:** 3-5 days per week
- **Intensity:** 60-90% of maximal heart rate
- **Time:** 20-60+ min /session of continuous activity
Type: Aerobic (run, brisk walk, bike, swim, cross country ski, dance, etc.)

Further instructions on anaerobic exercise were given using the same principle:

Frequency: 2-4 days per week

Intensity: 2-3 sets of 12-15 reps

Time: 30-45 min/session

Type: Upper body push, pull, squat, lunge, core exercise

Beyond informing the participants of exercise guidelines, this type of instruction allows the participant greater flexibility in choosing exercises that accommodate existing facilities and equipment. After each of the above topics was presented, a question was posed to make sure they had read the statement. For example:

Aerobic exercise includes exercises such as: walking, jogging, running, biking, swimming, basketball, cycling, rowing, cross-country skiing, snowshoeing, racquetball, or any other exercise that gets your heart rate above the minimum heart rate you calculated above. On a scale of 0 – 10, how do you feel about aerobic exercise?

0 1 2 3 4 5 6 7 8 9 10
Hate it no opinion Love it

Experimental group instruction (see Appendix D). In addition to the fitness guidelines presented above, implementation intentions were formed in the experimental group by asking the participants to address how, where, and when they plan to exercise. This detailed instruction has been shown to be instrumental in moving people from an intention mindset to action-oriented behavior through the use of planning as is demonstrated in the HAPA model (Milne et al., 2002). The experimental group was
guided to create implementation intentions by specifically identifying what type of aerobic and anaerobic exercise they were going to participate in, where they were going to exercise, and to schedule their exercise sessions for the following two weeks. An example of this guidance is:

Beginning an exercise program after you decide to work out can be difficult. Thorough and thoughtful planning is critical to success. Planning how, when, and where you are going to exercise has been found to be much more effective than simply saying you are going to exercise more. The following exercise will help you create a specific exercise schedule that you can stick to.

**HOW:**
How describes the type of exercise you plan on doing. If you are interested in aerobic exercise, select one or more aerobic exercise activities that you enjoy and will be likely to do on a regular basis:

Aerobic Exercise #1 ___________________
Aerobic Exercise #2 ___________________
Aerobic Exercise #3 ___________________

If you prefer strength training or want to commit to both strength training and cardiovascular exercise, select one or more strength training exercises:

**Strength Training Push (push ups, chest press, fly, military press, etc)**
Strength Training Exercise #1
Strength Training Exercise #2
Strength Training Exercise #3

**WHERE:**
Where do you think you will most likely be able to exercise on a regular basis? This might be at home, walking in the neighborhood, at a gym, at the fire station, a swimming pool, or anywhere else you prefer. It should be someplace that is easy to access.

Where: Aerobic Exercise 1: ___________________
       Aerobic Exercise 2: ___________________
       Aerobic Exercise 3: ___________________
       Strength training: ___________________

**WHEN:**
When describes when you are going to exercise. Some people find that mornings are the only time they can make sure to get their exercise done, others workout in
the evening. Pick a schedule that works best for you and your situation. Don’t forget to include rest days.

First, make a checkmark on the days you will exercise. Second, write in the time you will exercise each day. Third, write in how long you will exercise each session. Fourth, write in the type of exercise you will do.

Finally, commit to your exercise plan.

On a scale from 0 to 100, how committed are you to exercising using the plan you have just created?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Not at all likely 100% sure

**Control group instruction** (see Appendix E). Implementation guidelines were not given to the control group. Instead, the control group was given approximately 17 paragraphs from the National Volunteer Fire Council’s Heart Healthy Firefighter Resource Guide (NVFC, 2005) describing the risk of heart attack and coronary heart disease. The control group was then asked 10 questions regarding heart health and the need to exercise from the Heart Healthy Firefighter Resource Guide. The control group instructional data were used for analysis and comparison with the treatment group. The additional material on heart health was used to balance the time required by the treatment group to form implementation intentions.

A small pilot study was performed to match the number of questions needed in the control group to counterbalance the amount of time required by the treatment group members for creating implementation intentions. The researchers found that the nonfirefighter pilot study participants read approximately 17 paragraphs in the same amount of time as it took them to answer the implementation intention questions.
Procedures

Following approval of the research proposal and IRB approval, the researcher contacted nine volunteer fire chiefs in three counties for approval to recruit participants for this study from the members of their department. The researcher visited those departments that were willing to participate during their weekly fire drill held either Wednesday or Thursday night. One department held their drill Saturday morning. Data collection took place in the spring beginning early March and ending early April.

At the beginning of the meeting, the researcher explained the study and asked for volunteers to take part in a study examining volunteer firefighter’s attitudes towards exercise. The participants were not told that this was a randomized controlled experiment, nor were they told that there was a control group and a treatment group. In the event that a participant looked at his neighbor’s paper and found that they were not the same, the researcher announced that there were “a couple of different versions of the survey.” All of these precautions are taken to reduce cross-contamination between the control group and the treatment group. There was no indication that participants compared questions with each other after the data session.

The researcher passed out the letter of information document to each participant and reviewed it with the group. Because an informed consent was not required by the IRB, no signed copies of consent were retrieved. After the review of the letter of information, the researcher explained how to create each participant’s identification number (as previously described).
The researchers distributed the TLFB instructions and sample TLFB calendar. The researchers reviewed the TLFB instructions and asked each participant to write down significant events including birthdays, holidays, anniversaries, previous fire or medical calls, work shifts, and so forth. We then asked each participant to recall past exercise and TV/computer viewing behavior for the past two weeks beginning with the previous day at the bottom of the calendar and working their way back. Participants were also given a list of activities that could be counted as leisure time exercise behavior to prompt them to record activities they did. The exercise list also included a list of activities that were expressly not to be included. Of special concern was walking as an exercise activity. We only included walking as exercise when it was brisk, sustained, and lasted longer than 20 minutes.

When the participant finished the TLFB, they signaled their completion and the researcher or a research assistant retrieved the TLFB calendar and handed them a survey packet from the top of a preordered alternating stack of control/treatment survey packets. This assured that each participant would alternately receive either a treatment or control survey creating a pseudo-stratified random group assignment based on the time required to complete the TLFB. Because the intervention was part of this survey (i.e., the survey serves the double duty of collecting preintervention data AND provide instructions to create implementation intentions in the treatment group), randomization was achieved by random distribution of the questionnaires. Because elimination of bias is the primary purpose of randomization, the most effective method of unbiased distribution appeared to be to preorder the questionnaires in an alternating sequence (prepared by a research assistant) and distributing the copies from the preordered stack. Preordering in alternating
sequence (rather than complete random mixing) helped to even out the number of treatment and control subjects recruited at each fire department.

Both versions of the survey contained identical questions on demographic information, general health information, current exercise stage based on the TTM, and elements of exercise guidelines using the FITT principle promoted by the ACSM (1998). Additionally, the treatment group survey included items to create implementation intentions by assessing how, when, and where the participant could regularly exercise. As a counter balance, the control group survey contained a similar number of items regarding cardiovascular health.

Surveys were collected immediately after being completed (participants passed them to the researcher). Participants were then asked to keep the diary card and record their exercise/TV/Computer behavior daily during the next two weeks. At the end of the two-week period, the participants were asked to return the exercise log to an envelope in the fire station where the researcher collected the data logs. A roster of the total number of firefighters in the department was obtained to account for total participation potential compared to actual participation.

**Data Preparation**

The data were doubly checked to identify coding and other errors. Descriptive statistics, including frequency, means, and standard deviations were used to describe the sample characteristics. Data were analyzed using PASW Statistics version 18.

Originally it was planned to focus on participants belonging to the contemplation stage (intention formation) of the TTM. Theoretically, implementation intentions should
be particularly effective among motivated but still inactive persons to move them into the action stage. However, because of the limited number of participants that took part in this research, attempts to isolate Stage-2 (contemplator) participants and/or compare against later stages had to be given up. Only 20 participants identified themselves as belonging to Stage 2 (see Table 1). Therefore, early exercise stage categories (1-3, precontemplators to irregular exercisers) were grouped together and compared against late exercise stage categories (4-5, short- and long-term regular exercisers). Early stage members were coded (-1), while late stage members were coded (+1). Distribution of stage membership is presented in Table 1.

Effect dummy coding was applied to treatment/control group membership. The treatment group was coded (+1), while the control group was coded (-1).

Finally, to compare those who finished the study (completers) to those who did not complete the study by returning the postexercise diary (drop-outs) a dichotomous code was created using PASW. Completers were coded (1) while dropouts were coded (0).

Data preparation for the dependent variables (postexercise minutes, postexercise sessions, and post-TV minutes) involved transforming units of measurement (hours to minutes) and applying a cut-off criterion for the definition and identification of an exercise “session.” Postexercise sessions were identified as any exercise session lasting at least 20 min. In some cases, participants exercised less than 20 min and those sessions were not counted toward the total. Nine participants reported a total of 22 sessions that were less than 20 min. These were not counted. Of greater interest are the sessions that
Table 1

*Distribution of Exercise Stage for All Participants (n = 147)*

<table>
<thead>
<tr>
<th>Stage</th>
<th>Frequency</th>
<th>Dichotomous coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>-1</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>-1</td>
</tr>
<tr>
<td>3</td>
<td>57</td>
<td>-1</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
<td>+1</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>+1</td>
</tr>
</tbody>
</table>

lasted as long as eight hours. Several participants reported sessions lasting multiple hours, yet these were only counted as a single session. The range of counted sessions was between 20 min and eight hours. The long sessions had the same weight as the short sessions.

Postexercise TV minutes were transformed from hours to minutes by the researcher in order to apply negative binomial regression, which does not accommodate data other than integers. The participants were asked to report minutes of TV time and computer time; however, almost all participants reported this variable in hours or fractions of hours.
Data Analysis

Preliminary Analyses

Three types of preliminary analyses were performed. First, a randomization check was performed to determine whether the treatment and control groups were comparable in demographic characteristics and preintervention outcome measures. Preexisting differences in any demographic background variable were to be resolved by entering the respective variable as covariates in the analyses. Second, completers were compared to drop-outs (those who did not return the postintervention diaries) to determine whether any self-selection bias would limit the generalization of the findings. Third, the data were checked for distribution characteristics to determine whether a linear model fits the data.

Primary Analyses

Distribution analysis of the dependent variables showed that none of the dependent variables met the assumptions of normal distribution. Both post-TV minutes and postexercise minutes exhibited skewed data with a high frequency of zero-counts. Postexercise sessions also exhibited a high number of zero-counts, thus typical parametric procedures could not be used to analyze the data. The dependent variables appeared to meet the criteria under the Generalized Linear Model for Poisson regression with overdispersion. The variables were count data with a positive skew and a high number of zero-counts and no possibility of a negative count. One assumption of Poisson Probability Distribution is that the variance equals the mean. Due to the failure to meet the assumptions described, negative binomial regression was used to accomplish the
study objectives. Negative binomial regression is an extension of Poisson’s regression. Both are methods to analyze count data characterized by integer values with a true zero, no negative values, and no upper limit. Count data are often skewed with a high number of zero counts and few cases with large counts. Poisson regression is limited to count data whose mean equals the variance. However, many count data have a variance much larger than the mean. This “overdispersion” cannot be accounted for by the Poisson model and requires the application of negative binomial regression, which combines the Poisson distribution with a secondary “Gamma” distribution accounting for extreme variance on the upper end of the count measure.

Analysis of demographic variables indicated that the education variable was significantly different between groups at baseline and should be controlled for in the regression model. Marriage was significantly different between completers and dropouts, but was not included as a control variable because it was nonsignificant at baseline.

Only those who completed the research by returning the exercise diary were included in this analysis. A type 1 error rate of $p < 0.05$ was used as a criterion for significance in this study. Because the hypothesis was directional, a 1-tailed test $p < 0.10$ was considered to be statistically significant when confirming a directional hypothesis.

**Primary Hypothesis Testing.** To determine if the implementation intention intervention increased exercise behavior over time in volunteer firefighters, measures of the pre- and posttreatment exercise minutes and pre- and posttreatment exercise sessions were separately analyzed. Preintervention data were used to control for preexisting differences in the dependent variable. Accordingly, the statistical effects of the intervention was to be interpreted as an effect on CHANGE in exercise behavior over
time. A hierarchal stepwise method was utilized to determine if the treatment had a significant effect ($p < 0.10$, one-tailed test) on both of these variables.

In the first step, each of the relevant preintervention dependent variables was predicted using significant preexisting demographic variables and the dichotomous exercise stage membership as predictors in the negative binomial regression model. For our model, only education level was significantly different between the treatment and control group. Therefore, the first step included predicting postintervention exercise minutes using preintervention exercise minutes, education, and dichotomous exercise stage. In the second step, the intervention variable was added. Finally, the third step included adding the interaction between stage and intervention. Likewise, postintervention exercise sessions was analyzed.

