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Occupational Athletes: An Integrated Approach to Firefighting Performance

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OCCUPATIONAL ATHLETES: AN INTEGRATED APPROACH TO FIREFIGHTING PERFORMANCE

by

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ABSTRACT

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Introduction: Over the past 20 years, the injury rates among firefighters have captured the interest of sport scientists. In order to prevent firefighter injuries, however, scholars must first gain a better understanding of firefighting performance (Smith, 2011). This has been a challenge, since to date sport scientists have focused primarily on the physical aspects of firefighting performance and have overlooked the multidimensional nature of firefighting performance (Gnacinski, Meyer, & Ebersole, in press). In the sport arena, sport scientists often use theoretical models to conceptualize the multiple demands experienced by an athlete. Guided by an integrated model of sport performance, the Meyer Athlete Performance Management Model (MAPM; Meyer, Merkur, Ebersole, & Massey, in press), the purposes of the current study were to: (a) describe the physical and psychological characteristics of cadets, recruits, and active firefighters; (b) compare physical and psychological characteristics of cadets, recruits, and active firefighters; and (c) provide evidence-based recommendations for the development of integrated firefighting training programs. **Methods:** Male cadets (*n* = 11), recruits (*n* = 27), and active firefighters (*n* = 15) completed a battery of physical (i.e., aerobic fitness, muscular strength and endurance, body composition, functional movement, muscular power) and psychological (i.e., personality, self-efficacy, intrinsic motivation, anxiety, psychological skills use) assessments. **Results:** No significant differences emerged between groups for any of the physical or psychological characteristics assessed with the exception of several psychological skills used during training. Specifically, cadets and active firefighters reported using self-talk, emotional control, and attentional control more than recruits ($ps < .001$), active firefighters reported using automaticity more so than recruits ($p = .003$), and cadets reported using activation more so than recruits ($p = .001$). **Discussion:** Results of the current study supported the use of an integrated model of sport performance to conceptualize firefighting performance. Results of the current study also provided directions for firefighting training programs and future research.

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I also owe a great deal of thanks to the Milwaukee Fire Department (MFD) for welcoming faculty and students into their world to extend this line of research. I would like to acknowledge some individuals in particular for their significant contributions to the success of this project as well: Jason Mims (MFD Health and Safety Officer), Mark Rohlfing (Milwaukee Fire Chief), Erich Roden (Milwaukee Battalion Chief), Luis Rivera (AthletiCo Physical Therapy Facility Manager), the MFD Peer Fitness Trainers, the MFD Fire Academy Instructors, all of the participants who volunteered their time to participate in this study, the members of the Human Performance and Sport Physiology Laboratory, and the members of the Sport Psychology and Performance Excellence Laboratory.

The success of this project can also be attributed, in large part, to the commitments made by the individuals mentioned above (i.e., sport psychology faculty and students, sport physiology faculty and students, physical therapists, and firefighters) to work collaboratively in an effort to achieve a common goal—optimize firefighter health, safety, and performance.

Chapter I: Introduction

Background

The widespread interest with sport performance has been a driving force behind the research and applied work of sport scientists for over a century. Augmenting the work of sport scientists, the work of researchers and practitioners in other domains such as physical therapy (Cochrane, 2004), counseling (Chartrand & Lent, 1987), and clinical psychology (Mogg & Marden, 1990) have further expanded the overall conceptualization of sport performance. Similarly, the work of researchers and practitioners from the sport sciences has augmented the work of professionals in other performance domains such as the military (Fiore & Salas, 2008) and law enforcement (Spitler, Jones, Hawkins, Dudka, 1987). Evidenced by the successful exchanges of scholarly resources between performance domains, most notably the exchange between sport and the public service sector, the work of sport scientists could be of benefit to yet another population of *athletes*—firefighters.

Like athletes, firefighters experience a dynamic range of performance demands on a daily basis. In the sport arena, sport psychologists have utilized models such as Bronfenbrenner's Ecological Model (Bronfenbrenner, 1995; Gilbert, 2011; Meyer & Fletcher, 2009) to conceptualize the multiple performance demands of athletes (i.e., technical, physical, psychological). An athlete-centered model of sport performance, the Meyer Athlete Performance Management Model (MAPM; Meyer, Merkur, Ebersole, & Massey, in press), further posits the need for collaborative efforts between experts from multiple training domains to best facilitate the athlete's performance and development. The aforementioned benefits of scholarly exchanges between performance domains, in conjunction with the parallels drawn between athletes and firefighters, prompts scholars to consider the use of a sport performance model to conceptualize the multidimensional (e.g., physical, psychological) nature of firefighting performance.

Informed by theoretical, scientific and professional practical knowledge, the MAPM highlights the importance of understanding both the unique physical and psychological aspects of a particular sport to best facilitate the athlete's development. Conveniently, research has already been conducted to better understand the physical and psychological aspects of firefighting, thus providing a foundation for future integrated performance research and applied work. That said, while a sufficient body of literature exists to support the relationships between several physical aspects and firefighting performance (Elsner & Kolkhorst, 2008; Michaelides, Parpa, Thompson, & Brown, 2008; Peate, Bates, Lunda, Francis, & Bellamy, 2007; Williams-Bell, Villar, Sharratt, & Hughson, 2009), far less research has been devoted to the psychological aspects of firefighting performance. From the psychological research that has been conducted, constructs such as personality (Fannin & Dabbs, 2003), self-efficacy (Regehr, Hill, Knott, & Sault, 2003), motivation (Grant, 2008), and stress (Tuckey & Hayward, 2011) have emerged as important aspects among firefighters. Further supporting the proposed link between sport and firefighting, a model of sport performance like the MAPM, in combination with the sport performance literature, could be used to forge theoretical *performance* links between sport and firefighting. In forging these links, scholars will achieve a more comprehensive understanding of firefighting performance and may begin moving toward an integrated approach to improving that performance.

Beyond the theoretical rationale provided above, a recent report of civilian and firefighter casualties contributes additional salient evidence for the proposed need to better conceptualize the multidimensional performance needs of firefighters. In 2009, there were 1.35 million fires in the United States (U.S.) resulting in 3,010 civilian deaths, 17,050 civilian injuries, and approximately $12.5 billion in property damage (Smith, 2011). In addition to civilian causalities, approximately 80,000 U.S. firefighters experience injury and 100 lose their lives while fighting fires annually. According to Smith, "The safety of the public and the health and safety of firefighters would be enhanced if firefighters followed well-designed fitness programs to improve overall health and fitness" (p. 167). To Smith's point, aided by scholarship and best practices from the sport sciences, perhaps the numbers of both civilian and firefighter injuries can be reduced by developing and implementing programs aimed at meeting the multidimensional performance demands of the occupation. Although the proposed link between sport and firefighting performance is not unassailable, we know from the statistics provided above, that a firefighter's ability to perform well could quite literally mean the difference between life and death. Thus, by providing additional support for the transfer of academic and applied resources from sport to this population of *occupational athletes,* the proposed study may concomitantly provide a scientific foundation for the future development of integrated firefighter training programs.

Statement of Purpose

Guided by the MAPM, the purposes of the current study were to: (a) use descriptive data from physical and psychological assessments to characterize cadets, recruits, and experienced firefighters; (b) compare the current physical and psychological states of cadets, recruits, and active firefighters; and (c) provide evidence-based recommendations for the development of comprehensive firefighting training programs.

Delimitations

The sample for the current study was delimited to individuals who: (a) were currently involved in the Milwaukee Fire Department (MFD) as a cadet, recruit, or active firefighter; and (b) were between the ages of 18-50 years.

Assumptions

In conducting the current study, the following assumptions were made: (a) the participants completed all physical tests to the best of their ability, and (b) the participants completed all psychological tests accurately and honestly.

Scientific Significance

The results of the current study contribute to both the sport and firefighting literatures. In a sport context, the current study is the first of its kind to: (a) utilize the MAPM in an effort to best conceptualize the multidimensional needs of an *athlete* population, and (b) utilize the MAPM to structure integrated research aimed at performance assessment and development. In addition, the results of the study provide further evidence for the transfer of sport-based theories and knowledge to non-sport domains. In a firefighting context, the current study is the first of its kind to utilize a model of sport performance to conceptualize the multidimensional nature of firefighting. In addition, the results of the current study expand upon the firefighting literature by adding new variables (i.e., Functional Movement Screen™, psychological skills) to consider when conceptualizing the physical and psychological aspects of firefighting performance.

Practical Significance

In a sport context, the results of the current study provide evidence for the use of the MAPM to structure interdisciplinary collaborations for the optimization of performance assessment, education, and training of athletes. In a firefighting context, although additional research will be needed to support the prescription of appropriate training programs for firefighters, evidence-based recommendations for future applied endeavors with firefighters were made based on the results of the current study. The theoretical foundation utilized in the current study also provides a novel framework for assessing and enhancing multiple dimensions of firefighting performance.

Chapter II: Review of the Literature

For over a century, the work of scholars and practitioners in applied sport psychology has been driven by the widespread interest in sport performance. Exercise physiologists and sport psychologists interested in enhancing sport performance have benefitted from the academic and best practices from the sports world as well as other domains such as physical therapy (Cochrane, 2004), counseling (Chartrand & Lent, 1987), and clinical psychology (Mogg & Marden, 1990). In turn, the research and best practices from the sports world have been used to enhance performance among business professionals (Ducharme, 2004), military personnel (Fiore & Salas, 2008), and law enforcement officers (Spitler, Jones, Hawkins, Dudka, 1987). With each exchange of scholarly resources, the applied scope of sport performance enhancement expands to accommodate a more diverse range of performers. This symbiotic exchange between the sports world and public service sector (e.g., military, law enforcement) in particular, prompts sport scientists to consider another population that could benefit from performance enhancement—firefighters.

Firefighters, like athletes, experience a dynamic range of occupational demands every day. Within this dynamic range, considerable overlaps are observed in the physical (e.g., cardiovascular strain, muscular fatigue, dehydration) and psychological (e.g., exposure to various stressors, confidence, motivation) demands experienced by both athletes and firefighters. Models, such as Bronfenbrenner's Ecological Model (Bronfenbrenner, 1995), have been used by sport psychologists to conceptualize the multidimensional nature of sport performance (Gilbert, 2011; Meyer & Fletcher, 2009). Likewise, one athlete-centered performance model, the Meyer Athlete Performance

Management Model (MAPM; Meyer, Merkur, Ebersole, & Massey, in press), highlights the need for collaborative efforts between professionals across multiple training disciplines in order to optimize athletes' development and performance. Given the inferred similarities between sport and firefighting, as well as the theoretical utility of models of sport performance, sport scientists could inform the process of assessing the physical and psychological performance states of firefighters and subsequently provide recommendations for the development of those performance states. With that in mind, I will use the MAPM to systematically organize and explore the existing literature on firefighting performance, thereby illustrating how models of sport performance and evidence-based practice from the sport sciences can be used to enhance the performance of this unique population of *athletes.*

Physical Aspects of Performance

To date, a great deal of research on firefighting has been dedicated to the importance of one of the main components of the MAPM, the physical aspects of performance. Much of the knowledge that has been gained regarding the physical demands of firefighting has stemmed from research of laboratory measures of overall fitness to performance during simulated firefighting tasks. In a recent review, Smith (2011) claimed that there are several physical aspects of firefighting performance including aerobic fitness, muscular strength and endurance, and body composition. Furthermore, Smith asserted that fitness prescriptions to improve firefighter health and safety should include a functional training component aimed at improving every day functional movement patterns. Emerging from the firefighting literature more recently, various measures of muscular power have also been linked to firefighting performance.

The well-established body of literature on sport performance has consistently identified the importance of these same physical aspects, thus underlining their importance in firefighting. To support the proposed similarities between sport and firefighting, and concurrently support the aims of this study, I will review the literature addressing the relationships between the physical aspects mentioned above and performance among firefighters.

Aerobic fitness. Aerobic cardiovascular fitness, often characterized by maximal aerobic capacity (i.e., VO_{2max}) or the body's ability to deliver and utilize oxygen during dynamic work (Rowell, 1986), has been associated with performance across several sports (e.g., basketball [Narazaki, Berg, Stergiou, & Chen, 2009], endurance running [Morgan, Baldini, Martin, & Kohrt, 1989; Noakes, Myburgh, & Schall, 1990], rowing [Yoshiga & Higuchi, 2003], and soccer [Dellal, Varliette, Owen, Chirico, & Pialoux, 2011]). Similar to the evidence from the sport performance literature, studies examining the physical demands of firefighting have shown that aerobic fitness may be an important aspect of performance among that population as well (Elsner & Kolkhorst, 2008; Perroni et al., 2010; Sheaff et al., 2010; Williams-Bell, Villar, Sharratt, & Hughson, 2009).

In 2008, Elsner & Kolkhorst examined the energy expenditure required to complete various simulated firefighting tasks. Twenty male active firefighters (M_{age} = 37.4 years), participating in a regional wellness center program, completed a graded treadmill test to exhaustion to determine $VO_{2max.}$ On a separate day, the participants performed a firefighting training protocol which included 10 firefighting tasks (e.g., advancing a fire hose, carrying a ladder, etc.) representative of a low-rise fire fighting performance. Participants wore standard firefighting gear during the protocol, accounting for an additional 27 kg, and performance was evaluated by time required to complete all 10 tasks. Pearson product-moment correlation coefficients were calculated between metabolic measurements (i.e., VO_{2max}, average VO_2, percent VO_{2max}) and performance times. The researchers reported that VO_{2max} (M = 46.2 mL/kg/min, SD = 7.8 mL/kg/min) was inversely related to performance time ($r = -.725$, $p < .05$), VO_{2max} was positively related to the mean VO_2 reached during the protocol ($r = .825$, $p < .05$), and the mean VO_2 reached was inversely related to performance time ($r = -.707$, $p < .05$). The researchers also noted that when the mean VO_2 was expressed as a percent of VO_{2max}, the relationship with performance was weaker but still significant ($r = -.450$, $p < .05$). Overall, these data denote the importance of aerobic fitness as it relates to the timely completion of simulated firefighting tasks.

Just two years later, another group of researchers (Perroni et al., 2010), investigated the same relationship between aerobic fitness and simulated rescue performance. Unlike the inclusion criteria for the study reviewed above, only firefighters who were not engaged in a structured physical training program at the time of the 2010 study were eligible to participate. During one session, male Italian firefighters (n = 20, M_{age} =32 years) completed a graded incremental treadmill test to exhaustion while wearing standard firefighting gear, accounting for an additional 23 kg. In a separate session, performance was determined by the participants' ability to complete a timed simulated rescue intervention while wearing standard firefighting gear. The simulated rescue intervention included four tasks deemed representative of varying instances of increased physical and cognitive demands in actual firefighting: (a) climbing a firemen's ladder and descending a three-floor building while carrying a 20 kg dummy,

(b) sprinting for 250 meters, (c) completing a maze in a dark chamber, and (d) sprinting another 250 meters. Contrary to the findings of Elsner and Kolkhorst (2008), a correlational analysis indicated no significant relationship between VO_{2peak} (M = 43.1 mL/kg/min, SD = 4.9 mL/kg/min) and job completion time (r = .09, p = .72). Although Perroni et al. did not find empirical evidence to support the relationship between aerobic fitness and the performance during the four tasks, they suggested that the high physical demands of true firefighting work are sustained primarily via aerobic metabolism. Stated another way, although aerobic metabolism is a necessary component of firefighting, it may not be a determining factor of timed rescue performance. One should also recognize the need to interpret these findings with caution as the timed tasks chosen for this study draw heavily upon anaerobic means of energy production rather than aerobic energy production.

The disparity between the findings of the two studies reviewed above can be partially explained by a lack of consistency in methodological procedures (e.g., fitness level of sample population, use of gear or weighted vest during laboratory fitness assessments and simulation tasks), emphasizing the need for continued research efforts to better understand the value of aerobic fitness in actual firefighting. Regardless of these methodological inconsistencies, the overall consensus in the firefighter literature is that aerobic fitness should be considered in the evaluation of the physical aspects of firefighting performance. Shifting the attention from aerobic to anaerobic fitness, I will next summarize the research examining the relationship between muscular strength and endurance, and firefighting performance.

Muscular strength and endurance. Measures of muscular strength and endurance have been linked to performance across sport (Girard & Millet, 2009; Peterson, Alvar, & Rhea, 2006; Wisløff, Helgerud, & Hoff, 1998; Young, McLean, & Ardagna, 1995) and firefighting alike (Harvey, Kraemer, Sharratt, & Hughson, 2008; Michaelides, Parpa, Thompson, & Brown, 2008; Rhea, Alvar, & Gray, 2004; Sheaff et al., 2010; Sothmann, Gebhardt, Baker, Kastello, & Sheppard, 2004). According to Beam and Adams (2011), muscular strength is the maximal amount of force generated in one repetition of a particular exercise and is typically measured via isotonic, isometric, or isokinetic exercises. Conversely, muscular endurance is the ability to produce force over multiple consecutive repetitions during a given time period and is typically measured via exercise tests such as timed push-ups to exhaustion and timed sit-ups. Taking into consideration the anaerobic nature of various firefighting tasks mentioned earlier, it is logical that researchers have examined the relationship between muscular strength and endurance and firefighting performance.

In an effort to understand the demands of firefighting, Rhea et al. (2004) conducted a study to identify relationships between various physiological measures, most notably muscular strength and endurance, and simulated firefighting task performances. Male (n = 17) and female (n = 3) professional firefighters (M_{age} = 34.5 years) completed, among other fitness tests: (a) a five repetition maximum bench press and back squat to determine muscular strength; (b) maximal repetitions for bench press, squat, bent-over row, bicep curls, and shoulder press to determine local muscular endurance; and (c) hand grip dynamometry to fatigue to determine hand grip strength and endurance. During a separate session, participants performed four timed tasks (i.e., hose pull, stair climb, simulated victim drag, equipment hoist) deemed representative of potential fire scene tasks. Job performance was evaluated by the summation of the time required to complete each of the fours tasks, and a full 10-minute recovery period was implemented between the completions of the tasks to minimize declines in performance due to fatigue. Calculated Pearson product-moment correlation coefficients revealed significant ($p < .05$) negative correlations between job performance and total fitness ($r = -.62$), bench press strength ($r = -.66$), hand grip strength ($r = -.71$), bench press endurance ($r = -.73$), bent-over row endurance ($r = -.61$), shoulder press endurance ($r = -.71$), bicep curl endurance ($r = -.69$), and squat endurance ($r = -.47$). Taken together, these data clearly support the importance of muscular strength and endurance in firefighting performance.

Consistent with the aims of previous research, Michaelides et al. (2008) attempted to identify relationships between various fitness parameters and performances during a timed ability test (e.g., stair climb, rolled hose lift and move, rescue mannequin drag, etc.) among volunteer firefighters ($n = 38$, $M_{age} = 32.25$ years). During one session, participants performed a one repetition maximum (1 RM) bench press and squat to assess muscular strength, as well as a one minute sit-up test (Pollock, Willmore, & Fox, 1978) and maximum push-up test (Johnson & Nelson, 1986) to assess muscular endurance. During another session, the participants completed the ability test in which they wore a 22.68 kg weighted vest to simulate the weight of standard firefighting gear. After finishing the ability test, participants rated each task on a 5-point Likert-type scale to evaluate the relevance of each task to actual firefighting performances. The researchers reported that 76.67% of the firefighters rated the tasks to be very relevant to typical firefighting performance. Calculated Pearson product-moment correlation coefficients showed significant ($p < .01$) negative correlations between ability test performance times and 1 RM bench press ($r = -.44$), and number of push-ups completed ($r = -.41$). Reinforcing the findings of Rhea et al. (2004), Michaelides and colleagues concluded that upper body strength and endurance were related to firefighting performance.

In their study of 99 professional male firefighters ($M_{age} = 33$ years), Michaelides, Parpa, Henry, Thompson, and Brown (2011) sought to augment the evidence linking muscular strength and endurance to firefighting performance by adding a measure of abdominal strength to the methods design of Michaelides et al. (2008). Again, consistent with the research reviewed thus far, the researchers reported significant negative correlations between ability test performance times and abdominal strength ($r = -.53$, $p < .01$), maximum number of push-ups ($r = -.27$, $p < .05$), sit-up repetitions in one minute ($r = -.31$, $p < .01$), and 1 RM bench press ($r = -.31$, $p < .01$).

Much like the concerns noted in reviewing the literature on aerobic fitness in firefighting, methodological concerns (e.g., use of rest periods during testing) prompt the need to interpret the results linking muscular strength and endurance and performance with caution. Even with cautious interpretation, the results of the studies reviewed above provide a substantial amount evidence to support a relationship between muscular strength and endurance and firefighting performance. Continuing this discussion relating various physical aspects to firefighting performance, researchers have also examined the potential relationship between body composition and firefighting performance.

Body composition. Another physical aspect of performance, body composition, has been supported by research in both sport (Fleck, 1983; Silvestre, West, Maresh, & Kraemer, 2006; Siders, Lukaski, & Bolonchuk, 1993) and firefighting (Michaelides et al., 2011; Michaelides et al., 2008; Myhre, Tucker, Bauer, & Fisher, 1997; Williams-Bell et al., 2009). Body composition is the proportion of fat and lean tissues in human bodies, and is commonly measured using anthropometric measures of girths or skinfolds, densitometry (i.e., underwater weighing), bioelectrical impedance, volume displacement (i.e., Bod Pod; Cosmed), dual x-ray absorptiometry, and other imaging techniques (Beam & Adams, 2011). Consistent with the focus of this review, below I will summarize the literature which addresses the potential relationship between body composition and firefighting performance.

In one study (Myhre et al., 1997) of the relationship between body composition and firefighting performance, male (n = 218) and female (n =4) Army and Air Force Base career firefighters (M_{age} = 30.4 years) were tested on baseline measures of fitness (i.e., body density, percent body fat) during a normally scheduled military testing cycle. Body density was determined via hydrostatic weighing (Myhre & Kessler, 1966) and percent body fat was calculated from body density (Keys & Brozek, 1953). During the simulated rescues, other firefighters volunteered to be victims, accounting for approximately 77 kg, and the participants were required to wear standard firefighting gear, accounting for an additional 23.23 kg. A successful performance of the firefighting task was scored based on the timed completion of a B-52 crash aircrew rescue and a modified standard search and rescue, while an aborted rescue attempt was scored on the time to task failure. Calculation of Pearson product-moment correlations indicated significant ($p < .05$) relationships between rescue times and both percent body fat (r = .36) and lean body mass (r = -.21). Informed by the findings summarized above, the researchers determined that body composition may be related to firefighting performance.

Michaelides et al. (2011) also examined the relationship between body fat percentage and firefighters' performance during an ability test. Results of a correlational analysis revealed a significant association between poor performance times during the ability test and high percentages of body fat ($r = .57$, $p < .01$), as measured via leg-to-leg bioelectrical impedance analyses. Additionally, a subsequent multiple regression analysis revealed that 60% of the variance observed in ability test performance was explained by fitness variables including percent body fat, $F(5, 53) = 14.02$, $p < .01$.

Despite methodological limitations (e.g., standardization of body composition measures) which prompt me to urge caution in interpreting the results summarized above, literature on this topic is suggestive of body composition as a contributing factor in firefighting performance. In addition to advocating for the importance of aerobic fitness, muscular strength and endurance, and body composition among firefighters, Smith (2011) highlighted the need to evaluate functional movement in order to appropriately design and implement exercise prescriptions for this specialized population. In contrast to the literature reviewed thus far, which supports the relationship between several physical aspects and performance among athletes and firefighters, no such relationship has been identified between functional movement and performance in sport or firefighting. Research has shown, however, that proper functional movement patterns may reduce risk of injury in athlete (Chorba, Chorba, Bouillon, Overmyer, & Landis, 2010; Kiesel, Plisky, & Voight, 2007) and firefighter populations (Peate, Bates, Lunda, Francis, & Bellamy, 2007). As injury and injury prevention are obvious underlying components to performance, I will review the literature linking functional movement to injury among both populations.

