

DEVELOPMENT OF AN ASSESSMENT OF RECOVERY ACTIVITIES FOR ATHLETES

by

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## ABSTRACT

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To optimize the performance and health of elite athletes, there has been an increase in the development of athlete monitoring systems to measure *if* athletes perceive themselves to be adequately recovered (i.e., counterbalancing the effects of stressors after a demanding activity). While these monitoring systems have been instrumental in describing athlete recovery states, little research has been conducted to establish *why* and *how* athletes engage in recovery behaviors or to identify barriers that prevent athletes from initiating the recovery process. As such, the purpose of the current study was to develop and evaluate the psychometric properties of an assessment that will allow practitioners and researchers to measure and monitor the recovery activities an athlete engages in to enhance performance, health, and well-being. This purpose was achieved through two studies. In Study 1, physical, psychological, and social recovery activity items were generated and content evaluated first by experts ( $N = 3$ ) and second by elite athletes ( $N = 8$ ). Results of Study 1 yielded the retention of 71 items. In Study 2, the recovery activity items were distributed to elite athletes ( $N = 265$ ) and the factor structure was tested using confirmatory factor analysis (CFA). Convergent validity and reliability of the assessment were also tested. Results of the CFA revealed a 56-item, 10-factor model. Convergent validity was supported, and reliability for each of the 10 subscales was good. Overall, the Assessment of Recovery Activities for Athletes (ARAA) provides practitioners and researchers with a valid and reliable instrument from which to monitor recovery activities engaged in by elite athletes.

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## Chapter I: Introduction & Literature Review

### Background and Practical Context

Driven by the desire to gain a competitive advantage in elite sport, researchers have spent the last two decades examining the significance of recovery among athletes. Although the conceptualization of recovery is still widely debated in the sport and performance literature, researchers agree that recovery is essential for optimizing athlete health and peak performance (Kellmann et al., 2018) and consists of psychological, physiological, and social components (Beckmann & Kellmann, 2004; Heidari et al., 2018; Kallus & Kellmann, 2016). To better understand recovery within the athlete population, researchers continue to shed light on the various conceptualizations of recovery, its significance to athletes, as well as the implications of underrecovery.

Researchers (e.g., Beckmann & Kellmann, 2004; Kellmann & Kallus, 2001; Kenttä & Hassmén, 1998) have historically conceptualized and defined recovery within the context of, and intertwined with, psychophysiological stress. Recovery is thought to be a restorative process occurring after a psychophysiological stressor arises and/or as a proactive process before the stressor arises (Filho et al., 2013; Kallus & Kellmann, 2016; Kellmann et al., 2018; Nicolas et al., 2019). As there is no clear agreement on the definition of stress (Kallus, 2016), researchers have recently placed more emphasis on understanding athlete recovery as opposed to athlete stress (Kellmann et al., 2018). Despite the trend towards examining recovery exclusively, seminal stress-recovery research is still widely used today and provides the foundation for the conceptualization of recovery.

The most cited definition of recovery is that of Kellmann and Kallus (2001): “an inter- and intraindividual multilevel (e.g., psychological, physiological, social) process in time for the re-establishment of performance abilities” (p. 22). According to Kellmann (2002) this recovery process encompasses three approaches including a passive approach (i.e., applying a physiological stimuli such as hot or cold products which are accompanied by a psychological reaction), an active approach (i.e.,

engaging in low to moderate dynamic activities following a training load), and a proactive approach (i.e., employing purposeful, preventative activities). Two years later, Kellmann and colleagues refined the conceptualization of recovery, suggesting that in order for the three multilevel approaches to be effective, an athlete must engage in a self-regulation process thereby investing time and energy into initiating the strategies (Beckmann & Kellmann, 2004).

Despite knowledge of the importance of recovery in athletes, barriers to recovery exist including: failure to initiate recovery strategies, implementation of inappropriate strategies, ineffective execution of strategies, mismatch between coach and athlete perceptions of recovery strategies, and failure to monitor the effectiveness of recovery strategies once implemented (Beckmann & Kellmann, 2004; Kellmann et al., 2018). These barriers to recovery can lead to underrecovery, which has been described as the “failure to fulfill current recovery demands” (Kellmann, 2002, p. 3). Underrecovery is linked to a host of deleterious consequences such as performance decrements (Nicolas et al., 2019; Skorski et al., 2019a) and increased rates of injury and illness (Drew et al., 2017; van der Does et al., 2017; Veugelers et al., 2016).

As suggested above, performance decrements can occur when there is a chronic mismatch between training load and recovery. To benefit from training adaptations, athletes engage in periods of short-term deliberate overtraining, which may result in acute fatigue and a slight decrease in performance (Meeusen et al., 2013). When acute fatigue is followed by sufficient recovery, in terms of activity and/or time, performance improves and is known as short-term functional overreaching. When acute fatigue is followed by a period of insufficient recovery, or underrecovery, nonfunctional overreaching (NFOR) occurs. NFOR can develop into overtraining syndrome whereby an athlete’s performance declines, and mood, hormone, and sleep disruptions occur (Cardoos, 2015; Meeusen et al., 2013). Accompanying the effects of overtraining is the risk for injury and illness. Following a period of decreased recovery, researchers report increased risk for both acute and overuse injury (Brink et al.,

2010; Gabbett et al., 2012; Laux et al., 2015; van der Does et al., 2017), as well as increased occurrence of high stress, low energy, and depressive symptoms (Drew et al., 2017).

To mitigate the consequences of overtraining and to reduce the risk of injury and illness, researchers and practitioners alike proactively monitor athletes' responses to training (Meeusen et al., 2013; Saw et al., 2016; Schwellnus et al., 2016; Soligard et al., 2016). Methods for monitoring these responses include both subjective and objective measures, yet because of their sensitivity to fluctuations in acute and chronic training, subjective assessments are used more frequently than objective assessments (Meeusen et al., 2013; Saw et al., 2016). And while subjective assessments are considered best practice to monitor training response, the currently used assessments are not without their shortcomings. Failure of assessment developers to incorporate recovery research into the recovery assessments used with athletes contributes to a gap in the translation of research to practice, thereby decreasing practitioners' ability to facilitate optimal recovery in athletes.

The absence of contemporary recovery research in subjective recovery assessments is evident in two ways. First, recovery is conceptualized as a multidimensional process consisting of physical, psychological, and social components (Beckmann & Kellmann, 2004; Heidari et al., 2018; Kallus & Kellmann, 2016), yet only one recovery assessment to date (Recovery-Stress Questionnaire for Athletes [RESTQ-Sport]; Kallus & Kellmann, 2016; Kellmann & Kallus, 2001) includes all three of these components of recovery status. Second, most of the recovery assessments are used to monitor the recovery status of an athlete, yet this information does not shed light on *how* the athlete achieved that recovery status. This information on *how* athletes achieve a given recovery status is important because it allows practitioners to understand *what* athletes did to achieve that recovery status so that effective recovery activities may be replicated. As such, in addition to monitoring recovery status, researchers have begun to emphasize the importance of monitoring volitional, individual-specific recovery activities in order to optimize performance and reduce the risk of injury (Beckmann & Kellmann, 2004; Heidari et

al., 2018; Kellmann et al., 2018). Only one recovery assessment to date monitors recovery activities (Total Quality Recovery scale [TQR]; Kenttä & Hassmén, 1998), and many of the items on this scale are obsolete and/or not individual-specific (e.g., nutrition requirements; see Belski, 2019). Unless recovery status and activities are monitored from a physical, psychological, and social standpoint, it is difficult for an athlete to determine what they need to do to maintain or improve their recovery status (Kellmann et al., 2018).

Taken together, and to close the gap between research and practice, a subjective assessment of multidimensional recovery activities should be developed for athletes. In order to justify the development of a novel assessment of recovery activities as well as to support the theoretical and empirical choices made in the assessment development process, the purpose of this literature review is to critically: (a) examine the current recovery theories and models from multiple fields of recovery research, (b) evaluate the recovery assessments currently utilized within the athlete population, and (c) summarize the multidimensional recovery activities that will be used to develop the recovery activities assessment.

### **Recovery Theories and Models**

Recovery theories and models are used to describe the recovery status of an athlete and to explain specific recovery activities an athlete may engage in on a regular basis. The recovery theories and models most relevant to athletes include restorative environment theories, occupational recovery theories, and athlete recovery models, each of which is described in detail below. The critical exploration of these theories and models inform the conceptualization of the proposed subjective assessment of recovery activities, which will be discussed in a forthcoming section of the literature review.

**Restorative environment theories.** Restorative environment theories are used to explain how immersion in natural environments can improve mental, physical, and emotional well-being following

exposure to stressors (Joye & van den Berg, 2018; Rydstedt & Johnsen, 2019). These recovery theories are applicable to athletes as some may train and/or compete in a natural environment (e.g., cycling, biathlon, rowing, etc.) while others may choose to spend time in nature as a means of recovery. The restorative process facilitated by the natural environment is explained by the stress recovery theory (SRT; Ulrich, 1983) and the attention restoration theory (ART; Kaplan & Kaplan, 1989).

***Stress recovery theory.*** Originally suggested by Ulrich (1983), SRT is used to describe how positive appraisals of nature may facilitate beneficial psychological and physiological changes in individuals, including an increase in positive emotions and activation of the parasympathetic nervous system (Ulrich et al., 1991). This restorative process is initiated by positive affective responses to the natural environment, thereby reducing negative emotions and stress (Joye & van den Berg, 2018; Rydstedt & Johnsen, 2019). Scholars (Berto, 2014; Ulrich et al., 1991) suggest these positive reactions are not elicited when individuals are in urban settings, indicating that natural environments may be more beneficial than urban environments in reducing stress.

***Attention restoration theory.*** Kaplan and Kaplan (1989) developed ART to explain how mental fatigue may be combated by time spent in nature. It has been suggested that being in the natural environment allows individuals to reflect on unresolved issues, leading to improvement in attentional focus when returning to tasks that require effort (Ohly et al., 2016). In accordance with ART, an individual has the most success in diminishing mental fatigue when the following four human-environment qualities exist: (a) *extent* or connection to the environment, (b) *fascination* with the environment, (c) *compatibility* between the individual's interests and characteristics of the environment, and (d) *being away* from every day obligations (Joye & van den Berg, 2018). When one or more of the aforementioned qualities are present, negative thoughts and emotions are replaced by positive ones thereby facilitating an improvement in attentional focus (Berto, 2014).

**Restorative environment theories summary and practical application.** Through the lens of SRT, restoration occurs when positive emotions are elicited in individuals following immersion in nature, whereas through the lens of ART, restoration occurs as a result of a complex human-environment interaction with nature (Joye & van den Berg, 2018). Despite these nuances, both theories are used to describe the benefits of natural environments over urban environments in enhancing positive emotions and reducing stress (Rydstedt & Johnsen, 2019). While spending time in nature may facilitate recovery for athletes who positively appraise nature, a natural environment may not be effective for athletes who perceive a natural environment to be uninteresting or threatening to their well-being. As such, using restorative environment theories to inform the assessment development process will be used cautiously with the knowledge that recovery is individual-specific.