Of special interest is to understand if the intervention had the capability to initiate behavior rather than simply increase behavior. Firefighters who do not exercise at all are more likely to be at higher risk of myocardial infarction. Thus, getting them to begin to exercise is especially important. We hoped to determine if the intervention was able to promote the onset of exercise rather than simply increase exercise. To do this, we dichotomously recoded exercise behavior as +1 if they reported any exercise behavior and 0 if they reported none. The binary outcome variable suggested the use of binary logistic regression to analyze the data. Similar to the methods described above, we first included preintervention exercise minutes, dichotomous stage membership, and education as predictor variables in the first analysis. The second step included the addition of the treatment. The third step added an interaction component consisting of dichotomous stage
membership and the treatment. This analysis was only conducted on the exercise minutes variable.

**Secondary Hypothesis Testing.** To determine if there was an indirect effect ($p < 0.10$, one-tailed test) of the intervention to decrease sedentary behavior, the same hierarchal stepwise negative binomial regression method described in the primary analysis was used. In the first step, postintervention TV/Computer viewing minutes was predicted using preintervention TV/Computer viewing minutes, stage membership and education as predictors. In the second step, the intervention variable was added. Finally, the third step included adding the interaction between stage and intervention.
CHAPTER IV

RESULTS

This chapter begins with a description of the baseline variables of all participants to determine if proper randomization occurred. Next, the same analysis was used to determine if there was any self-selection bias in those who completed the study. An examination of the data of those who completed the study was conducted to determine the appropriate statistical method for analysis. Data were found to be non-normal, skewed, and overdispersed leading to the use of a negative binomial regression analysis.

Preliminary Analyses

Description of Sample

Of the 216 members of the volunteer fire departments currently active at the time of this study, 157 participants attended their weekly drill when the research study was scheduled. Of those, 149 elected to participate at the time the study began. Approximately eight participants arrived after the initial instructions were given and surveys were passed out. These late arrivals did not take part and are not included in the N of 149 participants approached to participate. Two participants did not return the preintervention questionnaires. No explanation was asked or given from those who elected to not participate. Seven participants (4.7%) who received the survey materials and took part in the study did not complete the demographic data portion of the survey during the initial session. See Figure 4 for a flow diagram of participant randomization.
Figure 4. Flow diagram for participant randomization

Of those who reported their demographic information ($n = 147$), the majority were male (91.4%; $n = 128$), white (93.2%; $n = 137$), and married (70.1%; $n = 103$). Half of the participants (50.7%; $n = 71$) were 35 years of age or younger. Most participants’ highest level of education was identified as: a high school diploma (25.2%; $n = 37$), vocational
training (23.8%; n = 35), or some college education (27.2%; n = 40). Three participants indicated less than a high school education. Nearly half (49.6%; n = 73) have been in the fire service six or fewer years.

Only 20.1% (n = 28) had a normal body mass index of less than 25.0. Most (48.9%; n = 67) were overweight (BMI ≥ 25) and 31.0% (n = 43) were classified as obese (BMI ≥ 30). Three of the obese individuals had a BMI ≥ 40. Just over half of the participants (55.1%; n = 81) indicated that they were in the preaction stages of exercise including stages 1-3. A summary of demographic characteristics are presented in Tables 2 and 3.

**Randomization**

To assure nonbiased randomization between the treatment and control groups, independent samples t tests of the means of the demographic and prebehavioral dependent variables were conducted. See Table 2 for details. The grouping factor was the dichotomous treatment/control variable coded +1 for treatment and -1 for the control group. None of the variables showed significant differences between the control group and the treatment group at baseline with the exception of the education variable. As can be seen in Table 3, the control group had more participants with postsecondary education than did the treatment group. The treatment group included more participants whose education level was limited to high school graduation or vocational training. Due to the significant difference between the treatment and control groups, education was controlled as a covariate in the regression analyses.
Table 2

Baseline Descriptive Statistics for Quantitative Demographic Variables of All Participants (n = 147)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control group (n = 74)</th>
<th>Treatment group (n = 73)</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>38.61 ± 13.18</td>
<td>36.41 ± 10.72</td>
<td>138</td>
<td>1.088</td>
<td>.278</td>
</tr>
<tr>
<td>Height (inches)</td>
<td>70.00 ± 3.53</td>
<td>70.23 ± 3.41</td>
<td>138</td>
<td>-0.397</td>
<td>.692</td>
</tr>
<tr>
<td>Weight (lbs)</td>
<td>204.24 ± 44.73</td>
<td>199.12 ± 37.06</td>
<td>137</td>
<td>0.737</td>
<td>.462</td>
</tr>
<tr>
<td>BMI</td>
<td>29.21 ± 5.81</td>
<td>28.29 ± 4.42</td>
<td>137</td>
<td>1.048</td>
<td>.296</td>
</tr>
<tr>
<td>Sex*</td>
<td>0.90 ± 0.31</td>
<td>0.93 ± 0.25</td>
<td>138</td>
<td>0.756</td>
<td>.451</td>
</tr>
<tr>
<td>Marital Status*</td>
<td>1.93 ± 0.50</td>
<td>1.97 ± 0.53</td>
<td>138</td>
<td>-0.542</td>
<td>.589</td>
</tr>
<tr>
<td>Ethnicity*</td>
<td>1.06 ± 0.34</td>
<td>1.03 ± 0.23</td>
<td>138</td>
<td>0.656</td>
<td>.513</td>
</tr>
<tr>
<td>Income*</td>
<td>40,900 ± 21,158</td>
<td>40,830 ± 19,698</td>
<td>137</td>
<td>0.018</td>
<td>.986</td>
</tr>
<tr>
<td>Adults Working</td>
<td>1.59 ± 0.61</td>
<td>1.63 ± 0.59</td>
<td>134</td>
<td>-0.303</td>
<td>.762</td>
</tr>
<tr>
<td>Education*</td>
<td>4.82 ± 1.68</td>
<td>4.12 ± 1.30</td>
<td>138</td>
<td>2.761</td>
<td>.007*</td>
</tr>
<tr>
<td>Years of Service</td>
<td>9.27 ± 9.88</td>
<td>9.26 ± 8.83</td>
<td>133</td>
<td>0.005</td>
<td>.996</td>
</tr>
<tr>
<td>HSQ disabilities</td>
<td>0.53 ± 0.83</td>
<td>0.48 ± 0.80</td>
<td>140</td>
<td>-0.408</td>
<td>.684</td>
</tr>
<tr>
<td>Attitudes</td>
<td>7.06 ± 1.73</td>
<td>7.18 ± 1.66</td>
<td>145</td>
<td>0.448</td>
<td>.655</td>
</tr>
<tr>
<td>Exercise Category*</td>
<td>-0.03 ± 1.01</td>
<td>-0.15 ± 1.00</td>
<td>145</td>
<td>0.749</td>
<td>.445</td>
</tr>
<tr>
<td>Pre – TV Minutes</td>
<td>1296.04 ± 1028.05</td>
<td>1266.78 ± 786.33</td>
<td>145</td>
<td>0.194</td>
<td>.847</td>
</tr>
<tr>
<td>Pre – Exercise Minutes</td>
<td>408.95 ± 486.40</td>
<td>414.27 ± 496.42</td>
<td>145</td>
<td>-0.066</td>
<td>.948</td>
</tr>
<tr>
<td>Pre – Exercise Sessions</td>
<td>5.43 ± 4.15</td>
<td>5.32 ± 4.68</td>
<td>145</td>
<td>0.161</td>
<td>.872</td>
</tr>
</tbody>
</table>

*a Categorical variable. See Methods section for coding strategy.

* significant at $p < 0.05$
**Table 3**

**Detailed Baseline Descriptive Statistics for Categorical Demographic Variables of All Participants (n = 147)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control group (n = 74)</th>
<th>Treatment group (n = 73)</th>
<th>df</th>
<th>$\chi^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>60</td>
<td>68</td>
<td>1</td>
<td>.577</td>
<td>.447</td>
</tr>
<tr>
<td>Female</td>
<td>7</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(not reported*)</td>
<td>7</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Single</td>
<td>11</td>
<td>11</td>
<td>2</td>
<td>.431</td>
<td>.806</td>
</tr>
<tr>
<td>Married</td>
<td>50</td>
<td>53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>6</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Not reported*)</td>
<td>7</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>65</td>
<td>72</td>
<td>4</td>
<td>9.246</td>
<td>.055</td>
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<td>Hispanic</td>
<td>2</td>
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<td>(Not reported*)</td>
<td>7</td>
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<td></td>
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<tr>
<td><strong>Education</strong></td>
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<tr>
<td>High school diploma or less</td>
<td>15</td>
<td>26</td>
<td>4</td>
<td>4.468</td>
<td>.484</td>
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<tr>
<td>Vocational</td>
<td>15</td>
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<tr>
<td>Some college</td>
<td>19</td>
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<td></td>
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<tr>
<td>Associates</td>
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<td></td>
<td></td>
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<tr>
<td>Bachelor’s or higher</td>
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<td>4</td>
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<td>(Not reported*)</td>
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<td><strong>Annual income</strong></td>
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<td>$0 - 20,000</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>1.802</td>
<td>.614</td>
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<td>$20,000 - 40,000</td>
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<td>17</td>
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<tr>
<td>$40,000 - 60,000</td>
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</tr>
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<td>$60,000 - 80,000</td>
<td>11</td>
<td>12</td>
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<tr>
<td>(Not reported*)</td>
<td>7</td>
<td>1</td>
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<tr>
<td><strong>Exercise stage</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 1 – 2$^b$</td>
<td>10</td>
<td>14</td>
<td>3</td>
<td>1.802</td>
<td>.614</td>
</tr>
<tr>
<td>Stage 3</td>
<td>28</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 4</td>
<td>17</td>
<td>17</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Stage 5</td>
<td>19</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^a$ Chi-square is not analyzed due to insufficient n in Hispanic group.

$^b$ Stage 1 and 2 combined because Stage 1 had n < 5.

* Data listed as not reported is not included in Chi-squared analysis.
Of those who entered this study, 85 of 147 participants returned the postexercise diary. This accounted for a participation rate of 57.8% and a dropout rate of 42.2% (\(n = 62\)). Demographic characteristics comparing those who completed the study to those who did not are presented in Tables 4 and 5. To determine if there were factors that might account for drop-out bias, a second set of independent samples \(t\) tests of the means of the demographic and prebehavioral dependent variables was conducted comparing participants who completed and returned the exercise diary (Completers) with those who did not (Drop-outs). The only significant difference at baseline between Completers and Drop-outs was marital status. Results of these \(t\) tests are presented in Table 4.

**Data Distribution**

An examination of the distribution of the dependent posttreatment data was conducted to determine the proper inferential statistical method to analyze the data. Using PASW GradPack 18, graphs of the three dependent variables were plotted. See Figures 5-7. None of the dependent variables met the assumptions of normal distribution. Both post-TV minutes and postexercise minutes exhibited skewed data with a high frequency of zero-counts. Postexercise sessions also exhibited a high number of zero-counts, thus typical parametric procedures could not be used to analyze the data.

The dependent variables appeared to meet the criteria under the Generalized Linear Model for Poisson regression with over dispersion. The variables were count data with a positive skew and a high number of zero-counts. There was also no possibility of a negative count. One assumption of Poisson Probability Distribution is that the variance
Table 4

Baseline Descriptive Statistics for Demographic Variables Comparing Those Who Completed the Study to Those Who Dropped Out (n = 147)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Completed study (n = 85)</th>
<th>Dropouts (n = 62)</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>36.93 11.72</td>
<td>38.20 12.36</td>
<td>138</td>
<td>0.622</td>
<td>.535</td>
</tr>
<tr>
<td>Height (inches)</td>
<td>69.79 3.61</td>
<td>70.58 3.22</td>
<td>138</td>
<td>1.331</td>
<td>.185</td>
</tr>
<tr>
<td>Weight (lbs)</td>
<td>197.94 40.10</td>
<td>206.46 41.59</td>
<td>137</td>
<td>1.219</td>
<td>.225</td>
</tr>
<tr>
<td>BMI</td>
<td>28.48 5.09</td>
<td>29.08 5.21</td>
<td>137</td>
<td>0.680</td>
<td>.498</td>
</tr>
<tr>
<td>Sex</td>
<td>0.91 0.28</td>
<td>0.92 0.28</td>
<td>138</td>
<td>0.035</td>
<td>.972</td>
</tr>
<tr>
<td>Marital Status</td>
<td>1.88 0.51</td>
<td>2.05 0.51</td>
<td>138</td>
<td>2.005</td>
<td>.047*</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>1.05 0.31</td>
<td>1.03 0.26</td>
<td>137</td>
<td>0.310</td>
<td>.757</td>
</tr>
<tr>
<td>Income</td>
<td>41,110 20,310</td>
<td>40,520 20,556</td>
<td>137</td>
<td>-0.169</td>
<td>.866</td>
</tr>
<tr>
<td>Adults Working</td>
<td>1.57 0.65</td>
<td>1.64 0.56</td>
<td>134</td>
<td>-0.693</td>
<td>.489</td>
</tr>
<tr>
<td>Education</td>
<td>4.56 1.68</td>
<td>4.32 1.29</td>
<td>138</td>
<td>-0.892</td>
<td>.374</td>
</tr>
<tr>
<td>Years of Service</td>
<td>8.87 9.14</td>
<td>9.84 9.58</td>
<td>133</td>
<td>0.592</td>
<td>.555</td>
</tr>
<tr>
<td>HSQ disabilities</td>
<td>0.43 0.78</td>
<td>0.61 0.85</td>
<td>140</td>
<td>1.275</td>
<td>.204</td>
</tr>
<tr>
<td>Attitudes</td>
<td>7.16 1.67</td>
<td>7.16 1.68</td>
<td>145</td>
<td>-0.372</td>
<td>.710</td>
</tr>
<tr>
<td>Exercise Category</td>
<td>-0.15 0.99</td>
<td>0.00 1.01</td>
<td>145</td>
<td>0.916</td>
<td>.361</td>
</tr>
<tr>
<td>Pre – TV Minutes</td>
<td>1245.79 855.61</td>
<td>1330.48 991.36</td>
<td>145</td>
<td>0.554</td>
<td>.580</td>
</tr>
<tr>
<td>Pre – Exercise Minutes</td>
<td>371.53 441.23</td>
<td>466.52 548.30</td>
<td>145</td>
<td>1.163</td>
<td>.247</td>
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<td>Pre – Exercise Sessions</td>
<td>5.29 4.38</td>
<td>5.48 4.47</td>
<td>145</td>
<td>0.257</td>
<td>.798</td>
</tr>
</tbody>
</table>

a Categorical variables. See Methods section for effect coding description.