Functional movement. As mentioned above, recent literature has suggested that functional movement is a physical aspect that may be related to injury among athletes and firefighters. One popular method of assessing functional movement is the Functional Movement Screen (FMS™), developed by Gray Cook and colleagues in 1998. The purpose of the FMS™ is to identify functional asymmetries and limitations in basic movement patterns by scoring a set of seven tasks (e.g., single leg raise, hurdle step, etc.). Since functional asymmetries and limitations in basic movement patterns may increase an athlete's susceptibility to injury, and since injury prevention is of notable importance to firefighters (Peate et al., 2007; Smith, 2011), I will next review the research which has used the FMS™ to evaluate functional movement and injury risk in sport and firefighting.

Functional movement and injury in sport. In a prospective study of American professional football players (n = 46), Kiesel et al. (2007) examined the potential difference between the preseason FMS™ scores of injured and non-injured players. FMS™ Total Scores were obtained prior to the beginning of the football season, and serious injuries (i.e., membership on the injured reserve list for three or more weeks) were recorded over the course of the season. A t test indicated a significant difference between mean preseason FMS™ Total Scores of injured players and mean preseason FMS™ scores of non-injured players, $t(1, 44) = 5.63$, $p < .05$. Kiesel et al. also found that players scoring less than or equal to 14 of a possible 21 on their preseason FMS™ experienced a 15% increase in risk for injury.

In another prospective study, Chorba et al. (2010) sought to determine if FMS™ Total Scores could accurately predict injuries among National Collegiate Athletic

Association (NCAA) Division I female athletes (*n* = 38, M_{age} = 19.24 years) participating in various team sports. To be included in the study, the athletes must have been injury free in the 30 days leading up to the testing. Preseason FMS™ Total Scores were obtained and injuries occurring during practices and competitions were recorded over the course of the season. Statistical computation revealed a strong correlation between low preseason FMS™ Total Scores and injury ($r = .761$, $p = .021$). Consistent with the findings of Kiesel et al. (2007), the researchers also noted that individuals with a preseason FMS™ Total Score of 14 or lower experienced a four-fold increase in risk for injury during the season.

Functional movement and injury in firefighting. The possible link between FMS™ Total Scores and injury has also been investigated among firefighters. In a 2007 study, Peate et al. examined the association between FMS™ scores and injury history, as well as the effectiveness of a functional training intervention to reduce the total number of injuries and time lost due to injury. Over a 4-week period, FMS™ scores were collected among a sample (*n* = 433) of male (M_{age} = 41.8 years) and female (M_{age} = 37.4 years) firefighters. The participants were then enrolled in a 2-month training program (i.e., 21 sessions lasting 3 hours each) designed to increase core strength, flexibility, and proper body mechanics. A multiple logistic regression analysis, adjusted for age, showed that previously injured firefighters were 1.68 times more likely to fail the FMS™ (i.e., receive a score of 0 on any element of the screen) than firefighters with no injury history ($p = .033$). Also, a review of pre- and post-functional training intervention injury reports indicates a 44% reduction in injuries and a 62% reduction in work time lost due to injury. Most notably, back injuries ($p = .024$) and upper extremity injuries ($p = .0303$)

were significantly reduced after the intervention. Consistent with the research on athletes, results of these studies signify the importance of injury prevention in the firefighter population. In addition to Peate and colleagues, other scholars have noted the importance of functional movement in firefighting. In her 2011 review, Smith called attention to the importance of functional training in increasing aerobic capacity, muscular strength, and muscular endurance, all of which have been related to firefighting performance (Elsner & Kolkhorst, 2008; Michaelides et al., 2008). In other words, it is possible that functional movement training may have an indirect influence on firefighting performance via improvements in the three variables identified above. Recently, in May of 2012, authors of a tactical strength and conditioning report from the National Strength and Conditioning Association (NSCA) also proposed that regular assessments of functional movement among firefighters should be conducted to best prescribe exercise programs aimed at meeting performance demands. This evidence, in conjunction with the literature linking functional movement to injury in sport and firefighting, provides support for the consideration of functional movement as an important if not critical aspect of firefighting performance.

Muscular power. Since the 1970s, sport scientists have utilized various measures of muscular power (e.g., sprinting, the Wingate anaerobic cycling test, vertical jump, etc.) to quantify anaerobic fitness (Beam & Adams, 2011). Muscular power, in turn, has been linked to performance across several sports (Cronin & Sleivert, 2005; Mann & Sprague, 1980; Meckel, Atterbom, Grodjinovsky, Ben-Sira, & Rotstein, 1995). According to Beam and Adams (2011), muscular power is essentially a work rate, or a rate of force produced against an object over a given distance or displacement. Given the overlaps mentioned between sport and firefighting, it is not surprising that muscular power has been identified as an important aspect of firefighting performance as well (Michaelides et al., 2011; Sheaff et al., 2010). In the section below, I will briefly review the literature which supports the link between muscular power and performance in firefighting.

In addition to examining other measures of physical fitness in relation to firefighting performance, Michaelides and colleagues (2011) also studied muscular power in relation to performance times of simulated firefighting tasks. Among a sample of 90 firefighters, the researchers reported significant correlations between step test times and the stair climb ($r = -.39$, $p < .01$), the rolled hose lift and move ($r = -.34$, $p < .01$), and the charged hose advance ($r = -.27$, $p < .05$). The researchers also reported significant correlations between vertical jump distance and both the rescue mannequin drag ($r = -.31$, $p < .05$) and charged hose advance ($r = -.28$, $p < .05$). Taken together, results of the three studies reviewed above indicate that muscular power may be related to firefighting performance.

Similar to the need to better understand the links between the physical aspects of firefighting performance mentioned (i.e., aerobic fitness, muscular strength and endurance, body composition, functional movement) and firefighting performance, additional research is warranted to better understand the links between muscular power and firefighting performance. Despite this need for additional research support, however, the literature to date suggests that muscular power is an important physical aspect of firefighting performance.

Summary. Supported by the studies reviewed above, clear parallels can be drawn between the physical aspects of performance in sport and firefighting. Beyond the methodological limitations mentioned already, additional concerns across all of the studies include the lack of control for environmental conditions during testing (e.g., temperature, humidity, etc.), as well as the lack of consideration for potential differences between firefighters of different genders and levels of involvement (i.e., professional, volunteer). Apart from these minor methodological flaws, researchers have consistently demonstrated the importance of physical variables (i.e., aerobic fitness, muscular strength and endurance, body composition, functional movement, muscular power) to firefighting performance, thus providing support for the proposed link between sport and firefighting and the proposed value of the sport sciences to firefighter populations. Providing further support for the aims of the proposed study, and in order to complete the conceptualization of performance for this unique population of *athletes*, I will next provide a review of the psychological aspects of firefighting performance.

Psychological Aspects of Performance

In contrast to the plethora of research which has been devoted to the physical aspects of firefighting performance, little research to date has been devoted to the psychological aspects. This paucity of research prompts the need to more thoroughly review the sport literature in an effort to forge links between the psychological aspects of performance for athletes and firefighters, thereby filling the gaps in the firefighting literature and allowing us to use sport models such as the MAPM to conceptualize firefighting performance. Given the similarities in physical constructs identified above, it is not surprising that the few psychological constructs which have recently emerged in the firefighting literature (i.e., personality, self-efficacy, motivation, stress) have also been studied extensively in sport research. Although psychological skills have yet to be assessed in a firefighter population, given the parallels between sport and firefighting, it is logical to include the use of psychological skills in the conceptualization of firefighting performance. To those ends, in the section that follows, I will provide additional support for the proposed study by reviewing the literature addressing the importance of the aforementioned psychological constructs in sport and firefighting as well as the importance of psychological skills use in sport.

Personality. The combination of psychological characteristics that make an individual unique, personality, has been of interest to sport psychology researchers for over 30 years. Personality can be conceptualized using several frameworks, most notably the Big Five (McCrae & Costa, 1987) and the Profile of Mood States (POMS; Morgan, 1979b), both of which have been linked to performance in sport. Below, I will review the research identifying relationships between characteristics of personality, sport performance, and firefighting.

Big Five framework in sport. As stated previously, the five core characteristics of the Big Five framework (i.e., extraversion, agreeableness, conscientiousness, neuroticism, openness) have been studied in regard to sport participation (Morgan, 1974) and performance (Eagleton, McKelvie, & deMan, 2007; Eysenck, Nias, & Cox, 1982; Garland & Barry, 1990; Kaiseler, Polman, & Nicholls, 2012; McKelvie, Lemieux, & Stout, 2003). For example, Garland and Barry (1990) examined the predictive value of personality in football performance. Collegiate scholarship football players (n = 272) completed the 16 Personality Factor Questionnaire (16PF; Cattell, Eber, & Tatsuoka,

1982) before the first game of the season and player football performance was evaluated at the conclusion of the season via playing time. Results of between-subjects multiple stepwise regression analyses of personality factors indicated that group-dependence, $F(1, 270) = 31.25$, $p <.0001$, tough-mindedness, $F(1, 270) = 39.80$, $p <.0001$, extraversion, $F(1, 270) = 37.43$, $p <.0001$, and emotional stability, $F(1, 270) = 4.15$, $p <.05$, were associated with high levels of performance. Those four personality traits together accounted for approximately 29% of the total variance in performance, $F(4, 267) = 26.88$, $p <.0001$.

Additional research by McKelvie, Lemeiux, and Stout (2003) was conducted to examine differences in extraversion and neuroticism among university contact sport athletes ($n = 46$), non-contact sport athletes ($n = 40$), and non-sport students ($n = 86$). To eliminate the potential for differences due to physical size, the control group was split into a *bigger* and *smaller* group to match contact (i.e., bigger) and non-contact (i.e., smaller) athletes respectively. Measures of extraversion and neuroticism were assessed via participants' responses to the Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1968). In assessing group differences in extraversion, the researchers found no significant differences in scores between athletes and non-athletes. In a follow-up analysis, researchers compared the extraversion scores of athletes and non-athletes to previously established population norms from a sample of American college students ($M_{age} = 13.1$ years; Eysenck & Eysenck, 1968). A *t* test revealed that contact sport athletes and non-contact sport athletes reported higher extraversion scores than the population norms, $t(45) = 2.60$, $p < .01$ and $t(39) = 2.85$, $p < .01$ respectively, while non-athletes, regardless of size, did not differ from the population norms. In their assessment of group differences in neuroticism, the researchers conducted a three-way analysis of variance (ANOVA) calculation which revealed that the total athlete group reported lower scores in neuroticism than the non-athlete group, $F(1, 168) = 7.63$, $p < .01$, yet no differences in neuroticism were observed between athletes in contact and non-contact sports. While the study lacked power due to the small sample size, the results were consistent with previous research (Newcombe & Boyle, 1985) which suggests that homogenous personality characteristics such as extraversion and neuroticism may be observed at more elite levels of sport performance.

More recently, researchers (Kaiseler, Polman, & Nicholls, 2012) examined the association between personality characteristics and athletes' appraisals of stress, a construct which has consistently been linked to performance (Pensgaard & Duda, 2003). During the competitive season, athletes ($M_{\text{age}} = 20.4$ years) active at the club/university ($n = 175$), county ($n = 220$), national ($n = 60$), and international ($n = 15$) levels, completed the Big Five Inventory (BFI; John, Donahue, & Kentle, 1991) to assess personality, and a pair of 1-item visual analogue scales to assess perceptions of stress intensity and perceptions of control over a stressful event, respectively. Results of a multiple regression analysis showed that the Big Five personality dimensions were predictive of stress intensity ($R^2 = .06$, $p < .001$) and perceptions of control ($R^2 = .04$, $p <.001$) but not stressor type ($R^2 = .01$, $p =.79$). High scores in neuroticism were found to be associated with high scores of stress intensity ($\beta = .26$, $p <.001$) and perceptions of control ($\beta = -.21$, $p <.001$), while high scores in agreeableness were associated with low scores of stress intensity ($\beta = -.10$, $p <.05$). Finally, high scores in conscientiousness were associated with high scores of perceived control ($\beta = .09$, $p < .05$). As stress has been consistently studied in relation to sport performance (De Witt, 1980; Lazarus, 2000; Pensgaard & Duda, 2003), these data suggest that personality characteristics (i.e., neuroticism, agreeableness, and conscientiousness) may have an indirect influence on performance outcomes.

POMS in sport. In addition to the evidence supporting links between characteristics of the Big Five framework and sport performance, the POMS has been studied extensively in sport as well. Through use of the POMS, researchers and practitioners can assess six prominent mood states: tension, depression, anger, vigor, fatigue, and confusion. When all six moods are interpreted together, the resulting profile can be compared to a standard iceberg profile in which athletes exhibit low levels of all mood states except vigor (Cox, 2007). The iceberg profile and characteristics of the POMS have been consistently linked to sport performance (Beedie, Terry, & Lane, 2000; Lane & Terry, 2000; Morgan, 1979b; Rowley, Landers, Kyllo, & Etnier, 1995). This link will be further conveyed as I review the research analyzing the use of POMS in sport.

A meta-analysis was conducted by Rowley et al. in 1995 to examine the effectiveness of the POMS in predicting athletic success. Thirty-three studies and 411 effect sizes comparing athletes' POMS scores to evaluations of successful performances were included in the meta-analysis. The researchers reported a mean effect size of .15 (*SD* = .89), indicating that successful athletes may possess a slightly more optimal profile of moods states (i.e., iceberg profile) than less successful athletes. Even though the reported mean effect size was significantly different from zero (χ^2 (194) = 817.69,

$p < .05$), the researchers noted that only 1% of the variance between successful and less successful athletes was accounted for by the POMS. While it appears that successful athletes may exhibit a slightly more positive mood profile than less successful athletes, the researchers concluded that the POMS may be ineffective in accurately predicting successful performances.

Five years later, a review of the literature compiled by Beedie et al. (2000) expanded upon the work of Rowley et al. by including studies published after the 1995 meta-analysis. More specifically, the researchers attempted to identify two distinct associations: one between athletes' POMS scores and level of sport achievement attained (i.e., varsity, elite, etc.), and another between the iceberg profile and performance. Studies in which mood states were assessed after performance were not included to control for the potential influence of performance outcomes on mood states. In their examination of the association between POMS scores and level of athletic achievement attained, researchers stated that 39 of 90 effect sizes followed the iceberg profile and reported a mean effect size of .10 ($SD = .07$) which was consistent with the 1995 meta-analysis. Augmenting the work of Rowley et al., in their examination of the association between POMS scores and performance, Beedie et al. found that 75 of the 102 effect sizes reflected the iceberg profile and reported a mean effect size of .31 ($SD = .12$). Taken together, the reviewed meta-analyses provide support for the consideration of personality as a contributing factor to level of success attained in sport and performance outcomes. In an effort to forge a link between the psychological aspects of performance in sport and firefighting, I will next review the research which has examined the construct of personality in firefighting.

Personality in firefighting. For almost a decade, researchers (Fannin & Dabbs, 2003; Salters-Pedneault, Ruef, & Orr, 2010; Wagner, Martin, McFee, 2009) have attempted to determine the potential influence of personality characteristics in firefighting. For instance, in 2003, Fannin and Dabbs examined the relationship between personality characteristics and firefighting performance. A sample of 195 male metropolitan county firefighters (M_{age} = 37.9 years) answered questions assessing relative preference for firefighting or emergency service work, fearfulness (Lilienfeld & Andrews, 1996), agency and communion (Vogt & Colvin, 1999), and personality (NEO Five Factor Inventory; Costa & McCrae, 1991). A 4-point subjective scale was used by six expert judges to evaluate performance and firefighting skills. Calculated Pearson product-moment correlation coefficients revealed that fearlessness, ($r = .20$, $p <.01$), communion ($r = -.28$, $p < .001$), openness ($r = -.28$, $p < .001$), and agreeableness ($r = -.22$, $p < .001$) were related to the preference for firefighting over emergency service work. Furthermore, fearlessness ($r = .33$, $p < .001$), agency ($r = .19$, $p < .01$), extraversion ($r = .27$, $p < .01$), and openness ($r = -.26$, $p < .01$) were related to firefighting performance. As performance was merely assessed via the subjective opinions of six judges, one should interpret the performance correlations with caution.

Several years later, other researchers (Wagner et al., 2009), examined personality differences between a group of firefighters ($n = 94$, M_{age} = 42.04 years) and a group of individuals from non-emergency occupations ($n = 91$, M = 43.77 years) via responses to the Revised NEO Five-Factor Inventory (NEO-FFI-R; Costa & McCrae, 1992). In analyzing the responses to the NEO-FFI-R, a repeated measures multivariate analysis of variance (MANOVA) showed a significant difference between the two groups, *F*(4, 177) = 19.39, $p < .001$, $\varepsilon^2 = .118$. A follow-up one-way ANOVA showed that firefighters reported significantly higher scores for extraversion than the individuals with non-emergency occupations, *F*(1, 181) = 16.71, $p < .001$. Similar results were obtained in a study conducted by Salters-Pedeault et al. in 2010. Using the Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992), the researchers compared the reported responses of firefighters ($n = 101$) to the previously established norm values of adult men and women. When compared with the normative data, the sample of firefighters reported higher scores in excitement-seeking, a facet of extraversion. Even though no inferential statistics were calculated, the results were still consistent with those of Wagner and colleagues.

In the studies summarized above, researchers have suggested that personality may be an important psychological construct to consider when examining performance in both sport and firefighting. One other psychological construct that has been mentioned in the firefighting literature, self-efficacy, is one of the most frequently studied constructs in sport psychology (Feltz, 1992). To forge another link between sport and firefighting, in the next section, I will review the connections between self-efficacy, sport performance, and firefighting.

Self-efficacy. Self-efficacy, or an individual's belief in his or her ability to successfully accomplish a specific task (Bandura, 1997), has long been linked to performance in several domains including music (McPherson & McCormick, 2006), academics (Lane & Lane, 2001), and sport (Moritz, Feltz, Fahrbach, & Mack, 2000). Unlike self-efficacy, which represents an individual's belief, *collective efficacy* represents a group's shared beliefs regarding their ability to successfully accomplish a specific task as a collective unit (Bandura, 1997). In following section, I will provide a review of the literature on the relationship between self-efficacy and individual performance in sport, the relationship between collective efficacy and team performance in sport, and the influences of self-efficacy in firefighting.

Self-efficacy and individual performance in sport. As indicated above, there is a strong and consistent link between self-efficacy and sport performance (Moritz et al., 2000). According to Bandura (1977 & 1997), there are four sources of self-efficacy: previous performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal. Bandura (1986) further suggested that an individual's efficacy beliefs (e.g., ability to complete the Lakefront Marathon in under 3:35) may be a stronger predictor of performance than an individual's outcome beliefs (e.g., a sub 3:35 time at the Lakefront Marathon will result in qualification for the Boston Marathon). Accordingly, perceptions of self-efficacy have repeatedly surfaced in the sport psychology literature as an important aspect of individual sport performance among both men and women (Beauchamp, Bray, & Albinson, 2002; Haney & Long, 1995; Hepler & Chase; 2008; Martin & Gill, 1991; Treasure, Monson, & Lox, 1996). Given that performance in sport requires coordination of several fine and gross motor tasks, to adequately explain the relationship between self-efficacy and sport performance, I will first review the literature supporting the relationship between self-efficacy and motor task performance, and then review the literature supporting the relationship between self-efficacy and sport performance.

Self-efficacy and motor task performance. Sport psychology researchers (Weinberg, Yukelson, & Jackson, 1979) conducted one of the earliest studies examining the link between self-efficacy and motor task performance. Male and female university students (*n* = 60) were randomly assigned to a manipulated high or low self-efficacy group and asked to perform a leg extension task (Martens & Landers, 1969) in a competitive environment. Each participant was paired with a confederate competitor and was instructed that s/he would perform two related strength tasks. In order to manipulate self-efficacy between the groups, participants performed the first leg strength task and were given bogus feedback from confederate competitors completing same task. After completing the first leg strength task and manipulating the self-efficacy between groups, participants were told that they would perform a different leg strength task (i.e., a leg extension task) in two competitive trials against their respective confederate competitor. To control for the influence of prior performance (i.e., Trial 1) on self-efficacy during Trial 2, the competition was set-up so that no participant could win during Trial 1. After the competition, participants were asked to complete a questionnaire to retrospectively assess feelings of confidence prior to completing the task, frequency and nature of self-talk, and confidence in ability regarding future trials (i.e., "how many trials out of 10 do you think you could win? [p. 324]"). Results of a repeated measures ANOVA indicated that the manipulation had a significant effect on self-efficacy, $F(1, 56) = 39.52$, $p < .001$, and that the high self-efficacy participants extended their legs significantly longer, $F(1, 56) = 3.88$, $p < .006$, than the low self-efficacy participants during the first and second competitive trials.

Some 30 years later, researchers (Gilson, Chow, & Feltz, 2012) continued to examine the relationship between self-efficacy and motor task performance. Gilson et al. hypothesized that increases in self-efficacy would be related to increases in 1 RM squat performances within and between individuals over time. A sample of 115 NCAA Division I football players reported responses to the Self-Efficacy Questionnaire for Athletes (SEQ-A, Gilson et al., 2012) prior to three 1 RM squat assessments during standard testing sessions. Results indicated that self-efficacy was positively related to squat performance at both the within-participants level, $t(112) = 2.78$, $p = .007$, and the between-participants level, $t(114) = 3.05$, $p = .003$, across the three trials.

The results of the two studies reviewed above, in which relationships were reported between self-efficacy and motor task performance, mirror the results of studies examining the relationship between self-efficacy and sport performance. Below, I will summarize the robust body of literature supporting self-efficacy as an important aspect of individual performance in sport.

Self-efficacy and individual performance in competitive sport. Building on the literature reviewed above, researchers have spent the past 20 years examining the relationship between self-efficacy and performance in sport (Beauchamp et al., 2002; Hepler & Chase, 2008; Martin & Gill, 1991). In an early study, Martin and Gill (1991) examined the relationship between self-efficacy and running performance among a sample of 73 male track athletes ($M_{age} = 16$ years). Self-efficacy was evaluated via a battery of questionnaires assessing the participant's efficacy about achieving a performance goal (i.e., running faster than one's personal best) and achieving an outcome goal (i.e., winning the race). The participants provided responses to the questionnaires 25-35 minutes prior to a track competition where running performance was evaluated by finishing time and place of the first race. Results of a stepwise multiple regression analysis revealed that outcome self-efficacy was predictive of finishing time, $R = .71$,

$F(1, 72) = 75.56$, $p < .001$, and finishing place, $R = .79$, $F(1, 71) = 119.09$, $p < .001$, whereas performance self-efficacy was not predictive of finishing time or place. In another study of 84 male and female competitive swimmers, Miller (1993) examined the relationship between self-efficacy and swimming performance. Results revealed a significant relationship between self-efficacy and swimming performance, $F(1, 65) = 37.95$, $p < .001$, at three different skill levels (i.e., low, moderate, and high), providing additional support for the relationship between self-efficacy and sport performance.

In accordance with preceding findings, Beauchamp and colleagues (2002) identified a relationship between pre-competitive self-efficacy and golf performance. In their experiment, male collegiate golfers ($n = 36$), with a mean of 8.95 years of experience, completed a golf self-efficacy questionnaire one day prior to a Provincial Golf Championship. The efficacy questionnaire incorporated items assessing the athlete's confidence in his ability to engage in behaviors (e.g., manage emotions, etc.) that experts considered to be related to golf performance (i.e., evaluated via gross score). A simple linear regression analysis showed that self-efficacy accounted for a significant amount of variance, Adj $R^2 = .14$, $F(1,35) = 7.41$, $p < .01$, in golf performance.

Hepler and Chase (2008) further advanced the literature on self-efficacy in sport by examining the relationships between decision-making self-efficacy, task self-efficacy, and softball performance in undergraduate students ($n = 65$) with some (i.e., minimum of 2 years) softball or baseball experience. Self-efficacy was assessed before and after performance trials using a decision-making self-efficacy questionnaire and a task self-efficacy questionnaire. Decision-making performance was evaluated by the participant choosing or not choosing the correct defensive solution from three trials of softball game scenarios and task performance was evaluated via the speed and accuracy of a softball throwing task across 30 trials. Bouts of negative feedback were interjected between blocks of trials in both the decision-making and task performances. Results of a multivariate multiple regression analysis indicated that while task self-efficacy was a significant predictor of task performance ($R^2 = .330$, $p < .001$), decision-making self-efficacy was not a significant predictor of decision-making performance.