**Occupational recovery theories.** Occupational recovery theories and models are used to explain the balance between the psychological stressors of work and/or academics and the recovery processes used to restore energy and mental resources (de Bloom et al., 2015; Zijlstra et al., 2014). This line of recovery research is applicable to the athlete population as elite athletes often view their sport as work (e.g., full-time occupation or part-time sponsorships). Concurrently, elite athletes may supplement their sport careers with collegiate courses and thus require recovery from both sport and academics. The occupational recovery research can be explained by the following theories and models: conservation of resources (COR) theory (Hobfoll, 1989), effort-recovery (E-R) model (Meijman & Mulder, 1998), recovery experience model (Sonnentag & Fritz, 2007), and integrated model of stress and recovery on the weekend (Ragsdale et al., 2011).

**Conservation of resources theory.** Developed by Hobfoll (1989), COR theory is used to describe the motivation that drives humans to both retain their current resources and to pursue new resources. When resources are lost or limited, individuals become stressed until those resources are regained (Hobfoll, 1989; Hobfoll et al., 2018). Resources are characterized as objects, individuals, personal

attributes, and values that are important to the individual, and which help to decrease stress and improve mood. There are four principles of COR theory: (a) resource loss adversely affects individuals more quickly and powerfully than the benefits of resource gain, (b) individuals must save and invest resources to protect against future resource loss, (c) if there is an impending potential for resource loss, gaining resources becomes even more important than usual, and (d) when resources become exhausted, an individual's demeanor changes to be irrational or aggressive in an attempt to preserve any remaining resources (Hobfoll et al., 2018).

**Effort-recovery model.** Meijman and Mulder (1998) suggested the E-R model to explain how an increase in mental or physical work demands lead to fatigue (Zijlstra et al., 2014). Within this model, fatigue is characterized by low energy levels, high irritability, and lack of motivation (Meijman, 1991), while recovery is characterized as the process of eliminating fatigue symptoms in order to improve energy levels (Meijman & Mulder, 1998). According to the E-R model, an individual will accept new tasks if they feel energized enough to complete the demands required of the task. If fatigue remains high due to the unwillingness or inability to engage in the recovery process, the individual is in a reduced capacity to work (Zijlstra et al., 2014).

**Recovery experience model.** As described by Sonnentag and Fritz (2007), the recovery experience model explains the processes related to relaxing from work stressors (Hunter & Wu, 2016; Sonnentag & Fritz, 2007; Sonnentag et al., 2017). The ways in which individuals recuperate from work include four recovery experiences: (a) *psychological detachment* from work, (b) *relaxation* during leisure time, (c) *mastery* of challenging tasks or activities outside of the workplace environment, and (d) *control* of activity type, duration, and length during leisure time (Sonnentag & Fritz, 2007). These four recovery experiences have been utilized in the literature to describe off-job leisure time such as evenings and weekends (e.g., Binnewies et al., 2010; Fritz et al., 2010; Sonnentag, 2012), vacations (e.g., de Bloom et al., 2012; Hächler et al., 2017), and lunch breaks (e.g., Bosch et al., 2018).

***Integrated model of stress and recovery on the weekend.*** Ragsdale and colleagues (2011)

offered the integrated model of stress and recovery on the weekend to describe how a college student's academic stressors during the week can be counterbalanced by engaging in recovery activities on the weekend. Stressors are characterized by workload (i.e., volume of work) and role ambiguity (i.e., uncertainty as to how to complete the volume of workload), while recovery activities include any action that helps to rebuild resources and prepare for the weekdays ahead, such as social activities or low effort, relaxing activities (Ragsdale et al., 2011). The subjective thoughts and feelings related to the chosen recovery activities are known as the recovery experience. Since researchers and practitioners using this model operate under the assumption that students have an abundance of free time on the weekends, it may not be appropriate for students who have jobs or other obligations on the weekend.

***Occupational recovery theories summary and practical application.*** Consistent with authors of other recovery theories and models (e.g., Kellmann, 2002; Kenttä & Hassmén, 1998), authors of the occupational recovery theories and models suggest that resources can be accumulated and are made available to individuals in the event that psychological or physiological stressors develop (i.e., an individual can "bank" recovery activities in preparation for stressful events). If resources are depleted, negative consequences will arise until the resources are replete again (Zijlstra et al., 2014). When considering the athlete population, athletes must engage in physical, psychological, and social recovery activities such as attaining adequate sleep, engaging in relaxation techniques, and talking with friends, respectively, to optimize performance as well as reduce the risk of overtraining and injury. As psychological and physical work demands fluctuate, a novel subjective assessment of recovery will be used to monitor recovery activities in order to improve and maintain resources.

***Athlete recovery models.*** Athlete recovery models are used to explain the balance between psychological and physiological stress and recovery in order to facilitate performance and to prevent injury and illness. This stress-recovery balance is explained using the overtraining and recovery

conceptual model (Kenttä & Hassmén, 1998) as well as the scissors-model of the interrelation of stress-states and recovery demands (Kellmann, 2002).

***Overtraining and recovery conceptual model.*** Developed by Kenttä and Hassmén (1998), the overtraining and recovery conceptual model is used to describe the balance between training and recovery, specifically an athlete's ability to adapt to and withstand stress without exhibiting overtraining symptoms. To combat stress, the recovery process must include engagement in recovery activities which match the source of the stress (Kenttä & Hassmén, 1998). For example, stressors of a psychological origin should be matched with recovery interventions that alleviate the psychological stress, such as meditation or journaling. When the recovery intervention matches the origin (i.e., psychological, physiological, social) and magnitude (i.e., minor, major) of the stressor, an athlete develops stress tolerance. As stress tolerance increases, an athlete begins to adapt to the stressors and will no longer be as affected by the stressor. This concept is known as the *individual adaptation threshold* as it describes an athlete's total stress, their ability to tolerate the stress, and the recovery activities an athlete chooses to engage in to alleviate the stress.

***Scissors-model of the interrelation of stress-states and recovery demands.*** Kellmann (2002) suggested the scissors-model of the interrelation of stress-states and recovery demands, whereby increases in recovery must simultaneously occur as stress increases if the stress-recovery balance is to remain stable. The stress states and recovery demands affect one another such that if an athlete is unwilling or unable to take the time to recover, more stress will accumulate which can lead to symptoms of overtraining (Kellmann, 2002). If an athlete *is* able to make the time to recover and regularly engages in quality recovery activities, however, an increase in stress will not necessarily impact their performance and health (Kellmann, 2010). In the above-mentioned instance, the stress-recovery balance remains stable and an athlete can cope effectively with the stress.

***Athlete recovery models summary and practical application.*** Authors of the athlete recovery models propose that individual-specific recovery activities are essential for optimizing performance and maintaining health and wellness. The recovery activities must also match the stressor that is placed upon the athlete, be it psychological, physiological, or social stress. While the sources of stress may not be controllable for an athlete, the *management* of that stress is controllable in the way an athlete chooses their recovery activities as well as the frequency and duration of engagement in those activities.

**Recovery theories and models conclusions.** In review of the literature on recovery theories and models, it becomes apparent that athletes have individual preferences for the environments, interactions, and activities believed to facilitate their recovery. Together, components of the aforementioned recovery theories and models will be used to inform the development of a subjective assessment of recovery activities for athletes. From the restoration environment theories, for example, some athletes may choose to spend their leisure time in nature thus reducing their mental fatigue and improving their concentration, positive thoughts, and emotions. From the occupational athlete theories, athletes may regularly engage in psychological and physiological recovery activities to counteract the potential stressors that result from their sport and/or academic endeavors and to maintain high energy levels and attentional focus. From the athlete recovery models, athletes may choose individual-specific recovery activities that match the origin of their stressor. As it is typical for assessments to be derived from theories and models, the purpose of the following section is to evaluate the current recovery assessments used among athletes.

### **Recovery Assessments**

Consistent with the scientist-practitioner approach, several of the preceding theories and models have been used to conceptualize recovery assessments currently applied within the athlete population. While various objective measures of recovery exist including biochemical (e.g., Garatachea et al., 2011; Hecksteden et al., 2017), hormonal (e.g., Auersperger et al., 2014; Faude et al., 2009), and

immunological (e.g., Nunes et al., 2014; Papacosta & Nassis, 2011), researchers (Meeusen et al., 2013; Saw et al., 2016) have suggested that data from *subjective* assessments may provide the best indication of an athlete's recovery status. Table 1 and the review by Nässi et al. (2017) contain a comprehensive description of the most commonly used subjective assessments in the athlete recovery literature. To augment the work of Nässi and colleagues (2017), the purpose of the current section is to critically evaluate these six subjective assessments in chronological order and in so doing demonstrate the need to develop a new subjective recovery assessment for athletes.

**Profile of Mood States (POMS).** The POMS (McNair et al., 1992) is used to determine the mood states of an individual using various stems including how one feels in the moment as well as how one feels generally over the past week. The 65-item assessment consists of six scales including *Tension*, *Depression*, *Anger*, *Fatigue*, *Confusion*, *Vigor*, and a global mood score. Within the context of the athlete recovery literature specifically, and because only one positive mood state is assessed in the POMS, the assessment may be better suited to detect symptoms of overtraining than to detect processes of recovery. Since the POMS is only used to evaluate mood states, other components of the recovery process such as physical or social recovery are not considered. As such, practitioners need to use the POMS in conjunction with other assessments to facilitate overall athlete recovery, a method which is neither time nor cost effective. Researchers should ensure that future assessments include multidimensional components of recovery to provide a more economical and holistic tool for athletes.

**Total Quality Recovery (TQR).** The TQR (Kenttä & Hassmén, 1998), developed using the overtraining and recovery conceptual model, is a two-part assessment used to determine an athlete's current perceived recovery status as well as the recovery activities an athlete has engaged in over the past 24 hours. Adapted from Borg's Rating of Perceived Exertion scale (Borg, 1998), the TQR perceived scale (TQRper) consists of one item that asks athletes to rate their recovery right now on a scale from 6 (no recovery) to 20 (maximal recovery). The TQR action scale (TQRact) consists of 13 items that are

point-based and related to the areas of nutrition and hydration, sleep and rest, relaxation and emotional support, and stretching and cooldown. Athletes accumulate points every day by engaging in specific recovery activities in each of the four areas. One limitation of the TQRact is the seemingly arbitrary point system (e.g., lack of explanation as to why nutrition is worth twice as many points as sleep/rest points given current research on sleep; no rationale for the decision to award more points to lunch than to breakfast, etc.). Furthermore, activities on the TQRact could be considered outdated compared to current best practices (i.e., specific carbohydrate intake [Belski, 2019], sleep recommendations [Halson, 2019]), impractical (i.e., post-workout relaxation, no daily psycho-social stress), and incomplete (e.g., absence of social recovery, psychological detachment [Heidari et al., 2018]). Given these limitations, the development of an updated, psychometrically-sound assessment of recovery activities would provide more accurate and useful information to facilitate recovery in athletes.