* significant at p < 0.05.
Table 5

Baseline Descriptive Statistics for Categorical Demographic Variables Comparing Those Who Completed the Study to Those Who Dropped Out (n = 147)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Completers (n = 85)</th>
<th>Drop-outs (n = 62)</th>
<th>df</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>74</td>
<td>54</td>
<td>1</td>
<td>.001</td>
<td>.972</td>
</tr>
<tr>
<td>Female</td>
<td>7</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Not reported*)</td>
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<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>16</td>
<td>6</td>
<td>2</td>
<td>3.971</td>
<td>.137</td>
</tr>
<tr>
<td>Married</td>
<td>59</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>6</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Not reported*)</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity(^a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>79</td>
<td>58</td>
<td>4</td>
<td>.558</td>
<td>.968</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Not reported*)</td>
<td>4</td>
<td>3</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
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<td>1</td>
<td>4</td>
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</tr>
<tr>
<td>GED</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school diploma</td>
<td>20</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
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<td>Vocational</td>
<td>19</td>
<td>16</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>24</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associates</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
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<td>Bachelor’s</td>
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<td></td>
</tr>
<tr>
<td>Master’s</td>
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<td></td>
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<tr>
<td>Ph.D</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Not reported*)</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Continued)
### Completers (n = 85) vs. Drop-outs (n = 62)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Completers</th>
<th>Drop-outs</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - $20,000</td>
<td>19</td>
<td>15</td>
<td>1.148</td>
<td>.950</td>
</tr>
<tr>
<td>$20,000 - $40,000</td>
<td>27</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$40,000 - $60,000</td>
<td>26</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;$60,000</td>
<td>9</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Not reported*)</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Exercise stage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 1 - 2$^b$</td>
<td>14</td>
<td>10</td>
<td>2.315</td>
<td>.510</td>
</tr>
<tr>
<td>Stage 3</td>
<td>36</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 4</td>
<td>16</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 5</td>
<td>19</td>
<td>13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a* Chi-square is not analyzed due to insufficient n in Hispanic group.

b Stage 1 and 2 combined because Stage 1 had n < 5.

* Data listed as not reported is not included in Chi-squared analysis.
Figure 5. Data distribution of postintervention exercise minutes.
Figure 6. Data distribution of postintervention exercise sessions.
Figure 7. Data distribution of postintervention TV/computer minutes.
equals the mean. An examination of the mean and variance of the three dependent variables showed that this assumption was not met (see Table 6). Due to the failure to meet the assumptions described, negative binomial regression was used to test the hypotheses.

**Primary Analysis**

**Experimental Design**

An experimental randomized control design was used to address the following hypothesis: an intervention designed to facilitate the formation of implementation intentions would increase exercise behavior in volunteer firefighters relative to a control group of volunteer firefighters who were equally motivated to exercise but did not receive the action control intervention. Furthermore, dichotomous stage membership would be related to increases in exercise beyond its effects on preexisting exercise habits and there would be an interaction between the implementation intention intervention and

Table 6

*Mean and Variance of the Dependent Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Mean</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postexercise minutes</td>
<td>85</td>
<td>366.0</td>
<td>112151.7</td>
</tr>
<tr>
<td>Postexercise sessions</td>
<td>85</td>
<td>6.0</td>
<td>17.9</td>
</tr>
<tr>
<td>Post-TV minutes</td>
<td>85</td>
<td>1135.8</td>
<td>752438.7</td>
</tr>
</tbody>
</table>
stage membership whereby the intervention would be more effective among firefighters in the earlier stages of change compared to its effects among firefighters in late stages of exercise. Finally, the intervention would indirectly decrease sedentary behavior by reducing the amount of time spent in leisure activities such as watching television or recreational computer use.

A hierarchal stepwise method was utilized to determine if the treatment had a significant effect. The first step included the relevant preintervention dependent variable together with education (identified as a significant preintervention difference) and the dichotomous exercise stage coded (-1) for stages 1-3 and (+1) for stages 4-5. The second step included the variables of the first step with the addition of the intervention variable coded (-1) for the control group and (+1) for the treatment group. Finally, the third step examined the interaction between stage and intervention to the first two steps. Only those who completed the research by returning the exercise diary were included in this analysis. This method was separately applied to each of the dependent variables: posttreatment exercise minutes, posttreatment exercise sessions, and posttreatment TV minutes.

At each step described above, a likelihood ratio chi square analysis was conducted to establish the significance of the model fit. A type 1 error rate of 0.05 was used as a criterion for significance in this study. Because the hypothesis was directional, a one-tailed test of $p < .05$ (i.e., $p < 0.10$, two-sided) was considered to be statistically significant.

**Postexercise Minutes**

Table 7 displays the results of the hierarchical negative binomial regression of
postexercise minutes. The results in Step 1 indicate a significant model fit predicting postexercise minutes with preexercise minutes, education, and dichotomous exercise stage as predictors (likelihood ratio chi-square = 10.353, $df = 3$, $p = .016$). Only preexercise minutes was significant in a one-tailed test. The second step involved predicting postexercise minutes using the previous covariates and adding intervention as a predictor. Again, this model was significant (likelihood ratio chi-square = 15.131, $df = 4$, $p = .004$). In the step two model, only the intervention ($p = .028$) was a significant predictor of postexercise behavior. An analysis of the difference in likelihood ratio chi-square of step one and two also resulted in a significant difference between models (likelihood ratio chi-square = 4.78, $df = 1$, $p = .029$). In the third step, the interaction between stage and intervention was added. This model proved to be significant as well (likelihood ratio chi-square = 15.199, $df = 5$, $p = .010$). However, the interaction of stage and intervention was not significant ($p = .793$) suggesting no interaction effect. Like- lihood ratio chi-square analysis between steps two and three indicated a nonsignificant difference between the two models (likelihood ratio chi-square = 0.07, $df = 1$, $p = .79$).

Preexercise minutes ($p = .045$, one-tailed), and intervention ($p = .028$) were significant predictors of postintervention exercise behavior. Dichotomous stage membership was not a significant predictor of behavior change, and neither was the stage x intervention interaction ($p > .08$, and $p = .793$, respectively). While education ($p = .427$) was not a significant predictor of exercise, it had to be included to account for significant baseline differences between the control and treatment groups. See Table 7 for a summary of the results.
Table 7

Summary of Hierarchical Negative Binomial Regression Analysis for Variables Predicting Postexercise Minutes in Volunteer Firefighters (n = 85)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE_B</th>
<th>p</th>
<th>Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preexercise minutes</td>
<td>0.001</td>
<td>0.0003</td>
<td>.09*</td>
<td>2.842</td>
</tr>
<tr>
<td>Education*</td>
<td>0.04</td>
<td>0.07</td>
<td>.54</td>
<td>.379</td>
</tr>
<tr>
<td>Stage*</td>
<td>0.18</td>
<td>0.12</td>
<td>.15</td>
<td>2.076</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preexercise minutes</td>
<td>0.001</td>
<td>0.0003</td>
<td>.11</td>
<td>2.619</td>
</tr>
<tr>
<td>Education*</td>
<td>0.05</td>
<td>0.06</td>
<td>.43</td>
<td>.427</td>
</tr>
<tr>
<td>Stage*</td>
<td>0.22</td>
<td>0.12</td>
<td>.08</td>
<td>3.102</td>
</tr>
<tr>
<td>Intervention*</td>
<td>0.24</td>
<td>0.11</td>
<td>.03**</td>
<td>4.802</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preexercise minutes</td>
<td>0.001</td>
<td>0.0003</td>
<td>.11</td>
<td>2.618</td>
</tr>
<tr>
<td>Education*</td>
<td>0.05</td>
<td>0.06</td>
<td>.46</td>
<td>.550</td>
</tr>
<tr>
<td>Stage*</td>
<td>0.22</td>
<td>0.12</td>
<td>.08*</td>
<td>2.998</td>
</tr>
<tr>
<td>Intervention*</td>
<td>0.24</td>
<td>0.11</td>
<td>.03**</td>
<td>4.475</td>
</tr>
<tr>
<td>Intervention* x stage*</td>
<td>-0.03</td>
<td>0.11</td>
<td>.79</td>
<td>.069</td>
</tr>
</tbody>
</table>

*a Categorical variables: Stage = dichotomous stage grouping (TTM stage 1-3 = -1, TTM stage 4-5 = +1), Education = coded by education level (less than high school = 1, through Ph.D = 9).

*b Intervention: Treatment = +1, Control = -1.

* significant at p < 0.10 in one-tailed test.

Prediction of postintervention exercise minutes supports hypothesis one.

However, it does not show support for hypothesis two or hypothesis three. Only the treatment was a significant predictor of increased postintervention exercise. An examination of the raw data indicates the significant effects of treatment was in the direction hypothesized in hypotheses one. The number of minutes exercised by the early stage member’s (TTM stage 1-3) treatment group increased 87.9 minutes after the intervention during the 2-week period of this study. The number of minutes exercised by
the early stage exerciser’s control group only increased 13.7 minutes during the same period. Both the treatment and control late stage exercise groups (TTM stage 4-5) exercised less (treatment group = -108.6 min, control group = -68.7 min) after the intervention. Even though the early stage members increased the number of minutes as hypothesized, stage membership was not significant in the direction of the hypothesis and did not lend support for hypothesis two. The treatment had a significant effect on postintervention exercise behavior; however, there was not a significant interaction between stage and treatment indicating hypothesis three was not supported.

**Postexercise Sessions**

Table 8 displays the results of the hierarchical negative binomial regression of postexercise sessions. The initial model results including only the control variables indicate a significant model fit predicting postexercise sessions with preexercise sessions, education, and dichotomous exercise stage as predictors (likelihood ratio chi-square = 14.457; $df = 3$, $p = .002$). Only the preexercise session covariate was significant ($p = .002$). None of the other predictors were significant. The second step involved adding intervention as a predictor variable to the step one model. This model was again significant (likelihood ratio chi-square = 16.035; $df = 4$, $p = .003$). However, only the preexercise session variable was significant ($p = .002$) indicating that the intervention ($p = .209$) did not result in an increase of the number of exercise sessions.

The third step examined the interaction between stage and intervention. This interaction effect was added to the stage two model described previously. This model again proved to be significant as well (likelihood ratio chi-square = 17.409; $df = 5$, $p =
### Table 8

*Summary of Hierarchical Negative Binomial Regression Analysis for Variables Predicting Postexercise Sessions in Volunteer Firefighters (n = 85)*

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Variable</th>
<th>B</th>
<th>SE_B</th>
<th>p</th>
<th>Wald chi-square</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preexercise sessions</td>
<td>0.10</td>
<td>0.03</td>
<td>.002*</td>
<td>5.510</td>
</tr>
<tr>
<td></td>
<td>Education(^a)</td>
<td>0.05</td>
<td>0.07</td>
<td>.48</td>
<td>.507</td>
</tr>
<tr>
<td></td>
<td>Stage(^a)</td>
<td>0.03</td>
<td>0.14</td>
<td>.83</td>
<td>.045</td>
</tr>
<tr>
<td>Step 2</td>
<td>Preexercise sessions</td>
<td>0.10</td>
<td>0.03</td>
<td>.002*</td>
<td>9.155</td>
</tr>
<tr>
<td></td>
<td>Education(^a)</td>
<td>0.06</td>
<td>0.07</td>
<td>.42</td>
<td>.650</td>
</tr>
<tr>
<td></td>
<td>Stage(^a)</td>
<td>0.06</td>
<td>0.14</td>
<td>.66</td>
<td>.199</td>
</tr>
<tr>
<td></td>
<td>Intervention(^b)</td>
<td>0.15</td>
<td>0.12</td>
<td>.21</td>
<td>1.575</td>
</tr>
<tr>
<td>Step 3</td>
<td>Preexercise sessions</td>
<td>0.11</td>
<td>0.03</td>
<td>.001*</td>
<td>10.170</td>
</tr>
<tr>
<td></td>
<td>Education(^a)</td>
<td>0.04</td>
<td>0.07</td>
<td>.56</td>
<td>.332</td>
</tr>
<tr>
<td></td>
<td>Stage(^a)</td>
<td>0.03</td>
<td>0.14</td>
<td>.83</td>
<td>.047</td>
</tr>
<tr>
<td></td>
<td>Intervention(^b)</td>
<td>0.13</td>
<td>0.12</td>
<td>.28</td>
<td>1.178</td>
</tr>
<tr>
<td></td>
<td>Intervention(^b) x stage(^a)</td>
<td>-0.15</td>
<td>0.13</td>
<td>.24</td>
<td>1.378</td>
</tr>
</tbody>
</table>

\(^a\) Categorical variables: Stage = dichotomous stage grouping (TTM stage 1-3 = -1, TTM stage 4-5 = +1), Education = coded by education level (less than high school = 1, through Ph.D = 9).  
\(^b\) Intervention: Treatment = +1, Control = -1.  
* significant at \(p < 0.10\), or \(p < .05\) in one-tailed test

.004. Similar to postexercise minutes, no interaction was detected between treatment and stage of change \((p = .240)\). Only preexercise sessions \((p = .001)\) was a significant predictor in a one-tailed test in the direction of the hypothesis, thus, neither the treatment nor the stage had significant effects on the number of postexercise sessions. See Table 8 for a summary of the results.