Whether studying athletes at the novice or elite level (Beauchamp et al., 2002; Haney & Long, 1995; Theodorakis, 1995), or athletes who participate in individual or team sport (Escarti & Guzman, 1999; Hepler & Chase, 2008; Martin & Gill, 1991; Treasure et al., 1996), researchers have reported significant relationships between self-efficacy and the performance of individual athletes. In light of the substantial amount of evidence supporting the relationship between self-efficacy and individual sport performance, it is not surprising that sport psychology researchers have extended this line of inquiry to include the potential influence of efficacy in *team* performance. To that end, I will briefly review the literature examining the relationship between collective efficacy and team performance in sport.

Collective efficacy and team performance in sport. While self-efficacy refers to the confidence an individual has in his or her ability to complete a specific task, collective efficacy refers to the shared level of confidence individuals have in the ability of the group to successfully complete a specific task (Bandura, 1997). Sources of collective efficacy include but are not limited to prior performance, vicarious experience, verbal persuasion, group cohesion, group leaders, group size, and motivational climate

(Carron & Brawley, 2008). In sport, significant relationships have been found between collective efficacy and team performance (Feltz & Lirgg, 1998; Myers, Feltz, & Short, 2004).

In 1998, Feltz and Lirgg conducted the first study to examine the relationship between collective efficacy and team performance over an entire sport season. Participants (n = 159) from six different collegiate hockey teams completed measures of collective efficacy, which assessed individual team member's perceptions of the team's ability to competently perform in hockey (i.e., outskate the opponent, bounce back from performing poorly, etc.). The collective efficacy questionnaires were completed within a 24-hour window prior to each game over a season of 141 total games. Team performance was evaluated by performance outcomes (i.e., margin of win, game outcome, scoring percentage, short-handed defense, and power play percentage) over the course of the season. Pearson's approximation to chi square revealed that collective efficacy beta weights were not significant $\chi^2(5) = 3.12$, $p < .05$. Subsequently, further analysis of the collective efficacy beta weights showed that collective efficacy had an effect on performance ($z = 3.80$).

Corresponding with the work of Feltz and Lirgg (1998), Myers, Feltz, and Short (2004) investigated the potential influence of aggregated collective efficacy on offensive performance among 197 players from 10 different NCAA Division III football teams. Aggregated collective efficacy, or the summation of each individual team member's perception of the team's ability to complete a task, was evaluated via a 9-item questionnaire assessing the degree of confidence each athlete had in the team's ability to competently perform against an opponent. Offensive performance was evaluated via points scored, total yardage, average gained per play, number of turnovers committed, number of punts, and game outcome. In their longitudinal analysis of offensive performance, Myers et al. (2004) used a linear growth model and reported that collective efficacy was a significant positive predictor of future offensive performance ($\beta = .29$, $z = 2.89$).

Based on the literature reviewed, it appears that the relationship between collective efficacy and team performance in sport parallels the relationship between self-efficacy and individual performance in sport. Thus, it is possible that in team sports, both individual and collective efficacy beliefs may influence performance. Self-efficacy, unlike the construct of personality, has not yet been examined in relation to firefighting performance. However, the construct has been linked to traumatic stress, depressive symptomatology (Regehr, Hill, Knott, & Sault, 2003), and quality of life (Prati, Pietrantoni, & Cicognani, 2010), implying its importance to firefighting generally. To continue forging links between psychological constructs of sport and firefighting, I will review the literature addressing the construct of self-efficacy in firefighting in the section below.

Self-efficacy in firefighting. One of the objectives of a study by Regehr and colleagues (2003) was to examine self-efficacy differences between new recruits and experienced firefighters. The study included 65 newly recruited firefighters (M_{age} = 27.35 years) and 58 experienced firefighters (M_{age} = 37.84 years), all of whom completed the following questionnaires: the Beck Depression Inventory (BDI; Beck & Beamesderfer, 1974), the Impact of Event Scale (IES; Zilberg, Weiss, & Horowitz, 1982) to assess the intensity of traumatic stress symptoms, and the Self-Efficacy Scale (Sherer

& Adams, 1983). A simple *t* test showed that new recruits reported higher scores for self-efficacy than experienced firefighters ($t = 5.56$, $p \leq .001$). In conducting additional analyses, the researchers discovered that self-efficacy was negatively related to BDI ($r = -.35$, $p \leq .01$) and IES ($r = -.25$, $p \leq .05$) scores, respectively. Altogether, these data indicate that self-efficacy may have a protective effect on traumatic stress and depression, and that the implied buffering effect of self-efficacy may diminish as firefighting experience increases.

Other researchers (Prati et al., 2010), suggested that the construct may be related to quality of life among both male and female rescue workers, including firefighters ($n = 451$, $M_{age} = 33.66$ years). In this study, self-efficacy was assessed via the Perceived Personal Efficacy scale (Barbaranelli & Capanna, 2001) while quality of life was assessed via the Professional Quality of Life Scale Revision IV (ProQOL R-IV; Palestini, Prati, Pietratoni, & Cicognani, 2009; Stamm, 2005). Results of a correlational analysis revealed significant correlations between self-efficacy and each of the three components of quality of life: compassion satisfaction ($r = .41$, $p < .001$), compassion fatigue ($r = -.24$, $p < .001$), and burnout ($r = -.29$, $p < .001$). Collectively, these findings suggest that self-efficacy may be an important factor in the quality of life of rescue workers such as firefighters.

The work of Regehr et al. (2003) and Prati et al. (2010), despite the absence of evidence supporting a relationship to performance, demonstrate the importance of self-efficacy among firefighters. Another psychological construct, motivation, has been indirectly linked to sport performance via positive affect (Brière, Vallerand, Blais, & Pelletier, 1995) and persistence (Pelletier, Fortier, Vallerand, & Brière, 2001), and directly linked to persistence in firefighting (Grant, 2008). To facilitate the conceptual link between motivation in sport and firefighting, within the following section, I will provide a review of the literature explaining the links between motivation and sport performance, and the links between motivation and persistence in firefighting.

Motivation. Similar to the literature on self-efficacy, the literature on motivation is informed by research conducted in academics (Schunk, 1991; Vallerand et al., 1992; Walker, Greene, & Mansell, 2006) and sport (Brière, Vallerand, Blais, & Pelletier, 1995; Feltz & Petlichkoff, 1983; Rudisill, 1989). Motivation, or the intensity and direction of effort dedicated to a particular task (Sage, 1977 as cited in Weinberg & Gould, 2011), can be further divided into several theoretical perspectives. Accordingly, there is research to support links between sport performance and two such motivational perspectives: intrinsic motivation and competence motivation. While there is a considerable amount of research supporting the importance of motivation to performance in sport, only one study has been conducted to examine the construct of motivation in firefighting. In the section below, I will review both the literature on motivation (i.e., intrinsic and competence) in sport and the influence of motivation (i.e., intrinsic) on persistence in firefighting.

Intrinsic motivation in sport. As stated above, intrinsic motivation has been linked to sport performance (Beauchamp, Halliwell, Fournier, & Koestner, 1996; Brière, Vallerand, Blais, & Pelletier, 1995; Jackson, Kimiecik, Ford, & Marsh, 1998; Pelletier et al., 2001). As explained by Ryan and Deci (2000), intrinsic motivation is the inherent satisfaction and desire to seek challenges. Vallerand and Losier (1999) further suggest that athletes experiencing higher levels of intrinsic motivation may experience greater positive affect and greater levels of persistence than athletes experiencing higher levels of extrinsic motivation. As positive affect (Anshel, & Anderson, 2002; Totterdell, 2000) and persistence (Baker, Côté, & Deakin, 2005; Hodges & Starkes, 1996) have been linked to performance, an indirect relationship between intrinsic motivation and sport performance is inferred. Below, I will provide a review of the literature linking intrinsic motivation directly and indirectly to sport performance.

Intrinsic motivation and sport performance. In a study of novice golfers (M_{age} = 19.53 years), intrinsic motivation was examined as a mediating factor between the use of psychological skills training (PST) and performance outcomes (Beauchamp et al., 1996). Male and female junior-college students (n = 65) were divided into three groups: (a) PST, which utilized cognitive-behavioral group training to promote golf knowledge, self-assessment, motivation, and integration of psychological skills in performance; (b) physical skills training, which emphasized the mechanics of putting and the essentials of the putting stroke; and (c) control, which followed a regular golf instructional program with no additional skills training (i.e., psychological or physical). All participants, using identical golf equipment, partook in a 14-week instructional program including lessons devoted to putting and a pre-putt routine. At four different times during the instructional program, participants first provided responses to the Sport Motivation Scale (SMS; Pelletier et al., 1995) and then completed a series of 12 putts, alternating between two different starting points (i.e, 4 ft [1.22 m] from the cup and 12 ft [3.66 m] from the cup). Putting performance was determined via a point system relative to finishing distance from the ball to the cup. A linear trend analysis of dependent variables over four trials demonstrated that only the PST group experienced significant increases in intrinsic motivation over time, $F(1, 177) = 32.54$, $p < .0001$. Additional orthogonal contrasts further revealed that the PST group experienced greater rates of increased performance than the physical skills and control groups combined, $F(1, 177) = 13.77$, $p < .0005$. Thus, it is apparent that PST programs aimed at increasing intrinsic motivation may enhance performance outcomes in golf.

Intrinsic motivation and positive affect. Contrary to the direct relationship identified between intrinsic motivation and performance above, intrinsic motivation may be indirectly related to performance via positive affect. Vallerand (1997) acknowledged the potential effect of intrinsic motivation on several positive affective experiences including flow, interest, enjoyment, and satisfaction among both elite and recreational athletes of varying ages. Since positive affect appears to play a role in sport performance (Anshel, & Anderson, 2002; Totterdell, 2000), I will review the literature supporting the link between intrinsic motivation and positive affect.

In validating the French version of the Sport Motivation Scale (SMS; Brière et al., 1995), researchers explored seven types of motivation (e.g., intrinsic knowledge, intrinsic accomplishment, intrinsic passion, etc.) and positive emotions in sport. Participants ($n = 252$, $M_{age} = 19.33$ years) completed the new SMS as well as questionnaires adapted from Ryan and Connell (1989), which assessed the positive emotions experienced while engaging in sport. In conducting a correlational analysis, Brière et al. found significant correlations between positive affect and intrinsic knowledge motivation ($r = .27$, $p < .001$), intrinsic accomplishment motivation ($r = .34$, $p < .001$), and intrinsic stimulation motivation ($r = .47$, $p < .001$).

More evidence to support the importance of intrinsic motivation in sport was provided by Jackson and colleagues (1998) in their examination of the relationship between intrinsic motivation and flow state, or an optimal, enjoyable experience in sport (Csikszentmihalyi & LeFevre, 1989). Male and female World Masters Games athletes (n = 389, M_{age} = 46.1 years), competing in various individual sports, answered questions from the SMS (Pelletier et al., 1995), Trait Flow Scale (TFS; Csikszentmihalyi, 1990), and Flow State Scale (FSS; Jackson & Marsh, 1996). The researchers collected data over the course of 7 days during the World Masters Games. Participants were instructed to complete the trait measures at a convenient time, and were asked to complete the state measures as soon as possible after performing in a competitive event. Results of a standard multiple regression analysis showed that intrinsic motivation was a predictor variable of global trait flow ($\beta = .24$, $p < .05$) and global state flow ($\beta = .22$, $p < .05$). Consistent with the findings of Brière et al. (1995), the enjoyable experience of flow state, a contributor to positive affect (Vallerand, 1997), may be influenced by intrinsic motivation. As indicated by the studies reviewed above, it is clear that intrinsic motivation may have an indirect effect on sport performance via positive affect.

Intrinsic motivation and persistence. Like the role of affect, persistence may also be a mediating factor between intrinsic motivation and sport performance. In an effort to further explore motivation in sport, Pelletier et al. (2001) assessed five forms of regulated motivation (i.e., intrinsic, identified, introjected, external, amotivation) in relation to persistence among competitive swimmers. Prior to their first competitive season and after the completion of each of two competitive seasons, male (n = 174) and female (n = 195) swimmers (M_{age} = 15.6 years) completed the SMS (Pelletier et al., 1995) to assess motivational orientation. Persistence, over two competitive seasons, was determined by continuation of the sport after the completion of a single competitive season. A series of *t* tests indicated that the persistent athletes reported higher levels of intrinsic motivation than the dropout athletes ($t = 3.83$, $p < .001$).

Others (Sarrazin, Vallerand, Guillet, Pelletier, & Cury, 2002), studied the relationship between levels of intrinsic motivation and rates of dropout among female handball players ($n = 335$, $M_{age} = 14.07$ years). Specifically, the researchers attempted to test the Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM; Vallerand, 1997) which highlights the importance of intrinsic motivation to motivational consequences such as persistence. The participants completed the SMS (Pelletier et al., 1995) at mid-season, and 21 months later the researchers used players' registration to participate to determine persistence in the sport. Results of a repeated measures ANOVA revealed significant differences between dropout players and persistent players for intrinsic motivation-stimulation ($p < .05$), intrinsic motivation-knowledge ($p < .01$), and intrinsic motivation-accomplishment ($p < .0001$), thereby suggesting intrinsic motivation may be a contributing factor to continued participation or persistence among handball players.

Results from the collection of studies reviewed above suggest that intrinsic motivation, both directly and indirectly, may have an effect on sport performance. Sport psychology researchers have also found that intrinsic motivation may be associated with feelings of perceived competence (Weiss & Chaumeton, 1992), prompting the need to consider competence motivation as an aspect of sport performance as well. With that association in mind, I will now provide a brief discussion of the literature on competence motivation in sport.

Competence motivation in sport. Researchers have consistently linked competence, an inherent desire of all athletes (Harter, 1988), to continued persistence or the continuation of mastery attempts in sport (Feltz & Petlichkoff, 1983; Mouratidis, Vansteenkiste, Lens, Sideridis, 2008; Papaioannou, Bebetsos, Theodorakis, Christodoulidis, & Kouli 2006; Rudisill, 1989; Ulrich, 1987). As Harter proposed in her competence motivation theory (1978), successful performances lead to a positive cycle of increased self-efficacy, increased perceptions of competence, and continued mastery attempts. Conversely, unsuccessful performances can lead to increased negative affect, reduced competence motivation, and fewer mastery attempts or ultimate cessation of attempts altogether. Since the persistence has been associated with sport performance (Baker, et al., 2005; Hodges & Starkes, 1996), it is reasonable to infer that feelings of competence may have an influence on sport performance. To that end, I will next review the literature relating competence to persistence and performance in sport.

Researchers have consistently shown that feelings of competence may have an influence on persistence in sport (Feltz, 1988; Klint & Weiss, 1987; Papaioannou et al., 2006; Rudisill, 1989). For example, in 1988, Feltz provided a review of the literature linking competence to sport participation. According to Feltz, prior to 1988, investigators found that older youth sport participants experienced higher levels of perceived physical competence than age-matched non-sport participants and sport participants reported higher levels of perceived physical competence than sport dropouts.

One year later, Rudisill (1989) investigated the influence of perceived competence on persistence and performance among junior high school students (n = 332) during perceived failure. Students were asked to answer questionnaires assessing perceptions of task-specific competence (Vallerand & Reid, 1984), and were subsequently separated into groups of low and high perceived competene. Participants were then asked to perform a balancing task on a stabilometer for 20 seconds, across 15 total trials. After a series of three trials, the participants were given negative feedback to create an environment of perceived failure and were then given a 3-minute break. Persistence was evaluated via time spent practicing during the 3-minute break periods between trials, and performance was evaluated by the participant's ability to maintain side-to-side balance on a stabilometer. Results of an ANOVA and an analysis of covariance (ANCOVA), in which the mean time of the first three performances was used as a covariate, showed that the high perceived competence group persisted longer, $F(1, 72) = 12.41$, $p < .001$, and performed better, $F(1, 71) = 4.03$, $p < .05$, than the low perceived competence group.

Fifteen years later, Papaioannou et al. (2006) investigated the influence of perceived competence on sport and exercise participation. Participants, 4,432 students from the 5th through 11th grades, completed a physical self-perception profile (Fox & Corbin, 1989) to assess their perceptions of athletic competence. Participation in sport and exercise was determined by reports of frequency and time spent engaging in sport and exercise outside of physical education classes. A structural equation model ($\chi 2 = 246$, *d.f.* = 72, Tucker-Lewis Index [TLI] = .939, Comparative Fit Index [CFI] = .952, Root Mean Square Error of Approximation [RMSEA] = .052) was used to determine the causal paths of sport and exercise participation. Consistent with the research reviewed by Feltz (1988) and Rudisill (1989), results indicated that perceptions of competence were related to sport and exercise participation ($\beta = .17$, $p < .001$).

The research which has been conducted on motivation in sport clearly demonstrates the importance of the construct in regard to performance. Like self-efficacy, motivation is a psychological construct that has yet to be directly linked to performance in firefighting but has been linked to persistence (Grant, 2008). As demonstrated above, motivation may have an indirect influence on sport performance via persistence, prompting the consideration of a similar indirect relationship between motivation and firefighting performance. With that, I will provide a brief summary of the one study which has examined the influence of motivation on persistence in firefighting.

Motivation in firefighting. In the study alluded to above, Grant (2008) proposed that prosocial motivation (i.e., desire to expend effort to help others), mediated by intrinsic motivation, would increase persistence among male (n = 56) and female (n = 2) firefighters. Measures of prosocial motivation and intrinsic motivation were assessed via adapted forms of Ryan and Connell's (1989) self-regulation scales, while persistence was measured via the number of volunteer overtime hours worked. Results of an exploratory factor analysis revealed that the interaction between prosocial motivation and intrinsic motivation was significant, $\beta = .35$, $t(54) = 2.47$, $p = .02$, intrinsic motivation was a significant predictor of overtime, $\beta = .29$, $t(54) = 2.13$, $p = .04$, and prosocial motivation was not a significant predictor of overtime, $\beta = .02$, $t(54) = .14$, $p = .89$. Stated another way, when intrinsic motivation was high, prosocial motivation was positively associated with overtime hours ($\beta = .44$), and when intrinsic motivation was low, prosocial motivation was negatively associated with overtime hours ($\beta =-.53$). Furthermore, the researchers found that firefighters who reported higher levels of prosocial and intrinsic motivations averaged 33.12 hours of overtime per week while firefighters who reported lower levels of prosocial and intrinsic motivations averaged 19.78 hours of overtime per week. After interpreting the data, the researcher proposed that intrinsic motivation may be a moderating factor in the relationship between prosocial motivation and persistence.

The study conducted by Grant (2008), taken together with the review of the literature which links motivation to sport performance, provides support for the hypothetical link between the psychological aspects of sport and firefighting performance. In addition to the links discussed already, a final link between sport and firefighting can be conceptualized via the psychological construct of stress. Logically, both athletes and firefighters experience numerous stressful events on a regular basis, which justifies the need to examine the potential influence of the construct on performance in sport and firefighting. That said, I will conclude the exploration of psychological aspects of firefighting performance by providing a review of the literature on the constructs of stress and anxiety in sport and firefighting.

Stress and anxiety. The constructs of stress and anxiety, like the constructs of self-efficacy and motivation, have been studied by sport psychology researchers since the 1980s. Stress, or the negative emotional responses associated with the perceived inability to meet environmental demands (Lazarus and Folkman, 1984), has been reported among athletes of varying ages and levels of expertise (De Witt, 1980; Lazarus, 2000; Pensgaard & Duda, 2003). McGrath's model (1970) posits that the construct of stress involves a four-stage cyclical process involving: (a) the environmental demand, (b) the individual's appraisal of the environmental demand, (c) the stress response (e.g., state anxiety, arousal, muscle tension, changes in attention), and (d) the behavioral consequence or outcome (as cited in Weinberg & Gould, 2011, p. 82). The dynamic, often uncontrollable, and stressful competitive environmental demands of sport, have prompted sport psychology researchers to devote much of their attention to the most controllable of the four stages –the stress response (i.e., anxiety). Given the focus of the proposed study, I will next review the research supporting the relationship between anxiety and sport performance.

Anxiety in sport. The psychological response to stress, anxiety, has been of particular interest to sport psychology researchers and practitioners for the past 25 years. In an early study, Taylor (1987) investigated the relationship between anxiety and sport performance among 84 male and female NCAA Division I athletes involved in gross motor aerobic sports (e.g., nordic ski racing, cross country running, track & field) and fine motor anaerobic sports (e.g., alpine ski racing, tennis, basketball). To determine levels of anxiety, participants responded to the Sport Competition Anxiety Test (SCAT; Martens, 1977) to assess trait somatic anxiety, and the CSAI-2 (Martens, Burton, Vealey, Bump, & Smith, 1983b) to assess trait cognitive anxiety, state somatic anxiety, and state cognitive anxiety. Trait assessments were administered one week prior to the athletes' respective competitive seasons, and all state assessments were administered 1-2 hours prior to several competitions throughout the season. Performance outcomes for all but one sport, tennis, were subjectively rated by athletes and their coaches after individual competitions and at the conclusions of the seasons. Among gross motor aerobic sport athletes, results of a between-subjects regression analysis showed that trait cognitive anxiety was a significant predictor of performance, $F(1, 34) = 4.50$, $p < .05$, $\beta = .47$, and that the interaction between trait somatic anxiety and trait cognitive anxiety was related to coaches' ratings of performance, $F(1, 33) = 6.57$, $p < .03$, $\beta = .82$. In only one sport, cross country running, was a significant quadratic relationship identified between state cognitive anxiety and performance, $F(1, 36) = 4.61$, $p < .04$, $\beta = -.59$. Among fine motor anaerobic sport athletes, results of a between-subjects regression analysis showed that state somatic anxiety was a significant predictor of individual success, $F(1, 58) = 7.13$, $p < .01$, $\beta = -.41$; and that there was a significant quadratic relationship between state cognitive anxiety and coaches' ratings of performance, $F(1, 54) = 6.32$, $p < .02$, $\beta = -.49$. Collectively, these data indicate that both trait and state anxiety may have an influence on performance across sports.

Years later, Woodman and Hardy (2003) conducted a meta-analysis to investigate the relationship between state cognitive anxiety and competitive performance across 22 different sports. In their analysis, the researchers considered the anxiety-performance link between high-standard athletes (e.g., national or international level competition) and low-standard athletes (e.g., below national level competition), and between genders. Researchers found that the overall mean effect size of state cognitive anxiety was -.10. Furthermore, researchers discovered a greater mean effect size of state cognitive anxiety among high-standard athletes ($r = -.27$) than low-standard competition athletes ($r = -.06$), and a greater mean effect size among men ($r = -.22$) than women ($r = -.03$). The results of the meta-analysis affirmed the potential relationship between state cognitive anxiety and sport performance, particularly among high standard and/or male athletes.

In more recent research, Hayslip, Petrie, MacIntire, and Jones (2010) explored the influence of anxiety on performance among amateur golfers. Male ($n = 1147$) and female ($n = 173$) experienced ($M = 23$ years of experience) amateur golfers of varying skill level completed the Sport Anxiety Scale (SAS; Smith, Smoll, & Schultz, 1990) to assess sport-specific trait anxiety (i.e., concentration disruption, worry, somatic anxiety) before a tournament. Performance was evaluated via gross, uncorrected scores across three rounds of the tournament. Results of hierarchical regression analyses revealed that two of the three sources of sport-specific trait anxiety, concentration disruption (β = -.09, $p < .01$) and worry (β = -.11, $p < .01$), were predictive of performance. Consistent with the findings of other researchers (Taylor, 1987; Woodman & Hardy, 2003), a significant relationship was identified between anxiety and performance.

In comparison to the extensive research conducted on anxiety and stress in sport, the construct has received far less attention in the firefighting literature. Considering the prevalence of anxiety and stress in firefighting, it is surprising that only one study has been conducted to examine anxiety among firefighters (Smith, Petruzzello, Kramer, & Misner, 1996) and only one has attempted to illustrate a relationship between stress and firefighting performance (Hytten & Hasle, 1989). Despite this apparent gap in the literature, researchers have linked stress to other important aspects of firefighting such as psychological distress, burnout (Tuckey & Hayward, 2011), and psychological well-being (Malek, Mearns, & Flin, 2010). In the section to follow, I will review the literature that has addressed anxiety and stress in the firefighting profession.