**Recovery-Stress Questionnaire for Athletes (RESTQ-Sport).** Developed using the scissors-model of the interrelation of stress-states and recovery demands, the RESTQ-Sport (Kallus & Kellmann, 2016; Kellmann & Kallus, 2001) is used to assess stress and recovery related to the physical, mental, and social aspects of an athlete's sport-specific and overall life. Originally developed as a 76-item assessment (Kellmann & Kallus, 2001), the RESTQ-Sport is now available in a 52-item and 36-item version, both of which retain the adequate psychometric properties of the longer version (Kallus & Kellmann, 2016). Although the RESTQ-Sport is considered one of the best assessments to guide intervention strategies in athletes (Brink et al., 2012), Kallus (2016) clearly affirms in the *RESTQ User Manual* that the primary purpose of the RESTQ-Sport is to assess the stress-recovery *state* of the individual. Failure of the RESTQ-Sport to provide information regarding the recovery activities an athlete engages in, along with the fact that stress is often uncontrollable, prompts the suggestion that researchers should focus future studies on monitoring recovery generally and recovery activities specifically.

**Emotional Recovery Questionnaire (EmRecQ).** The EmRecQ (Lundqvist & Kenttä, 2010) was

developed to fill the gap in emotional recovery research created by the POMS, as the presence of positive emotions indicates recovery processes occurring. Comprised of 22 items, the EmRecQ includes the scales of *Happiness, Security, Harmony, Love, and Vitality*, whereby athletes are asked to respond to the items with the last few days in mind. As discussed by Nässi et al. (2017), limitations exist with the EmRecQ including few published research studies using the assessment and no psychometric evaluations conducted with the English version. Lundqvist & Kenttä (2010) also acknowledged that in order to understand the range of an athlete's emotional states, the EmRecQ should be implemented along with the POMS, which would be time consuming for an athlete to complete regularly. In addition to the above limitations, and consistent with the POMS, the EmRecQ can only be used to evaluate *emotional* recovery. Since the EmRecQ does not include multidimensional components, a holistic representation of recovery cannot be established with this assessment and other assessments would be required to fill gaps in the recovery process.

**Acute Recovery and Stress Scale (ARSS).** The ARSS (Kellmann et al., 2016) includes adjectives to describe how athletes currently feel regarding their stress and recovery states. The assessment consists of 32 items and includes four stress scales (i.e., *Muscular Stress, Lack of Activation, Negative Emotional State, Overall Stress*), and four recovery scales (i.e., *Physical Performance Capability, Mental Performance Capability, Emotional Balance, Overall Recovery*). Although the items are relatively straightforward and comprehensive, the amount of time it takes to complete the items is seen as prohibitive to complete on a daily basis (Nässi et al., 2017). Additionally, and similar to the RESTQ-Sport, the purpose of the ARSS is to determine athlete stress and recovery status which does not provide information related to *how* the athlete arrived to their indicated recovery state. With the absence of items related to recovery activities, the ARSS cannot be used in isolation and is therefore not an economical tool.

**Short Recovery and Stress Scale (SRSS).** The SRSS (Kellmann et al., 2016), a shortened version of the ARSS, was developed for daily monitoring of athletes. The eight items of the SRSS reflect each of the eight scales of the ARSS. Limitations of the SRSS include social desirability bias (Nässi et al., 2017) and lack of items related to recovery activities. The latter limitation is a concern consistent with the RESTQ-Sport and the ARSS, which should be considered in the development of future recovery assessments.

**Recovery assessment conclusions.** Over the last three decades, and in an effort to optimize athlete performance, health, and well-being, researchers have made significant progress in developing assessments to monitor recovery. While most of the assessments include components of recovery and stress, researchers have recently focused their efforts on the more controllable component—recovery. That said, the present-day emphasis on recovery *status* rather than recovery *activities* limits practitioner understanding of how an athlete arrived at their recovery state and thereby reduces the ability to replicate activities that may facilitate recovery. Taking into consideration the limitations of the current assessments, in conjunction with the need to optimize recovery among athletes through an actionable process, the development of a multidimensional subjective assessment of recovery activities is warranted.

### **Directions for Future Research**

Given the limitations of the currently utilized recovery assessments, the next logical step in recovery research is to develop a new subjective assessment of recovery activities for athletes. In so doing, a new assessment should reflect contemporary recovery research, including: (a) a focus on recovery activities in addition to recovery status, (b) an emphasis on individual-specific activities as opposed to a one-size-fits-all model (Beckmann & Kellmann, 2004; Heidari et al., 2018; Kellmann et al., 2018), and (c) a conceptualization of recovery through a multidimensional lens as opposed to a unidimensional lens (Heidari et al., 2018; Kellmann et al., 2018; Mujika et al., 2018). To inform the development of items on the proposed assessment, the purpose of the current section is to summarize

the types of physical, psychological, and social recovery activities an athlete may volitionally choose to complete.

**Sleep.** Sleep has been identified as a major contributor to athletic performance such as speed (Skein et al., 2011), endurance (Oliver et al., 2009), and anaerobic power (Taheri & Arabameri, 2012), as well as cognitive performance such as reaction time (Taheri & Arabameri, 2012) and decision making (Almonroeder et al., 2020). Researchers have also highlighted the importance of sleep as one way to reduce the incidence of injuries and to improve injury rehabilitation outcomes (Charest et al., 2020; Walsh et al., 2020; Watson, 2017). Given the restorative properties of sleep (Fullagar et al., 2017; Kölling et al., 2019; Lastella et al., 2014), it comes as no surprise that many researchers believe sleep to be an integral component of the sport recovery process (Biggins et al., 2019; Gupta et al., 2017; Halson, 2013; Kölling et al., 2019). Expert consensus statements (Walsh et al., 2020) recommend an individualized approach to sleep as a result of differences in sport (e.g., training load, travel schedule) and non-sport (e.g., gender, stress levels) factors. Sleep recommendations—which will translate to sleep activities for item development—include improving the sleep environment, considering naps, implementing a sleep/wake schedule, limiting caffeine and alcohol in the hours leading up to sleeping, and reducing light exposure before bedtime (Driller et al., 2018; Halson, 2013; Simpson et al., 2017; Vitale et al., 2019).

**Fuel.** Nutrition and hydration (collectively called *fuel*) tailored to the specific needs of the athlete are essential for maintaining energy levels and preventing muscle breakdown (Heaton et al., 2017; Kim & Kim, 2020; Vitale & Getzin, 2019). The importance of proper nutrition is reinforced via a consensus statement made by several prominent organizations within the sport science industry: “It is the position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine that the performance of, and recovery from, sporting activities are enhanced by well-chosen nutrition strategies” (Thomas et al., 2016, p. 543). Hydration status is also imperative to monitor and replenish as exercise is known to alter an individual’s fluid balance, which could decrease

performance and create safety risks for athletes (Belval et al., 2019). Dehydration can also cause physiological strain on the body (Trangmar & González-Alonso, 2019), thus it is recommended that hydration be incorporated in an athlete's post-exercise recovery plans (Armstrong & Casa, 2009). While an athlete's nutrition and hydration needs vary drastically due to the athlete's sport, training load, goals, and the environment (Beck et al., 2015; Belval et al., 2019), common fuel practices should be taken into consideration daily to improve recovery and to prepare for future events. Examples of fuel practices (i.e., activities) for item development include attaining appropriately portioned macro- and micronutrients to meet the unique demands of sport and to support cognitive function, timing nutrient intake relative to past and future training/competition, avoiding excessive alcohol, and observing urine color to assess adequate hydration status (Belski et al., 2019; Kostelnik et al., 2020; Thomas et al., 2016; Vitale & Getzin, 2019).

***Physical strategies.*** The construct of *physical strategies* is all-encompassing and describes the recovery activities athletes may utilize to feel physically relaxed following training and/or competition and to feel prepared for subsequent events. The physical recovery strategies athletes may choose to use are extensive and include cold water immersion (Getto & Golden, 2013; Martinez-Guardado et al., 2020), cryotherapy (Douzi et al., 2019; Wilson et al., 2019), stretching (Behara & Jacobson, 2017; Merrigan et al., 2017), foam rolling (Hendricks et al., 2020; Skinner et al., 2020), compression garments (Atkins et al., 2020; Brown et al., 2017), massage (Davis et al., 2020; Poppendieck et al., 2016), and sauna (Mero et al., 2015; Skorski et al., 2019b), among various other strategies. Given that the effectiveness of and preference for various physical recovery strategies has been widely debated in the recovery literature (Crowther et al., 2017; Murray et al., 2018; Ortiz et al., 2019; Shell et al., 2020), and the notion that athletes have access to different recovery modalities (Shell et al., 2020; Tavares et al., 2017), specific strategies will not be explicitly identified within the development of the items. Instead,

athletes will be asked whether or not they engaged in an activity that allowed their body to feel physically relaxed and ready for sport.

**Training breaks.** Training breaks can be defined as the cessation from training/competition and may be considered synonymous with passive rest, or a period of physical inactivity (Kellmann et al., 2018). Similarly, Bishop and colleagues (2008) use the phrase “training recovery” to describe the period of time between workouts or competitions. Allowing athletes time to physically rest after strenuous training loads or competitions is important to avoid symptoms of overtraining and burnout (Cardoos, 2015; Hausswirth & Majika, 2013; Meeusen et al., 2013). Research suggests that athletes spend far more time in recovery (i.e., training breaks) compared to active training (Bishop et al., 2008), with results of one study indicating that athletes spend up to 79% of their time in sedentary activity while not in training (Weiler et al., 2015). Conversely, anecdotal evidence and popular press articles suggest that athletes use training breaks to catch up on non-sport tasks (e.g., running errands, cleaning) or to engage in non-primary sport physical activities (e.g., hiking, snowboarding, windsurfing), which may not necessarily be activities that promote physical recovery. Regardless of how effortful an athlete perceives their non-sport activities to be, athletes should take time away from strenuous physical activity in order for the body to recuperate and to avoid overtraining and burnout (Kellmann, 2010). For the purposes of item development, controllable activities will include the act of physically resting or pursuing individual-specific, low intensity endeavors (e.g., walking the dog, stretching).

**Psychological detachment.** Derived from the occupational recovery literature, psychological detachment refers to the idea of “switching off” from work while away from work, or the cessation of work-related thoughts in off-job time (Sonnentag & Fritz, 2007; 2015). In recent years, the concept of psychological detachment has been translated to the sport literature where researchers have provided empirical support indicating that a reduction in sport-related thoughts and emotions enhances perceptions of mental recovery (Balk et al., 2017; Eccles & Kazmier, 2019) and health and well-being

(Balk et al., 2019), and can reduce perceptions of mental fatigue (Balk & de Jonge, 2021; Russell et al., 2019). Indeed, ceasing physical activity alone does not necessarily provide athletes with a mental break, thus compromising overall perceptions of recovery (Eccles & Kazmier, 2019; Loch et al., 2019). As such, and drawing upon the stressor-detachment model (Sonnentag & Fritz, 2015), recovery activities that facilitate psychological detachment from sport will include shifting focus away from sport activities (e.g., engage in a hobby, avoid cues that are a reminder of sport) and taking time to interact with individuals other than teammates (Eccles & Kazmier, 2019; Eccles et al., 2021).