Results of the step one negative binomial regression for postexercise sessions was
the most significant model fit compared to a Null-model. Preexercise sessions, education, and dichotomous exercise stage, without intervention or an intervention x stage interaction component created the best model fit. Only preexercise sessions was a significant predictor ($p = .002$) of postexercise sessions. Neither dichotomous stage ($p = .66$) or intervention ($p = .21$) were significant predictors of the number of postintervention exercise sessions in a one-tailed test in the direction of the hypothesis. Analysis of postintervention exercise sessions did not support hypothesis one, two, or three even though the number of exercise sessions increased 87% over the preintervention session count in the early stage exerciser group.

**Dichotomous Exercise Behavior**

As a secondary method to investigate our hypotheses, we attempted to determine if the intervention had an effect on postintervention onset of exercise behavior. This author hoped to see if the intervention was able to promote the onset of exercise rather than simply increase exercise. To determine this, I examined the effects of the intervention on those who reported no exercise at baseline. I dichotomously recoded exercise behavior as +1 if they reported any exercise behavior and 0 if they reported none.

The dichotomous recoding and a binary outcome suggested the use of binary logistic regression to determine if the intervention had any effect on those who reported posttreatment exercise compared to those who reported no exercise at all. The same hierarchical stepwise method was used in this analysis as was used in the primary analysis.
The initial model included only the control variables predichotomous exercise, dichotomous stage, and education. Each variable was identified as categorical. Forward stepwise binary logistic regression modeling included only the predichotomous exercise control variable as a significant \( (p = .001) \). Dichotomous stage \( (p = .210) \) and education \( (p = .550) \) were not significant predictors of postintervention exercise. The second step involved predicting dichotomous postexercise activity in the same manner and adding the intervention variable. Again, only dichotomous preexercise behavior \( (p = .001) \) was included in the regression equation. Dichotomous stage \( (p = .205) \), education \( (p = .558) \), and intervention \( (p = .144) \) were not significant. The third step involved the same prediction as described before with the addition of a treatment x stage interaction. Only the predichotomous exercise control variable was significant \( (p = .001) \). Dichotomous stage \( (p = .256) \), education \( (p = .598) \), intervention \( (p = .394) \), and stage x intervention \( (p = .530) \) were not significant predictors of dichotomous postintervention exercise.

Hypothesis one was not supported by analysis of onset of exercise. The intervention was not a significant predictor of exercise in those who reported no exercise at the beginning of the study. Hypothesis two was also not supported. Stage membership was not a significant predictor either. This would only occur if many of those who reported no exercise at the beginning began to exercise. There was also no stage x intervention interaction lending no support to hypothesis three. It appears that when analyzing dichotomous exercise behavior, preexercise behavior has the greatest effect size in all three models. See Table 9 for a summary of the results.
Table 9

Summary of Hierarchical Logistic Regression Analysis for Variables Predicting Dichotomous Postexercise Behavior in Volunteer Firefighters (n = 85)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>Wald</th>
<th>p</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preintervention exercise</td>
<td>2.563</td>
<td>.704</td>
<td>13.269</td>
<td>.001</td>
<td>12.971</td>
</tr>
<tr>
<td>Education(^a)</td>
<td>.122</td>
<td>.204</td>
<td>.357</td>
<td>.550</td>
<td>1.130</td>
</tr>
<tr>
<td>Stage(^a)</td>
<td>.549</td>
<td>.438</td>
<td>1.571</td>
<td>.210</td>
<td>1.731</td>
</tr>
<tr>
<td>Constant</td>
<td>-.650</td>
<td>1.125</td>
<td>.334</td>
<td>.563</td>
<td>.522</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preintervention exercise</td>
<td>2.827</td>
<td>.781</td>
<td>13.112</td>
<td>.001</td>
<td>16.892</td>
</tr>
<tr>
<td>Education(^a)</td>
<td>.118</td>
<td>.201</td>
<td>.343</td>
<td>.558</td>
<td>1.125</td>
</tr>
<tr>
<td>Stage(^a)</td>
<td>.560</td>
<td>.442</td>
<td>1.603</td>
<td>.205</td>
<td>1.751</td>
</tr>
<tr>
<td>Intervention(^b)</td>
<td>.541</td>
<td>.370</td>
<td>2.131</td>
<td>.144</td>
<td>1.717</td>
</tr>
<tr>
<td>Constant</td>
<td>-.764</td>
<td>1.139</td>
<td>.450</td>
<td>.502</td>
<td>.466</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preintervention exercise</td>
<td>2.833</td>
<td>.786</td>
<td>12.984</td>
<td>.001</td>
<td>16.991</td>
</tr>
<tr>
<td>Education(^a)</td>
<td>.107</td>
<td>.203</td>
<td>.278</td>
<td>.598</td>
<td>1.113</td>
</tr>
<tr>
<td>Stage(^a)</td>
<td>.507</td>
<td>.446</td>
<td>1.293</td>
<td>.256</td>
<td>1.661</td>
</tr>
<tr>
<td>Intervention(^b)</td>
<td>.380</td>
<td>.445</td>
<td>.726</td>
<td>.394</td>
<td>1.462</td>
</tr>
<tr>
<td>Stage(^b) x Intervention(^a)</td>
<td>-.267</td>
<td>.425</td>
<td>.394</td>
<td>.530</td>
<td>.766</td>
</tr>
<tr>
<td>Constant</td>
<td>-.764</td>
<td>1.139</td>
<td>.450</td>
<td>.502</td>
<td>.466</td>
</tr>
</tbody>
</table>

\(^a\) Categorical variables: Stage = dichotomous stage grouping (TTM stage 1-3 = -1, TTM stage 4-5 = +1), Education = coded by education level (less than high school = 1, through Ph.D = 9).

\(^b\) Intervention: Treatment = +1, Control = -1.

**Sedentary Behavior**

Hypothesis Four claimed a secondary effect of the intervention on sedentary behavior. The same testing procedure applied to exercise behavior was applied to TV/computer time. The initial negative binomial regression model results including only the control variables indicated a significant model fit predicting postexercise TV/computer with preexercise TV/computer, education, and dichotomous exercise stage.
as predictors (likelihood ratio chi-square = 17.834, df = 3, p = .001). The preexercise
TV/computer covariate was significant (p = .001). None of the other predictors were
significant in a one-tailed test. The second step involved predicting postexercise
TV/computer adding the intervention as a predictor to the step one model. This model
was also significant (likelihood ratio chi-square = 17.918, df = 4, p = .001). However, no
intervention effects were detected. Only pre-TV/computer viewing was a significant
predictor (p = .001). An analysis of the difference in likelihood ratio chi-square of step
one and two showed a nonsignificant difference between models (likelihood ratio chi-
square = 0.08, df = 1, p = .772).

The third step added the interaction between stage and intervention to the stage
two model. This proved to be significant as well (likelihood ratio chi-square = 18.495, df
= 4, p = .002). Again, only pre-TV/computer viewing was a significant predictor (p =
.001). An analysis of the difference in likelihood ratio chi-square of step two and three
showed a nonsignificant difference between models (likelihood ratio chi-square = 0.58, df
= 1, p = .447).

Results of the step one negative binomial regression for post-TV/computer
viewing minutes indicated the most significant model fit compared to a Null-model.
Preexercise sessions, education, and dichotomous exercise stage, without intervention or
an intervention x stage interaction component created the best fit. Only pre-TV/computer
viewing minutes was a significant predictor (p = .001) of post-TV/computer viewing
minutes. Neither dichotomous stage (p = .409) or intervention (p = .771) are significant
predictors of TV/computer viewing behavior in a one-tailed test in the direction of the
hypothesis. See Table 10 for a summary of the results.
Table 10

Summary of Hierarchical Negative Binomial Regression Analysis for Variables Predicting Postintervention Sedentary Behavior in Volunteer Firefighters \((n = 85)\)

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Variable</th>
<th>(B)</th>
<th>(SE_B)</th>
<th>(p)</th>
<th>Wald chi-square</th>
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<tbody>
<tr>
<td>Pre-TV/computer viewing</td>
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<td>0.0001</td>
<td>.001*</td>
<td>15.288</td>
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</tr>
<tr>
<td>Education(^a)</td>
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<td>0.07</td>
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<td>1.009</td>
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</tr>
<tr>
<td>Stage(^a)</td>
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<td>0.12</td>
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<td>.621</td>
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<table>
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<tr>
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<th>Variable</th>
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<th>(SE_B)</th>
<th>(p)</th>
<th>Wald chi-square</th>
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</thead>
<tbody>
<tr>
<td>Pre-TV/computer viewing</td>
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<td>0.0002</td>
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<tr>
<td>Education(^a)</td>
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<tr>
<td>Stage(^a)</td>
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<tr>
<td>Intervention(^b)</td>
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<td>.085</td>
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<table>
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<th>Variable</th>
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<th>(SE_B)</th>
<th>(p)</th>
<th>Wald chi-square</th>
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</thead>
<tbody>
<tr>
<td>Pre-TV/computer viewing</td>
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<td>0.0002</td>
<td>.001*</td>
<td>15.396</td>
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</tr>
<tr>
<td>Education(^a)</td>
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<td>.544</td>
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</tr>
<tr>
<td>Stage(^a)</td>
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<td>0.12</td>
<td>.39</td>
<td>.733</td>
<td></td>
</tr>
<tr>
<td>Intervention(^b)</td>
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<td>0.12</td>
<td>.65</td>
<td>.202</td>
<td></td>
</tr>
<tr>
<td>Intervention(^b) x Stage(^a)</td>
<td>-0.09</td>
<td>0.11</td>
<td>.45</td>
<td>.581</td>
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</tr>
</tbody>
</table>

\(^a\) Categorical variables: Stage = dichotomous stage grouping (TTM stage 1-3 = -1, TTM stage 4-5 = +1), Education = coded by education level (less than high school = 1, through Ph.D = 9).

\(^b\) Intervention: Treatment = +1, Control = -1.

* significant at \(p < 0.10\) in one-tailed test.

This analysis of changes in sedentary behavior showed no support for hypothesis four. The intervention did not significantly indirectly decrease TV/computer viewing time even though the number of minutes reported in this sedentary behavior decreased 30.5 minutes in the control group and 195.2 minutes in the treatment group.
Cohen’s $d$ Effect Size

An analysis of the means and standard deviations of pre- and posttreatment behavior determined the Cohen’s $d$ effect size of the change in behavior ($ES = \text{mean}_{\text{postintervention}} - \text{mean}_{\text{preintervention}} \div SD_{\text{preintervention}}$). Table 11 shows the effect size of the treatment disaggregated by stage and treatment. The number of exercise minutes (see Figure 8) and the number of exercise sessions increased in both the treatment and control groups of Categories 1-3 but decreased in both the treatment and control groups of Categories 4-5. Sedentary TV/computer viewing decreased in both the control group and treatment group of both stage categories except for the control group in Stage 4-5, which increased TV/computer viewing time. The greatest effect size was 0.30 in exercise sessions in the treatment group of the early stage exercisers. The effect sizes were small to moderate yet nonsignificant.