Anxiety in firefighting. In 1996, Smith and colleagues conducted a study to describe the psychological response of firefighters who were wearing their gear during a 16-minute live firefighting drill. Prior to completing the firefighting drill, the participants (n = 15, M_{age} = 30.3 years) completed the trait scale of the State-Trait Anxiety Inventory (Form Y-2). The firefighting drill, which took place inside a structure that contained three controlled fires, included two 8-minute firefighting tasks (i.e., advancing a fire hose and chopping a wood block). After completing the drill, participants completed the Activation-Deactivation Adjective Checklist (Thayer, 1986) to assess perceptions of energetic and tense arousal. The participants also provided their rate of perceived exertion (i.e., 15 point scale) and perceived affect (i.e., ranging from 5 meaning they felt very good to -5 meaning they felt very bad) after each drill. Repeated measures ANOVA calculations were used to assess differences from pre- to post-task in the various measures described above. The researchers reported that from pre-task to post-task, firefighters' energetic arousal decreased, $F(1, 13) = 21.19$, $p = .001$, tense arousal did not change , $F(1, 13) = 0.01$, $p = .937$, perceived exertion increased, $F(1, 14) = 11.76$, $p = .004$), and in-task affect decreased, $F(1, 14) = 33.98$, $p = .937$. While no significant change was observed in tense arousal from pre-to post-task, the researchers also reported that trait anxiety was related to the degree of change in tense arousal ($r = .61$, $p = .013$). Taken together, these data indicate that higher levels of trait anxiety in firefighters may lead to greater changes in tense arousal (i.e., more intense state anxiety responses) from pre- to post-task. In addition to the potential anxiety response to physical stress (i.e., live firefighting drill), researchers have also noted the need to examine psychological stress among firefighters. To that point, I will provide a review of the research examining the construct of stress among firefighters in the section below.

Stress in firefighting. As mentioned previously, there is a dearth of literature examining the influence of stress on firefighting performance. In one study, however, researchers (Hytten & Hasle, 1989) retrospectively examined stress reactions during disaster experiences among non-professional male firefighters ($n = 58$, $M_{age} = 37.8$ years). Three days after experiencing a traumatic disaster on the job, participants completed the Impact of Event Scale (IES; Horowitz, Wilner, & Alvarez, 1979) to assess the intensity of traumatic stress symptoms as well as a questionnaire constructed by the researchers which included information on preparation and training, physical strain during effort, coping, and stress reactions during action. The researchers found that approximately 50% of the participants reported stress reactions ranging from a moderate to strong degree during the rescue action, while only 10% of the participants reported stress reactions that somewhat impaired their ability to effectively execute rescue tasks. Additionally, the sum scores of the IES were greater among firefighters with no practical experience than among firefighters with experience. Even though no inferential evidence was obtained from this study, it appears that stress may still be an influential factor in the traumatic disasters experienced by firefighters.

Decades later, other researchers (Tuckey & Hayward, 2011) sought to examine the association between the emotional demands of emergency services work and adverse psychological health outcomes (i.e., psychological distress and burnout). A sample of 150 volunteer firefighters (M_{age} = 44.03 years) responded to a set of questionnaires, all recorded on a 5-point Likert-type scale, to assess: (a) the cognitive, emotional, and physical nature of job demands (Demand-Induced Strain Questionnaire; de Jonge, et al., 2004); (b) the intensity of traumatic stress symptoms (Impact of Events Scale-Revised; Weiss, 2004); (c) psychological distress (General Health Questionnaire; Goldberg & Williams, 1988); and (d) levels of burnout (Copenhagen Burnout Inventory; Kristensen, Borritz, Villadsen, & Christensen, 2005). A correlational analysis showed significant relationships between emotional demands and emotional resources ($r = -.12$, $p < .01$), traumatic stress symptoms ($r = .33$, $p < .05$), psychological distress ($r = .40$, $p < .001$), and burnout ($r = .44$, $p < .001$). In a similar trend, emotional resources were also found to be related to traumatic stress symptoms ($r = -.09$, $p < .05$), psychological distress ($r = -.31$, $p < .001$), and burnout ($r = -.27$, $p < .001$).

Concurrent with the research conducted by Tuckey & Hayward (2011), Malek et al. examined sources of stress as a predictor of psychological well-being among United Kingdom (UK) and Malaysian firefighters. Participants, ranging in age from 21-60 years, responded to a series of questionnaires to assess sources of stress (Sources of Stress in Firefighters & Parametics; Beaton & Murphy, 1993), psychological well-being (Psychological Well-being Scale), and job satisfaction (Job Satisfaction Scale; Warr, Cook, & Wall, 1979). Among UK firefighters ($n = 617$), results of correlational analyses indicated significant ($p < .01$) relationships between sources of stress and overall coping behavior ($r = .14$), psychological well-being ($r = .48$), and job satisfaction ($r = -.35$). Among Malaysian firefighters ($n = 436$), significant ($p < .01$) relationships were found between sources of stress and overall coping behavior ($r = .13$), psychological well-being ($r = .34$), and job satisfaction ($r = -.18$). Additional hierarchical regression analyses indicated that sources of stress ($\Delta R^2 = .230$, $p < .01$) and overall coping behavior ($\Delta R^2 = .009$, $p < .05$) were predictive of overall psychological well-being among UK firefighters, while sources of stress ($\Delta R^2 = .104$, $p < .01$) and the interaction between sources of stress and overall coping behavior ($\Delta R^2 = .007$, $p < .05$) were predictive of psychological well-being among Malaysian firefighters. Likewise, among UK firefighters sources of stress ($\Delta R^2 = .127$, $p < .01$), overall coping behavior, ($\Delta R^2 = .073$, $p < .01$), and the interaction between sources of stress and overall coping behavior

($\Delta R^2 = .015$, $p < .001$) were predictive of job satisfaction. Among Malaysian firefighters, sources of stress ($\Delta R^2 = .036$, $p < .01$) and overall coping behavior ($\Delta R^2 = .018$, $p < .01$) were found to be predictive of job satisfaction. All of these data denote that sources of stress, and whether or not someone has the ability to cope with stress, may influence psychological well-being and job satisfaction among firefighters.

Research in sport has consistently suggested that the potential consequences of stress in sport (e.g., state anxiety, arousal, muscle tension, changes in attention) may have an influence on performance. Even though stress and anxiety have been addressed in the literature on firefighters, it is quite clear that additional research must be conducted to better understand both the relationship between stress and firefighting performance and the relationship between the psychological responses to stress (e.g., anxiety) and firefighting performance. From a broader perspective, by conducting this additional research examining the potential relationships between any and all of the psychological constructs reviewed above (e.g., stress and anxiety) and firefighting performance, researchers may also gain a better understanding of the psychological skills which may be necessary for optimal firefighting performance.

The use of psychological skills in sport. As I stated previously, experts in the field of sport psychology have recognized the importance of psychological skills use in elite levels of sport. For example, in their review of the literature on mental preparation of successful athletes, Krane and Williams (2006 as cited in Harmison, 2011) reported that psychological skills such as goal setting, imagery, competition and refocusing plans, well-learned coping skills, thought control strategies, arousal regulation, and attentional control were correlates of peak performance. Furthermore, according to MacNamara, Button, and Collins (2010), past research has indicated that the use of psychological skills (e.g., commitment, imagery, focus, etc.) has differentiated between successful and less successful elite athletes. While psychological skills have yet to be examined among firefighters, it is obvious that psychological skills (e.g., concentration and intensity regulation) could be beneficial to a firefighter during performance. To provide support for the potential benefit of psychological skills to firefighting performance, I will next provide a brief review of the literature which highlights the relationship between the use of psychological skills and elite sport performance.

In an early study, Mahoney, Gabriel, and Perkins (1987) examined the use of psychological skills among 713 male and female athletes across 23 sports. More specifically, these researchers examined the differences in the use of psychological skills between elite (i.e., placed 4th or higher in national, Olympic, or world competitions), pre-elite (i.e., attended special training camps or competed in junior national championships), and non-elite (i.e., collegiate) athletes. To assess the use of psychological skills, the researchers developed a 51-item Psychological Skills Inventory for Sports (PSIS; Mahoney, Gabriel, & Perkins, 1987), which was then administered to all participants. Using Hotelling's T^2 to assess group differences, the researchers identified significant differences between the responses provided between elite (n = 126, M_{age} = 24.1 years) and both pre-elite (n = 14, M_{age} = 18.6 years) athletes (T^2 = 94.3, F(51, 202) = 1.48, p < .03) and non-elite (n = 446, M_{age} = 19.8 years) athletes (T^2 = 241.4, F(51. 498) = 4.30, p < .0001). In further analyzing the data, the researchers found that elite athletes reported dreaming less frequently about performance than pre-elite athletes, while pre-elite athletes reported higher levels of anxiety associated with performance, greater negative impacts of anxiety during times of increased intensity, less consistent concentration on performance, and greater use of self-coaching during performances than elite athletes. Finally, in comparing elite to non-elite athletes, the researchers found that elite athletes reported: (a) greater levels of balance in their experiences of worry and performance anxiety, (b) more efficient deployment of concentration before and after competition, (c) stronger and more stable self-confidence, (d) greater levels of internal focus and kinesthetic imagery, and (e) greater levels of motivation and personal meaning in sport participation. Collectively, these data indicate that differences may exist between the use of psychological skills among elite, pre-elite, and non-elite athletes.

Decades later, Taylor, Gould, and Rolo (2008) conducted a similar study to compare the use of psychological skills during practice and competition between U.S. Olympic medalists (n = 52) and non-medalists (n = 124). To assess the use of psychological skills during practice and competition, participants (M_{age} = 28.90 years) completed the 64-item Test of Performance Strategies (TOPS; Thomas, Murphy, & Hardy, 1999). In analyzing the athletes' responses to the competition subscale of the TOPS, results of a discriminant function analysis (Wilks' $\lambda = .90$, $\chi^2(8) = 17.14$, $p < .05$) revealed that medalists indicated greater levels of emotional control and automaticity than non-medalists, while non-medalists indicated greater imagery scores than medalists. In analyzing the responses to the practice subscale of the TOPS, results of a discriminant function analysis (Wilks' $\lambda = .90$, $\chi^2(8) = 17.10$, $p < .01$) indicated that medalists reported greater emotional control and greater use of self-talk than non-medalists. Consistent with the findings of Mahoney, Gabriel, and Perkins (1987), these data again indicate that psychological skills may differentiate between successful and less successful elite athletes.

As evidenced by the literature reviewed above, it is clear that the use of psychological skills may play a role in the attainment of success in elite sport. As such, noting that other psychological constructs (i.e., personality, self-efficacy, motivation, stress) have emerged as important aspects in both sport and firefighting, perhaps the use of psychological skills could potentially play a role in the achievement of peak performance among firefighters as well. Paralleled by the sport performance literature, and in an effort to best conceptualize the psychological aspects of firefighting performance, I propose that future research should consider both stable aspects (e.g., personality, intrinsic motivation, trait anxiety) and dynamic aspects (e.g., self-efficacy, psychological skills, etc.) in relation to performance.

Summary. The connections made between the psychological aspects of sport and firefighting, although not perfect, contribute to a better understanding of the psychological performance needs of firefighters. While in elite sport, a mental mistake during performance may result in undesirable consequences (e.g., diminished self-confidence, criticism in the media, loss of sponsorship, etc.), in firefighting, a mental mistake during performance could result in the loss of a life. A firefighter experiences this reality on a regular basis, which in and of itself justifies the need for additional research to better understand the psychological aspects of firefighting performance. This anecdotal evidence, paired with the evidence from sport and firefighting research provided in section above, demonstrates both the importance of psychological factors (i.e., personality, self-efficacy, motivation, stress) and psychological skills to performance in firefighting as well as the consequent value of the sport sciences to this unique population of *athletes*.

Conclusion

Although the literature reviewed above provides a general understanding of distinct physical and psychological aspects of firefighting performance, firefighting performance has yet to be conceptualized from an integrated perspective whereby the physical and psychological aspects of performance are concomitantly assessed and developed. This review of the literature further illustrates the considerable overlap between aspects of performance in sport and firefighting, thereby supporting the use of the research, theories, and best practices from the sport sciences to inform future research on firefighting performance. In support of previous research which has prompted the consideration of firefighters as athletes (Gnacinski, Meyer, & Ebersole, in press), I propose that a model of sport performance like the MAPM, in combination with the evidence-based training principles of sport, could be used to provide an integrated assessment of the performance needs of firefighters. As such, guided by the MAPM, the purposes of the proposed study are to: (a) use descriptive data from physical and psychological assessments to characterize the multidimensional performance states of active and novice firefighters; (b) compare the current performance states of active and novice firefighters; and (c) provide evidence-based recommendations for the development of comprehensive firefighting training programs.

Chapter III: Methodology

Over the last decade, researchers and practitioners in the sport sciences have supported the need to consider both the physical and psychological aspects of firefighting performance (Smith, 2010). Given the apparent overlaps between the performance demands of athletes and firefighters, I propose that the Meyer Athlete Performance Management Model (MAPM; Meyer, Merkur, Ebersole, & Massey, in press), an integrated model of sport performance, be utilized to conceptualize the multidimensional nature of firefighting performance as well. Informed by the MAPM, the purposes of the current study were to: (a) use descriptive data from physical and psychological assessments to characterize cadets, recruits, and experienced firefighters; (b) compare the current physical and psychological states of cadets, recruits, and experienced firefighters; and (c) provide evidence-based recommendations for the development of comprehensive firefighting training programs. The methods that were used in the current study are outlined below.

Participants

All cadets from the incoming class of the Milwaukee Fire Department (MFD) cadet training program, all recruits from the incoming class of the MFD recruit training program, and all active duty MFD firefighters were invited to participate in the current study. As defined by the MFD, cadets are young adults (i.e., 17-19 years of age at program onset) who are recruited from local high schools to participate in a 2-year cadet training program as uniformed employees upon high school graduation. By contrast, recruits are adults (i.e., 18 years of age or older) who apply for the traditional 14-week recruit training program as a uniformed employee. In the current study, the cadet and recruit groups represent individuals following two different paths to becoming active duty firefighters. An active duty firefighter, for the purposes of the current study, was defined as any MFD employee with the titles: Level 1, 2, 3 Firefighter, Heavy Equipment Operator, or Lieutenant. After extending the invitation to participate, 11 cadets (i.e., entire incoming class), 27 recruits (i.e., entire incoming class), and 15 active duty firefighters volunteered to participate in the current study. Given that the cadet and recruit classes consisted only of males, for the purposes of comparison, only male active duty firefighters were included in the study. Prior to data collection, all potential participants were screened to determine eligibility to participate via the process described in the section below.

Inclusion criteria. In an effort to determine eligibility to participate in the study, all potential participants completed a paper-pencil version of the Criteria for Inclusion Questionnaire (see Appendix A), which was administered on their respective testing days. Individuals were invited to participate in the study if they: (a) were not taking any prescribed medication for a symptomatic illness; (b) had no injury, surgery, or bone abnormalities on their knees, hips, or ankles in the last year; (c) had no existing a heart condition; and (d) did not currently suffer from chest pain or dizziness. In addition to the physical criteria mentioned above, eligibility for participation in this study was also determined by the following criteria: (a) the participant had to be between the ages of 18-50 years, (b) the participant had to be fluent in speaking and writing English, (c) the participant must have passed all MFD standard physical and psychological screenings prior to this study, and (d) the participant had to be willing and able to give their informed consent to participate in the study. If the participant met the criteria outlined above, he was presented with the Consent Form (see Appendix B). All participants were deemed eligible to be included and provided their informed consent to participate.

Demographic information. Within the process of data collection, all participants completed a demographic questionnaire. The demographic questionnaire (see Appendix C) included items related to the following: (a) gender, (b) ethnicity, (c) age, (d) years of firefighting experience, (e) relationship status, and (f) number of children. All participants (i.e., cadets, recruits, and active duty firefighters) were male. Among cadets (n = 11), the following ethnicities were reported by participants: Caucasian (33.3%), African American (33.3%), Hispanic (25%), and other (8.3%). No cadets reported being married or having children. Among recruits (n = 27), the following ethnicities were reported by participants: Caucasian (85.2%), African American (3.7%), Hispanic (3.7%), and other (3.7%). In the recruit group, 55.6 % of the participants reported being married and 37% reported having children. Among active duty firefighters (n = 15), the following ethnicities were reported: Caucasian (77.8%), African American (16.7%), and Asian (5.6%). In the active duty firefighter group, 50% of the participants reported being married and 27.8% reported having children.

Measures

Researchers. Given the limited amount of time allotted for data collection for each group, a team of experienced Athletic Training (AT), Doctor of Physical Therapy (DPT), and Masters of Kinesiology (MSK) students conducted all physical assessments. All students were properly trained and deemed competent to perform testing protocols. All students were supervised at all times by Co-PI Dr. Kyle Ebersole. Once all data were collected and recorded, I, as the PI, independently transferred all physical and psychological data into Excel spreadsheets and conducted all of the subsequent analyses.

Physical measures. To examine the physical aspects of firefighting performance, participants completed a battery of physical assessments during their scheduled testing times at the MKE Fire and Safety Academy. Additionally, prior to completing the battery of physical assessments, the height (m) and weight (kg) of each participant was measured and recorded. All measures were previously utilized in either or both sport and firefighting performance research. Below is description of each physical measure assessed in the current study.

Aerobic fitness. To assess aerobic fitness, a submaximal, 5-minute step test (Sharkey, 1977, 1979), which was originally designed to test the fitness of firefighters, was used to estimate maximal oxygen uptake (VO_{2max}). Before beginning the test, the participant first sat quietly for 5 minutes to obtain a resting heart rate value. Once resting heart rate was recorded at the 5^{th} minute of rest, the participant then stood and faced a 15 ¾ inch step. Maintaining an upright position for the duration of the test, the participant then stepped up onto the step and down off of the step to the beat of a metronome (i.e., 90 beats per minute). After the 5-minute step test, the participant stopped and sat down on the step. After resting for 15 seconds, the participant’s heart rate was assessed and recorded. From a published table (Sharkey, 1977, 1979) of VO_{2max} estimations, the recorded 15-second heart rate value was then used to determine an estimated VO_{2max}. Polar T31i heart rate monitor straps and watches were used to assess heart rates. The estimated VO_{2max} values were expressed in relative terms or milliliters of oxygen consumed per kilogram of body weight per minute (mL/kg/min).

Muscular strength and endurance. To determine muscular strength, the participants' one repetition maximum (1 RM) squat and bench press (National Strength and Conditioning Association, 2000) were assessed. In this indirect assessment, participants: (a) completed a warm-up set (i.e., 15 repetitions of 60% of their perceived 1 RM), (b) rested for 3-4 minutes, and (c) the bar loaded to a 85% perceived 1 RM the participants completed repetitions until failure (i.e., with a goal of 4-8 repetitions completed). If the participant completed fewer than 8 repetitions, the test was complete and the weight lifted was recorded. If the participant completed more than 8 repetitions, the participant rested for 3-4 minutes and completed the indirect test again (see step c) with additional load (i.e., greater than 85% perceived 1 RM). This process, including the rest phase, would continue until the participant would reach failure in 8 repetitions or fewer. The 1 RM was estimated using the following equation: 1RM estimate = Weight lifted / (1.00 – (#reps * 0.02)).

To determine muscular endurance, participants performed push-ups to exhaustion (National Strength and Conditioning Association, 2000). The number of push-ups that were completed, to the beat of the metronome (i.e., 80 beats per minute), without losing proper form (i.e., body is rigid, back is straight, chest lowered to 5 cm from the ground, and arms fully extended in a complete push-up) or resting between repetitions was recorded. This push-up test was administered for no longer than 2 minutes or for no more than 80 consecutive repetitions.

Body composition. To assess body composition, body densities were calculated using the Jackson & Pollock Three Skinfold Site method (1978) and percent body fat was calculated using Siri's body fat percentage equation (Siri, 1961). Strong correlation coefficients have been consistently been reported (α = .70-.90) between skinfolds and the gold standard of hydrostatic weighing (American College of Sports Medicine, 2000 as cited in Beam & Adams, 2011). Using the right hand to measure and the left hand to pinch, skinfolds were measured at a 1 cm distance above the skinfold site. In measuring the skinfolds, the points of the calipers were perpendicular to the long axis of the skinfold site and the jaws of the calipers were compressed for no less than 1-2 seconds and no longer than 4 seconds. To ensure reliability, all skinfold measures were taken at least twice by the same expert researcher across participants. If two measures of the same skinfold varied greater than 1 mm, a third measure was taken. All skinfolds and the sum of three skinfolds were reported to the nearest 0.1 mm. For all participants, the chest, abdominal, and thigh skinfold measures were used to determine body density.

Functional movement (Cook et al., 1998). All seven tasks of the Functional Movement Screen™ (FMS™; Cook et al., 1998) were subjectively scored on a 3-point scale, for a total of 21 possible points (see Appendix D). The seven tasks included:

1. A deep squat, which involves holding a light weight plastic dowel rod over the head with arms extended and squatting as far down as the participant is able to go. This task was repeated five times.
2. A hurdle step, which involves holding the aforementioned dowel rod across the shoulders while stepping, one leg at a time, over a rubber tube that is anchored to two stationary poles. The height of the rubber tube is level with the tibial tuberosity, just below the knee. This task was also repeated five times.
3. A lunge, which involves the participant lunging forward and trying to touch the knee of the back leg to the heel of the front foot. This was repeated five times.

4. A measure of shoulder mobility, which involves the participant reaching behind their back with one hand coming from the head down the spine and the other hand coming from the waist up the spine. The distance separating the two hands was measured. Both shoulders were assessed.
5. A single-leg stretch, which involves the participant lying on his/her back and raising the leg up from the ground while keeping the knee straight. Both legs were assessed.
6. A push-up, which involves performing a push-up with the hands placed at the level of the chin or clavicle. This task was repeated three times.
7. A measure of rotary stability, which involves the participant being positioned in a 4-point stance (arms and legs) and trying to bring the right elbow to the left knee. This was repeated three times with the right elbow coming to the left knee and three times with the left elbow coming to the right knee.

Muscular power. To assess muscular power, each participant completed a counter movement jump (CMJ). A Myotest Sport unit (Nuzzo, Anning, & Scharfenberg, 2011), a small accelerometer-based device which measures height, force output, work output, and velocity of the jump, was used to assess CMJ performance. A neoprene belt was used to fasten the device to the participant's waist. The better of two successful CMJ performances, determined by jump height, were reported. The instructions for the CMJ are listed below:

1. The participant began each jump (trial) with their hands on their hips.
2. The participant listened for the sound of the beep from the Myotest unit.

3. The participant then squatted in a downward motion and propelled themselves upward, jumping off the ground as high and fast as they could while keeping their hands on their hips.
4. The participant completed two trials and the highest jump of the two trials was recorded.
5. A trial was considered unsuccessful if: the participant started their movement before the proper stimulus (e.g., false start), the participant removed their hands from their hips during the jump, or the Myotest Sport unit could not properly assess the trial.

Psychological measures. To examine the psychological aspects of firefighting performance, participants completed a battery of online psychological questionnaires in a computer laboratory within the same building used for physical testing. Previous research has shown online data collection to be equivalent to the paper-pencil method (Krantz, Ballard, & Scher, 1997; Meyer, Cashin, & Massey, 2012; Meyerson & Tyron, 2003). All of the psychological questionnaires selected for the current study have demonstrated reliability across a variety of adult populations. To ensure internal consistency, Cronbach's alpha reliability coefficients were calculated and reported for all subscales. Per the acceptability standards for reliability coefficients (Nunnally, 1978), reliability coefficients greater than .700 were considered minimally acceptable. The psychological questionnaires used in the current study are described in detail below.

Saucier's Mini-Markers (Saucier, 1994). The 40-item Mini-Markers scale (see Appendix E) was used to assess the Big Five personality characteristics (i.e., emotional stability, extroversion, openness to experience, agreeableness, conscientiousness) of the participants. Saucier's Mini-Markers scale is a well-established, reliable (α*s* = .69-.91), and valid personality scale which has been used among university students and adult populations (Saucier, 1994; Seibert & Kraimer, 2001). Calculated Cronbach's alpha reliability coefficients from the current study indicate similar internal consistency (α*s* = .728 - .866).