**Relaxation.** Relaxation is a process by which individuals deliberately engage in low effort leisure activities aimed at enhancing mood and overall health and well-being (Sonntag & Fritz, 2007; Stone et al., 1995). Engaging in relaxation activities facilitates the recovery process by reducing the risk of illness caused by stress (Brosschot et al., 2005). Said differently, and according to the conservation of resources theory (Hobfoll, 1998), when stress threatens an individual's resources (i.e., objects, personal attributes, values that are important to the individual), engagement in recovery is needed in order to regain those resources. Completing activities that are relaxing is one way to replenish lost resources, thereby improving mood and health. Furthermore, engaging in relaxation activities is an important process in not only an athlete's personal life, but also *during* sport to facilitate self-regulation and to enhance performance (Kellmann & Beckmann, 2014; Pelka et al., 2016; Solberg et al., 2000). In terms of item development, and similar to the *physical strategies* construct, athletes will be asked whether or not they engaged in an activity (e.g., breathing techniques, imagery, listening to music, watching television) that reduced their tension and anxiety during sport and non-sport time.

**Autonomy.** Autonomy is derived from the Greek phrase meaning "self-law" and is defined as exerting agency over one's life. According to Self-Determination Theory (Deci & Ryan, 1985), autonomy is a central need of every human being in order to grow, develop, and be motivated. Autonomy has been used as a construct throughout the occupational recovery literature to describe the personal

control that individuals have during leisure time (Beckmann & Kellmann, 2004; Sonnentag & Fritz, 2007). Sonnentag & Fritz (2007) proposed that autonomy may enhance the recovery process by increasing perceptions of competence and self-efficacy, thereby enhancing an individual's health and well-being. The need for autonomy has also been examined within the sport literature. Eccles and Kazmier (2019) observed that when athletes perceived themselves to be "externally controlled" by training or competition schedule or unable to make choices in their personal life, they felt less mentally rested, thus thwarting the recovery process. While recovery becomes exceedingly more important as the level of competition increases (Venter et al., 2010), ironically, autonomy over choices likely decreases for elite athletes due to contract stipulations (Kimball, 2007). For item development, athletes will be asked the extent to which they felt autonomous in their choices, both in and out of sport.

***Mastery.*** Derived from the occupational recovery literature, mastery experiences refer to activities that challenge an individual and allow for opportunities to learn in non-work environments (Sonnentag & Fritz, 2007). Mastering a task involves focusing on the process and attempting to improve at the task, thereby promoting competence (Nicholls, 1984). Competence improves positive affect and health and well-being (Fay & Sonnentag, 2012; Parkinson & Totterdell, 1999), which in turn enhances perceptions of recovery (Fritz & Sonnentag, 2007). Within the sport literature, researchers have discovered that engagement in recovery strategies is negatively associated with sport burnout (Kellmann & Gunther, 2000), and engagement in non-sport hobbies specifically could serve as one way to enhance the recovery process, thus reducing the potential for sport burnout (DeFreese et al., 2015). Furthermore, anecdotal evidence supports the notation of mastering an activity outside of sport, including enrolling in college courses, learning a language, or practicing a new skill. Viral media postings revealing British Olympic diver Tom Daley and his fondness for knitting between events at the Tokyo Olympics highlight the importance of pursuing a hobby outside of sport. Indeed, focusing on a hobby external to sport likely aids in recovery due to reducing burnout and frustrations associated with a sense

of missing out, thereby optimizing health (DeFreese et al., 2015; Eccles et al., 2021; Henriksen et al., 2020). For item development, athletes will be asked if they engaged in challenging tasks outside of sport or made progress toward sport and non-sport goals.

**Community.** Community is feeling a sense of belonging and participating in a shared goal bigger than oneself (Allen, 2003; McMillan & Chavis, 1986). While participation in sport inherently creates a sense of belonging among most athletes (Allen, 2006; Wann et al., 2017; Warner & Dixon, 2011), athletes also seek a desire to give back to the communities in which they reside, whether it be volunteering their time (Deal & Camiré, 2016; Hoffman et al., 2015) or participating in philanthropic endeavors (Babiak et al., 2012; Tainsky & Babiak, 2011). Even the International Olympic Committee (IOC) encourages athletes to be a part of something bigger than themselves with “building a better world through sport” at the heart of their values (IOC, 2020). Additionally, while the advantages and disadvantages of social media usage among athletes has been heavily discussed within the literature (Browning & Sanderson, 2012; Hayes et al., 2019; Sanderson, 2018), research consistently indicates that when used appropriately, social media can be a powerful platform for athletes to advocate and promote important causes (David et al., 2018) and to connect with fans and supporters (Browning & Sanderson, 2012; Kassing & Sanderson, 2010), thus fostering a sense of belonging. Indeed, Hayes and colleagues (2019) found that a primary purpose for athletes using social media was to feel connected to the outside world, as well as to relax and escape from the pressures of sport. These results suggest that social media can be used not only to promote a sense of belonging within the community, but also as a mechanism to increase perceived recovery. Taken together, and in order to facilitate recovery, items developed within the construct of *Community* will include activities such as volunteering in the community, offering support and/or listening to other individuals, and using social media in a beneficial manner.

**Sport interactions.** Interactions that allow the athlete to feel supported and valued by individuals associated with an athlete’s sport defines the construct of *sport interactions*. Perceptions of

social support and team cohesion are often cited as essential components to psychological well-being, enhancing sport satisfaction, and reducing susceptibility to stress and burnout (Cranmer & Sollitto, 2015; DeFreese & Smith, 2013, 2014; Gabana et al., 2017; Martin et al., 2013). Given the amount of time athletes spend in proximity to teammates, it is no surprise that athletes often call their teammates “family”. Furthermore, researchers have noted that athletes have a more pleasurable sport experience and feel especially supported when coaches and administration take an interest in the well-being of the *whole* athlete, including non-sport aspects of life (Warner & Dixon, 2011). As such, social recovery within the team setting may be facilitated by open communication among all members on a team (e.g., athletes, coaches, support staff), providing and receiving social support, and having fun together (Anderson & Dixon, 2018; DeFreese & Smith, 2014; Heidari et al., 2018), all of which will be considered when developing items.

***Non-sport interactions.*** Non-sport interactions are positive encounters with individuals not associated with an athlete’s sport, encounters which make the athlete feel valued and supported. Indeed, taking time away from teammates and coaches has been suggested as one way to enhance the rest and recovery experience of an athlete (Eccles & Kazmier, 2019; Eccles et al., 2020). Recovery is diminished when athletes do not feel they have time for a personal life outside of sport, including adequate time with friends and family (Eccles & Kazmier, 2019; Eccles et al., 2021). Given that teammate and coach conflict has frequently been cited as a source of stress for athletes in the literature (Fletcher et al., 2012; Kristiansen et al., 2012; Mellalieu et al., 2013; Wachsmuth et al., 2018) and because poor relationships with teammates/coaches are associated with an increased risk for injury (Pensgaard et al., 2018), making time for individuals not connected to their sport should be emphasized to facilitate recovery among athletes. Items developed within this construct will reflect the aforementioned considerations.

**Proposed subjective assessment of recovery activities conclusions.** As indicated above, there are a variety of physical, psychological, and social recovery activities in which an athlete can participate. That said, an athlete's perception of the recovery activity (Cook & Beaven, 2013; Crowther et al., 2017; Murray et al., 2018) as well as their access to the recovery activity (Venter, 2014) influence choice of recovery activity. For recovery activities to be effective, athletes must be educated on the type and purpose of recovery activities as well as be willing and able to regularly implement the activities into their schedule (Kellmann et al., 2018). To facilitate regular implementation of activities, a subjective assessment of recovery activities will be created to maximize athlete health and peak performance.

### **Literature Review Conclusions**

A thorough review of the recovery literature led to the identification of gaps in the currently used recovery assessments and the need for development of a new subjective assessment of recovery that reflects both seminal and contemporary recovery research. Specifically, the focus of future recovery research must move beyond describing only athlete recovery status and towards identifying and monitoring athlete recovery activities. As suggested by Kellmann (2002), the recovery activities can be passive, active, or proactive, yet the most important characteristics of the activities are that they are individual-specific and include multidimensional components (Heidari et al., 2018; Kallus & Kellmann, 2016). A multidimensional emphasis also means that physical, psychological, and social recovery activities must match the source of the stress as demonstrated by Kenttä and Hassmén's (1998) overtraining and recovery conceptual model. As athletes choose the appropriate recovery activities, they must also be mindful of *regularly* engaging in the activities so as to reduce the risk of stress accumulation and symptoms of overtraining (Kellmann, 2002). Given the findings of the current literature review, and in order to maximize athlete health and peak performance, the purpose of the current research was to develop a subjective assessment of multidimensional recovery activities for athletes.

## **Rationale for Dissertation Research**

The paucity of contemporary recovery assessments that monitor multidimensional recovery activities prompted the need for the current line of research dedicated to developing a subjective assessment of multidimensional recovery activities for athletes. In an effort to develop the most psychometrically sound assessment, the aims of the proposal were two-fold, as described below.

The purpose of Study 1 was to develop and evaluate the content validity of an initial item pool for the Assessment of Recovery Activities for Athletes (ARAA). Using guidelines proposed by DeVellis (2017) and Netemeyer et al. (2003), this purpose was accomplished via the following four-step process: (a) identify theoretical factors, (b) develop items within each factor, (c) evaluate content validity via expert reviewers, and (d) evaluate content validity via cognitive interviews with athletes. It was hypothesized that the items developed within each factor would be validated by both the expert item reviewers and by the athletes.

The purpose of Study 2 was to evaluate the factor structure and psychometric properties of the recovery activity items developed and content validated in Study 1. To achieve statistical rigor, the purpose was accomplished via the following four-step process: (a) distribute the recovery activity items and other assessments to athletes, (b) evaluate the factor structure of the recovery activity items, (c) evaluate the convergent validity of the assessment, and (d) evaluate the reliability of the assessment. It was hypothesized that the ARAA would yield an appropriate overall and local model fit consisting of three 2<sup>nd</sup> order factors and 11 1<sup>st</sup> order factors, and would be a valid and reliable measure of recovery activities.