Summary

Baseline analysis of the demographic variables showed the treatment and control groups to be equal at baseline with the exception of education level. The control group reported higher levels of education than the treatment group. Therefore, education was added as a control variable in all subsequent main hypothesis-testing procedures. Further analysis of those who completed the study compared to those who dropped out did not reveal any additional significant differences except for marital status. The treatment group reported a higher percentage of single to married participants than did the control group.
Table 11

*Pre- and Posttreatment Statistics and Cohen’s d Effect Size for Each Exercise Category Subdivision*

<table>
<thead>
<tr>
<th>Variable</th>
<th>All Participants</th>
<th></th>
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<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Control Group</td>
<td>Treatment Group (n = 44)</td>
<td>Treatment Group (n = 41)</td>
<td>Control Group (n = 41)</td>
<td>Treatment Group (n = 41)</td>
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<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Cohen’s d ES</td>
<td>Mean</td>
<td>SD</td>
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<tr>
<td>Preexercise minutes</td>
<td>323.5</td>
<td>378.9</td>
<td>-0.07</td>
<td>423.0</td>
<td>499.3</td>
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<tr>
<td>Postexercise minutes</td>
<td>297.9</td>
<td>267.9</td>
<td>0.03</td>
<td>439.0</td>
<td>384.4</td>
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<tr>
<td>Preexercise sessions</td>
<td>5.34</td>
<td>4.04</td>
<td>0.03</td>
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<td>4.77</td>
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<td>Postexercise sessions</td>
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<td>0.03</td>
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<td>4.60</td>
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<tr>
<td>Pre-TV minutes</td>
<td>1171.6</td>
<td>872.5</td>
<td>-0.04</td>
<td>1325.4</td>
<td>840.5</td>
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<tr>
<td>Post-TV minutes</td>
<td>1141.1</td>
<td>947.3</td>
<td>0.03</td>
<td>1130.2</td>
<td>784.5</td>
</tr>
</tbody>
</table>

| Cat 1-3                   |                  |                                          |                                          |                                          |                                          |
| Variable                  | Control Group    | Treatment Group (n = 23)               | Treatment Group (n = 26)               | Control Group (n = 26)                  | Treatment Group (n = 26)                  |
|                           | Mean             | SD                          | Cohen’s d ES | Mean             | SD                          | Cohen’s d ES | Mean             | SD                          | Cohen’s d ES |
| Preexercise minutes       | 186.3            | 179.2                       | 0.08        | 256.3            | 406.8                       | 0.21        |
| Postexercise minutes      | 200.0            | 229.0                       | 0.08        | 344.2            | 403.9                       | 0.21        |
| Preexercise sessions      | 3.52             | 3.60                        | 0.08        | 3.00             | 3.52                        | 0.08        |
| Postexercise sessions     | 3.83             | 3.86                        | 0.08        | 5.62             | 4.92                        | 0.08        |
| Pre-TV minutes            | 1189.1           | 808.6                       | -0.22       | 1248.5           | 604.5                       | -0.14       |
| Post-TV minutes           | 1015.1           | 649.4                       | 0.03        | 1160.8           | 709.2                       | 0.30        |

| Cat 4-5                   |                  |                                          |                                          |                                          |                                          |
| Variable                  | Control Group    | Treatment Group (n = 21)               | Treatment Group (n = 15)               | Control Group (n = 15)                  | Treatment Group (n = 15)                  |
|                           | Mean             | SD                          | Cohen’s d ES | Mean             | SD                          | Cohen’s d ES | Mean             | SD                          | Cohen’s d ES |
| Preexercise minutes       | 473.8            | 477.4                       | -0.14       | 712.0            | 525.0                       | -0.21       |
| Postexercise minutes      | 405.1            | 271.2                       | -0.14       | 603.4            | 291.9                       | -0.14       |
| Preexercise sessions      | 7.33             | 3.60                        | -0.04       | 9.13             | 4.16                        | -0.14       |
| Postexercise sessions     | 7.19             | 2.94                        | 0.03        | 8.53             | 3.38                        | 0.03        |
| Pre-TV minutes            | 1152.5           | 957.5                       | 0.13        | 1458.70          | 1155.80                     | -0.33       |
| Post-TV minutes           | 1279.0           | 1194.7                      | 0.13        | 1077.00          | 924.80                      | 0.30        |

The data were examined for normal distribution to determine the appropriate statistical method. Using only those who completed the exercise log, we found the data to be both skewed and characterized by a high number of zero counts. Due to this, parametric statistics of analysis of the means were not appropriate. Further investigation was conducted to examine the appropriateness of nonparametric Poisson regression for
count data. Our data exhibited the requisite requirements of a normal zero, no negative numbers, and skewed data; however, the variance of the data exceeded the limit of the assumptions of a Poisson regression, thus it was rejected as an appropriate statistical method. Due to the overdispersion of data, a negative binomial regression was found to be an appropriate statistical method to analyze our data.

Analyzing number of minutes exercised showed that the treatment had a
significant effect in the expected direction when predicting an increase in exercise minutes compared to the control group lending support to hypothesis one. There was not a significant effect of stage membership, providing no support for hypothesis two. Those identified as early stage exercisers saw a greater increase in exercise minutes postintervention than did the late stage exercisers, however stage membership was not a significant predictor of minutes of exercise. Treatment x stage was nonsignificant in the prediction of postintervention exercise minutes resulting in no support for hypothesis three.

Neither treatment nor stage membership had a significant effect on the number of postintervention exercise sessions, nor was there a significant stage x treatment interaction. Hypothesis one, two, and three were not supported using postintervention exercise sessions as a dependent variable in contrast to the analysis of postintervention exercise minutes.

When comparing those who reported exercise behavior to those who reported no exercise behavior, there were no significant predictors except for preintervention behavior. Neither the intervention or stage membership influenced this dichotomous behavior. This analysis did not support hypothesis one, two, or three.

A comparison of sedentary behavior (TV/computer viewing) found no significant effects of treatment, stage membership, or interaction between stage membership x treatment resulting in no support for hypothesis four.

In summary, hypothesis one was supported by the increase in postintervention minutes exercised but was not supported by comparisons of exercise sessions. Hypothesis two was not supported even though there was an increase in postintervention minutes in
the early stage members compared to the late stage members, nor was it supported in the measures of exercise sessions. Hypothesis three, the interaction of treatment x stage was not supported by any of the data. Finally, hypothesis four was not supported when analyzing changes in sedentary behavior.
CHAPTER V
DISCUSSION

An effort is currently underway to reduce the risk of death of volunteer firefighters caused by poor cardiovascular fitness. One facet of this effort is focused at changing volunteer firefighter exercise behavior. Building on established social-cognitive models associated with changes in health behavior, the present research applied the HAPA theory espoused by Schwarzer and Luszczynska (2008). We created an implementation intention intervention to determine if prompting a volitional, “action control” strategy often applied on the background of the HAPA and similar volition models of behavior is more effective at increasing exercise behavior in volunteer firefighters than a general exercise message. Using this theoretical background, the researcher created an instructional survey that informed participants of exercise guidelines and guided the development of implementation intentions in the treatment group.

Participants for this study were recruited from nine volunteer fire departments in three local counties. The postexercise diary response rate was 57.8% ranging from 40.0% to a high of 73.9% in the nine fire departments. Overweight and obesity was reported in 79.9% \((n = 110)\) of the initial sample compared to a national average of 67% (CDC, 2010). Almost 40% (39.4%, \(n = 56\)) reported at least one physiological issue precluding them from participation in the Forest Service Work Capacity Test (HSQ). Overall, this confirms the literature suggesting volunteer firefighters are in poor physical condition (Fahy, 2005; Hammer et al., 2009; Swank et al., 2000). Long-term research has shown
that obesity and overweight are related to increased coronary heart disease risk. This mechanism is not only through co-morbidity with hypertension; dyslipidemia, reduction is HDL cholesterol and impaired glucose tolerance but independently predicts coronary atherosclerosis (Eckel, 1997).

On a scale from 1 to 10 (1 = hate it to 10 = love it), the mean score for exercise attitudes was 7.16 (SD = 1.67) indicating that most volunteer firefighters have favorable attitudes towards exercise. As would be expected, early stage exercisers had lower (M = 6.46, SD = 1.63) favorable attitudes towards exercise than late stage exercisers (M = 8.12, SD = 1.22). HSQ barriers to exercise that indicated physical disabilities that might cause an individual to decline to participate in exercise due to discomfort or pain were not significantly different between treatment (M = 0.59, SD = .95) and control (M = 0.48, SD = .83) groups nor between stage membership (early stage M = 0.69, SD = .99; late stage M = 0.31, SD = .68). Self-reports indicated that 65.9% of respondents in both the treatment (27 of 41) group and the control group (29 of 44) had no HSQ barriers to exercise. However, this indicates that 34.1% of firefighters have one or more disabilities that might cause them to refrain from exercise.

One in five (20.4%; n = 30) reported no exercise at all in the two weeks prior to beginning this study. Just over half of the participants (55.1%; n = 81) indicated that they were in the preaction stages of exercise including stages 1-3. Demographic data collected on these volunteer firefighter confirms the need to create an intervention that effectively increases exercise behavior. To determine if our intervention was effective, the following hypothesis were tested:
Hypothesis One. An implementation intention intervention will increase exercise behavior over time in volunteer firefighters, while a general exercise message will have no effects on exercise.

Hypothesis Two. Those in the earlier stages of change as defined by the TTM will show greater increases in exercise behavior than those in later stages because early stage exercisers have more room for growth than late stage exercisers.

Hypothesis Three. There will be an interaction between the implementation intention intervention and stage membership. Those in the treatment group and in the earlier stages of change should increase more than those in late stages of exercise.

Hypothesis Four. The intervention will indirectly decrease sedentary behavior by reducing the amount of time spent in leisure activities such as watching television or recreational computer use.

Multiple outcomes were tested to determine the accuracy of the first three hypotheses. These included postintervention exercise minutes, postintervention exercise sessions, and dichotomous exercise behavior. To test the fourth hypothesis, we examined postintervention TV/computer use.

The best evidence supporting the first hypothesis was found in the comparison of the number of minutes exercised. Mean exercise minutes in the two week postintervention period increased 16.0 minutes in the treatment group after the intervention, while the control group decreased by 25.6 minutes. The results were greater for the early stage member subgroup. Even though there was a large increase in the number of exercise minutes in the early stage group, there was not a significant main effect for stage membership. This may be due in some part to collinearity between the
number of minutes exercised and stage membership. By definition, participants in stages one and two do not exercise and thus would not report any exercise time. Stage three members are not regular exercisers and would report lower exercise participation than those in stages four and five. Thus the collinearity between stage membership and minutes of exercise; early stages members are defined by low exercise rates, while late stage members are defined by higher exercise rates.

The treatment group increased the number of minutes exercised by 87.9 minutes, while the control group only increased by 13.7 min. The late stage members decreased 68.7 min (control group) and 108.6 min (treatment group). Even when controlling for preintervention exercise minutes and stage membership, the treatment was a significant predictor of increased exercise behavior as measured by time. This is consistent with the results of previous research on exercise using the HAPA but to a lesser degree. The pretreatment, posttreatment effect sizes were much smaller in our research than described by Schwarzer et al. (2008), Prestwich et al. (2003), and Gollwitzer and Sheeran (2006).

When looking for support of the first hypothesis by evaluating increases in the number of sessions of exercise, treatment was not a significant predictor. The number of exercise sessions in a two-week period increased in both the treatment (1.4 sessions) and control (0.1 sessions) groups. This indicates a large but nonsignificant difference. Most of the variance was accounted for by controlling for preintervention exercise sessions. The conflicting results between minutes of exercise and number of exercise sessions might be due to several causes. First, the number of sessions was a rough measure of exercise participation compared to the number of exercise minutes. If the participant did not exercise for at least 20 min, the session was not counted. Sessions were integer values
from 0-14. The number of minutes was a simple count. Dropping a session that did not include at least 20 min resulted in a possible 7% reduction in the overall number. In those who reported minimal exercise, the percentage could be much higher. Nine participants reported sessions lasting less than 20 min. Others reported sessions lasting as long as 8 hr (hiking). The 8-hr session and the 20-min session were both given the same weight and counted as one session.

Further support for hypothesis one was not presented in the evaluation of the onset of exercise as measured by a binary outcome. This was of special interest because ultimately, getting nonexercisers to do any exercise at all is a big achievement. Increases in exercise are good, but onset of exercise is particularly important, especially for the participants in our study. There was no significant increase in the number of individuals in the treatment group who reported exercise behavior on a dichotomous scale relative to the control group. This may be due in part to the dichotomization of the outcome. It would lead to limited test power and might have prevented the detection of significant effects. Dichotomizing of exercise behavior results in a less homogenous group, leading to greater variation and increased statistical weakness.

Contrary to Hypothesis One, Hypothesis Two was not supported when analyzing the number of minutes of exercise. Dichotomous stage membership did not present as a significant predictor of increased exercise behavior. Even though early stage members increased exercise minutes (control group = 13.7 min, treatment group = 87.9 min) while late stage exercisers decreased in number of minutes of exercise (control group = -68.7, treatment group = -108.6) there was not a significant main effect for stage membership. The β-value for stage membership was positive rather than negative indicating a stronger
effect on late stage members. This is contrary to the change we saw when analyzing the standardized mean difference effect sizes comparing pre- and postintervention minutes exercised. Despite the fact that the β-value was positive, early stage members increased exercise behavior more than late stage members. The discrepancy for this contradiction may lie in the collinearity between stage membership and preintervention exercise behavior. By definition, early stage membership indicates lower levels of exercise participation. Stage one and two do not exhibit exercise behavior and stage three does so only intermittently. Stages 4 and 5 are defined as regular exercise, naturally resulting in higher levels of exercise behavior.