Self-Efficacy Scale (Sherer & Adams, 1983). The 17-item general self-efficacy subscale (see Appendix F) of the Self-Efficacy Scale was used to assess the participants' self-efficacy, or their beliefs in their ability to competently perform across a variety of performance tasks. The general self-efficacy subscale of the Self-Efficacy Scale has been deemed both reliable (α = .86; Sherer et al., 1982), and appropriate for use in a firefighter population (Regehr, Hill, Knott, & Sault, 2003). Calculated Cronbach's alpha reliability coefficients from the current study indicate similar internal consistency (α = .875).

Sport Motivation Scale (SMS; Pelletier et al., 1995). No previous research has used any one particular questionnaire to assess intrinsic motivation among firefighters. That fact, along with the overlaps between sport and firefighting, prompted the use of the the intrinsic motivation subscales (i.e., intrinsic motivation to know, intrinsic motivation to accomplish, intrinsic motivation for stimulation) from the well-established 28-item SMS Scale (see Appendix G) from sport (α = .82; Brière, Vallerand, Blais, & Pelletier, 1995) to assess intrinsic motivation across groups. Calculated Cronbach's alpha reliability coefficients from the current study indicate similar internal consistency (α*s* = .731-.832).

Physical Self-Perception Profile (PSPP; Fox & Corbin, 1989)**.** Similar to intrinsic motivation, no previous research has examined perceptions of competence among firefighters. That fact, along with the overlap between sport and firefighting, prompted the use of two 5-item subscales (i.e., strength and condition) from the PSPP (α*s* = .81 - .92; Fox & Corbin, 1989) to determine perceptions of physical competence among participants (see Appendix H). Given that 20 of the 53 total participants included in the current study completed this scale incorrectly (i.e., provided more than one response to an item, provided no response to an item), the responses to the PSPP were not included in the analyses. Given the difficulties experienced with administering this survey online, I would recommend administering the paper-pencil version of this survey or considering other competence-related scales for future research.

State-Trait Anxiety Inventory (Trait Anxiety Scale [Form Y-2]; Spielberger, Gorsuch, & Lushene, 1970). The 20-item scale (see Appendix I) was used to assess the trait anxiety of study participants. This scale has been utilized in research across a variety of adult populations (i.e., working adults, college students, high school students, and military recruits) and is reported to have adequate reliability (α = .89-.91; Spielberger, 1983). Calculated Cronbach's alpha reliability coefficients from the current study indicate adequate internal consistency (α = .731-.832).

Test of Performance Strategies-2 (TOPS-2; Hardy, Roberts, Thomas, & Murphy, 2010). The practice-scale of the TOPS-2 (see Appendix J), was used to assess the use of psychological skills (i.e., self-talk, emotional control, automaticity, goal setting, imagery, activation, relaxation, attentional control) across the groups of participants. Due to low scores of internal consistency (α = .44), the distractability subscale was excluded from this assessment. Despite the poor internal consistency of the distractability subscale, the TOPS-2 has been used across a variety of athlete populations and all other subscales have been reported to have adequate reliability (α = .62-.89). Calculated Cronbach's alpha reliability coefficients from the current study indicate similar internal consistency (α = .754-.936) for six of the eight subscales. Coefficient calculations revealed unacceptable internal consistency for the subscales of emotional control (α = .572) and automaticity (α = .421).

Procedures

Prior to data collection, a human subjects approval form (see Appendix K) was submitted to the Institutional Review Board (IRB) at the University of Wisconsin-Milwaukee. Once the study was approved (see Appendix A; approval # 13.180), I collaborated with the MKE Fire Department to schedule one block of time per group (i.e., cadets, recruits, active duty firefighters) for data collection. On their respective scheduled testing days, all participants within the group completed all data collection procedures (i.e., screening, informed consent, demographic information, physical and psychological testing). On each day of data collection, I explained and administered paper-pencil versions of the Criteria for Inclusion Questionnaires and consent forms to all participants at MKE Fire and Safety Academy. Once the participants were screened and consented to participate, they were given their unique identification code (i.e., MFDFF1) and began progressing through the battery of physical and psychological assessments.

Data management. As indicated above, at the onset of data collection, each participant was issued a unique identification code (i.e., MFDFF1) to link the physical and psychological data to the corresponding criteria for inclusion and consent forms. A key containing the identification codes, participants' names, and contact information is stored in a locked file in the Human Performance and Sport Physiology (HPSP) Lab in Pavillion 365 at the University of Wisconsin-Milwaukee. All physical data obtained were transferred into an Excel file and stored on a password-protected computer inside Pavillion 375 at the University of Wisconsin-Milwaukee. Similarly, the responses from the online demographic and psychological questionnaires were transferred into an Excel file and stored on the aforementioned password-protected computer inside Pavillion 375. Only myself, Co-PIs (i.e., Kyle T. Ebersole or Barbara B. Meyer), and approved students had access to any data for research purposes only.

Omitted Data

In an effort to maintain accurate and comprehensive depictions of the physical and psychological states across groups, incomplete sets of participant data were omitted in the analyses. Specifically, due to incomplete sets of physical data, one recruit and one active duty firefighter were not included in any of the statistical analyses. Similarly, due to missing responses in the psychological questionnaires (i.e., reported in sum scores), data from three recruits and one active duty firefighter were not included in any of the statistical analyses.

Data Analysis

In accordance with the first objective of the current study (i.e., use descriptive data from physical and psychological assessments to characterize the physical and psychological states of cadets, recruits, and active duty firefighters), Microsoft Excel was used to organize and calculate descriptive statistics (i.e., means and standard deviations) for the physical and psychological data. In accordance with the second objective of the study (i.e., compare the current physical and psychological states of cadets, recruits, and active duty firefighters), the SPPS 19.0 © statistics package was used to calculate a series of one-way analyses of variance (ANOVA). Following significant findings in ANOVA calculations, Bonferroni post-hoc tests were used to specifically identify group differences. Lending consideration to the limitations of analyzing group differences across multiple dependent variables (i.e., 8 physical variables and 18 psychological variables) with small group sample sizes (i.e., 11 cadets, 27 recruits, 15 firefighters), effect sizes (η^2) were reported to determine the proportions of variance due to between-group differences (Cohen, 1988; Warner, 2008). In the section below, I have also outlined specific a priori considerations taken prior to analyzing group differences.

Alpha level. In an effort to minimize the possibility of committing a Type I error, an a priori Bonferroni adjustment was applied to all statistical analyses within the current study. Therefore, for all statistical analyses associated with the physical data (i.e., 8 measures, $\alpha = .05$), the adjusted alpha level was set to .006. For all statistical analyses associated with the psychological data (i.e., 18 measures, $\alpha = .05$), the adjusted alpha level was set to .003. As mentioned above, corresponding with this a priori adjustment, Bonferroni post-hoc tests were used to identify specific group differences as indicated by significant ANOVA calculations.

Correlation calculations. Prior to calculating the ANOVAs across physical and psychological variables, Pearson product-moment correlation coefficients were calculated to rule-out potential covariates within the physical (i.e., age, experience, height, weight) and psychological data sets (i.e., age and experience). Correlation calculations revealed a significant moderate correlation between the estimated 1 RM bench measures and body weight (*r* = .573, $p < .001$), thus, all measures of estimated 1 RM bench were normalized to body weight prior to performing the ANOVAs or post-hoc tests. A similar correlation was revealed between estimated 1 RM squat and body weight, albeit an insignificant one due to a conservative alpha level (*r* = .369, *p* = .008). As such, all 1 RM squat measures were normalized to body weight prior to performing the ANOVAs or post-hoc tests as well. No correlation calculations indicated correlations between the potential covariates (i.e., age, experience, height, weight) and any of the other physical or psychological variables.

In accordance with the third objective of the current study (i.e., provide evidence-based recommendations for the development of comprehensive firefighting training programs), directions for future research and professional practice endeavors with firefighting populations were identified. Collectively, the results of the current study provide a foundation for the ongoing assessment and training of firefighters with an eye toward enhancing firefighting performance.

Chapter IV: Results

Informed by the Meyer Athlete Performance Management Model (MAPM; Meyer, Merkur, Ebersole, & Massey, in press), the purposes of the current study were to: (a) use descriptive data from physical and psychological assessments to characterize the physical and psychological states of cadets, recruits, and active duty firefighters; (b) compare the current physical and psychological states of cadets, recruits, and active duty firefighters; and (c) provide evidence-based recommendations for the development of comprehensive firefighting training programs. To accomplish these objectives, the following methods were used for data analysis: (a) descriptive statistics were calculated for all physical and psychological measures between groups, and (b) a series of one-way analyses of variance (ANOVA) calculations were performed to assess differences between groups. In the section below, I will provide a description of and comparisons between the groups.

Describing the Groups

In Table 2, the means and standard deviations for all data collected were reported for the following physical aspects of firefighting: VO2max, estimated one repetition maximum (1 RM) squat, 1 RM bench, push-ups completed, sit-ups completed, muscular power, and Total FMS™ Score. In Table 3, the means and standard deviations for the following psychological aspects of firefighting are reported: personality (i.e., extraversion, conscientiousness, agreeableness, openness, emotional stability), self-efficacy, trait anxiety, intrinsic motivation (i.e., to know, to accomplish, and for stimulation), and the use of psychological skills (i.e., self-talk, emotional control, automaticity, goal-setting, imagery, activation, relaxation, attentional control).

Table 1. Physical characteristics of firefighting

Characteristic	Groups		
	Cadet (*n* = 11)	Recruit (*n* = 26)	Firefighter (*n* = 14)
	M (SD)	*M (SD)*	*M (SD)*
Age (years)	18.82 (0.72)	29.81 (3.79)	31.71 (5.46)
Experience (years)	0.14 (0.43)	2.04 (2.90)	8.14 (4.75)
Height (m)	1.80 (0.08)	1.80 (0.07)	1.80 (0.06)
Weight (kg)	85.73 (13.55)	86.94 (9.19)	93.65 (12.01)
VO2max (mL/kg/min)	48.00 (5.01)	46.58 (4.37)	43.07 (7.01)
Body Fat %	16.59 (3.85)	17.70 (5.13)	18.82 (3.86)
Est. 1 RM Squat (lb)	239.66 (44.96)	244.48 (39.75)	243.20 (63.27)
Est. 1 RM Bench (lb)	196.79 (35.53)	209.37 (40.29)	240.13 (63.70)
Push-ups (reps)	30.18 (7.68)	40.04 (10.18)	35.00 (10.26)
Sit-ups (reps)	41.73 (7.36)	44.54 (6.02)	43.64 (7.29)
FMS™ Total Score (out of 21)	12.45 (1.56)	12.38 (1.86)	12.14 (1.75)
Power (W/kg)	46.27 (12.64)	39.31 (10.27)	38.93 (12.23)

Table 2. Psychological characteristics of firefighting

Characteristic	Groups		
	Cadet (*n* = 11)	Recruit (*n* = 24)	Firefighter (*n* = 14)
	M (SD)	*M (SD)*	*M (SD)*
Age (years)	18.82 (0.72)	30.00(4.21)	31.57 (5.53)
Experience (years)	0.14 (0.43)	2.04 (2.97)	7.89 (4.62)
Extraversion (out of 9)	7.41 (1.00)	6.58 (1.08)	6.27 (1.57)
Conscientiousness (out of 9)	7.11 (1.08)	7.48 (0.68)	6.77 (1.44)
Agreeableness (out of 9)	7.55 (0.65)	7.73 (0.76)	6.82 (1.10)
Openness (out of 9)	6.44 (1.82)	6.65 (0.87)	6.27 (1.04)
Emotional Stability (out of 9)	7.15 (1.38)	6.69 (1.06)	5.94 (1.45)
Self-Efficacy (out of 238)	205.18 (26.42)	214.08 (15.69)	191.07 (34.6)
Trait Anxiety (out of 80)	32.26 (8.48)	27.21 (5.51)	31.00 (7.41)
IM to Know (out of 28)	22.91 (4.56)	22.52 (3.82)	21.57 (3.50)
IM to Accomplish (out of 28)	22.45 (4.19)	22.08 (3.41)	20.64 (3.48)
IM for Stimulation (out of 28)	21.27 (4.97)	22.00 (3.60)	22.71 (3.02)
Self-Talk (out of 5)	3.52 (.075)	2.30 (0.26)	3.29 (0.98)
Emotional Control (out of 5)	4.34 (0.44)	2.53 (0.32)	3.76 (0.63)
Automaticity (out of 5)	3.11 (0.63)	2.60 (0.53)	3.27 (0.50)
Goal-setting (out of 5)	3.82 (0.64)	3.34 (0.38)	3.73 (0.62)
Imagery(out of 5)	3.45 (0.74)	3.26 (0.38)	3.57 (0.91)
Activation(out of 5)	4.02 (0.39)	3.34 (0.34)	3.57 (0.65)
Relaxation (out of 5)	3.02 (0.97)	2.81 (0.36)	2.64 (0.84)
Attentional Control (out of 5)	3.84 (0.64)	2.56 (0.38)	3.79 (0.63)

Note. Self-efficacy, trait anxiety psychological skills use, and intrinsic motivation measures were reported in sum scores. Personality scores are reported as average response scores.

Comparing the Groups

As illustrated in Tables 3 and 4, ANOVA calculations revealed: (a) no significant differences between groups for any of the physical measures; (b) no significant differences between groups for personality, self-efficacy, trait anxiety, or intrinsic motivation, use of goal-setting, imagery, or relaxation; and (c) significant differences between groups for the use of several psychological skills: self-talk, emotional control, automaticity, activation, and attentional control. Post-hoc tests further revealed the following: (a) cadets and firefighters reported higher scores than recruits on self-talk (*ps* $< .001$), emotional control (*ps* $< .001$), and attentional control (*ps* $< .001$); (b) firefighters reported higher scores than recruits on automaticity ($p = .003$); and (c) cadets reported higher scores than recruits on activation ($p = .001$).

Table 3. ANOVA source table for differences between groups—physical characteristics

Source		*df*	*SS*	*MS*	*F*	*p*	η^2
VO2max							
	Between Groups	2	172.412	86.206	2.974	.061	.11
	Within Groups	48	1391.275	28.985			
Body Fat							
	Between Groups	2	31.056	15.528	0.735	.485	.03
	Within Groups	48	1014.569	21.137			
Est. 1 RM Squat							
	Between Groups	2	0.617	0.308	1.114	.337	.04
	Within Groups	48	13.296	0.277			
Est. 1 RM Bench							
	Between Groups	2	0.332	0.166	0.831	.442	.03
	Within Groups	48	9.590	0.200			
Push-ups							
	Between Groups	2	796.108	398.054	4.144	.022	.15
	Within Groups	48	4610.598	96.054			
Sit-ups							
	Between Groups	2	61.123	30.561	0.669	.517	.03
	Within Groups	48	2193.858	45.705			
FMS Total							
	Between Groups	2	0.738	0.369	0.116	.891	.01
	Within Groups	48	152.595	3.179			
Power							
	Between Groups	2	435.939	217.970	1.651	.203	.11
	Within Groups	48	6338.649	132.055			

Note. A Bonferroni adjustment was implemented in these analyses ($\alpha = .006$). Est 1 RM Squat and Bench were normalized to body weight prior to ANOVA calculation.

Table 4. ANOVA source table for differences between groups—psychological characteristics

Source	*df*	*SS*	*MS*	*F*	*p*	η^2
Extraversion						
Between Groups	2	8.479	4.239	2.798	.071	.11
Within Groups	46	69.684	1.515			
Conscientiousness						
Between Groups	2	4.566	2.283	2.074	.137	.08
Within Groups	46	50.631	1.101			
Agreeableness						
Between Groups	2	7.651	3.825	5.248	.009	.19
Within Groups	46	33.534	0.729			
Openness						
Between Groups	2	1.320	0.660	0.447	.643	.02
Within Groups	46	67.969	1.478			
Emotional Stability						
Between Groups	2	9.618	4.809	2.978	.061	.11
Within Groups	46	74.285	1.615			
Self-Efficacy						
Between Groups	2	4683.847	2341.923	3.729	.032	.14
Within Groups	46	28888.398	47.924			
IM to Know						
Between Groups	2	12.806	6.403	0.407	.668	.02
Within Groups	46	724.296	15.746			
IM to Accomplish						
Between Groups	2	25.286	12.643	0.941	.397	.04
Within Groups	46	617.775	13.430			
IM for Stimulation						
Between Groups	2	12.879	6.440	0.430	.653	.02
Within Groups	46	689.039	14.979			
Trait Anxiety						
Between Groups	2	247.619	123.809	2.583	.086	.10
Within Groups	46	2204.504	47.924			
Self-Talk						
Between Groups	2	16.846	8.423	18.990	.000*	.45
Within Groups	46	20.404	0.444			
Emotional Control						
Between Groups	2	29.001	14.501	68.420	.000*	.75
Within Groups	46	9.749	0.212			
Automaticity						
Between Groups	2	4.494	2.247	7.334	.002*	.24
Within Groups	46	14.093	0.306			
Goal-setting						
Between Groups	2	2.270	1.135	4.081	.023*	.15
Within Groups	46	12.796	0.278			
Imagery						
Between Groups	2	0.909	0.455	1.041	.361	.04
Within Groups	46	20.091	0.437			
Activation						
Between Groups	2	3.479	1.740	8.135	.001*	.26
Within Groups	46	9.837	0.214			
Relaxation						
Between Groups	2	0.889	0.444	0.907	.411	.04
Within Groups	46	22.552	0.490			
Attentional Control						
Between Groups	2	19.075	9.537	33.625	.000*	.59
Within Groups	46	13.047	0.284			

Note. A Bonferroni adjustment was implemented in these analyses (α = .003*).

Summary. Participants in the current study were drawn from three different groups, two of which represented firefighters in training (i.e., cadets and recruits) and one of which represented active firefighters. With regard to physical characteristics, a series of ANOVA calculations revealed no significant differences between the groups. With regard to psychological characteristics, a series of ANOVA calculations revealed no significant differences between the groups. Significant differences did emerge in the psychological skills used between the groups, specifically: (a) cadets and firefighters reported higher scores than recruits on self-talk ($ps < .001$), emotional control ($ps < .001$), and attentional control ($ps < .001$); (b) firefighters reported higher scores than recruits on automaticity ($p = .003$); and (c) cadets reported higher scores than recruits on activation ($p = .001$). In the chapter to follow, these results will be used to address the third and final purpose of the study—to provide evidence-based recommendations for the development of comprehensive firefighting training programs. Specifically, I will provide a more thorough interpretation of the findings by comparing the results of the current study to those of previous studies on firefighters and athletes, as well as propose future directions for research and applied endeavors with firefighters.

Chapter V: Discussion

For over a century, interest in sport performance has fueled the research and applied efforts of scholars across sport science disciplines (e.g., sport psychology, sport physiology, etc.). Together with the theoretical and scientific knowledge borrowed from other clinical domains (i.e., physical therapy [Cochrane, 2004], counseling [Chartrand & Lent, 1987], and clinical psychology [Mogg & Marden, 1990]), the efforts of sport scientists have resulted in a range of best practices for the enhancement of sport performance. In turn, the best practices for the enhancement of sport performance have been a valuable resource for experts in non-sport domains such as the military (Fiore & Salas, 2008) and law enforcement (Spitler, Jones, Hawkins, Dudka, 1987). Prompted by the successful transfer of sport-based theories and research to non-sport domains, sport scientists have also considered the value in transferring sport-based knowledge to another non-sport domain—firefighting.

The need to further examine the health, safety, and performance of firefighters is apparent when one considers that, each year, approximately 100 United States (U.S.) firefighters lose their lives and an additional 80,000 become injured (Smith, 2011). In response to these casualty rates, sport scientists have suggested that by acknowledging and investigating the multidimensional aspects of firefighting *performance*, we may be begin to establish more effective interventions for casualty prevention among this unique population of occupational athletes (Smith, 2011). In an effort to understand the various demands experienced by an athlete, sport psychologists have utilized theoretical models such as Bronfenbrenner's Ecological Model (Bronfenbrenner, 1995; Gilbert, 2011; Meyer & Fletcher, 2009) to conceptualize the multidimensional nature of sport performance. One integrated model of sport performance, the Meyer Athlete Performance Management Model (MAPM; Meyer, Merkur, Ebersole, & Massey, in press), demonstrates the need for collaborations between the experts of multiple training disciplines (i.e., physical, psychological, technical) to optimize an athlete's health, safety, and performance. Given the overlap between the physical and psychological demands of athletes and firefighters, a model like the MAPM can help us conceptualize the multidimensional demands of firefighting as well.

Using the MAPM to frame the first multidisciplinary investigation of firefighting performance, the purposes of the study were to: (a) use descriptive data from physical and psychological assessments to characterize cadets, recruits, and active firefighters; (b) compare the physical and psychological states of cadets, recruits, and active firefighters; and (c) provide evidence-based recommendations for the development of comprehensive firefighting training programs. In the pages below, I will: (a) summarize the physical and psychological data collected from the three different groups of firefighters who participated in the study; (b) compare the results of the study to previous research; and (c) provide evidence-based recommendations for the improvement of firefighter training programs. In addition to these discussion points, I will also address the limitations of the study, the implications of these findings for both the sport and firefighting literatures, and directions for future research.

Physical Aspects of Firefighting Performance

Prompted by the body of firefighting literature dedicated to the physical aspects of performance, in the study, data were collected to assess various physical characteristics of cadets, recruits, and active firefighters (i.e., aerobic fitness, muscular strength and endurance, body composition, functional movement, and muscular power). A series of analysis of variance (ANOVA) calculations revealed no significant differences between the groups for any of the physical variables. Given the lack of significant physical differences observed between groups, all participants will be collectively referred to as firefighters from this point forward. Below, I will briefly compare the results of the study to previous firefighting research.

Aerobic fitness. To assess aerobic fitness in the study, a submaximal aerobic step test was used to estimate maximal aerobic capacity (VO_{2max}). The maximal aerobic capacity (VO_{2max}) of the firefighters in the study was consistent with those of firefighters from previous firefighting research (Elsner & Kolkhorst, 2008; Myhre, Tucker, Bauer, & Fisher, 1997). These consistent and high levels of aerobic fitness observed in both the current sample and firefighters from previous research are not surprising given the recent national attention that has been dedicated to the importance of firefighters' cardiovascular health and fitness (The Fire Service Joint Labor Management Wellness-Fitness Initiative, 2008). Firefighting research also indicates that a firefighter's VO_{2max} is not only related to performance, but it is also related to the amount of oxygen consumed (i.e., VO_2) during a performance task (Elsner & Kolkhorst, 2008). In other words, by maintaining high VO_{2max} values, a firefighter may be increasing the likelihood that s/he can continue to create the energy necessary for performance over a longer period of time (i.e., aerobic endurance; Powers & Howley, 2009). While these results indicate adequate fitness levels among the firefighters in the study, training in such a way to achieve higher levels of aerobic fitness may serve to enhance the metabolic efficiency of task completion in the field.

Muscular strength and endurance. To assess muscular strength in the study, indirect estimations of one repetition maximum (RM) bench press and squat were used. Following the normalization of the 1 RM bench and squat values to firefighters' body weight, it appears that firefighters in the study have slightly higher levels of upper body strength and slightly lower levels of lower body strength than firefighters in previous research (Michaelides Parpa, Henry, Thompson, & Brown, 2011). These results are not surprising given that Michaelides and colleagues noted the significant correlations between upper body strength and performance, and that certified practitioners have expressed need to improve lower body strength in firefighters (Abel, 2011). Differences could also be due to measurement inconsistencies (i.e., subjective component of indirect measurement) and/or variance in the training habits or regimens implemented among fire departments in different cities. A recommendation for training programs would be to apply a greater emphasis to lower body strength training to match the apparent emphasis on upper body strength training.

To assess muscular endurance in the study, timed push-up and sit-up tests were implemented. The number of push-ups and sit-ups completed by firefighters in the study were consistent with the numbers completed by firefighters in previous research (Michaelides et al., 2011). While these results indicate firefighters have adequate levels of muscular endurance, firefighters may see improvements in performance by achieving even higher levels of muscular endurance. As such, a recommendation to improve training programs might be to consider ways to maintain and/or further advance overall muscular endurance among firefighters.