Table 1

*Psychological Tools for Monitoring Training Responses*

Measure	Structure	Purpose	Strengths	Limitations
Profile of Mood States (POMS)	65 items: 6 factors 5 negative affect scales 1 positive affect scale	Provide general mood state insights	Widely used in research and practice Available in many languages Several shorter modifications	Not initially developed with athletes in mind Full version is too lengthy for daily use
Total Quality Recovery (TQR)	5 items: 2 parts 1 perceived recovery score 4 recovery-related actions	Monitor recovery and prevent overtraining syndrome	Considers many aspects of recovery Reminds athletes of paramount recovery actions	Complex system to maintain in team environment
Recovery-Stress Questionnaire for Athletes (RESTQ-Sport)	76 items: 19 factors 10-stress related 9 recovery-related	Assess recovery-stress states	Comprehensive and multi-dimensional overview of both recovery and stress Available in many languages	Full version is too lengthy for daily use
Emotional Recovery Questionnaire (EmRecQ)	22 items: 5 positive emotional states	Evaluate emotional recovery	Considers positive emotional states that are often ignored	No published psychometric studies for the English version available
Acute Recovery and Stress Scale (ARSS)	32 items: 8 factors 4 stress-related 4 recovery-related	Assess current recovery-stress states	Multi-dimensional insights of recovery and stress	Too lengthy for daily use over a longer period
Short Recovery and Stress Scale (SRSS)	8 items: 2 factors 1 stress-related 1 recovery-related	Assess current recovery-stress states	Suitable for daily use Multidimensional overview of recovery and stress	At higher risk of biased responses, since all scales are obvious

Adapted from “Psychological tools used for monitoring training responses of athletes” by A. Nässi, A. Ferruauti, T. Meyer, M. Pfeiffer, and M. Kellmann, 2017, *Performance Enhancement & Health*, 5(4), p. 125 (<https://doi.org/10.1016/j.peh.2017.05.001>). Copyright 2020 by Elsevier Ltd.

## Chapter II: Development of an Assessment of Recovery Activities for Athletes

### Abstract

To optimize the performance and health of elite athletes, there has been an increase in the development of athlete monitoring systems to measure *if* athletes perceive themselves to be adequately recovered (i.e., counterbalancing the effects of stressors after a demanding activity). While these monitoring systems have been instrumental in describing athlete recovery states, little research has been conducted to establish *why* and *how* athletes engage in recovery behaviors or to identify barriers that prevent athletes from initiating the recovery process. As such, the purpose of the current study was to develop and evaluate the psychometric properties of an assessment that will allow practitioners and researchers to measure and monitor the recovery activities an athlete engages in to enhance performance, health, and well-being. This purpose was achieved through two studies. In Study 1, physical, psychological, and social recovery activity items were generated and content evaluated first by experts ( $N = 3$ ) and second by elite athletes ( $N = 8$ ). Results of Study 1 yielded the retention of 71 items. In Study 2, the recovery activity items were distributed to elite athletes ( $N = 265$ ) and the factor structure was tested using confirmatory factor analysis (CFA). Convergent validity and reliability of the assessment were also tested. Results of the CFA revealed a 56-item, 10-factor model. Convergent validity was supported, and reliability for each of the 10 subscales was good. Overall, the Assessment of Recovery Activities for Athletes (ARAA) provides practitioners and researchers with a valid and reliable instrument from which to monitor recovery activities engaged in by elite athletes.

*Keywords:* recovery, recovery activities, elite athletes, scale development

With the rise in popularity of wearable technology highlighting athlete recovery metrics, elite athlete endorsements of cutting-edge recovery products to relieve muscle soreness and fatigue, and sport science and mental health professionals emphasizing the importance of counterbalancing stress through non-sport activities, the term *recovery* has recently been propagated in the sporting world. Indeed, given the relative equality in the rigor of training regimens, it has been suggested that an athlete's ability to recover appropriately may be the defining factor in their athletic success and health and well-being (Aschwanden, 2019; Heidari et al., 2018). Despite the recent increase in the use of *recovery* within the popular press, the science of recovery is not a novel concept to researchers, who have been examining recovery modalities and processes for over two decades in an effort to optimize performance and to reduce injuries (Kellmann, 2010).

Recovery has been conceptualized as a restorative process occurring after a psychophysiological stressor arises and/or as a proactive process before the stressor arises (Filho et al., 2013, Kallus & Kellmann, 2016; Kellmann et al., 2018; Nicolas et al., 2019). While historically there has been no clear agreement on the definition of stress within the literature (Kallus, 2016), contemporary researchers have identified stress as a collection of demands that disturb the homeostasis of physiological and metabolic processes (Kellmann et al., 2018). To better conceptualize the relationship between recovery and stress, two main athlete recovery models have been proposed. Kenttä and Hassmén (1998) developed the overtraining and recovery conceptual model, stating that the recovery process must include engagement in recovery activities which match the source and magnitude of the stress in order to counterbalance the deleterious effects of stress. For example, stressors of a psychological origin should be matched with recovery interventions that alleviate the psychological stress, such as meditation or journaling. Kellmann and Kallus (2001) developed the scissors-model of the interrelation of stress-states and recovery demands, describing that increases in recovery must simultaneously occur as stress increases if the stress-recovery balance is to remain stable. The stress states and recovery

demands affect one another such that if an athlete is unwilling or unable to take the time to recover, more stress will accumulate which can lead to symptoms of overtraining (Kellmann, 2002). Collectively, these two theories have been utilized by researchers and practitioners alike to inform processes and modalities of recovery.

Current best practice in facilitating recovery is a multidimensional approach (Beckmann & Kellmann, 2004; Heidari et al., 2018; Kallus & Kellmann, 2016) and is comprised of physical recovery activities (Ortiz et al., 2019; Shell et al., 2020), psychological recovery activities (Pelka & Kellmann, 2017; Pelka et al., 2016; Shell et al., 2020), and social recovery activities (DeFreese & Smith, 2014; Heidari et al., 2018). Furthermore, and in contrast to a one-size-fits-all approach, researchers recommend that recovery activities be individualized to meet the unique needs of each athlete (Doeven et al., 2017; Kellmann et al., 2018). However, despite strong theoretical and empirical evidence to suggest that individual-specific engagement in multidimensional recovery activities is essential to improve and maintain peak performance and to reduce injuries among athletes, applied research is currently lacking an assessment tool to monitor these recovery activities for athletes.

The recovery assessments used among athletes today focus only on the recovery *status* of an athlete without the addition of understanding the recovery *activities* that an athlete may engage in on a regular basis. Indeed, authors of one of the most frequently used athlete assessments—the Recovery Stress Questionnaire for Athletes (RESTQ-Sport; Kallus & Kellmann, 2016; Kellmann & Kallus, 2001)—clearly state that the primary purpose of the instrument is to assess the stress-recovery *state* of the individual (Kallus, 2016). Other popular athlete assessments, including the Acute Recovery and Stress Scale (ARSS; Kellmann et al., 2016), and the abbreviated version of the ARSS, the Short Recovery and Stress Scale (SRSS; Kellmann et al., 2016) also monitor only stress and recovery states. Despite widespread use within the athlete population (Brink et al., 2012; Nässi et al., 2017), the RESTQ-Sport, ARSS, and SRSS have shortcomings which limit their translation from research to practice.

First, because these assessments only indicate states and not processes or behaviors of recovery, they do not provide information as to *how* the athlete arrived at their perceived stress/recovery states, or what activities may be needed to maintain or improve perceptions of recovery. Second, these assessments place an equal emphasis on perceptions of stress, yet stress and sources of stress are often an uncontrollable factor for athletes (e.g., training load, competition schedule, travel). Assessments should instead focus on recovery, particularly activities that facilitate multidimensional recovery, as this *is* a controllable process for most athletes (e.g., implementing relaxation activities, improving sleep hygiene). The few assessments that do place an emphasis on recovery have limitations of their own. For example, the Total Quality Recovery scale (TQR; Kenttä & Hassmén, 1998) assesses recovery activities, yet many of the items on the scale could be considered outdated compared to current best practices (i.e., specific carbohydrate intake; cf. Belski, 2019), impractical (i.e., post-workout relaxation, no daily psycho-social stress), and incomplete (e.g., absence of social recovery, psychological detachment; cf. Heidari et al., 2018). Similarly, the Emotional Recovery Questionnaire (EmRecQ; Lundqvist & Kenttä, 2010) assesses positive mood states indicative of recovery processes, yet no psychometric evaluations have been conducted with the English version (Nässi et al., 2017) and, as the EmRecQ evaluates only emotional recovery, a holistic representation of recovery cannot be established with this assessment alone, thus limiting its economic value.

The limitations of the currently utilized assessments of recovery prompt the need for the current study, that being to develop an assessment of recovery activities for athletes. In so doing, a new assessment will reflect contemporary recovery research, including: (a) a focus on recovery activities in addition to recovery status, (b) an emphasis on individual-specific activities as opposed to a one-size-fits-all model (Beckmann & Kellmann, 2004; Heidari et al., 2018; Kellmann et al., 2018), and (c) a conceptualization of recovery through a multidimensional lens as opposed to a unidimensional lens (Heidari et al., 2018; Kellmann et al., 2018; Mujika et al., 2018). To better understand the

multidimensional recovery activities athletes might engage in to improve recovery status, 11 recovery activities were thoroughly researched and are described briefly below. Findings of the literature search subsequently informed item development within the assessment.

### **Review of Recovery Activities**

**Sleep.** Sleep is essential for health and well-being and is believed to be an integral component of the sport recovery process (Biggins et al., 2019; Gupta et al., 2017; Halson, 2013; Kölling et al., 2019). Sleep has also been identified as a major contributor to athletic performance (Almonroder et al., 2020; Oliver et al., 2009; Taheri & Arabameri, 2012), and has been known to improve injury rehabilitation outcomes in athlete populations (Charest et al., 2020; Walsh et al., 2020; Watson, 2020). To facilitate the recovery process, sleep recommendations can include improving the sleep environment, considering naps, implementing a sleep/wake schedule, limiting caffeine and alcohol in the hours leading up to sleeping, and reducing light exposure before bedtime (Driller et al., 2018; Halson et al., 2013; Simpson et al., 2017; Vitale et al., 2019).

**Fuel.** Nutrition and hydration (collectively called *fuel*) tailored to the specific needs of the athlete are essential for maintaining energy levels and preventing muscle breakdown (Heaton et al., 2017; Vitale & Getzin, 2019), thus facilitating the recovery process in athletes (Thomas et al., 2016). Individual nutrition and hydration requirements vary drastically due to the athlete's sport, training load, goals, and the environment (Beck et al., 2015; Belval et al., 2019), and must be taken into consideration when developing quality fuel plans. Examples of fuel practices to facilitate recovery can include consuming appropriately portioned macro- and micronutrients, timing nutrient intake relative to past and future training/competition, avoiding excessive alcohol, and observing urine color to assess adequate hydration status (Belski et al., 2019; Kostelnik et al., 2020; Thomas et al., 2016; Vitale & Getzin, 2019).