While nonsignificant, one theory for the change in behavior of the early stage members compared to late stage members lies in the fact that those who regularly exercise have already formed habits and have passed beyond the intention and planning stages of the HAPA model (Marcus & Forsyth, 2003; Schwarzer & Luszczyska, 2008,). Those who do not regularly exercise are in the stages where implementation intentions and planning are theorized to be most effective at changing behavior and where even simple strategies to increase attention to this issue, such as exercise messages, may exert a small effect. Late stage exercisers already exhibit healthy behavior and it would be unlikely for them to increase exercise time as a result of this intervention. It is unclear why the late stage exercisers would decrease the reported number of minutes exercised; however, this was the case in both the control and treatment groups. This may be due in part because the intervention was not addressed to late stage exercisers. The intervention may have confirmed what they are already doing giving them no reason to try harder. They may have recognized that they were already above the norm allowing them room to
relax a little. Subsequent studies may attempt to encourage people in advanced exercise stages as well.

Further, the second hypothesis was not supported in the analysis of exercise sessions. This is likely due to the same reasons as described above for hypothesis one. The number of sessions was a rough measure of exercise participation compared to the number of exercise minutes. Exercise time may have been dropped if they were less than 20 min. For those who reported minimal exercise, the percentage of exercise time lost could be high.

Hypothesis three was not supported by either an increase in exercise minutes or in exercise sessions. There was no interaction between stage membership and treatment in any of the analyses. This was surprising because, theoretically, we could expect that early stage exercisers in the treatment group would see the greatest increase in exercise behavior. While this was the case, it was not significant. This may, in part, be due to the limited sample size and test power. Even with $n = 85$, disaggregating the sample into stage x treatment groups led to sample sizes ranging from 15-26 members. A larger sample size is definitely warranted to further investigate the potential interaction effect. Another possible explanation might be the limited strength of the intervention. As noted before, this intervention was less intense than typical interventions involving HAPA. A more refined intervention that is more personally engaging, discusses barriers and action control strategies on a one-on-one basis, and/or involves behavioral contracts or self-reward contingencies can be expected to display stronger effects.

The fourth hypothesis, claiming secondary intervention effects on sedentary behavior, was not supported by the results. Although the treatment group decreased
(−195.2 min) sedentary TV/computer time more than the control group (−30.5 minutes), treatment was not a significant predictor in the analysis, nor was stage membership. Although the treatment group reported a six times greater decrease in TV/computer time (3.25 hr vs. 0.50 hr over a two-week period), the enormous within-group variation in this behavior prevented a significant result. Future research with a more refined and intense intervention strategy may be more successful in supporting secondary intervention effects on sedentary behavior. We did not expect a large decrease in sedentary behavior, but suggested it may be reduced if the intervention displaced sedentary behavior with exercise. Most of the variance was accounted for by preintervention TV/computer time. Additionally, TV/computer viewing does not account for all sedentary behavior. Other social and personal behavior may have increased or decreased as a secondary effect of the intervention. More accurate collection of sedentary behavior would be required to confirm this theory.

Schwarzer and Luszczynska’s (2008) model describes the transition from preintentional motivation to intention followed by planning leading to the adoption of specific behavior. Firefighters receive a constant barrage of messages informing them of the importance of exercise. Most know that the leading cause of death among volunteer firefighters is heart attack. According to the HBM (Sheeran & Abraham, 1996), they have evaluated their susceptibility to having a myocardial infarction and the severity and consequences of such an incident. This was most likely not from a formal analysis, but through the lens of anecdotal evidence or personal experience. Theoretically, they would form the intention to engage in exercise behavior if they felt the risk and/or the severity were high. This is one of the fundamental prevolitional determinates of behavior in
Schwarzer and Luszczynska’s HAPA (2008). The other prevolitional determinants include preaction self-efficacy and positive outcome expectancies.

Of the firefighters participating in this study, 55.3% were either thinking about exercising in the next 6 months or reported they were already exercising but not regularly. In Schwarzer and Luszczynska’s (2008) model, this indicates they have moved beyond preintentional motivation and are in the postintentional volition process. They have formed intentions. These firefighters no longer require health risk information to adopt exercise behavior according to Schwarzer and Luszczynska (2008); rather, they need to form implementation intentions. They need to identify how, when, and where they will exercise. The theoretical implication is that an intervention focused on planning should be most effective at moving firefighters beyond the intention phase to exercise adoption. Indeed, those in the early stage treatment group reported higher levels of exercise participation than early stage participants in the control group who received only health risk information.

Even the limited strength of this intervention showed a positive effect on increased exercise behavior (those who were not regular exercisers) through implementation intention building. The intervention included a section requiring the participants to form implementation intentions by planning where, when, and how they would exercise. The control group received health risk information without any guidance to help them move from the intention phase to planning and exercise adoption. Additional health risk information had less effect on exercise behavior than the implementation intention intervention. This supports Schwarzer and Luszczynska’s (2008) model. The evidence from this study suggests that more information on health risks is less effective.
than changing volunteer firefighter’s exercise behavior using an implementation intention building exercise.

Of interest is the late stage members in both the treatment and control groups. We cannot account for the decrease in exercise time. Implementation intentions have already been formed in regular exercisers. They already plan and exercise thus there is very little room for increases in behavior. Additional health risk information had very little effect on regular exercisers because they are already doing the prescribed exercise program to reduce risk of myocardial infarction. This implies that spending time to form intentions or providing additional health risk information is not warranted for regular exercisers.

**Limitations**

There were several weaknesses that may have affected the internal validity of this study. First, was the relatively low number of participants. Not having enough nonexercisers required us to compare those who regularly exercise with those who did not. It is possible that the effects of the intervention may differ for those who do not exercise at all (stage 1) compared to those who are ready to exercise (stage 3). We were unable to analyze the data at each exercise stage as we had hoped, with a specific focus in the contemplators in Stage 2; rather, we had to group early stage members and late stage members and analyze the effects of the intervention across the entire sample. Combining stages lead to a more heterogeneous grouping factor. Dichotomizing reduces the ability to identify smaller changes in specific portions of the sample conceivably leading to possible type II errors.
It should be noted that this study was not a test of the TTM. We used this model to categorize behavior based on the stage theory and to identify those who were in the planning stage; however, due to the limited number of participants, we grouped participants into early stage and late stage and used this grouping as our predicting variable. This may have limited test power and suggests that a replication with a larger sample size may be indicated.

Second, there was a huge amount of variance in the data collected. This may have been the result of data recording, or simply because the variables being measured varied greatly between individuals. Preintervention minutes of exercise was based on recall rather than daily diary recording. While the TLFB method has been shown to be effective at increasing recall (Sobell & Sobell, 1992), it still allows for increased self-reporting error relative to contemporary self-reports or daily diary formats. Similarly, in the postintervention exercise assessment, we asked the participants to record daily activity on their exercise logs, but there was some evidence that this was not done as prescribed. It appears many of the logs were filled out at the end of the two-week postintervention time, likely involving substantial self-reporting error, forgetting, and/or self-reporting bias, such as overreporting prompted by socially desirable responding. As with any studies limited to self-report, the absence of objective criteria may threaten the internal validity of the results.

External validity may limited by the specific characteristics of the sample. The participants in this study were primarily white males. It is unknown if the participants represent the general population of volunteer firefighters in the United States. There were
very few minorities or females included in the sample as well; however, there are relatively few females involved in volunteer firefighting.

There was a significant difference \((p = .047)\) in marital status in the drop out rates comparing completers to dropouts. A higher percentage of singles returned the survey compared to married or divorced participants. The participants live in an area with a strong religious influence prohibiting consumption of alcohol and smoking. Results may differ in areas with differing social norms on alcohol consumption and acceptance of smoking.

This research took place in the spring. The local environment includes heavy snowfall in the winter with cold temperatures and weather inversions causing poor air quality in the valley. Winter sports are common and there is a high level of outdoor physical activity in the summer. This same research conducted during the summer months may have a different result.

A concerted effort was made to receive all postintervention diary logs with repeated visits and phone calls, but we still only had less than a 60% return rate. While the postexercise participants were equivalent at baseline, we do not know why participants dropped from the study. Because of these limitations, this study should be generalized with caution. It would be inappropriate to generalize these results to full-time paid firefighters because their circumstances are much different than volunteers.
Summary

Although the intervention had some effect, it was a low intensity intervention. Those in the treatment group were only exposed to the guidance to formulate implementation intentions during one group session for less than 10 min and this was only in written form. Typical motivational interviewing techniques are one-on-one and normally take much longer and occur over several sessions. This intervention was essentially hidden within the body of the instructional text as a subsection rather than being presented as a specific exercise to develop implementation intentions. While this was done to eliminate cross-contamination of the treatment and control groups, it may have diluted the strength of the intervention. Our intervention may have been more effective at changing behavior if it had been presented with specific implementation intention building instructions and examples rather than being disguised within the body of a general exercise message.

While the intervention was a significant predictor of the number of postintervention exercise minutes, it was not a significant predictor of the number of exercise sessions. This discrepancy may have been due to the requirement that only sessions lasting longer than 20 min were included. Sessions lasting less than 20 minutes were not counted in the total, reducing the overall amount of exercise time analyzed.

Dichotomous stage of change was not a significant predictor of the number of postintervention exercise minutes or of exercise sessions. The effects of stage grouping did not explain change in behavior over time, although we did see greater increases in exercise behavior for early stage members (Stages 1-3) than for late stage members
(Stages 4-5). This may have been because the early stage exercisers had more room for growth than the late stage exercisers. Late stage exercisers have already created habits and schedules for exercise behavior and do not need to add more to meet recommended levels unlike nonregular exercisers.

There was not a significant treatment x stage interaction with any of the dependent variables. This was not surprising given that stage did not have a significant main effect on the number of minutes of exercise. We assumed the treatment would have a greater effect on nonregular exercisers than on regular exercisers. While this was true, it was not significant. A significant interaction may be seen with a stronger intervention.

**Implications**

Our study builds on previous research of implementation intentions. We found that even a mild intervention may have a significant effect on exercise behavior in nonregular exercising volunteer firefighters. However, our results were mixed. We found that postintervention exercise minutes increased significantly while postintervention number of exercise sessions did not increase significantly. Further research will be required to address this discrepancy. Furthermore, we have evidence that a general exercise message is less effective at increasing exercise behavior than forming implementation intention.

We have only a rough measure of the effectiveness of implementation intention formation on volunteer firefighter exercise. We do not know if implementation formation is as effective for nonexercisers (Stage 1) as it was to the general group of nonregular
exercisers (Stages 1-3). One implication of our study is an awareness of this limitation and the exposure of a line of research that could be further studied.

We also found evidence that suggested our intervention decreased sedentary TV/computer behavior, but not at a significantly significant level. We do not know if that decrease was directly replaced by exercise. This study exposes a line of research that might further be developed.

The practical implication of this study is that implementation intention formation can be a practical way to increase exercise behavior in volunteer firefighters. To be sure, a stronger, more focused intervention should be developed prior to practical application. However, there is sufficient evidence that this technique is viable. A practical, focused, intervention should be developed and given to a broader volunteer firefighter audience.

**Future Research**

Future research along this line is recommended. One area of concern in this study is the use of recall data. While the methods used in this study have been shown to be valid, a longitudinal design recording exercise behavior for a longer period of time (up to 6 weeks) followed by the intervention and a similar 6-week follow-up measure would be more accurate. In this manner, the control group could be eliminated and the premeasure could control for the preintervention condition. This would easily double the number of participants in the study. The use of physiological measures might further identify those who are exercising on a regular basis. Measures of body fat percentage, blood chemistry, weight, and even accelerometer measures of movement might lead to more accurate data over diary logs.
This study illustrated the fact that implementation intention building is not effective for those who already have formed the intentions and regularly exercise. A better use of the firefighter’s time would be to focus the research only on those who are not regular exercisers.

A second area of concern was the weakness of the intervention. The portion of the study dedicated to the intervention was only a small percentage of the message presented to the participants. Focusing more on the formation of implementation intentions including the “how, when, and where” to exercise might increase exercise behavior more than the current intervention. Additionally, leaving the planning diary with the participant rather than collecting it might help reinforce behavior. Using preintervention behavior for the control condition and eliminating the general exercise message would focus the intervention on building implementation intentions.

Further research with a larger sample size should be done to determine the effectiveness of the intervention at each stage of exercise participation in the volunteer firefighter community. This study experienced difficulty identifying sufficient numbers of participants to thoroughly examine the various stages and was unable to find a significant main effect for stage membership, even though the treatment group of early stage membership showed greater increases in exercise behavior than other subgroups.
REFERENCES


Center for Disease Control and Prevention. (2010). Obesity and overweight. 


APPENDICES
Appendix A. Demographic Data Worksheet
Demographic Data

Please answer the following questions:

Age: ___________
Height: ___________
Weight: ___________
Sex: ___________

Number of years in the fire service: _________________

Marital status: ___ Single (never married)
                ___ Married
                ___ Divorced
                ___ Widowed

Ethnicity: _____ White     _____ Black     _____ Hispanic     _____ American Indian     _____ Asian
           ___________ Other (please identify)

Annual Household Income Level:
   ___ less than $10,000
   ___ $10,000 – $20,000
   ___ $20,000 – $30,000
   ___ $30,000 – $40,000
   ___ $40,000 – $50,000
   ___ $50,000 – $60,000
   ___ $60,000 – $70,000
   ___ $70,000 – $80,000
   ___ $80,000 – $90,000
   ___ Greater than $90,000

How many adults work outside of the home? ________________

Highest level of education:
   ___ Less than High School graduation
   ___ GED
   ___ High School Diploma
   ___ Vocational/Technical training
   ___ Some college coursework
   ___ Associates Degree
   ___ Bachelor’s Degree
   ___ Some graduate coursework
   ___ Master’s Degree
   ___ Ph.D

A. How many times do you usually exercise for at least 20 minutes per session per week?
   Usual number of 20-minute sessions per week: ____________

B. How many total minutes do you usually exercise per week?
Appendix B. Health Screening Questionnaire
HEALTH SCREENING QUESTIONNAIRE (HSQ)

Check 'Yes' or 'No' in response to the following questions:

Y  N  1) During the past 12 months have you at any time (during physical activity or while resting) experienced pain, discomfort or pressure in your chest.