Body composition. To assess body composition in the study, body density was calculated using the Jackson and Pollock Three Skinfold Site method (1978, 1985) and percent body fat was calculated using Siri's body fat percentage equation (Siri, 1961). The resulting body fat percentage of firefighters in the study was lower than that of firefighters from previous research (Michaelides et al., 2011; Myhre, Tucker, Bauer, & Fisher, 1997). The differences observed between firefighters in the study and those from previous studies are likely due to the different measurement techniques used in each study (e.g., skinfolds, bioelectrical impedance analysis, hydrostatic weighing). It is possible that the aforementioned recommendations to further improve aerobic fitness and muscular endurance will indirectly result in a reduction of body fat (Powers & Howley, 2009). Changes in nutrition may further aid in the reduction of body fat (Hedrick Fink, Mikesky, & Burgoon, 2012) for the optimization of performance.

Functional movement. The FMS™ was used to assess the functional movement patterns of participants in the study. The FMS™ Total Scores of firefighters in the study were lower than those of firefighters from previous research (Peate, Bates, Lunda, Francis, & Bellamy, 2007). In addition, the FMS™ Total Scores of firefighters in the study fell below a score of 14—the score at which previous FMS™ research has consistently indicated an increased risk for injury among athletes (Chorba, Chorba, Bouillon, Overmyer, & Landis, 2010; Kiesel, Plisky, & Voight, 2007) and firefighters (Peate et al., 2007). After using the FMS™ to assess functional movement among firefighters, Peate and colleagues also found that a 2-month functional training program to improve core strength, flexibility, and proper body mechanics resulted in a 44% reduction in the number of injuries observed and a 62% reduction in the work time lost due to injury. In particular, the functional training intervention significantly reduced back injuries and upper body injuries. Given the aforementioned importance of upper body strength and endurance to firefighting performance (Michaelides et al., 2011), one recommendation is to implement functional training to reduce the risk for injury while concomitantly protecting the muscular strength and endurance variables important to performance (i.e., preventing back and upper extremity injuries).

Muscular power. In the study, counter movement jump (CMJ) trials using a small accelerometer-based device (i.e., Myotest Sport Unit; Nuzzo, Anning, & Scharfenberg, 2011) were utilized to assess muscular power (W/kg). In performing the CMJs, firefighters in the study produced a greater amount of power than did the firefighters in previous research (Michaelides et al., 2011). Variations in measurement protocols (i.e., Myotest Sport Unit and Vertec) likely contributed to the observed difference in muscular power between the current sample and firefighters in previous research. When considering the explosive nature of many firefighting tasks (e.g., sprinting, climbing stairs in a short amount of time, dragging objects, etc.), and taken together with the research which indicates a significant correlation between muscular power and performance (Michaelides et al., 2011), one recommendation might be to incorporate a task-specific firefighting power training component into current programs. By doing so, firefighters may be better prepared for the power-related tasks of job performance (e.g., dragging a victim to safety).

Summary. With the exception of lower body strength and FMS™ Total Scores, the results of the study were generally consistent with the previous firefighting literature. The consistencies and inconsistencies observed between the physical characteristics of firefighters in the current study and those from previous studies, in conjunction with the established correlations between the physical variables examined and firefighting performance, prompts a set of broad recommendations for the improvement of firefighter training programs.

- Implement aerobic training such that firefighters achieve higher levels of aerobic fitness thus enhancing the metabolic efficiency of task completion in the field.
- Emphasize lower body strength training to match the apparent emphasis on upper body strength training.
- Maintain or further advance muscular endurance to optimize firefighting performance.
- Emphasize the importance of aerobic fitness, resistance training, and nutrition to maintain optimal body composition.
- Implement functional training to reduce the risk for injury while concomitantly protecting the muscular strength and endurance variables important to performance (i.e., preventing back and upper extremity injuries).
- Incorporate task-specific firefighting power training into current training programs.

Psychological Aspects of Firefighting Performance

In addition to assessments of the physical variables discussed above, data were also collected to identify the psychological characteristics of (i.e., personality, self-efficacy, trait anxiety, and intrinsic motivation), and psychological skills used by (i.e., self-talk, emotional control, automaticity, goal-setting, imagery, activation, relaxation, and emotional control), cadets, recruits, and active firefighters. A series of ANOVA calculations revealed no significant differences between the groups for any of the psychological characteristics. Since the psychological characteristics assessed in the study were not significantly different between groups, in the discussion provided below, the three groups will be described collectively as a sample of firefighters. By contrast, several differences between the groups (i.e., cadets and recruits, firefighters, recruits) emerged for the use of psychological skills in training settings. In the section below, I will compare the results of the current study to those of previous studies on firefighters and explore additional overlaps between the results of the current study with those of previous studies on athletes.

Personality. To provide a point of reference, firefighters in the study reported higher levels of extraversion, conscientiousness, and emotional stability than the general population, and lower levels of agreeableness and openness than the general population (Palmer & Loveland, 2004). These results are consistent, in part, with previous research which indicates firefighters report higher levels of extraversion than both the general population (Salters-Pedneault, Ruef, & Orr, 2010) and other non-emergency workers (Wagner, Martin, McFee, 2009). These results are also consistent with previous research which indicates that athletes report higher levels of extraversion than the general population, and lower levels of neuroticism than non-athletes (McKelvie, Lemeiux, & Stout, 2003). Trends in the personality characteristics observed for both firefighters and athletes provide support for the transfer of theoretical and scientific sport knowledge to this population of *occupational athletes.* While personality is not a *trainable* variable, per se, we know from the sport literature that knowledge of an athlete's personality characteristics provide a valuable context for determining the types of psychological skills training (PST) interventions that may be most beneficial for that athlete (Gould, Dieffenbach, & Moffett, 2002; Woodman, Zourbanos, Hardy, Beattie, & McQuillan, 2010). As such, it would be beneficial to assess and consider the personality characteristics of firefighters (e.g., extraverted, conscientious, less open, etc.) when designing and/or implementing PST interventions for this population.

Self-efficacy. Despite the fact that no significant differences in self-efficacy were observed between groups in the study, the levels of self-efficacy reported by the active firefighters were notably lower than those reported by cadets and recruits. These findings are consistent with previous firefighting research in which experienced firefighters reported lower levels of self-efficacy than recruits (Regehr, Hill, Knott, & Sault, 2003). The results of the study are not consistent with previous sport research that suggests expert athletes report higher levels of self-efficacy than non-expert and novice athletes (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002). While the inconsistencies between the results of the study and previous sport research may be due in part to methodological differences (i.e., sample characteristics, different measurement instruments used, etc.), the professional development experiences of firefighters and athletes should also be considered. For a professional firefighter, formal job-related training and education is front-loaded to the start of their career (e.g., cadet or recruit training), whereas for a professional or elite athlete, formal job-related training and education remains consistent or even increases as s/he moves through their career (Abbott & Collins, 2004). Regehr and colleagues suggest that the low levels of self-efficacy in experienced firefighters may be due to factors such as increased age and firefighting experience as well as limited opportunities for career advancement. Results of the study and others prompt the recommendation to actively protect and/or enhance the self-efficacy of firefighters as they progress throughout their careers. Specifically, fire departments might consider efficacy-protecting or enhancing strategies such as: (a) implementing regular debriefing sessions to process firefighting experiences (i.e., utilizing past experiences to enhance efficacy for future jobs [Hogg, 2002]); and (b) encouraging firefighters to continue gaining technical certifications to advance their careers (i.e., gaining competence to increase self-efficacy [Harter, 1978]).

Intrinsic motivation. The psychological characteristics discussed thus far (i.e., personality and self-efficacy) have been examined in a variety of populations (i.e., firefighters, athletes, general population), thereby providing opportunities to more thoroughly explore the meaning of the data collected in the study. By contrast, the paucity of research on intrinsic motivation in firefighters in conjunction with methodological challenges of that which has been conducted (i.e., measurement of the intrinsic motivation), limit the ability to provide a similar level of contextual relevance for this particular construct. That said, the results of the study indicate that firefighters reported higher levels of intrinsic motivation than a sample of Canadian university athletes (Pelletier et al., 1995). Given that the measurement instrument used in the study was developed to assess the intrinsic motivation of athletes, differences in the intrinsic motivation levels of firefighters and university athletes may be due to the inherent differences in the characteristics of the populations from with each sample was drawn. Although no normative values exist in the firefighting literature, research on firefighters (Grant, 2008) has indicated that intrinsic motivation may be related to persistence (i.e., number of volunteer overtime hours worked). Like the firefighting research mentioned above, intrinsic motivation in sport is also associated with levels of persistence (Pelletier, Fortier, Vallerand, & Brière, 2001; Sarrazin, Vallerand, Guillet, Pelletier, & Cury, 2002). Informed by the results of the study as well as the previous literature in firefighting and sport, one recommendation for training programs is to offer continuing education on such topics as recovery, rest, and symptoms of burnout. Additional awareness in this area may help firefighters maintain physical and mental health (i.e., avoid burnout and fatigue) during times of voluntarily heavy workloads (i.e., overtime).

Anxiety. Firefighters in the study reported lower levels of trait anxiety than the general population (Spielberger, 1983) and firefighters in previous research (Smith, Petruzello, Kramer, & Misner, 1996). Since we know that the traits of individuals are influenced by a combination of genetic and environmental factors, it is not unusual for individuals from a similar cohort (i.e., firefighters) to exhibit different levels of trait anxiety. Thus, an individual's trait anxiety score is less important than how that individual's trait anxiety manifests in response to stress on a regular basis (i.e., state anxiety responses). Corresponding with the statement prior, the firefighting literature suggests that firefighters with higher levels of trait anxiety may experience greater increases in negative affect when completing a strenuous firefighting training drill (Smith et al., 1996). Consistent with the findings of Smith et al. (1996), sport researchers (Martens, 1977 as cited in Robazza & Bortoli, 2003) suggest that athletes with high levels of trait anxiety may be more likely to respond to potentially stressful situations with worry, apprehension, and somatic symptoms. While we would not aim to train or alter levels of trait anxiety among firefighters, it may be important for firefighters, particularly those with high levels of trait anxiety, to monitor and evaluate responses to stress on a regular basis. Therefore, fire departments might consider implementing educational programs to raise awareness of typical responses to stress and strategies for managing stress.

Psychological skills use. While the psychological characteristics discussed above provide a psychological description of firefighters in the sample, the psychological skills used (e.g., self-talk, relaxation) provide insight to the psychological training behaviors of the firefighters in the sample. Given that no previous research has examined the use of psychological skills among firefighters, a sport-based measure of psychological skills use (Test of Performance Strategies; Hardy, Thomas, Sheppard, & Murphy, 2010) was implemented in the study. Unlike the psychological characteristics reviewed above, the results of the study revealed significant differences between groups with regard to the use of psychological skills. Specifically: (a) cadets and active firefighters used self-talk ($ps < .001$), emotional control ($ps < .001$), and attentional control ($ps < .001$) more than the recruits; (b) active firefighters used automaticity ($p = .003$) more than recruits; and (c) cadets used activation more than recruits ($p = .001$). The significant differences between groups may be due, in part, to the fact that the measurement instrument used in the study was validated in a sport population as opposed to a firefighting or general population, and/or that education or awareness of psychological skills may vary between firefighting and athlete populations. Although the study is the first to examine psychological skills use among firefighters, the psychological skills used among cadets, recruits, and active firefighters were consistent with those reported by a sample of young adult athletes (Hardy et al., 2010; Hayslip, Petrie, MacIntire, & Jones, 2010).

Like the psychological characteristics of firefighters and athletes discussed previously, similar trends in the psychological skills used by both firefighters and athletes provide additional support for the transfer of theoretical and scientific sport knowledge to this population of occupational athletes. In a sport domain, sport psychologists implement PST programs aimed at enhancing athlete performance, health, and well-being. Thus, as researchers continue to identify the psychological skills necessary to optimize firefighting performance, PST programs could be implemented immediately to enhance firefighter health and well-being.

Summary. By and large, the results of the study are consistent with the previous firefighting and sport research. Collectively, these consistencies provide further evidence for the continued transfer and utilization of sport-based theories and scientific knowledge to a firefighting domain (e.g., the MAPM, measurement instruments, PST interventions) moving forward. In accordance with these consistencies, several recommendations are made to improve firefighting training programs.

- Examine and consider personality characteristics when implementing or designing PST interventions.
- Protect the self-efficacy of experienced firefighters by implementing regular debriefing sessions to process live fire service experiences and encouraging firefighters to gain additional technical certifications to advance their careers.

- Raise awareness regarding optimal recovery, rest, and symptoms of burnout to help firefighters maintain physical and mental health (i.e., avoid burnout and fatigue) during times of heavy workload (i.e., overtime).
- Continue to implement educational programs to raise awareness of typical responses to stress and strategies for managing stress.
- Incorporate PST within current training programs or workshops for active firefighters to enhance health and well-being.

In the final sections below, I will address the limitations of the current study as well as the scientific and practical implications of the findings.

Study Limitations and Implications for Future Research

As is often the case with field research, there are several limitations of the current study. Given the small sample size, the study lacks statistical power and thus the results may not be generalizable to other firefighting populations. As such, researchers should investigate similar physical and psychological characteristics in larger samples and in different demographic areas. Doing so would enhance the generalizability of the results to other firefighting populations and increase the statistical power of future studies.

Furthermore, by implementing an a priori Bonferonni adjustment to reduce the possibility of committing a Type I error, the risk of committing a Type II error was consequently inflated (i.e., true differences may not have been identified). To minimize the need for this conservative approach to group differences, researchers might consider different methodological approaches to examining group differences across multiple variables of interest (e.g., R^2 change in general linear modeling, etc.).

Since this research study utilized a team of researchers for physical data collection, another limitation of the study is the inflated risk of measurement error. To minimize the risk for measurement error, researchers should continue to implement rigorous training to develop researchers' competencies prior to data collection.

Finally, since the psychological characteristics and skills measured in the study were selected based on the *theoretical* overlap between sport and firefighting, it will be imperative that future research be conducted to identify those correlations. By doing so, the theoretical framework for this study will be further enhanced and evidence-based psychological interventions may be developed to enhance firefighting performance.

In addition to addressing the limitations of the current study, and in an effort to advance the sport and firefighting literatures, researchers might also consider the following research topics: (a) the lived experiences of firefighters; (b) the physical and psychological correlates of in vivo firefighting performance; (b) the combination of, or interaction between, variables that influence firefighting performance; (c) prospective investigations to predict, using physical and psychological predictors, risk of injury occurrence; (d) the efficacy of sport-based physical and psychological interventions among *occupational athletes*; and (e) the barriers associated with implementing physical or psychological interventions among *occupational athletes.*

Based on the theoretical foundation of the current study, a final recommendation for future research is to continue conducting investigations in which multiple aspects of firefighting are concurrently captured at single points in time. Without assessing all relevant characteristics or skills related to firefighting performance, scholars will be limited in their abilities to recommend appropriate interventions aimed at performance enhancement or injury prevention. For example, if they only consider the physical characteristics of firefighting, scholars neglect to include a meaningful piece of the puzzle—the psychological characteristics of firefighting. Scientists have long established that physical variables (e.g., physiological activation) and psychological processes (e.g., visual attention, anxiety) are interrelated (Easterbrook, 1959) in such a way that the mind and body are constantly influencing one another in a reciprocal manner. To manage our uncertainty in clinical judgments and optimize our scholarly recommendations for performance interventions, we might first consider gaining a scientific understanding of the interactions between the physical and psychological variables discussed, and how those interactions may be related to firefighting performance and safety. Without knowing how all of the puzzle pieces fit together (i.e., physical and psychological variables), we may be making evidence-based clinical judgments recommendations based on an incomplete picture of firefighting.

Implications for Professional Practice

The current findings, taken together with the previous firefighting and sport literatures, prompt a number of recommendations for the immediate improvement of firefighting training programs. While these evidence-based recommendations include valuable strategies for the enhancement of firefighter health, safety, and performance, the creators of the MAPM suggest that collaborations between experts in multiple training disciplines are necessary for optimal results (Meyer et al., in press).

> This model fills a gap in the applied sport psychology literature, which acknowledges the importance of considering context when developing and implementing a treatment plan (e.g., Bronfenbrenner’s Bioecological Model

> [Bronfenbrenner, 1995]; Systems Theory [Barker & Garlock, 1968]; Carron's Framework for Cohesion in Sport and Exercise Groups [Carron & Hausenblas, 1998]), but to date fails to acknowledge the importance of teams of professionals from different disciplines (i.e., physical, technical, mental) working together to treat clients. While anecdotal observations informing this preliminary model have yet to be tested empirically, the efficacy of a team or systems approach to treatment has been supported in other disciplines (e.g., health behavior change [Prochaska, DiClemente, & Norcross, 1992]; psychology {Hardeman, Harding, & Narasimhan, 2010]; medicine [Medves, Godfrey, Turner, Paterson, Harrison, MacKenzie, & Durando, 2010]), and holds promise in performance psychology as well (Meyer et al., in press, p. 3-4).

As mentioned previously, the borrowing of theoretical and scientific knowledge from other domains (e.g., counseling, clinical psychology, physical therapy, etc.) has led to the development of best practices within the sport sciences aimed at sport performance enhancement. Given the benefits of transferring scholarly knowledge between domains, taken together with the evidence provided above regarding the utility of integrated approaches to treatment and intervention across multiple domains, scholars should consider applying a similar conceptual framework to develop the best practices for working with firefighters as well. Taking one step further, scholars should consider utilizing the MAPM specifically to guide performance-enhancement work with firefighters.

To build on the rationale provided above, a distinction needs should be made between *multidisciplinary* and *integrated* approaches. Using a *multidisciplinary* approach to performance enhancement, experts from the different training disciplines assess the firefighter’s needs separately and design multiple, separate programs for performance enhancement. Using an *integrated* approach, experts from the different training disciplines collaborate to assess the firefighter’s needs, and together create one training program which encompasses all areas of training (i.e., physical, psychological, technical). In achieving this complete conceptualization of firefighting, the *integration* of training programs may lead to an overall training effectiveness and efficiency over and above that which might be observed by implementing a *multidisciplinary* training program. Furthermore, by building such an integrated performance team, expertise is established across all training disciplines (i.e., implementation of best practices), goals are more effectively reached (i.e., high performing, uninjured firefighters), resources are maximized (i.e., save money), and training efficiency is maximized (i.e., save time). While the formation of such an integrated performance team will likely be resource-intensive at the start, the initial investment may be well worth the cost if performance is optimized, the occurrence and/or impact of injury reduced, and firefighter health and well-being enhanced.

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APPENDIX A

Criteria for Inclusion Questionnaire

Human Performance & Sport Physiology Lab
Department of Kinesiology
University of Wisconsin-Milwaukee
3409 N. Downer Ave
Pavilion – Physical Therapy, Room 365
Milwaukee, WI 53211

Eligible to Participate: YES NO

ID#:________________

Date:________________

Criteria for Inclusion Questionnaire

Title of Study: Occupational athletes: An integrated approach to understanding firefighting performance.

The following questions will help determine if you meet the criteria for inclusion into the study. It is important that you accurately answer each question.

Please answer the following questions with a yes or no response.	**YES**	**NO**
1. Are you currently between the ages of 18 and 50 years old?		
2. Are you currently engaged in any physical training?		
3. Have you engaged in at least 150 minutes of moderate intensity physical activity or at least 75 minutes of vigorous intensity physical activity per week, for the last 6 months?		
4. Do you currently take any prescribed medications for treatment of a symptomatic illness or condition?		
5. Do you have any serious symptomatic shoulder, back, hip, knee, and/or ankle trauma requiring medical attention within the last 3 months?		
6. Have you had any surgery on your shoulders, back, hip, knee, and/or ankle within the last year?		
7. Do you have any bone, joint, or muscle abnormalities (i.e. arthritis, muscle pain) that require medical attention?		
8. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?		
9. Do you feel pain in your chest when you do physical activity?		
10. In the past year, have you had chest pain when you are not doing physical activity?		
11. Do you often feel faint or have severe spells of dizziness?		
12. Do you require the use of an assistive or supportive device to perform physical activity (e.g., knee or ankle brace)?		
13. Are you currently pregnant?		
14. Do you know of any reason why you should not do physical activity?		

APPENDIX B

Consent Form

CONSENT FORM

1. General information

Study Title:
Occupational athletes: An integrated approach to understanding firefighting performance.
Person in Charge of Study (Principal Investigator):
Stacy L. Gnacinski, B.S.

Co-Principal Investigators:
Kyle T. Ebersole PhD
Barbara B. Meyer PhD

2. Study Description

You are being asked to participate in a research study. Your participation is completely voluntary. You do not have to participate if you do not want to. The results of this study will in no way affect any participant's status with the Milwaukee Fire Department. Collectively, the physical and psychological assessments will provide a unique opportunity to develop novel interventions for firefighting performance enhancement and/or injury prevention that are based on an integrated sport performance approach.

3. Study Procedures

YMCA Step-Test to predict VO_{2max}

An estimated maximal oxygen uptake (VO_{2max}) will be calculated through the use of a submaximal, five minute step test. The estimated VO_{2max} will be expressed in relative terms or milliliters of oxygen consumed per kilogram of body weight per minute (mL/kg/min). VO_{2max} is a commonly used means of predicting aerobic fitness. The participant will first sit quietly for five minutes and the researchers will record the resting heart rate of the participant. The participant will then stand and face the 15 ¾" step, maintaining an erect position for the entire duration of the test. The participant will then step up and down off the step, in time with the metronome, at a cadence of 90 beats per minute (bpm) for five minutes. After five minutes, the participant will stop, turn around, and sit down on the step. After 30-seconds, the researchers will record the heart rate of the participants. The two recorded heart rates are then used to calculate an estimated VO_{2max}. All recorded heart rates of each participant will be measured via Polar T31i heart rate monitor straps and watches.

Muscular Strength and Endurance

Estimation of one-repetition max. To assess muscular strength, participants will complete an estimated one-repetition max (1 RM) bench press and squat test. Participants will first complete a warm-up set (i.e., 15 repetitions of 60% of their perceived 1 RM). Participants will then perform consecutive and progressively heavier one-repetition efforts until they are at a load that they are unable to lift. This load will be recorded. Participants will then be given 3-4 minutes of rest.

Participants will then perform as many repetitions as possible at the previously recorded load until they are unable to complete a repetition. Estimation of one repetition maximum will be completed through the following equation: 1RM estimate = Weight lifted / (1.00 – (#reps * 0.02)).
To determine muscular endurance, participants will perform push-ups to exhaustion. Upper body muscular endurance will be determined by the number of push-ups that can be completed, to the beat of a metronome (i.e., 80 beats per minute), without losing proper form (i.e., body is rigid, back is straight, chest lowers to 5 cm from the ground, and arms fully extend in a complete push-up) or resting between repetitions. This test will be administered for no longer than 2 minutes or for greater than 80 consecutive push-ups.

Body Composition

To determine body composition, body fat percentages will be calculated using the Three Skinfold Site Jackson and Pollock method (1978, 1980). Using the right hand to measure and the left hand to pinch, skinfolds will be measured at a 1 cm distance above the skinfold site. In measuring the skinfolds, the points of the calipers will be perpendicular to the long axis of the skinfold site and the jaws of the calipers will be compressed for no less than 1-2 seconds and no longer than 4 seconds. To ensure reliability between measures, each skinfold will be measured at least twice. If two measures of the same skinfold vary greater than 2 mm, a third measure will be taken. All skinfolds and the sum of three skinfolds will be reported to the nearest 0.1 mm. For males, location of skinfold measures will be triceps, pectoral, and subscapular. For females, location of skinfold measures will be triceps, abdominal, and suprailiac.

The Functional Movement Screen consists of the following 7 tasks: (Takes approximately 30 min including NASM Overhead Squat)

8. Deep Squat – Involves holding a light weight plastic dowel rod over the head with arms extended and squatting as far down as the participant is able to go. This is repeated 5 times.
9. Hurdle Step – Involves holding the dowel rod (same dowel rod as used in the squat) across the shoulders while stepping (one leg at a time) over a rubber tube that is anchored to two stationary poles such that the height of the rubber tube is level with the bump on the leg bone, just below the knee. This is repeated 5 times.
10. Lunge – involves placing one leg in front of another such that the distance separating the two feet is equal to the distance used for placement of the rubber tube in the Hurdle Step. The participant will then lunge forward trying to touch the knee of the back leg touches the heel of the front foot. This is repeated 5 times.
11. Shoulder Mobility – involves the participant reaching behind their back with one hand coming from the head down the spine and the other hand coming from the waist up the spine. The distance separating the two hands will be

measured. The movement is repeated with the hands changing their positions.