**Physical Strategies.** The construct of *physical strategies* is all-encompassing and describes the recovery activities athletes may utilize to feel physically relaxed following training and/or competition and to feel prepared for subsequent events. The physical recovery strategies athletes may choose to use are extensive and can include cold water immersion (Martínez-Guardado et al., 2020), cryotherapy (Douzi et al., 2019), stretching (Merrigan et al., 2017), foam rolling (Skinner et al., 2020), compression garments (Atkins et al., 2020), massage (Davis et al., 2020), and sauna (Mero et al., 2015), among various other strategies. Given that the effectiveness of and preference for various physical recovery strategies has been widely debated in the recovery literature (Murray et al., 2018; Ortiz et al., 2019), and the understanding that athletes may have access to different recovery modalities (Shell et al., 2020; Tavares et al., 2017), it is critical that athletes engage in individual-specific activities that allow their body to feel physically relaxed and ready for sport.

**Training Breaks.** Training breaks can be defined as the cessation from training/competition and may be considered synonymous with passive rest, or a period of physical inactivity (Kellmann et al., 2018). Physical rest after strenuous training loads or competitions is important to avoid symptoms of overtraining and burnout (Cardoos, 2015; Meeusen et al., 2013), yet anecdotal evidence and popular press articles suggest that athletes use training breaks to catch up on non-sport tasks (e.g., completing errands, cleaning) or to engage in non-primary sport physical activities (e.g., snowboarding, windsurfing). Engagement in these activities may hinder the recovery process, and as such, it is recommended that athletes use training breaks to physically rest or to pursue individual-specific, low intensity endeavors (e.g., walking the dog, stretching).

**Psychological Detachment.** Derived from the occupational recovery literature, psychological detachment refers to the cessation of work-related thoughts in off-job time (Sonnentag & Fritz, 2007; 2015). Among athletes, researchers have also observed that ceasing physical activity alone does not necessarily provide athletes with a mental break (Eccles & Kazmier, 2019; Loch et al., 2019), and that

finding ways to reduce sport-related thoughts while away from sport enhances perceptions of mental recovery (Balk et al., 2017; Eccles & Kazmier, 2019). Recovery activities that facilitate psychological detachment from sport can include shifting focus away from sport activities (e.g., engage in a hobby, avoid cues that are a reminder of sport) and taking time to interact with individuals other than teammates (Eccles & Kazmier, 2019; Eccles et al., 2021).

**Relaxation.** Relaxation is a process by which individuals deliberately engage in low effort leisure activities aimed at enhancing mood and overall health and well-being (Sonnentag & Fritz, 2007; Stone et al., 1995). Engaging in relaxation activities facilitates the recovery process by reducing the risk of illness caused by stress (Brosschot et al., 2005). Similar to physical recovery strategies, preference for and access to relaxation strategies to facilitate the recovery process are individual-specific (Pelka et al., 2016) and can include any activity that reduces tension and anxiety (e.g., breathing techniques, imagery, listening to music, watching television).

**Autonomy.** Autonomy is derived from the Greek phrase meaning “self-law” and has been used to describe the personal control that individuals have during leisure time (Beckmann & Kellmann, 2004; Sonnentag & Fritz, 2007). Within sport, Eccles and Kazmier (2019) noted that when athletes perceived themselves to be “externally controlled” by training or competition schedule or unable to make choices in their personal life, they felt less mentally rested, thus thwarting the recovery process. Therefore, to facilitate the recovery process, athletes are encouraged to find aspects within their sport and non-sport life that they can control and feel autonomous in their choices (e.g., determine non-sport schedule, choose recovery activities).

**Mastery.** Derived from the occupational recovery literature, mastery experiences refer to activities that challenge an individual and allow for opportunities to learn in non-work environments (Sonnentag & Fritz, 2007). Within the sport literature, researchers have observed that engagement in a hobby external to sport facilitates the recovery process by reducing burnout and frustrations associated

with a sense of missing out (DeFreese et al., 2015; Eccles et al., 2021; Henriksen et al., 2020). Recovery activities that promote mastery include engaging in challenging tasks outside of sport and making progress toward sport and non-sport goals.

**Community.** Community is feeling a sense of belonging and participating in a shared goal bigger than oneself (Allen, 2003; McMillan & Chavis, 1986). While participation in sport inherently creates a sense of belonging among most athletes (Wann et al., 2017; Warner & Dixon, 2011), athletes also seek a desire to give back to the communities in which they reside, whether it be volunteering their time (Deal & Camiré, 2016; Hoffman et al., 2015), participating in philanthropic endeavors (Babiak et al., 2012; Tainsky & Babiak, 2011), or even using social media as a platform to advocate and promote important causes (David et al., 2018), and to connect with fans and supporters (Browning & Sanderson, 2012; Kassing & Sanderson, 2010). When athletes are able to connect with the outside world they often report feeling relaxed and able to escape from the pressures of sport (Hayes et al., 2019), thereby facilitating the recovery process.

**Sport Interactions.** Interactions that allow the athlete to feel supported and valued by individuals associated with an athlete's sport define the construct of *sport interactions*. Perceptions of social support and team cohesion are often cited as essential components to psychological well-being, enhancing sport satisfaction, and reducing susceptibility to stress and burnout (Cranmer & Sollitto, 2015; DeFreese & Smith, 2013, 2014; Gabana et al., 2017; Martin et al., 2013). As such, social recovery within the team setting may be facilitated by open communication among all members on a team (e.g., athletes, coaches, support staff), providing and receiving social support, and having fun together (Anderson & Dixon, 2018; DeFreese & Smith, 2014; Heidari et al., 2018).

**Non-Sport Interactions.** Non-sport interactions are positive encounters with individuals not associated with an athlete's sport, encounters which make the athlete feel valued and supported. Researchers have observed that recovery is diminished when athletes do not feel they have time for a

personal life outside of sport, including adequate time with friends and family (Eccles & Kazmier, 2019; Eccles et al., 2021). Given that teammate and coach conflict has frequently been cited in the literature as a source of stress and burnout for athletes (Fletcher et al., 2012; Kristiansen et al., 2012; Mellalieu et al., 2013; Wachsmuth et al., 2018), making time for individuals not connected to sport could enhance the rest and recovery experience of an athlete.

### **Study Purpose**

Despite literature to support the importance of athlete engagement in physical, psychological, and social recovery activities for overall well-being, health, and performance, applied research has historically lacked an assessment to monitor these recovery activities. Monitoring the recovery activities an athlete engages in regularly allows practitioners to identify the strengths and weaknesses of an athlete's recovery process, potential barriers to recovery, along with suggestions to promote a more beneficial recovery experience. As such, and in order to maximize athlete health and peak performance, the overarching purpose of the current research was to develop and examine the psychometric properties of a subjective assessment of multidimensional recovery activities. This research was accomplished through the completion of two studies, described below.

The purpose of Study 1 was to develop and evaluate the content validity of an initial item pool for the Assessment of Recovery Activities for Athletes (ARAA). Using guidelines proposed by DeVellis (2017) and Netemeyer et al. (2003), the purpose was accomplished via the following four-step process: (a) identify theoretical factors, (b) develop items within each factor, (c) evaluate content validity via expert reviewers, and (d) evaluate content validity via cognitive interviews with athletes. It was hypothesized that the items developed within each factor would be validated by both expert item reviewers and athletes.

The purpose of Study 2 was to evaluate the factor structure and psychometric properties of the recovery activity items developed and content validated in Study 1. To achieve statistical rigor, the

purpose was accomplished via the following four-step process: (a) distribute the recovery activity items and other assessments to athletes, (b) evaluate the factor structure of the recovery activity items, (c) evaluate the convergent validity of the assessment, and (d) evaluate the reliability of the assessment. It was hypothesized that the ARAA would yield an appropriate overall and local model fit consisting of three 2<sup>nd</sup> order factors and 11 1<sup>st</sup> order factors, and would be a valid and reliable measure of recovery activities.

## Study 1- Item Generation and Content Validation

### Methods

#### Procedures

**Theoretical Factors.** To identify theoretical factors for the ARAA, a review of the current sport and occupational recovery literature was conducted. Given the extant literature promoting a multidimensional approach to recovery (Heidari et al., 2018; Kellmann et al., 2018; Mujika et al., 2018), it was determined that the 2<sup>nd</sup> order factors would be labeled as *Physical Recovery Activities*, *Psychological Recovery Activities*, and *Social Recovery Activities*, respectively. To describe the *Physical Recovery Activities* 2<sup>nd</sup> order factor, it can be said that when an athlete regularly engages in quality physical recovery strategies, they would likely feel rested, healthy, strong, capable, and/or energetic (Crowther et al., 2017; Kellmann & Kölling, 2019; Venter & Grobbelaar, 2018). To describe the *Psychological Recovery Activities* 2<sup>nd</sup> order factor, it can be said that when an athlete regularly engages in quality psychological recovery activities, they would likely feel mentally energized, balanced, motivated, and/or refreshed (Balk et al., 2017; Eccles & Kazmier, 2019; Loch et al., 2019). Lastly, to describe the *Social Recovery Activities* 2<sup>nd</sup> order factor, it can be said that when an athlete regularly engages in quality social recovery activities, they would likely feel supported and valued, experience positive interactions with other individuals, and/or have a sense of belonging (DeFreese & Smith, 2014; Freeman et al., 2014; Heidari et al., 2018).

Guided by literature in physical, psychological, and social athlete recovery (cf. Balk et al., 2021; Eccles & Kazmier, 2019; DeFreese & Smith, 2014; Hausswirth & Majika, 2013; Vitale & Getzin, 2019; Walsh et al., 2020), and consistent with best scale development practices (Kline, 2016), a minimum of three 1<sup>st</sup> order factors were identified within each 2<sup>nd</sup> order factor. Specifically, four 1<sup>st</sup> order factors were identified within *Physical Recovery Activities* (i.e., *Sleep, Fuel, Physical Strategies, Training Breaks*), four factors were identified within *Psychological Recovery Activities* (i.e., *Relaxation, Psychological Detachment, Mastery, Autonomy*), and three factors were identified within *Social Recovery Activities* (i.e., *Community, Sport Interactions, Non-Sport Interactions*).

**Item Development.** Following identification of the higher- and lower-order factors, an initial pool of items was created within each of the 11 1<sup>st</sup> order factors. The item development process was informed by sport recovery literature (cf. Balk et al., 2021; Eccles & Kazmier, 2019; DeFreese & Smith, 2014; Hausswirth & Majika, 2013; Vitale & Getzin, 2019; Walsh et al., 2020), previously established and validated recovery assessments (e.g., RESTQ-Sport-36, SRSS, TQR), and professional practice experiences of the authors. This process yielded 131 total recovery activity items, as well as six items related to physical, psychological, and social stress and recovery states, respectively. From an applied perspective, the six stress and recovery status items were included in order to ascertain the frequency and variety of recovery activities an athlete may need to engage in to maintain or improve their recovery.