Y  N  2) During the past 12 months have you experienced difficulty breathing or shortness of breath, dizziness, fainting, or blackout?

Y  N  3) Do you have a blood pressure with systolic (top #) greater than 140 or diastolic (bottom #) greater than 90?

Y  N  4) Have you ever been diagnosed or treated for any heart disease, heart murmur, chest pain (angina), palpitations (irregular beat), or heart attack?

Y  N  5) Have you ever had heart surgery, angioplasty, or a pace maker, valve replacement, or heart transplant?

Y  N  6) Do you have a resting pulse greater than 100 beats per minute?

Y  N  7) Do you have any arthritis, back trouble, hip/knee/joint/pain, or any other bone or joint condition that could be aggravated or made worse by the Work Capacity Test?

Y  N  8) Do you have personal experience or doctor’s advice of any other medical or physical reason that would prohibit you from taking the Work Capacity Test?

Y  N  9) Has your personal physician recommended against taking the Work Capacity Test because of asthma, diabetes, epilepsy or elevated cholesterol or a hernia?

Y  N  10) In the past year, have you been advised by a physician to refrain from exercise? If yes, please follow your doctor’s advice.


Appendix C. Timeline Follow-back
INSTRUCTIONS FOR FILLING OUT THE TIMELINE LEISURE TIME BEHAVIOR CALENDAR

To help us evaluate your exercise behavior, we need to get an idea of what your behavior was like in the past 14 days. We also want to compare it to your TV/computer viewing habits. To do this, we would like you to fill out the attached calendar.

✓ Filling out the calendar is not hard!
✓ Try to be as accurate as possible.
✓ We recognize you won’t have perfect recall. That’s OKAY.

✓ WHAT TO FILL IN

• The idea is to record how much exercise and TV/computer viewing you did for each day on the calendar.

• On days when you did not exercise, not even once, you should write a “0.” If you did not watch any TV or spend time on the computer you should write a “0” for TV/computer.

It’s important that something is written for every day, even if it is a “0”.

✓ YOUR BEST ESTIMATE

• We realize it isn’t easy to recall things with 100% accuracy.

• If you are not sure how long you exercised or whether you exercised on a Thursday or a Friday, give it your best guess! What is important is that 60 minutes is very different from 10 minutes. The goal is to get a sense of how frequently you exercise, how much you exercise, and your patterns of exercising, TV/computer viewing frequency, how much time you spend viewing TV/computer and your pattern of TV/computer watching.

✓ HELPFUL HINTS

• If you have an appointment book you can use it to help you recall your use.

• Holidays such as Thanksgiving and Christmas are marked on the calendar to help you recall your exercise. Also, think about how much you exercised on personal holidays & events such as birthdays, vacations, or parties.

• If you have regular patterns to your exercise or TV/computer viewing, you can use these to help you recall your use. For example, some people may only exercise on weekends or watch TV on Sundays.

✓ COMPLETING THE CALENDAR

• A blank calendar is attached. Write in the minutes of exercise you completed on each day. Then write the minutes of TV/computer viewing you completed each day.

• The time period we are talking about on the calendar is from ___________ to ________________.

• In estimating the duration of exercise and TV/computer viewing you completed, be as accurate as possible.

• DOUBLE CHECK THAT ALL DAYS ARE FILLED IN BEFORE RETURNING THE CALENDAR.

• Before you start look at the SAMPLE CALENDAR on the next page.
**SAMPLE CALENDAR**

<table>
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<tr>
<th>Sunday</th>
<th>Monday</th>
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<td>Fire drill</td>
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<td>basketball</td>
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<td></td>
<td>0 exercise 2 hrs TV</td>
<td>0 Exercise 0 TV 2 hr vide game</td>
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<td>60 min 2 hrs TV</td>
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<td>18</td>
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<tr>
<td>watched football</td>
<td>Choking call</td>
<td>Jane’s b-day</td>
<td>Hazmat drill</td>
<td>EMS drill</td>
<td>house fire</td>
<td>21</td>
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<tr>
<td>6 hrs TV</td>
<td>10-50 pi county meeting</td>
<td>0 exercise 0 hrs TV</td>
<td>0 exercise 1.5 hrs computer</td>
<td>0 exercise 2 hrs tv</td>
<td>0 exercise 0 TV</td>
<td>skiing 4 hours 3 hrs dvd</td>
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<td>0 exercise</td>
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<td>visit grandma</td>
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<td>basketball 45 min</td>
<td>racquetball 90 min</td>
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<td>0 exercise</td>
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<td>rock climbing</td>
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**Aerobic Exercise:**

- Cycling
- *Walking*
- Running
- Rowing
- Ski machine
- aerobics
- Volleyball
- basketball
- tennis
- boxing
- martial arts
- Racquetball
- Hockey

**Strength training:**

- rock climbing
- rope jumping
- rugby
- soccer
- softball
- skiing
- snowboarding
- swimming
- scuba
- skating
- snowshoeing
- cardio videos
- football
- push-up/pull ups
- weight lifting
- circuit training
- weight machines
- Free weights
- squats
- lunges
- dead lift
- dumbbells

**Liesure Time:**

- Computer
- Games
- Surfing

* walking only counts if it is a part of an exercise routine such as walking your dog or going on a walk for exercise.
Appendix D. Treatment Group Survey Sheet
Which statement currently best fits your plans regarding exercise? (circle one)

1. I presently do not exercise and do not plan to start exercising in the next 6 months.

2. I presently do not exercise, but I have been thinking about starting to exercise within the next 6 months.

3. I presently get some exercise, but not regularly.

4. I presently exercise on a regular basis, but I have only begun doing so within the past 6 months.

5. I presently exercise on a regular basis and have been doing so for longer than 6 months.

For questions asking “how likely...”, please circle a number representing how likely you are to participate with 0% = not at all likely and 100% = 100% sure.

1. Research has shown that the leading cause of death among volunteer firefighters is heart attack due to poor physical conditioning, heart disease, and/or overexertion on the fire ground. How likely do you think you are to suffer from a heart attack on a scale from 0 to 100?

   0%  10%  20%  30%  40%  50%  60%  70%  80%  90%  100%

   Not at all likely  100% sure
2. According to the American College of Sports Medicine, aerobic exercise is important for cardiovascular health. Aerobic exercise means exercising hard enough to get your heart rate between 60% and 90% of your age predicted maximum heart rate. However, it is important that you begin slowly. Determine your exercise heart rate range from the heart rate chart:

Heart rate minimum = _____________

Heart rate maximum = _____________

![Heart Rate Chart]

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<tr>
<th>Age</th>
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<th>Max Heart Rate</th>
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</table>
3. Aerobic exercise includes exercises such as: walking, jogging, running, biking, swimming, basketball, cycling, rowing, cross-country skiing, snowshoeing, racquetball, or any other exercise that gets your heart rate above the minimum heart rate you calculated above. On a scale of 0 – 10, how do you feel about aerobic exercise?

0 1 2 3 4 5 6 7 8 9 10
Hate it no opinion Love it

4. The Centers for Disease Control and Prevention recommend aerobic exercise most days of the week. On a scale of 0 – 10, how do you feel about this prescription to exercise most days of the week?

0 1 2 3 4 5 6 7 8 9 10
Hate it no opinion Love it

5. The American College of Sports Medicine recommends that an aerobic exercise session should last at least 20 minutes and might last more than an hour. How do you feel about exercising for at least 20 minutes per session?

0 1 2 3 4 5 6 7 8 9 10
Hate it no opinion Love it

6. Strength training is important to firefighter safety. Fundamental conditioning allows for longer and more strenuous work on the fire ground without taxing your body or causing injury, especially for older firefighters. Basic strength training prescription usually involves 2 – 4 strength-training sessions per week with one day off between sessions. How do you feel about strength training using these guidelines?

0 1 2 3 4 5 6 7 8 9 10
Hate it no opinion Love it

7. Many beginning exercisers overdue their initial strength training leaving them with sore muscles and no desire to continue. Proper beginning strength training involves using only enough weight to be able to lift 2 – 3 sets of 12 – 15 reps of each exercise. How do feel about limiting your weight so that you follow the prescription of lifting 2 – 3 sets of 12 – 15 reps of each exercise?

0 1 2 3 4 5 6 7 8 9 10
Hate it no opinion Love it
8. There are many techniques used in strength training. The most effective are the ones that focus on the movement patterns you will use in your daily activities. This is called functional training. For firefighting, focus on exercises that strengthen your legs and back as well as your arms and chest. One way to do this is to use a series of exercises that are broken down by movement pattern. These patterns include: upper body push, upper body pull, squat, lunge, and core. Each of these patterns should be performed during the workout session using the resistance described above. How likely are you to participate in strength training?

0 1 2 3 4 5 6 7 8 9 10

Hate it  no opinion  Love it

GETTING STARTED

Beginning an exercise program after you decide to work out can be difficult. Thorough and thoughtful planning is critical to success. Planning how, when, and where you are going to exercise has been found to be much more effective than simply saying you are going to exercise more. The following exercise will help you create a specific exercise schedule that you can stick to.

HOW:

HOW describes the type of exercise you plan on doing. Select one or more aerobic exercise activities that you prefer to do and will be likely to do on a regular basis:

Aerobic Exercise #1 _________________

Aerobic Exercise #2 _________________

Aerobic Exercise #3 _________________

If you wish to do strength training, please select one or more strength training exercises:

Strength Training Push (push ups, chest press, fly, military press, etc)

Exercise #1 _________________

Exercise #2 _________________
Strength Training Pull (pull up, bicep curl, etc.)
Exercise #1 ___________________
Exercise #2 ___________________

Lunges
Exercise #1 ___________________
Exercise #2 ___________________

Squats
Exercise #1 ___________________
Exercise #2 ___________________

Core Exercise (sit-ups, oblique crunches, planks)
Exercise #1 ___________________
Exercise #2 ___________________

WHERE:

WHERE do you think you will most likely be able to exercise on a regular basis? This might be at home, walking in the neighborhood, at a gym, at the fire station, a swimming pool, or anywhere else you prefer. It should be someplace that is easy to access.

Where: Aerobic Exercise 1: ___________________
Aerobic Exercise 2: ___________________
Aerobic Exercise 3: ___________________
Strength Training: ___________________
WHEN:

*WHEN* describes when you are going to exercise. Some people find that mornings are the only time they can make sure to get their exercise done, others workout in the evening. Pick a schedule that works best for you and your situation. Don’t forget to include rest days. Write down your schedule on the exercise-planning sheet.

First, make a checkmark on the days you will exercise.

Second, write in the time you will exercise each day.

Third, write in how long you will exercise each session.

Fourth, write in the type of exercise you will do.

Finally, commit to your exercise plan.

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Appendix E. Control Group Survey Sheet
Which statement currently best fits your plans regarding exercise? (circle one)

1. I presently do not exercise and do not plan to start exercising in the next 6 months.

2. I presently do not exercise, but I have been thinking about starting to exercise within the next 6 months.

3. I presently get some exercise, but not regularly.

4. I presently exercise on a regular basis, but I have only begun doing so within the past 6 months.

5. I presently exercise on a regular basis and have been doing so for longer than 6 months.

For questions asking “how likely...”, please circle a number representing how likely you are to participate with 0% = not at all likely and 100% = 100% sure.

1. Research has shown that the leading cause of death among volunteer firefighters is heart attack due to poor physical conditioning, heart disease, and/or overexertion on the fire ground. How likely do you think you are to suffer from a heart attack on a scale from 0 to 100?

0%  10%  20%  30%  40%  50%  60%  70%  80%  90%  100%

Not at all likely  100% sure
2. According to the American College of Sports Medicine, aerobic exercise is important for cardiovascular health. Aerobic exercise means exercising hard enough to get your heart rate between 60% and 90% of your age predicted maximum heart rate. However, it is important that you begin slowly. Determine your exercise heart rate range from the heart rate chart:

Heart rate minimum = _____________
Heart rate maximum = _____________

Heart Rate Chart

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3. Aerobic exercise includes exercises such as: walking, jogging, running, biking, swimming, basketball, cycling, rowing, cross-country skiing, snowshoeing, racquetball, or any other exercise that gets your heart rate above the minimum heart rate you calculated above. On a scale of 0 – 10, how do you feel about aerobic exercise?

Hate it  no opinion  Love it

4. The Centers for Disease Control and Prevention recommend aerobic exercise most days of the week. On a scale of 0 – 10, how do you feel about this prescription to exercise most days of the week?