12. Hamstring Length – involves the participant lying on his/her back and raising the leg up from the ground while keeping the knee straight. The distance the leg is raised will be measured. This is repeated with the other leg.
13. Push-Up – involves performing a push-up and evaluating the movement of the low back and upper back during the motion. This is repeated 3 times.
14. Rotary Stability – involves the participant being positioned in a 4-point stance (arms and legs) and trying to bring the right elbow to the left knee. This is then repeated with the left elbow coming to the right knee.

Anaerobic power

To assess anaerobic power, each participant will complete a counter movement jump (CMJ). A Myotest Sport unit (Nuzzo, Anning, & Scharfenberg, 2010), a small accelerometer-based device which measures height, force output, work output, and velocity of the jump will be used to assess CMJ performance. A neoprene belt will be used to fasten the device to the participant's waist. The better of two successful CMJ performances will be reported.

Online Surveys (Takes approximately 1 hour to complete)

Online surveys can be completed at the participant's convenience from any computer with internet access or participants can complete the surveys on campus when they come for the movement screen. Survey questions will provide information regarding the participant's personality, self-efficacy, intrinsic motivation, perceptions of competence, trait anxiety, and psychological skill levels. All data collected will be identified only by the unique identification code provided to each participant (see **Confidentiality** section below).

4. Risks involved in this study

The potential risks due to performing any of the physical tasks in this study are minimal. It is possible, but highly unlikely, that participants may experience minor musculoskeletal strains, muscle soreness, and/or tightness. All personnel involved in testing are trained in adult cardiopulmonary resuscitation (CPR) and first aid procedures. The testing session will be terminated in the event that the partifcipant indicates any discomfort such as leg pain or cramping or other sign and symptom that could be associated with a medical condition. The testing will also be terminated if requested by the participant. In the event that an exercise session is terminated for a possible medical reason, laboratory personnel will manage the situation per the standard first aid guidelines and procedures of the American Red Cross and refer to the appropriate medical staff according to standard Milwaukee Fire Department policies.

There are no risks greater than the completion of any other survey about attitudes or experiences. Safeguards include keeping the data in a password protected online database through the secure UWM Survey website. All survey responses (i.e., data) will be exported into a statistical software package (Excel or SPSS) within 30 days of the completion of the surveys. At this point, data will be deleted from the online server. While it is possible that the participants may become upset while answering the online surveys, the risk is no greater than that typically encountered when performing online work.

5. Benefits

The participants in the proposed study will gain a greater knowledge regarding their personal performance states as firefighters. Participants will also receive recommendations (but not prescriptions) for the improvement of those performance states. The benefits to participating in this study far outweigh the risks associated with participation.

6. Study Costs

There will be no charge to the participants for this study

7. Confidentiality

A key containing the identification codes, participants' names, and contact information will be stored in a locked file in the Human Performance and Sport Physiology (HPSP) Lab in Pavillion 365 at the University of Wisconsin-Milwaukee. All physical data obtained will be transferred into an Excel file and stored on a password-protected computer inside Pavillion 375 at the University of Wisconsin-Milwaukee. Similarly, the responses from the online or paper-pencil psychological questionnaires will be transferred into an Excel file and stored on the aforementioned password-protected computer inside Pavillion 375. Only myself, Co-PIs (i.e., Kyle T. Ebersole or Barbara B. Meyer), and approved students will have access to any and all data for research purposes. Once the study is completed, the data will be archived for the duration of ongoing collaborations with the Milwaukee Fire Department. Should those collaborations ever cease to exist, all data containing the participants' names, demographic information, and subsequent physical and psychological information will be destroyed.

8. Alternatives

There alternatives to participating in this study include not being involved with the study. There are no other known alternatives.

9. Voluntary Participation and Withdrawal

Your participation in this study is entirely voluntary. You may choose not to take part in this study. If you decide to take part, you can change your mind later and withdraw from the study. You are free to not answer any questions or withdraw at any time. Your decision will not change any present or future relationships with the University of Wisconsin-Milwaukee. Your withdrawl from this study does not affect your status with the Milwaukee Fire Department.

10. Questions

Who do I contact for questions about this study?

Stacy L. Gnacinski
College of Health Sciences
Dept. of Kinesiology
PAV Room375
229-3364

Gnacins4@uwm.edu

Who do I contact for questions about my rights or complaints towards my treatment as a research participant?

The Institutional Review Board may ask your name, but all complaints are kept in confidence.

Institutional Review Board
Human Research Protection Program
Department of University Safety and Assurances
University of Wisconsin-Milwaukee
P.O. Box 413
Milwaukee WI 53201
(414) 229-3173

11. Signatures

Research Participant's Consent to Participate in Research:
To voluntarily agree to take part in this study, you must complete this online consent form. If you choose to take part in this study, you may withdraw at any time. You are not giving up any of your legal rights by signing this form. Your completion of the online consent form indicates that you have read or had read to you this entire consent form, including the risks and benefits, have had all of your questions answered, and are 18 years of age or older.
I have read and understand the above terms and conditions of this study:
Yes No

Signature____Date:
____

APPENDIX C

Demographic Information Questionnaire

Default Question Block
DEMOGRAPHIC INFORMATION
Please indicate your responses to the following items.

1. Identification Code

2. Gender

3. Ethnicity

4. Age

5. Years of firefighting experience

6. Relationship status

7. Number of children

8. Body weight (lb)

9. Height (feet, in)

10. Do you currently, or have you ever, participated in any sport? If so:

    a. What sports?
    b. How long did you play for?

APPENDIX D

Functional Movement Screen

ID:________________________ **Date:_____________________**

Age:________ Gender:_______ Ht(in):_______ Wt(lbs):_____

Preferred Throwing Limb:_______ Preferred Stance Limb:_______

Functional Movement Screen

Test	Side	Raw Score	Final Score	Notes
1. Deep Squat • Torso // with tibia or toward vertical • Femur < HZ • Knees over feet • Dowel over feet				
2. Hurdle Step • Hips, knees, ankles aligned in sagittal plane • Min. movement of L-spine • Dowel and hurdle remain // • Loss of balance or contact w/hurdle = 1	**R (stepping)**			
	L			
3. In-Line Lunge • Dowel remains in contact w/L-ext • No torso movement • Dowel & feet remain in sagittal plane • Knee touches board behind heel	**R (front)**			
	L			
4. Shoulder Mobility • Fists w/in 1 hand length = 3 • Fists w/in 1.5 units = 2 • Fists > 1.5 units = 1	**R (flexed)**			
	L			
Impingement Clearing (NO = pain)	**R**	**YES / NO**		
	L	**YES / NO**		
5. Active SLR • Ankle & dowel bt mid-thigh & ASIS • Ankle & dowel bt mid-thigh & mid-knee • Ankle & dowel below mid joint	**R**			
	L			

6. Trunk Stability PU • Males = 1 rep w/thumbs at top of forehead then chin • Females = 1 rep w/thumbs at chin then clavicle				
Spinal Ext Clearing		**YES / NO**		
7. Rotary Stability • 1 correct unilateral rep w/spine // to board • Knee & elbow touch • II = diagonal	**R (upper moving)**			
	L			
Spinal Flex Clearing		**YES / NO**		

TOTAL SCORE = _____ / 21

APPENDIX E

Saucier’s Mini-Markers

APPENDIX

The 40-Item Mini-Marker Set

How Accurately Can You Describe Yourself?

Please use this list of common human traits to describe yourself as accurately as possible. Describe yourself as you see yourself at the present time, not as you wish to be in the future. Describe yourself as you are generally or typically, as compared with other persons you know of the same sex and of roughly your same age.

Before each trait, please write a number indicating how accurately that trait describes you, using the following rating scale:

Inaccurate				*?*	*Accurate*			
Extremely	*Very*	*Moderately*	*Slightly*		*Slightly*	*Moderately*	*Very*	*Extremely*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*

___ Bashful	___ Energetic	___ Moody	___ Systematic
___ Bold	___ Envious	___ Organized	___ Talkative
___ Careless	___ Extraverted	___ Philosophical	___ Temperamental
___ Cold	___ Fretful	___ Practical	___ Touchy
___ Complex	___ Harsh	___ Quiet	___ Uncreative
___ Cooperative	___ Imaginative	___ Relaxed	___ Unenvious
___ Creative	___ Inefficient	___ Rude	___ Unintellectual
___ Deep	___ Intellectual	___ Shy	___ Unsympathetic
___ Disorganized	___ Jealous	___ Sloppy	___ Warm
___ Efficient	___ Kind	___ Sympathetic	___ Withdrawn

APPENDIX F

Self-Efficacy Scale

Please rate the following items on scale of 1 (strongly disagree) to 14 (strongly agree).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
When I make plans, I am certain I can make them work.														
One of my problems is that I cannot get down to work when I should.														
If I can't do a job the first time, I keep trying until I can.														
When I set important goals for myself, I rarely achieve them.														
I give up on things before completing them.														
I avoid facing difficulties.														
If something looks too complicated, I will not even bother to try it.														
When I have something unpleasant to do, I stick to it until I finish it.														
When I decide to do something, I go right to work on it.														
When trying to learn something new, I soon give up if I am not initially successful.														
When unexpected problems occur, I don't handle them well.														
I avoid trying to learn new things when they look too difficult for me.														
Failure just makes me try harder.														
I feel insecure about my ability to do things.														
I am a self-reliant person.														
I give up easily.														
I do not seem capable of dealing with most problems that come up in my life.														

APPENDIX G

Sport Motivation Scale

Appendix

Why Do You Practice Your Sport?

Using the scale below, please indicate to what extent each of the following items corresponds to one of the reasons for which you are presently practicing your sport.

	Does not correspond at all		Corresponds moderately		Corresponds exactly		
1. For the pleasure I feel in living exciting experiences.	1	2	3	4	5	6	7
2. For the pleasure it gives me to know more about the sport that I practice.	1	2	3	4	5	6	7
3. I used to have good reasons for doing sports, but now I am asking myself if I should continue doing it.	1	2	3	4	5	6	7
4. For the pleasure of discovering new training techniques.	1	2	3	4	5	6	7
5. I don't know anymore; I have the impression that I am incapable of succeeding in this sport.	1	2	3	4	5	6	7
6. Because it allows me to be well regarded by people that I know.	1	2	3	4	5	6	7
7. Because, in my opinion, it is one of the best ways to meet people.	1	2	3	4	5	6	7
8. Because I feel a lot of personal satisfaction while mastering certain difficult training techniques.	1	2	3	4	5	6	7
9. Because it is absolutely necessary to do sports if one wants to be in shape.	1	2	3	4	5	6	7
10. For the prestige of being an athlete.	1	2	3	4	5	6	7
11. Because it is one of the best ways I have chosen to develop other aspects of myself.	1	2	3	4	5	6	7
12. For the pleasure I feel while improving some of my weak points.	1	2	3	4	5	6	7
13. For the excitement I feel when I am really involved in the activity.	1	2	3	4	5	6	7
14. Because I must do sports to feel good about myself.	1	2	3	4	5	6	7
15. For the satisfaction I experience while I am perfecting my abilities.	1	2	3	4	5	6	7
16. Because people around me think it is important to be in shape.	1	2	3	4	5	6	7

17. Because it is a good way to learn lots of things which could be useful to me in other areas of my life.	1	2	3	4	5	6	7
18. For the intense emotions that I feel while I am doing a sport that I like.	1	2	3	4	5	6	7
19. It is not clear to me anymore; I don't really think my place is in sport.	1	2	3	4	5	6	7
20. For the pleasure that I feel while executing certain difficult movements.	1	2	3	4	5	6	7
21. Because I would feel bad if I was not taking time to do it.	1	2	3	4	5	6	7
22. To show others how good I am at my sport.	1	2	3	4	5	6	7
23. For the pleasure that I feel while learning training techniques that I have never tried before.	1	2	3	4	5	6	7
24. Because it is one of the best ways to maintain good relationships with my friends.	1	2	3	4	5	6	7
25. Because I like the feeling of being totally immersed in the activity.	1	2	3	4	5	6	7
26. Because I must do sports regularly.	1	2	3	4	5	6	7
27. For the pleasure of discovering new performance strategies.	1	2	3	4	5	6	7
28. I often ask myself; I can't seem to achieve the goals that I set for myself.	1	2	3	4	5	6	7

Notes

[1]Deci and Ryan (1985) also include integrated regulation as one type of extrinsic motivation. However, integrated regulation was not initially included in the EMS and therefore is not assessed in the SMS. Pilot data revealed that integrated regulation did not come out as a perceived reason for participating in sport. Future research would appear necessary on this issue.

[2]Although the alpha reliability values of some of determinants and consequences are low, it was decided to use these measures since they were also used with the French version.

Acknowledgments

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APPENDIX H

Physical Self-Perception Profile

THE PHYSICAL SELF PERCEPTION PROFILE (PSPP)

WHAT AM I LIKE?

These are statements which allow people to describe themselves. There are no right or wrong answers since people differ a lot.

First, decide which one of the two statements best describes you.

Then, go to that side of the statement and check if it is just "sort of true" or "really true" FOR YOU.

EXAMPLE

	Really True for Me	Sort of True for Me				Sort of True for Me	Really True for Me
	☐	☐	Some people are very competitive	OR	Others are not quite so competitive	☒	☐

REMEMBER to check only ONE of the four boxes

	Really True for Me	Sort of True for Me				Sort of True for Me	Really True for Me
1.	☐	☐	Some people feel that they are not very good when it comes to playing sports	OR	Others feel that they are really good at just about every sport	☐	☐
2.	☐	☐	Some people are not very confident about their level of physical conditioning and fitness	OR	Others always feel confident that they maintain excellent conditioning and fitness	☐	☐
3.	☐	☐	Some people feel that compared to most, they have an attractive body	OR	Others feel that compared to most, their body is not quite so attractive	☐	☐
4.	☐	☐	Some people feel that they are physically stronger than most people of their sex	OR	Others feel that they lack physical strength compared to most others of their sex	☐	☐
5.	☐	☐	Some people feel extremely proud of who they are and what they can do physically	OR	Others are sometimes not quite so proud of who they are physically	☐	☐
6.	☐	☐	Some people feel that they are among the best when it comes to athletic ability	OR	Others feel that they are not among the most able when it comes to athletics	☐	☐

	Really True for Me	Sort of True for Me				Sort of True for Me	Really True for Me
7.	☐	☐	Some people make certain they take part in some form of regular vigorous physical exercise	OR	Others don't often manage to keep up regular vigorous physical exercise	☐	☐
8.	☐	☐	Some people feel that they have difficulty maintaining an attractive body	OR	Others feel that they are easily able to keep their bodies looking attractive	☐	☐
9.	☐	☐	Some people feel that their muscles are much stronger than most others of their sex	OR	Others feel that on the whole their muscles are not quite so strong as most others of their sex	☐	☐
10.	☐	☐	Some people are sometimes not so happy with the way they are or what they can do physically	OR	Others always feel happy about the kind of person they are physically	☐	☐
11.	☐	☐	Some people are not quite so confident when it comes to taking part in sports activities	OR	Others are among the most confident when it comes to taking part in sports activities	☐	☐
12.	☐	☐	Some people do not usually have a high level of stamina and fitness	OR	Others always maintain a high level of stamina and fitness	☐	☐
13.	☐	☐	Some people feel embarrassed by their bodies when it comes to wearing few clothes	OR	Others do not feel embarrassed by their bodies when it comes wearing few clothes	☐	☐
14.	☐	☐	When it comes to situations requiring strength some people are one of the first to step forward	OR	When it comes to situations requiring strength some people are one of the last to step forward	☐	☐
15.	☐	☐	When it comes to the physical side of themselves some people do not feel very confident	OR	Others seem to have a real sense of confidence in the physical side of themselves	☐	☐
16.	☐	☐	Some people feel that they are always one of the best when it comes to joining in sports activities	OR	Others feel that they are not one of the best when it comes to joining in sports activities	☐	☐

	Really True for Me	Sort of True for Me				Sort of True for Me	Really True for Me
17.	☐	☐	Some people tend to feel a little uneasy in fitness and exercise settings	OR	Others feel confident and at ease at all times in fitness and exercise settings	☐	☐
18.	☐	☐	Some people feel that they are often admired because their physique or figure is considered attractive	OR	Others rarely feel that they receive admiration for the way their body looks	☐	☐
19.	☐	☐	Some people tend to lack confidence when it comes to their physical strength	OR	Others are extremely confident when it comes to their physical strength	☐	☐
20.	☐	☐	Some people always have a really positive feeling about the physical side of themselves	OR	Others sometimes do not feel positive about the physical side of themselves	☐	☐
21.	☐	☐	Some people are sometimes a little slower than most when it comes to learning new skills in a sports situation	OR	Others have always seemed to be among the quickest when it comes to learning new sports skills	☐	☐
22.	☐	☐	Some people feel extremely confident about their ability to maintain regular exercise and physical condition	OR	Others don't feel quite so confident about their ability to maintain regular exercise and physical condition	☐	☐
23.	☐	☐	Some people feel that compared to most, their bodies do not look in the best of shape	OR	Others feel that compared to most their bodies always look in excellent physical shape	☐	☐
24.	☐	☐	Some people feel that they are very strong and have well developed muscles compared to most people	OR	Others feel that they are not so strong and their muscles are not very well developed	☐	☐
25.	☐	☐	Some people wish that they could have more respect for their physical selves	OR	Others always have great respect for their physical selves	☐	☐
26.	☐	☐	Given the chance, some people are always one of the first to join in sports activities	OR	Other people sometimes hold back and are not usually among the first to join in sports	☐	☐

	Really True for Me	Sort of True for Me				Sort of True for Me	Really True for Me
27.	☐	☐	Some people feel that compared to most they always maintain a high level of physical conditioning	OR	Others feel that compared to most their level of physical conditioning is not usually so high	☐	☐
28.	☐	☐	Some people are extremely confident about the appearance of their body	OR	Others are a little self-conscious about the appearance of their bodies	☐	☐
29.	☐	☐	Some people feel that they are not as good as most at dealing with situations requiring physical strength	OR	Others feel that they are among the best at dealing with situations which require physical strength	☐	☐
30.	☐	☐	Some people feel extremely satisfied with the kind of person they are physically	OR	Others sometimes feel a little dissatisfied with their physical selves	☐	☐

APPENDIX I

State-Trait Anxiety Inventory (Trait Anxiety Subscale Only)

SELF-EVALUATION QUESTIONNAIRE

STAI Form Y-2

Name ____ Date ________________

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	①	②	③	④
22. I feel nervous and restless	①	②	③	④
23. I feel satisfied with myself	①	②	③	④
24. I wish I could be as happy as others seem to be	①	②	③	④
25. I feel like a failure	①	②	③	④
26. I feel rested	①	②	③	④
27. I am "calm, cool, and collected"	①	②	③	④
28. I feel that difficulties are piling up so that I cannot overcome them	①	②	③	④
29. I worry too much over something that really doesn't matter	①	②	③	④
30. I am happy	①	②	③	④
31. I have disturbing thoughts	①	②	③	④
32. I lack self-confidence	①	②	③	④
33. I feel secure	①	②	③	④
34. I make decisions easily	①	②	③	④
35. I feel inadequate	①	②	③	④
36. I am content	①	②	③	④
37. Some unimportant thought runs through my mind and bothers me	①	②	③	④
38. I take disappointments so keenly that I can't put them out of my mind	①	②	③	④
39. I am a steady person	①	②	③	④
40. I get in a state of tension or turmoil as I think over my recent concerns and interests	①	②	③	④

APPENDIX J

Test of Performance Strategies-2

Name:

This questionnaire measures performance strategies used by athletes in various sport situations. Because individual athletes are very different in their approach to their sport, we expect the responses to be different. We want to stress, therefore, that there are no right or wrong answers. All that is required is for you to be open and honest in your responses. Each of the following items describes a specific situation that you may encounter in your training and competition. Please circle how frequently these situations apply to you on the following 1-5 scale:

	Never	Rarely	Sometimes	Often	Always
I set realistic but challenging goals for myself					
I say things to myself to help my practice performance					
During practice I visualize successful past performance					
My attention wanders while I am training					
I practice using relaxation techniques at workouts					
In practice, I use relaxation techniques to improve my performance					
During competition I set specific goals for myself					
In competitions I use relaxation techniques to improve my performance					
My self-talk during competition is negative					
During practice, I am able to perform skills without consciously thinking about it					
I trust my body to perform skills during competition					
I rehearse my performance in my mind before practice					
I can psych myself to perform well in competitions when necessary					
	Never	Rarely	Sometimes	Often	Always
During competitions I have thoughts of failure					
I use practice time to work on my relaxation techniques					
I manage my self-talk effectively during practice					

In competition, I use relaxation as a coping strategy					
I visualize my competition going exactly the way I want it to go					
I am able to control distracting thoughts while I am training					
I get frustrated and emotionally upset when practice does not go well					
I have specific cue words or phrases that I say to myself to help my performance during competition					
I evaluate whether I achieve my competition goals					
During practice, I perform automatically without having to consciously control each movement					
When I need to, I can relax myself at a competition to get ready to perform					
I have difficulty controlling my emotions if I make a mistake in competition					
I set very specific goals for competition					
	Never	**Rarely**	**Sometimes**	**Often**	**Always**
I practice using relaxation techniques at workouts					
I psych myself up at competitions to get ready to perform					
At practice, I can allow the whole skill of movement to happen naturally without concentrating on each part of the skill					
During competition I am sufficiently prepared to perform on "Automatic Pilot"					
I have difficulty with emotions at competitions					
I keep my thoughts positive during competition					
I say things to myself to help my competitive performances					
At competitions, I rehearse the feel of my performance in my imagination					
I can get my intensity level just right at practice					
I manage my self-talk effectively during competition					

I set goals to help me use practice time effectively					
I can get myself "up" if I feel flat during practice					
My performance suffers when something upsets me in practice					
	Never	**Rarely**	**Sometimes**	**Often**	**Always**
I can psych myself up to perform well during practice					
During competition, I am unable to perform skills without consciously thinking					
At practice, when I visualize my performance, I imagine what it will feel like					
During competition, if I am starting to "lose it" I use a relaxation technique					
I can get myself up if I feel flat at a competition					
During practice I focus my attention effectively					
I set personal performance goals for competition					
I motivate myself to train through positive self-talk					
During practice, I monitor the details of each move to successfully execute skills					
In practice, I have difficulty getting into an ideal performance state					
I have trouble maintaining my concentration during long practices					
I talk positively to myself to get the most out of practice					
I can increase my energy level to just the right level of performance					
	Never	**Rarely**	**Sometimes**	**Often**	**Always**
I have very specific goals for practice					
During competition I allow the skill to happen naturally without focusing on each part					
I imagine my competitive routine before I do it at a competition					
I imagine screwing up during competition					
I talk positively to myself to get the most out of competitions					

I dont set goals for practices; I just go out and do it					
I rehearse my performance in my mind at competitions					
I have trouble controlling my emotions when things are not going well at practice					
Emotions keep me from performing my best in practice					
Emotions keep me from performing my best at competitions					
My emotions get out of control under pressure in competition					
At practice, when I visualize my performance, I imagine watching myself as if on a video replay					

APPENDIX K

Institutional Review Board Protocol Summary

IRBManager Protocol Form

Instructions: Each Section must be completed unless directed otherwise. Incomplete forms will delay the IRB review process and may be returned to you. Enter your information in the **colored boxes** or place an **"X"** in front of the appropriate response(s). If the question does not apply, write **"N/A."**

SECTION A: Title

A1. Full Study Title:

Occupational athletes: An integrated approach to understanding firefighting performance.

SECTION B: Study Duration

B1. What is the expected start date? *Data collection, screening, recruitment, enrollment, or consenting activities may not begin until IRB approval has been granted. Format: 07/05/2011*

12/01/2012

B2. What is the expected end date? *Expected end date should take into account data analysis, queries, and paper write-up. Format: 07/05/2014*

12/01/2014

SECTION C: Summary

C1. Write a brief descriptive summary of this study in Layman Terms (non-technical language):

The purposes of the proposed study are to: (a) use descriptive statistics from physical and psychological assessments to characterize the multi-dimensional performance states of active and novice firefighters; (b) use unpaired, two-tailed *t* tests to compare the current performance states of active and novice firefighters; and (c) to use these statistical findings to provide recommendations for the development of comprehensive recruit training programs.