**Expert Review.** An important step during the item development process includes the review of items by experts for clarity and conciseness, relevance to the construct, and appropriateness for the target sample (Davis, 1992; DeVellis, 2017; Rubio et al., 2003). Soliciting feedback on each item from individuals with an expertise in the content reduces bias of the items and offers an opportunity for expert input on ideas that might have otherwise been missed (Rubio et al., 2003), thereby enhancing the quality of the assessment. Lynn (1986) suggests a minimum of three content experts, with the knowledge that an increased number of experts may result in decreased chances of agreement. As such,

the content validity of all 131 items in the current study were evaluated by three expert reviewers: (a) a faculty member of social sciences with extensive research and teaching experience in assessment development, (b) a faculty member of sport and performance psychology with extensive knowledge in the psychology of rest in athletes, and (c) an Olympic sport scientist with extensive applied knowledge in physiological recovery.

After selecting the three expert reviewers, all 131 items were entered into the online survey platform Qualtrics (Provo, UT). Consistent with guidelines outlined by Lynn (1986), reviewers were asked to rate the relevance of each item according to our definition of the corresponding 1<sup>st</sup> order factors on a scale from 1 (poor) to 4 (very good). When rating each item, reviewers were asked to consider if the item was actionable (i.e., could an athlete be tasked to complete the item?) and if the item was appropriate for the target sample (i.e., elite athletes). A comment box was available for each item so reviewers could explain their decision on the item and provide feedback if they wished. If the item was not rated a 3 or 4 by all expert reviewers, the item was reviewed and revised for clarity or discarded (Davis, 1992).

**Cognitive Interviews.** While the expert review process is essential for assessment development, limitations in the process exist such as the possibility that experts might fail to recognize problems of comprehension or recall (Ryan et al., 2012). To reduce this limitation within the development process, cognitive interviews with the target population (i.e., elite athletes) were conducted. Cognitive interviewing is an evidence-based qualitative method used to identify areas of confusion and misalignment between the developer's intended meaning of an item and the target respondent's interpretation of an item (Castillo-Díaz & Padilla, 2013; Dumas et al., 2008; Peterson et al., 2017; Willis & Artino, 2013). All cognitive interviews followed the guidelines set forth by Peterson et al. (2017) and Willis and Artino (2013). Cognitive interview procedures were approved by the first author's university Institutional Review Board (IRB).

In order to achieve a diverse sample of elite athletes that matched the intended target population, two athletes (i.e., one male and one female) were recruited from a team sport and an individual sport at the National Collegiate Athletic Association (NCAA) Division I level and the professional level. The eight athletes interviewed included four NCAA Division I athletes (i.e., female volleyball player, female rifle athlete, male baseball player, male cross country runner) and four professional athletes (i.e., female soccer player, female trail runner, male football player, male golfer). A sample of eight participants is consistent with the current best practice of cognitive interviewing (Beatty & Willis, 2007; Peterson et al., 2017). The average age of athletes was  $22.63 \pm 2.97$  years. After explanation of informed consent, all interviews were conducted and recorded via the University-sponsored online video platform Microsoft Teams (Microsoft Corporation, Redmond, WA).

Prior to the start of each interview, the procedures were described to the participants and a cognitive warm-up exercise ensued to introduce participants to the techniques used during the interviews. Asking participants to picture where they currently lived and to describe out loud how many windows there are in the house/apartment is a warm-up exercise designed to replicate a similar process used during the interview (Willis, 2005). Participants then followed a think-aloud procedure (Willis & Artino, 2013), a cognitive interview technique in which they were asked to describe their thoughts out loud while answering the items with minimal prompts from the interviewer. For example, one item included, "How many days this week did you fuel your body to recovery from your sport?". Additional questions were asked of the participants using the verbal probe technique described by Buers et al. (2014) and Willis and Artino (2013) to elicit detailed information about certain items. For example, "what does *fuel* mean to you?". If at any time the participant hesitated before answering a question, the interviewer asked, "I can see that you are thinking about your answer, would you please speak your thoughts aloud?" (Peterson et al., 2017, p. 219).

Following verbatim transcription of the interviews, and in accordance with Peterson et al.'s (2017) comprehensive cognitive interview protocol, participant responses were reviewed, and statements related to the item interpretation were extracted for each item and compared across participants. If there was an item in which half or more of the athletes' interpretations did not correspond with the developers' intent of the item or was found to be confusing or difficult to recall, that item was reviewed and revised for clarity or discarded (Peterson et al., 2017). A total of 71 recovery activity items were retained at the conclusion of the validity process.

## **Results**

Results of the initial identification of factors and items revealed three 2<sup>nd</sup> order factors, 11 1<sup>st</sup> order factors, and 131 recovery activity items. Based upon the feedback and ratings of the three expert reviewers, seven items were discarded, resulting in the retention of 124 recovery activity items. Following the cognitive interviews conducted with the eight elite athletes, 53 items were either discarded or revised for clarity. Overall results of Study 1 indicated the retention of 71 recovery activity items. The hypothesized hierarchical factor structure for the 71-item preliminary ARAA is depicted in Figure 1.

## **Study 2- Psychometric Evaluation**

The purpose of Study 2 was to evaluate the factor structure and psychometric properties of the recovery activity items developed and content validated in Study 1. Upon distribution of the recovery activity items to elite athletes, the factor structure, convergent validity, and reliability were evaluated to determine the most theoretically sound and parsimonious assessment.

## **Methods**

### **Participants and Procedure**

After obtaining IRB approval for Study 2, study recruitment occurred via email solicitation flyers, word-of-mouth, and personal invitation through existing collaborations. Using the *simsem* package

(Pornprasertmanit et al., 2020) of the R statistical software (R Core Team, 2018), a Monte Carlo simulation approach was used to estimate adequate sample size (Múthen & Múthen, 2002). Using expected factor loadings and factor correlations, this method of power analysis revealed that with an estimated small correlation ( $r = 0.1$ ) between factors and a power of 80% (Brown, 2015; Kline, 2016), 224 participants would be required to achieve adequate sample size for the current study. Upon removal of athletes who identified themselves to be injured (i.e., not actively training/competing as normal), thus potentially inhibiting their ability to engage in typical recovery activities, the final sample consisted of 265 athletes ( $M_{age} = 20.45$  years;  $SD = 1.73$  years) actively participating at the NCAA Division I, Olympic, or professional level of competition. Demographic characteristics of the sample are displayed in Table 2. After providing their informed consent, all participants completed the measures described below. Completion of these measures required approximately 10 minutes.

## Measures

**Assessment of Recovery Activities for Athletes (ARAA).** To assess the physical, psychological, and social recovery activities an athlete has recently engaged in, the 71 validated items created in Study 1 were administered to all participants. Consisting of 11 total subscales, items on seven of the subscales asked participants to recall how many days over the past week they engaged in a specific recovery activity. These items were scored on an 8-point Likert scale ranging from 0 (*0 days*) to 7 (*7 days*). An example item is, “Over the past week, how many days did I make time for a relaxing activity?”. Items on the remaining four subscales asked participants to recall how often over the past week they engaged in a specific recovery activity. These items were scored on a 5-point Likert scale ranging from 0 (*never*) to 4 (*always*). An example item is, “Over the past week, how often did I provide support to teammates or other athletes?”. The two different stems and response options for items were informed by the recovery literature (e.g., Heidari et al., 2019; Kellmann et al., 2018) and the assessment development literature (Simms et al., 2019), as the frequency of some recovery activities would ideally be daily (e.g.,

fueling body, hydrating appropriately, engaging in a relaxing activity) while the frequency of other recovery activities could be completed less to still maintain the recovery benefits (e.g., engaging in social activities). Participants were also asked to rate their level of physical, psychological, and social stress and recovery, respectively, over the past 7 days. These items were scored on an 11-point scale from 0 (*not at all*) to 10 (*extremely*).

**Recovery Stress Questionnaire for Athletes (RESTQ-Sport-36).** To assess athlete perceptions of stress and recovery, the 36-item RESTQ-Sport (Kellmann & Kallus, 2016) was administered to all participants. Consisting of 12 total subscales, the RESTQ-Sport-36 asks participants to reflect on the past 7 days/nights as it relates to their perceptions of stress and recovery states. All items are scored on a 7-point Likert scale ranging from 0 (*never*) to 6 (*always*). An example of a stress item is, “In the past 7 days/nights, I had muscle pain after performance” while an example of a recovery item is, “In the past 7 days/nights, I fell asleep satisfied and relaxed”.

## Data Analysis

**Factor Structure.** Using the *lavaan* package (Rosseel, 2012) within the R software (R Core Team, 2018), confirmatory factor analysis (CFA) was used to evaluate the a priori latent structure of the ARAA. CFA is recommended when there is a strong theoretical rationale for the hypothesized model (Brown, 2015). Two models of increasing structural complexity were tested to determine the best fitting and most theoretically accurate factor structure. Model 1 represented the 1<sup>st</sup> order factors, whereby the 71 recovery activity items loaded onto the 11 latent variables. Model 2 represented the factor structure described in Model 1, with the addition of the three 2<sup>nd</sup> order *Physical Recovery Activities*, *Psychological Recovery Activities*, and *Social Recovery Activities* latent variables. Model 2 represented the complete factor structure as originally hypothesized.

As some response options were categorical (i.e., 0-7 days), the *lavaan* defaulted diagonally weighted least squares (DWLS) estimator was used to estimate the model parameters when the items

are ordered categorical. Variance of the latent variables were fixed to 1.0 for model identification. Overall model fit was primarily evaluated using comparative fit index (CFI), gamma hat scaled ( $\hat{\gamma}$ ), and standardized root mean squared residual (SRMR) as these indices take into consideration model size and sensitivity to model misspecification (Fan & Sivo, 2007; Garnier-Villarreal & Jorgensen, 2019). In light of the literature that has succeeded Hu & Bentler's (1999) strict cut-off value recommendations, specific cut-off values were not used for evaluating fit indices (Garnier-Villarreal & Jorgensen, 2019; Marsh et al., 2004). Rather, fit indices were used to measure approximate model fit while also investigating sources of model misspecification (Thoemmes et al., 2018; Whittaker, 2012). Parameters were only added to the model if they improved local fit and were theoretically justifiable. Items with standardized factor loadings below 0.30 were deleted (Pett et al., 2003; Russell, 2002). Items were also deleted if a large modification index suggested that the item loaded better on a factor that did not match the original theoretical framework.

**Convergent Validity.** Using multiple CFAs, the convergent validity of the ARAA was evaluated against a well-established and validated assessment of stress and recovery status: the RESTQ-Sport-36. Given the nature of the ARAA examining recovery activities, only the recovery-related status items were included from the RESTQ-Sport-36. The recovery items of the RESTQ-Sport-36 were tested first, with two models of increasing structural complexity used to determine the best fitting factor structure. Model 1 represented the 1<sup>st</sup> order factor structure, whereby 18 recovery items loaded onto the six recovery latent variables. Model 2 represented the structure described in Model 1, with the inclusion of the two 2<sup>nd</sup> order *General Recovery* and *Sport-specific Recovery* latent variables. The RESTQ-Sport-36 models were analyzed using maximum likelihood (ML) estimation procedures, with CFI,  $\hat{\gamma}$ , and SRMR used to evaluate overall model fit.