Hate it  no opinion  Love it

5. The American College of Sports Medicine recommends that an aerobic exercise session should last at least 20 minutes and might last up to an hour. How do you feel about exercising for at least 20 minutes per session?

Hate it  no opinion  Love it

6. Basic strength training prescription usually involves 2 – 4 strength training sessions per week with one day off between sessions. How do you feel about strength training using these guidelines?

Hate it  no opinion  Love it

7. Many beginning exercisers overdue their initial strength training leaving them with sore muscles and no desire to continue. Proper beginning strength training involves using only enough weight to be able to lift 2 – 3 sets of 12 – 15 reps of each exercise. How do you feel about limiting your weight so that you follow the prescription of lifting 2 – 3 sets of 12 – 15 reps of each exercise?

Hate it  no opinion  Love it
8. There are many techniques used in strength training. The most effective are the ones that focus on the movement patterns you will use in your daily activities. This is called functional training. For firefighting, focus on exercises that strengthen your legs and back as well as your arms and chest. One way to do this is to use a series of exercises that are broken down by movement pattern. These patterns include: upper body push, upper body pull, squat, lunge, and core. Each of these patterns should be performed during the workout session using the resistance described above. How likely are you to participate in strength training?

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Please read the following section and answer the questions below:

Our Nation’s First Responders at Risk

The heart attack epidemic among the fire service is one of serious concern that deserves much attention. Why are so many firefighters suffering from heart attacks? What can be done to reverse this trend? These are some of the questions the NVFC Heart-Healthy Firefighter Program will help to answer.

Day in and day out, firefighters risk their lives protecting people and property in their communities. But what many Americans – and often firefighters themselves – don’t see, is that firefighters need protecting, too.

Did you know that nearly one-half of all firefighter deaths each year are attributed to heart attacks? According to a study by the U.S. fire Administration, many of these firefighters had pre-existing conditions such as hypertension and arteriosclerosis that contributed to the heart attack. Such conditions, if left untreated, often leave individuals at an increased risk for suffering from a heart attack. Coupling that with the strenuous task of firefighting makes a lethal combination.

The statistics are clear. Firefighters are at an extremely high risk of suffering from heart attacks. The strenuous task of firefighting places increased demands on firefighter’s bodies, which, in many cases, are not physically prepared for the strain. Contributing to this risk is the fact that many departments do not require their firefighters to stay physically active and maintain a healthy physical condition. While on duty, firefighters often have large amounts of time in between calls. Also, there are nearly 800,000 volunteer firefighters in the U.S. – most having other jobs that are far less physically demanding than firefighting.
Firefighters are men and women who serve their country and their communities with distinction, every day. We’re proud to provide information, education and support to help firefighters as they prepare for their noble work.

**Coronary Heart Disease**

Coronary heart disease (CHD) is the most common form of heart disease. It’s also the leading cause of death for all Americans – not just firefighters. More than 12 million Americans suffer from CHD, which often results in a heart attack. About 1.1 million Americans suffer a heart attack each year – and almost half of them are fatal.

Fortunately, CHD can be prevented or controlled. Here’s an overview of CHD and its prevention, diagnosis, and treatment.

**What is CHD?**

The heart is a muscle that works 24 hours a day. To perform well, it needs a constant supply of oxygen and nutrients, which is delivered by the blood through the coronary arteries.

That blood flow can be reduced by the process called atherosclerosis, in which plaques or fatty substances build up inside the walls of blood vessels. The plaques attract blood components, which stick to the inside surface of the vessel walls. Atherosclerosis can affect many blood vessels and causes them to narrow and harden. It develops over many years and can begin early in life.

In CHD, atherosclerosis affects the coronary arteries. The fatty buildup, or plaque, can break open and lead to the formation of a blood clot. The clot covers the site of the rupture, also reducing blood flow. Eventually, the clot becomes firm. The process of fatty buildup, plaque rupture, and clot formation recurs, progressively narrowing the arteries. Over time, less blood reaches the heart muscle.

If the blood supply is nearly, completely, and/or abruptly cut off, a heart attack results and cells in the heart muscle that do not receive enough oxygen and begin to die. The more time that passes without treatment to restore blood flow, the greater the damage to the heart. Because heart cells cannot be replaced, the cell loss is permanent.

**What are the symptoms of CHD?**

Symptoms of CHD can vary. One person may feel no discomfort, while another might experience chest pain or shortness of breath. Sometimes the very first symptom of CHD is a heart attack or cardiac arrest (a sudden abrupt loss of heart function).

Chest pain also can vary in its occurrence. Chest pain occurs when the blood flow to the heart is critically reduced and does not match the demands placed on the heart. Called
angina, the pain may be mild and intermittent – or more pronounced and steady. It can be severe enough to make normal everyday activities difficult. The same inadequate blood supply also may cause no symptoms, a condition called silent ischemia.

Particularly in men, angina is often felt behind the breastbone and may radiate up the left arm or neck. It may also be felt in the shoulders, jaw or back. Angina is usually brought on by exercise. It may last 2 to 5 minutes, does not change with breathing, and is eased by rest.

Women may experience a less typical form of angina that feels like shortness of breath or indigestion, and can linger or occur in a different location than behind the breastbone. It may not be brought on by exertion or be eased by rest. In fact, it may occur only at rest.

A person who has any symptoms should talk with his or her doctor. Without treatment, symptoms may return, worsen, become unstable, or progress to a heart attack.

Regular exercise is an important part of being a volunteer firefighter. The following questions will address your knowledge of heart health:

- **T** or **F** Risk factors for heart disease that you can do something about are: high blood pressure, high blood cholesterol; smoking; obesity, and physical exercise.

- **T** or **F** A stroke is often the first symptom of high blood pressure, and a heart attack is often the first symptom of high cholesterol.

- **T** or **F** A blood pressure greater than or equal to 140/90 mmHg is generally considered to be high.

- **T** or **F** The best ways to treat and control high blood pressure are to control your weight, exercise, eat less salt (sodium), restrict your intake of alcohol, and take your high blood pressure medicine, if prescribed by your doctor.

- **T** or **F** A blood cholesterol of 240 mg/dL is desirable for adults.

- **T** or **F** The most effective dietary way to lower the level of your blood cholesterol is to eat foods that are low in cholesterol.

- **T** or **F** Lowering blood cholesterol levels can help people who’ve already had a heart attack.

- **T** or **F** Only children from families at high risk of heart disease need to have their blood cholesterol levels checked.
T or F  The best way to lose weight is to increase physical activity and eat fewer calories

T or F  Heart disease is the leading killer of men and women in the United States
Appendix F. Exercise Record
**EXERCISE LOG**

- TV/Computer time is the amount of time you spend watching TV or on the computer for enjoyment or leisure activity. This includes web surfing and video gaming.

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**TURN IN TO FIRE STATION ON THE 31st!**

- Exercise is defined as a specific sport or fitness activity to increase or maintain your strength and physical conditioning using traditional exercise and sports participation modes. Do not include activities that are strenuous but are a normal part of your employment such as carpentry or farming activities. Do not include lifestyle activities like gardening or using the stairs instead of the elevator. Walking is considered an exercise activity for this study if it is sustained, brisk at lasts at least 20 minutes in an exercise mode. See the list of sport and exercise examples on the back.

- Exercise time is the number of minutes spent doing an exercise or sport activity.
- Exercise mode is a description of the sport or activity.
- If you are not sure if an activity should count or not, see the list on the back. If you are still not sure, record the time and describe the activity as accurately as possible.
EXAMPLES OF SPORTS AND EXERCISES THAT WILL COUNT FOR THIS STUDY:

- Cycling
- *Walking
- Running
- Rowing
- Ski machine
- Aerobics
- Volleyball
- Basketball
- Tennis
- Boxing
- Martial Arts
- Racquetball
- Hockey
- Rock Climbing
- Rope Jumping
- Rugby
- Soccer
- LaCrosse
- Softball
- Skiing
- Snowboarding
- Swimming
- Scuba
- Skating
- Snowshoeing
- Video Workouts
- Football
- Push ups
- Pull ups
- Weight Lifting
- Circuit training
- Weight machines
- Free weights
- Squats

* WALKING ONLY COUNTS IF IT IS SUSTAINED, BRISK, AND LASTS AT LEAST 20 MINUTES.

EXAMPLES OF ACTIVITIES THAT ARE NOT COUNTED FOR THIS STUDY:

- Walking from the car to the store
- Walking around while shopping
- Carpentry
- Iron work
- Firefighting
- Chopping firewood
- Fishing
- Hunting
- Vacuuming
- Moping
- Cleaning house
- Washing dishes
- Carrying groceries
- Ironing
- Moving furniture
- Child care
- Auto repair
- Cleaning gutters
- Laying carpet
- Painting
- Home repair
- Lawn and Garden work
- Shoveling snow
- Farming
- Machining

EXAMPLES OF TV/COMPUTER TIME THAT IS COUNTED FOR THIS STUDY:

- Video games
- Surfing the web
- Facebook
- TV shows
- Movies
- Any leisure time digital media viewing

DO NOT COUNT TV/COMPUTER TIME LISTED ABOVE IF IT IS PART OF YOUR EMPLOYMENT RESPONSIBILITIES
CURRICULUM VITAE

Rodney L. Hammer
381 N Main
Lewiston, UT 84320
435-994-1549 cell
435-258-3679 home

EDUCATION:

Ph.D.  Utah State University – Psychology, 2010
Research and Evaluation Methodology Program
Health Psychology Emphasis
Dissertation: The effects of implementation intentions on volunteer firefighter exercise behavior: A randomized controlled study
Chair: Kerstin E. E. Schroder

M.S.  Utah State University - Exercise Science, 2002
Master’s Thesis: Comparison of aerobic power in annually certified volunteer firefighters and uncertified volunteer firefighters.
Chair: Edward M. Heath

B.S.  Utah State University - Industrial Technology (Aerospace), 1991

UNIVERSITY TEACHING EXPERIENCE:

PSY 1010  Introduction to Psychology, Instructor
PSY 3110  Health Psychology, Instructor
          Developed course for classroom and distance education
EDUC 6600  Measurement, Design, and Analysis, Instructor
          Developed course for classroom and distance education
EDUC 5560  Measurement, Design, and Analysis (special topics), Instructor
          Developed course for distance education
PSY 6330  Psychometrics, TA
PSY 5100  History of Psychology, TA

CORPORATE RESEARCH EXPERIENCE:


PUBLICATIONS: (refereed)


PUBLICATIONS: (non-refereed)


**TECHNICAL PUBLICATIONS:**


**PRESENTATIONS:**


COMPUTER SOFTWARE DEVELOPMENT:


GRANTS:

Assistance to Firefighters Grant Program. Fire Operations and Firefighter Safety. Regional communication equipment (2009) $312,000.


Utah State Bureau of Emergency Medical Services Grant. EMS equipment/training (2005) $12,000.


Fire and Rescue Academy and Rural Community fire Protection Grant Programs Training and firefighting equipment(2002) $2,283.

Fire and Rescue Academy and Rural Community fire Protection Grant Programs Training and firefighting equipment(2001) $12,073.

OTHER PROFESSIONAL EXPERIENCE:

2009 – present Fire Chief, Cache County, Utah

Coordination of 11 volunteer and one full time fire departments Manage county-wide fire suppression, hazardous materials and technical rescue services. Report to County Fire Board and County Council.
2005 - 2009  Product Development Manager, ICON Health & Fitness, FreeMotion brand fitness equipment

Manage team of engineers to collaborate in product development. Cooperatively work with different departments to design and produce quality, innovative exercise equipment.

2002 – 2007  Director, Human Performance Research, ICON Health & Fitness.

Conduct research in all aspects of human interaction with fitness equipment including cognitive and ergonomics. Create biomechanical and ergonomic guidelines for equipment design. Create fitness assessment models for health promotion


Responsible for working with major retailers to create product lines of exercise equipment, design and source the equipment, create customer presentations, program costing, etc. Attend trade shows to present equipment to customers. Work with executive management to create product lines.

1993 – 1995  Lead Engineer, ICON Health & Fitness, Treadmill Design
1991 – 1993  Product Engineer, Murray Ohio Manufacturing, Bicycle Engineer
1987 – 1991  Drafter/Engineer, ICON Health & Fitness, Treadmill Design

PATENTS:

7,192,388  Fold-out treadmill
6,761,667  Hiking exercise apparatus
6,471,622  Low-profile folding, motorized treadmill
6,350,218  Fold-out treadmill
6,261,022  Adjustable dumbbell and system
6,033,347  Fold-out treadmill
5,899,834  Fold-out treadmill
5,676,624  Portable reorienting treadmill
5,672,140  Reorienting treadmill with inclination mechanism
5,669,857  Treadmill with elevation
D340,434  Bicycle fork
VOLUNTEER SERVICE:

1998 – 2009  
**Lewiston City, Utah**  
Lewiston Fire Department  
Captain/Training officer  
Certified Firefighter – I  
Certified Wildland Firefighter

1997 – 2007  
**Lewiston City, Utah**  
Lewiston Emergency Medical Service  
Assistant Chief in charge of Emergency Medical Service  
EMT-B Instructor  
EMT-B  
CPR Instructor