C2. Describe the purpose/objective and the significance of the research:

In conducting the proposed study, I will address gaps in both the firefighting and sport science literatures. By examining the physical and psychological performance states of active and novice firefighters, results of the proposed study will add to the firefighting literature by: (a) utilizing the Meyer Athlete Performance Management Model (MAPM to conceptualize the multi-dimensional performance needs of firefighters as a population of occupational athletes, and (b) informing the development of evidence-based training programs aimed at achieving and maintaining optimal firefighting performance. Similarly, the results of the proposed study will add to the sport science literature by: (a) utilizing the MAPM to simultaneously conceptualize the multi-dimensional performance needs of athletes, and (b) providing the first line of empirical evidence for the use of the MAPM in a performance domain.

Results of the proposed study have the potential to inform applied endeavors with firefighters and athletes alike. In a firefighting context, although additional research will be needed to support the prescription of appropriate training programs for firefighters, results of the proposed study will: (a) provide an ecologically valid means of standardizing performance for a given fire department, and (b) provide a novel and integrated framework for the process of assessing and enhancing the multi-dimensional aspects of firefighting performance. In a sport context, the results of the proposed study will provide evidence for the use of the MAPM to structure interdisciplinary collaborations for the optimization of performance assessment, education, and training among athletes.

C3. Cite any relevant literature pertaining to the proposed research:

Berger, R.A., & Smith, K.J. (1991). Effects of the tonic neck reflex in bench press. *The Journal of Applied Sport Science Research, 5(4),* 188.

Cook, G., Burton, L., Fields, K., & Kiesel K. (1998). Athletic Testing Services, Inc. *The Functional Movement Screen.* Danville, VA.

Fox, K.R., & Corbin, C.B. (1989). The Physical Self-Perception Profile: Development and preliminary validation. *Journal of Sport & Exercise Psychology, 11(4),* 408-430.

Hardy, L., Roberts, R., Thomas, P. R., & Murphy, S. M. (2010). Test of performance strategies (TOPS): Instrument refinement using confirmatory factor analysis. *Psychology of Sport and Exercise, 11,* 27-35.

Jackson, A.S., & Pollock, M.L. (1985). Practical assessment of body composition. *The Physician and Sports Medicine, 13(5),* 76-80, 82-90.

Kasch, F.W., Phillips, W.H., Ross, W.D., Carter, J.E., & Boyer, J.L. (1966). A comparison of maximal uptake by treadmill and step-test procedures. *Journal of Applied Physiology, 21(4),* 1387-1388.

Pelletier, L. G., Fortier, M. S., Vallerand, R. J., Tuson, K. M., Brière, N. M., & Blais, M. R. (1995). Toward a new measure of intrinsic motivation, extrinsic motivation, and amotivation in sports: The sport motivation scale (SMS). *Journal of Sport*

and Exercise Psychology, *17*, 35–53.
Saucier, G. (1994). Mini-markers: A brief version of Goldberg's unipolar big-five markers. *Journal of Personality Assessment*, *63*(3), 506-516.
Sherer, M., & Adams, C. H. (1983). Construct validation of the Self–efficacy Scale. *Psychological Reports*, *53*, 899–902.

SECTION D: Subject Population

Section Notes…

- D1. If this study involves analysis of de-identified data only (i.e., no human subject interaction), IRB submission/review may not be necessary. Visit the Pre-Submission section in the IRB website for more information.

D1. Identify any population(s) that you will be specifically targeting for the study. Check all that apply: (Place an "X" in the column next to the name of the special population.)

x	Not Applicable (e.g., de-identified datasets)		Institutionalized/ Nursing home residents recruited in the nursing home
	UWM Students of PI or study staff		Diagnosable Psychological Disorder/Psychiatrically impaired
	Non-UWM students to be recruited in their educational setting, i.e. in class or at school		Decisionally/Cognitively Impaired
	UWM Staff or Faculty		Economically/Educationally Disadvantaged
	Pregnant Women/Neonates		Prisoners
	Minors under 18 and ARE NOT wards of the State		Non-English Speaking
	Minors under 18 and ARE wards of the State		Terminally ill
	Other (Please identify):Milwaukee area firefighter recruits and active firefighters		

D2. Describe the subject group and enter the total number to be enrolled for each group. For example: teachers-50, students-200, parents-25, parent's children-25, student control-30, student experimental-30, medical charts-500, dataset of 1500, etc. Enter the total number of subjects below.

Describe subject group:	Number:
Novice firefighters, or firefighter recruits	10-15 in an incoming class; all will be invited to participate
Active Milwaukee Firefighters, noted by elite firefighting performance	10-15 active firefighters who demonstrate elite firefighting status (as determined by a team of experts) will be invited to participate
TOTAL # OF SUBJECTS:	20-30
TOTAL # OF SUBJECTS (If UWM is a collaborating site):	

D3. List any major inclusion and exclusion criteria (e.g., age, gender, health status/condition, ethnicity, location, English speaking, etc.) and state the justification for the inclusion and exclusion:

Please also see attached Criteria for Inclusion form and consent form

Prior to data collection, for the purpose of screening for inclusion, participants will complete a paper-pencil version of the Criteria for Inclusion form. Once participants have completed the Criteria for Inclusion form. Once participants have completed the Criteria for Inclusion form, they will next be asked to complete the consent form. Accordingly, participants will be included in the study if they: (a) are not taking any prescribed medication for a symptomatic illness; (b) have not had an injury, surgery, or bone abnormalities on their knees, hips, or ankles in the last year; (c) have not had a heart condition; (d) do not currently suffer from chest pain or dizziness; and/or (e) are not currently pregnant. Eligibility for participation in the proposed study will also be determined by the following criteria: (a) the elite firefighter participant is currently an active firefighter in the MKE Fire Department, (b) the novice firefighter participant is currently enrolled in the MKE Firefighter Recruit program, (c) participant is fluent in speaking and writing English, and (d) the participant is able and willing to give their informed consent (see consent form, Appendix B) to participate in the study.

SECTION E: Informed Consent

Section Notes…

- E1. Make sure to attach any recruitment materials for IRB approval.
- E3. The privacy of the participants must be maintained throughout the consent process.

E1. Describe how the subjects will be recruited. (E.g., through flyers, beginning announcement for X class, referrals, random telephone sampling, etc.). If this study involves secondary analysis of data/charts/specimens only, provide information on the source of the data, whether the data is publicly available and whether the data contains direct or indirect identifiers.

As a result of ongoing collaborations between the Milwaukee Fire Department and the Human Performance & Sport Physiology Laboratory at the University of Wisconsin-Milwaukee, an overwhelming number of recruits and firefighters have indicated that they would like to participate in a study such as this proposed study. To that point, I will invite all recruits from the current incoming class and all designated elite firefighters to participate.

E2. Describe the forms that will be used for each subject group (e.g., short version, combined parent/child consent form, child assent form, verbal script, information sheet): If data from failed eligibility screenings will be used as part of your "research data", then these individuals **are** considered research subjects and consent will need to be obtained. Copies of all forms should be attached for approval. If requesting to waive documentation (not collecting subject's signature) or to waive consent all together, state so and complete the "Waiver to Obtain-Document-Alter Consent" and attach:

Please see all included documents: Criteria for Inclusion, Consent form, and Demographic Information Questionnaire.

On the day of data collection, I will administer paper-pencil versions of the Criteria for Inclusion Questionnaire, consent form, and demographic information questionnaire to the participants at the designated testing site determined by the MKE Fire Department. I have outlined the basic structure of the Criteria for Inclusion form above in section D3. The consent form will provide the participant with an overview of the risks and benefits associated with the study as well as the opportunity to accept or decline the invitation to participate. The demographic information I wish to collect only includes age, gender, years of firefighting experience, and body weight. Age, gender, and firefighting experience will not determine inclusion for participation, nor will they be considered in any data analysis (other than descriptive statistics). Body weight will only be used to calculate and report various physical testing results (e.g., relative aerobic fitness, and body composition).

The form which is used to assess functional movement has also been included for reference.

Movement Screen

Each participant will complete a Functional Movement Screen. The Functional Movement Screen, created by Gray Cook and Lee Burton in 1995, will provide an objective assessment of normal movement. Functional asymmetries and imbalances can be exploited in this movement screen.

E3. Describe who will obtain consent and where and when consent will be obtained.
When appropriate (for higher risk and complex study activities), a process should be mentioned to assure that participants understand the information. For example, in addition to the signed consent form, describing the study procedures verbally or visually**:**

I, as the PI, will obtain consent at a location designated by the Milwaukee Fire Department as the testing location (will likely be the MKE Fire House, or the MKE Fire and Police Safety Academy). Before beginning any data collection, the full procedure will be explained to each participant. Additionally, the participants will be educated about the risks and benefits associated with participation in this study.

SECTION F: Data Collection and Design

Section Notes…

- F1. Reminder, all data collection instruments should be attached for IRB review.
- F1. The IRB welcomes the use of flowcharts and tables in the consent form for complex/ multiple study activities.

F1. In the table below, chronologically describe all study activities where human subjects are involved.

- In **column A**, give the activity a short name. E.g., Obtaining Dataset, Records Review, Recruiting, Consenting, Screening, Interview, Online Survey, Lab Visit 1, 4 Week Follow-Up, Debriefing, etc.
- In **column B**, describe in greater detail the activities (surveys, audiotaped interviews, tasks, etc.) research participants will be engaged in. Address where, how long, and when each activity takes place.
- In **column C,** describe any possible risks (e.g., physical, psychological, social, economic, legal, etc.) the subject may ***reasonably*** encounter. Describe the

safeguards that will be put into place to minimize possible risks (e.g., interviews are in a private location, data is anonymous, assigning pseudonyms, where data is stored, coded data, etc.) and what happens if the participant gets hurt or upset (e.g., referred to Norris Health Center, PI will stop the interview and assess, given referral, etc.).		
A. Activity Name:	**B. Activity Description:**	**C. Activity Risks and Safeguards:**
Screening	Participant will complete a Criteria for Inclusion Form	Data will be stored in a locked file in PAV 365 (UW-Milwaukee campus) where only the myself and co-PIs (Barbara B. Meyer, PhD & Kyle T. Ebersole, PhD) will have access to the files.
Consenting	Participant will complete and sign the Consent Form	Data will be stored in a locked file in PAV 365 (UW-Milwaukee campus) where only the myself and co-PIs (Barbara B. Meyer, PhD & Kyle T. Ebersole, PhD) will have access to the files.
Paper-Pencil Demographic Survey	Participant will complete a short demographic information questionnaire	All data collected will be only identified with the unique identification code provided to the participant after signing the consent form.
Physical testing procedures	The physical testing will be administered at a testing site determined by the Milwaukee Fire Department. Each physical test is outlined below	The potential risks due to performing any of the movement tasks in this study are minimal and no different from those associated with every day life. It is possible, but highly unlikely, that participants may experience minor musculoskeletal strains, muscle soreness, and/or tightness. All personnel involved in testing are trained in adult cardiopulmonary resuscitation (CPR) and first aid

		procedures. The session will be terminated in the event that the participant indicates any discomfort such as chest pain, leg pain or cramping or other sign and symptom that could be associated with a medical condition. The testing will also be terminated if requested by the participant. In the event that an exercise session is terminated for a possible medical reason, laboratory personnel will manage the situation per the standard first aid guidelines and procedures of the American Red Cross and refer to the appropriate medical staff (through Milwaukee Fire Department) or contact the Emergency Medical System.
Aerobic fitness	Corresponding with the procedure outlined by Kasch, Phillips, Ross, Carter, and Boyer (1966), the YMCA Submaximal 3-Minute Step Test will be used to determine aerobic fitness via a predicted measure of VO_{2max}. According to Kasch et al., the correlation coefficient between the step test and treadmill protocol was .95. The predicted VO_{2max} will be expressed in relative terms or milliliters of oxygen consumed per kilogram of body weight per minute (mL/kg/min). Furthermore, not only does this test provide a reliable means of predicting aerobic fitness, but it can also be easily transferred	See above

	into the firefighting domain for the use of future assessments.	
Muscular Strength & Endurance	To determine muscular strength, participants will complete the widely-accepted one repetition max (1 RM) bench press and squat. Given that the test-restest reliability of the direct 1 RM method and indirect 1 RM method ranges from 5-15% (Berger & Smith, 1991), and no children or elderly participants will be included in the sample population, the direct 1 RM method will be used to achieve the highest accuracy possible. Corresponding with the methods used by Kraemer & Fry (1995), participants will complete the proper warm-up (i.e., 5-10 repetitions of 60-80% perceived 1 RM, one minute of rest, and subsequent 3-5 repetitions of 60-80% perceived 1 RM) and perform one repetition. Both bench press and squat measures will be recorded in absolute values. To determine muscular endurance, participants will perform push-ups to exhaustion. Corresponding with the procedure designed by Johnson and Nelson (1986), upper body muscular endurance will be determined by the number of push-ups that can be completed without losing proper form (i.e., body is rigid, back is straight, chest lowers to 5 cm from the ground, and arms fully extend in a complete push-up) or resting between repetitions.	See above
Body	To determine body composition,	There are no risks involved with

composition	body fat percentages will be calculated using the Three Skinfold Site Jackson and Pollock method (1978, 1980). Strong correlation coefficients have been consistently been reported (α = .70-.90) between skinfolds and hydrostatic weighing (American College of Sports Medicine, 2000 as cited in Beam & Adams, 2011). Using the right hand to measure and the left hand to pinch, skinfolds will be measured at a 1 cm distance above the skinfold site. In measuring the skinfolds, the points of the calipers will be perpendicular to the long axis of the skinfold site and the jaws of the calipers will be compressed for no less than 1-2 seconds and no longer than 4 seconds. To ensure reliability between measures, each skinfold will be measured at least twice. If two measures of the same skinfold vary greater than 2 mm, a third measure will be taken. All skinfolds and the sum of three skinfolds will be reported to the nearest 0.1 mm.	the body composition assessment.
Movement Screen	***The Functional Movement Screen consists of the following 7 tasks: (Takes approximately 30 min)*** 15. Deep Squat – Involves holding a light weight plastic dowel rod over the head with arms extended and squatting as far down as the participant is able to go. This is repeated 5 times. 16. Hurdle Step – Involves holding the dowel rod (same dowel rod as used	See above

		in the squat) across the shoulders while stepping (one leg at a time) over a rubber tube that is anchored to two stationary poles such that the height of the rubber tube is level with the bump on the leg bone, just below the knee. This is repeated 5 times. 17. Lunge – involves placing one leg in front of another such that the distance separating the two feet is equal to the distance used for placement of the rubber tube in the Hurdle Step. The participant will then lunge forward trying to touch the knee of the back leg touches the heel of the front foot. This is repeated 5 times. 18. Shoulder Mobility – involves the participant reaching behind their back with one hand coming from the head down the spine and the other hand coming from the waist up the spine. The distance separating the two hands will be measured. The movement is repeated with the hands changing their positions. 19. Hamstring Length – involves the participant lying on his/her back and raising the leg up from the ground while keeping the knee straight. The distance the leg is raised	

	will be measured. This is repeated with the other leg. 20. Push-Up – involves performing a push-up and evaluating the movement of the low back and upper back during the motion. This is repeated 3 times. 21. Rotary Stability – involves the participant being positioned in a 4-point stance (arms and legs) and trying to bring the right elbow to the left knee. This is then repeated with the left elbow coming to the right knee.	
Psychological Questionnaires	The psychological questionnaires will be administered via online surveys. In the event that the questionnaires cannot be completed online, the participants will be given a postage-stamped paper-pencil version to complete.	Again, all data collected during the psychological testing will be identified only by the unique identification code described in the consent form. There will be no risk greater than the completion of any other survey about attitudes or experiences about something. Similarly, there will be no greater risk than any other online activity (ex. Email, Facebook, etc.). Safeguards include keeping the data in a password protected online database through the secure UWM Survey website.
Saucier's Mini-Markers (Saucier, 1994).	The 40-item Mini-Markers scale will be used to assess the Big Five personality characteristics (i.e., neuroticism, extroversion, openness to experience, agreeableness, conscientiousness) of the	

	participants. Saucier's Mini-Markers scale is a well-established, reliable (α = .69-.91), and valid personality scale which has been used among university students and adult populations (Saucier, 1994; Seibert & Kraimer, 2001).	
Self-Efficacy Scale (Sherer et al., 1982)	The 17-item general self-efficacy subscale of the Self-Efficacy Scale will be used to assess the participants' self-efficacy, or their beliefs in their ability to competently perform across a variety of performance tasks. The general self-efficacy subscale of the Self-Efficacy Scale has been deemed both reliable (α = .86; Sherer et al., 1982) and appropriate for use in a firefighter population (Regehr, Hill, Knott, & Sault, 2003).	
Sport Motivation Scale (SMS; Pelletier, Fortier, Blais, Tuson, Brière, Vallerand, 1995)	No previous research has used any one particular questionnaire to assess intrinsic motivation among firefighters. That fact, along with the overlap between sport and firefighting, prompts the use of the the well-established 28-item scale SMS from sport (α = .82; Brière, Vallerand, Blais, & Pelletier, 1995) to assess intrinsic motivation in the proposed study.	
Physical Self-Perception Profile (PSPP; Fox & Corbin, 1989)	No previous research has examined perceptions of competence among firefighters. That fact, along with the overlap between sport and firefighting, prompts the use of two 5-item subscales (i.e., strength and condition) from the PSPP (α = .81 -	

	.92; Fox & Corbin, 1989) to determine perceptions of physical competence among participants.	
Trait Anxiety Inventory (TAI; Spielberger, 1970)	The 20-item TAI will be used to assess the trait anxiety of study participants. This scale has been utilized in research across a variety of adult populations (i.e., working adults, college students, high school students, and military recruits) and is reported to have adequate reliability (α = .89-.91; Spielberger, 1983).	
Test of Performance Strategies-2 (TOPS-2; Hardy, Thomas, Sheppard, & Murphy, 2005).	The TOPS-2 will be used to assess mental skills (i.e., self-talk, emotional control, automaticity, goal setting, imagery, activation, relaxation, negative thinking, attentional control) in this population. Due to low scores of internal consistency (α = .44), the distractability subscale will be excluded from this assessment. Despite the poor internal consistency of the distractability subscale, the TOPS-2 has been used across a variety of athlete populations and all other subscales have been reported to have adequate reliability (α = .62-.89).	

F2. Explain how the privacy and confidentiality of the participants' data will be maintained after study closure:

A key containing the identification codes, participants' names, and contact information will be stored in a locked file in the Human Performance and Sport Physiology (HPSP) Lab in Pavillion 365 at the University of Wisconsin-Milwaukee. All physical data obtained will be transferred into an Excel file and stored on a password-protected computer inside Pavillion 375 at the University of Wisconsin-Milwaukee. Similarly, the responses from the online or paper-pencil psychological questionnaires will be transferred into an Excel file and stored on the aforementioned password-protected computer inside Pavillion 375. Only myself, Co-PIs (i.e., Kyle T. Ebersole or Barbara B. Meyer), and approved students will have access to any and all data for research purposes. Once the study is completed, the data will be archived for the duration of ongoing collaborations with the Milwaukee Fire Department. Should those collaborations ever cease to exist, all data containing the participants' names, demographic information, and subsequent physical and psychological information will be destroyed.

F3. Explain how the data will be analyzed or studied (i.e. quantitatively or qualitatively) and how the data will be reported (i.e. aggregated, anonymously, pseudonyms for participants, etc.):

The data will be analyzed quantitatively and reported anonymously in aggregate form.

SECTION G: Benefits and Risk/Benefit Analysis

Section Notes…

- Do not include Incentives/ Compensations in this section.

G1. Describe any benefits to the individual participants. If there are no anticipated benefits to the subject directly, state so. Describe potential benefits to society (i.e., further knowledge to the area of study) or a specific group of individuals (i.e., teachers, foster children). Describe the ratio of risks to benefits.

The participants in the proposed study will gain a greater knowledge regarding their personal performance states as firefighters. Participants will also receive recommendations (but not prescriptions) for the improvement of those performance states. The benefits to participating in this study far outweigh the risks associated with participation.

G2. Risks to research participants should be justified by the anticipated benefits to the participants or society. Provide your assessment of how the anticipated risks to participants and steps taken to minimize these risks, balance against anticipated benefits to the individual or to society.

The results of the proposed study will benefit both the participants and society. By examining the multi-dimensional aspects of firefighting performance, results will inform the development of future training programs to best prepare the next generations (and current generations) of firefighters for the unique occupational demands associated with firefighting. Furthermore, by improving the performance of firefighters, theoretically, the number of citizen and firefighter casualties will be reduced.

SECTION H: Subject Incentives/ Compensations

Section Notes…

- H2 & H3. The IRB recognizes the potential for undue influence and coercion when extra credit is offered. The UWM IRB, as also recommended by OHRP and APA Code of Ethics, agrees when extra credit is offered or required, prospective subjects should be given the choice of an equitable alternative. In instances where the researcher does not know whether extra credit will be accepted and its worth, such information should be conveyed to the subject in the recruitment materials and the consent form. For example, "The awarding of extra credit and its amount is dependent upon your instructor. Please contact your instructor before participating if you have any questions. If extra credit is awarded and you choose to not participate, the instructor will offer an equitable alternative."
- H4. If you intend to submit to the Travel Management Office for reimbursement purposes make sure you understand what each level of payment confidentiality means **(click here for additional information).**

H1. Does this study involve incentives or compensation to the subjects? For example cash, class extra credit, gift cards, or items.

[__] **Yes**
[X] **No [SKIP THIS SECTION]**

H2. Explain what (a) the item is, (b) the amount or approximate value of the item, and (c) when it will be given. For extra credit, state the number of credit hours and/or points. (e.g., $5 after completing each survey, subject will receive [item] even if they do not complete the procedure, extra credit will be award at the end of the semester)**:**

H3. If extra credit is offered as compensation/incentive, an alternative activity (which can be another research study or class assignment) should be offered. The alternative activity (either class assignment or another research study) should be similar in the amount of time involved to complete and worth the same extra credit.

H4. If cash or gift cards, select the appropriate confidentiality level for payments (see section notes):

[__] **Level 1** indicates that confidentiality of the subjects is not a serious issue, e.g., providing a social security number or other identifying information for payment would not pose a serious risk to subjects.

- Choosing a Level 1 requires the researcher to maintain a record of the following: The payee's name, address, and social security number and the amount paid.
- When Level 1 is selected, a formal notice is not issued by the IRB and the Travel Management Office assumes Level 1.
- Level 1 payment information will be retained in the extramural account folder at UWM/Research Services and attached to the voucher in Accounts Payable. These are public documents, potentially open to public review.

[__] **Level 2** indicates that confidentiality is an issue, but is not paramount to the study, e.g., the participant will be involved in a study researching sensitive, yet not illegal issues.

- Choosing a Level 2 requires the researcher to maintain a record of the following: A list of names, social security numbers, home addresses and amounts paid.
- When Level 2 is selected, a formal notice will be issued by the IRB.
- Level 2 payment information, including the names, are attached to the PIR and become part of the voucher in Accounts Payable. The records retained by Accounts Payable are not considered public record.

[__] **Level 3** indicates that confidentiality of the subjects must be guaranteed. In this category, identifying information such as a social security number would put a subject at increased risk.

- Choosing a Level 3 requires the researcher to maintain a record of the following: research subject's name and corresponding coded identification. This will be the only record of payee names, and it will stay in the control of the PI.
- Payments are made to the research subjects by either personal check or cash.
- Gift cards are considered cash.
- If a cash payment is made, the PI must obtain signed receipts.

SECTION I: Deception/ Incomplete Disclosure (INSERT "NA" IF NOT APPLICABLE)
Section Notes… • If you cannot adequately state the true purpose of the study to the subject in the informed consent, deception/ incomplete disclosure is involved.

I1. Describe (a) what information will be withheld from the subject (b) why such deception/ incomplete disclosure is necessary, and (c) when the subjects will be debriefed about the deception/ incomplete disclosure.

NA

IMPORTANT – Make sure all sections are complete and attach this document to your IRBManager web submission in the Attachment Page (Y1).