In the final CFA (i.e., Model 3), the most parsimonious and best fitting model of the RESTQ-Sport-36 was then added to model structure of the ARAA. The correlations between the ARAA subscales

and the RESTQ-Sport-36 recovery subscales were then compared to examine convergence between assessment subscales.

**Reliability.** The *semTools* package (Jorgensen et al., 2020) with the R software was used to evaluate the reliability of each of the final 10 ARAA subscales. McDonald's omega ( $\omega$ ) was specifically used to estimate factor reliability as it is based upon the correlation between lower order factors and is more realistic representation of relationships between items and the construct as compared to Cronbach's alpha or Revelle's beta (Cho & Kim, 2015; Zinbarg et al., 2005).

## Results

**Factor Structure.** Results of the original 1<sup>st</sup> order hypothesized model produced a poor fit ( $\chi^2[2359] = 4946.815, p < 0.05, CFI = 0.648, TLI = .630, RMSEA = 0.066$  (95% confidence interval [0.064, 0.069]), SRMR = 0.095,  $\hat{f} = 0.776$ ). After accounting for the categorical response options (i.e., 0 to 7 days), the model fit improved slightly. Poor-performing items with standardized factor loadings below 0.30 were deleted one at a time to improve model fit, resulting in the elimination of 11 items. Additionally, several items within the *Fuel* factor cross-loaded onto the *Physical Strategies* factor. Merging the *Fuel* and the *Physical Strategies* factors into one factor made practical sense and improved the overall fit of the model. Further examination of the modification indices revealed that four items loaded better on unintended factors (e.g., a *Mastery* item loading onto the *Sleep* factor). Because it did not match the original theoretical framework nor was it appropriate from an applied perspective to allow these items to cross-load onto other factors, the items were removed and the model tested once again. The final first-order model demonstrated acceptable fit: ( $\chi^2[1540] = 7274.886, p < 0.001, CFI = 0.856, TLI = 0.846, RMSEA = 0.047$  (95% confidence interval [0.043, 0.050]), SRMR = .076,  $\hat{f} = 0.900$ ).

The model fit did not improve when the 2<sup>nd</sup> order factors were added to the model ( $\chi^2[1540] = 7274.886, CFI = 0.768, TLI = 0.757, RMSEA = 0.058$  (95% confidence interval [0.055, 0.061]), SRMR = .092,  $\hat{f} = 0.857$ ). Several of the items were identified as problematic due to low standardized factor

loadings. Parameters were not added to the model as they did not make theoretical sense. Overall, support was not observed for the fit of a hierarchical structure, indicating that a 1<sup>st</sup> order 10-factor structure (and the retention of 56 items) was the best fitting model of all models tested. Standardized parameter estimates and standard errors for the final revised model are displayed in Table 3. The revised factor structure is depicted in Figure 2.

**Convergent Validity.** Results indicated that measurement model parsimony was observed in Model 1 of the RESTQ-Sport-36 recovery subscales ( $\chi^2[120] = 399.207, p < 0.001, CFI = 0.877, TLI = 0.856, RMSEA = 0.094$  (95% confidence interval [0.084, 0.105]), SRMR = 0.069,  $\hat{f} = 0.849$ ). Support was not observed for the fit of a hierarchical structure. Specifically, adding in *General Recovery* and *Sport-specific Recovery* as 2<sup>nd</sup> order factors did not improve the model fit ( $\chi^2[128] = 451.279, p < 0.001, CFI = 0.869, TLI = 0.844, RMSEA = 0.098$  (95% confidence interval [0.088, 0.108]), SRMR = 0.079,  $\hat{f} = 0.839$ ).

As such, the first-order factor structure of the RESTQ-Sport-36 recovery subscales was added to the factor structure of the ARAA. CFA results of this merged model were deemed an acceptable fit ( $\chi^2[2628] = 8770.099, p < 0.001, CFI = 0.848, TLI = 0.836, RMSEA = 0.038$  (95% confidence interval [0.035, 0.041]), SRMR = 0.069,  $\hat{f} = 0.911$ ). Correlations between the ARAA and the RESTQ-Sport-36 recovery subscales revealed that six of the 10 ARAA subscales (i.e., *Readiness, Training Breaks, Autonomy, Community, Sport Interactions, Non-Sport Interactions*) were significantly positively related to all six RESTQ-Sport-36 recovery subscales ( $r$  coefficients ranged between 0.184 – 0.782,  $p < 0.05$ ). Model fit of the tested models are displayed in Table 4. Correlations between the ARAA and the RESTQ-Sport-36 recovery latent variables are displayed in Table 5.

**Reliability.** The reliability of each of the ARAA subscales was acceptable, with an omega coefficient range between 0.60 – 0.87. Specifically, the omega coefficient for each subscale was: *Sleep* (0.64), *Readiness* (0.83), *Training Breaks* (0.78), *Relaxation* (0.87), *Psychological Detachment* (0.73),

*Mastery* (0.60), *Autonomy* (0.66), *Community* (0.80), *Sport Interactions* (0.86), and *Non-Sport Interactions* (0.86). Omega coefficients for each subscale can be found in Table 6.

## Discussion

The overall purpose of the current study was to develop and evaluate the psychometric properties of a subjective assessment of recovery activities for athletes. Two studies were completed to develop the ARAA, with evidence obtained to support the content validity, convergent validity, and reliability of the assessment. The final assessment included 56 recovery activity items distributed across 10 subscales, as well as six individual stress and recovery status items. Factor structure and convergent validity results are explained below.

**Factor Structure.** Given that the hypothesized factor structure was developed in conjunction with contemporary multidimensional recovery literature (Heidari et al., 2018; Kellmann et al., 2018), it is important to first discuss the revised final factor structure. Contrary to the authors' Study 2 hypothesis, results of the confirmatory factor analysis did not support a hierarchical factor structure of the ARAA, that being the inclusion of *Physical Recovery Activities*, *Psychological Recovery Activities*, and *Social Recovery Activities* as 2<sup>nd</sup> order factors. The most parsimonious model was Model 1, which included only the 56 items and 10 1<sup>st</sup> order factors. Said differently, the 10 1<sup>st</sup> order factors loaded onto *each* of the three 2<sup>nd</sup> order factors (i.e., *Physical Recovery Activities*, *Psychological Recovery Activities*, *Social Recovery Activities*), rather than supporting the hypothesized factor structure whereby the four physically-related 1<sup>st</sup> order factors loaded onto only *Physical Recovery Activities*, the four psychologically-related 1<sup>st</sup> order factors loaded onto only *Psychological Recovery Activities*, and the three socially-related 1<sup>st</sup> order factors loaded onto only *Social Recovery Activities*.

These results suggest that typical physical recovery activities (i.e., sleep, nutrition, readiness, training breaks) can influence more than just physical recovery; they can influence psychological and social recovery as well. The same can be said for typical psychological (i.e., psychological detachment,

relaxation, autonomy, mastery) and social (i.e., community, sport interactions, non-sport interactions) recovery activities, as they influence more than just psychological or social recovery, respectively. Results of the factor structure can be explained when reviewing both the general exercise science and mental health literature, as well as the sport recovery literature. For example, while the latent factor of *Sleep* was hypothesized to load onto the *Physical Recovery Activities* higher order factor, in applied practice if an athlete were to have poor sleep quality and duration, the consequences affect much more than just the physical aspects of recovery. Indeed, cognitive abilities (Wild et al., 2018), emotion regulation (Palmer & Alfano, 2017), and social interactions (Diekelmann et al., 2018) among other psychological and social facets, are impacted by poor sleep as well. Similarly, relaxation activities have dual-role benefits known to promote both physical and psychological recovery (Kellmann et al., 2017; Kudlackova et al., 2013; Pelka & Kellmann, 2017). As a final example, feeling supported by teammates, friends, and family improves not only social recovery, but also contributes to improved mental health and reduces symptoms of depression (Fogaca, 2019; Sullivan et al., 2020). The inclusion of only 1<sup>st</sup> order factors (and lack of evidence supporting 2<sup>nd</sup> order factors) emphasizes the view that recovery is not only multidimensional, but also integrated. Indeed, physical, psychological, and social activities can be used to facilitate physical, psychological, *and* social recovery.

The integration of physical, psychological, and social components of recovery can be explained further by the *recovery paradox*. First postulated by Sonnentag (2018) within the occupational recovery literature, the recovery paradox refers to the observation that high job stress leads to less propensity to engage in activities that promote recovery. Informed by the recovery paradox, Balk and de Jong (2021) observed that within an athlete population, high levels of physical fatigue interfere with both the physical *and* the psychological recovery process in athletes, and labeled this phenomenon the *underrecovery trap*. Given that physical stress can impair not only physical recovery but also psychological recovery, it is proposed that physical recovery activities might facilitate not only physical

recovery, but psychological recovery as well. The recovery paradox supports the results of the current study that a higher order model did not emerge and that a multitude of recovery activities (e.g., sleep, nutrition, relaxation, psychological detachment, sport and non-sport interactions) can work interdependently to facilitate physical, psychological, *and* social recovery.

When discussing the revised factor structure of the ARAA, it is also important to note the final retained 1<sup>st</sup> order factors. Specifically, in partial support of the authors' Study 2 hypothesized factor structure, the best fitting model included 10 latent factors, not 11 latent factors. The items within the *Physical Strategies* factor and the *Fuel* factor loaded best onto just one factor. This result could be explained by verbiage used when developing the items and very high correlations between the two factors (DeVellis, 2017). As such, the good-performing items were grouped together into one factor and labeled *Readiness* due to the central theme emerging within this factor.

**Convergent Validity.** In addition to evaluating the factor structure to determine factor and item retention, convergent validity was also evaluated in Study 2. In partial support of the authors' Study 2 hypothesis, the results provided initial evidence for convergent validity. The ARAA fills a gap in the current recovery literature whereby a similar recovery activity assessment does not already exist. As such, a true comparative analysis with another related recovery activity assessment could not be made and instead, ARAA subscales were compared to recovery status subscales (i.e., RESTQ-Sport-36 recovery subscales) via confirmatory factor analysis. Specifically, six of the 10 ARAA subscales (i.e., *Readiness, Training Breaks, Autonomy, Community, Sport Interactions, Non-Sport Interactions*) were significantly related to all six RESTQ-Sport-36 recovery subscales (i.e., *General Well-Being, Sleep Quality, Social Recovery, Personal Accomplishment, Being in Shape, Self-Efficacy*). While *Sleep, Mastery, Relaxation, and Psychological Detachment* from the ARAA were not related to all of the RESTQ-Sport-36 subscales, some relationships did exist. For example, *Sleep, Relaxation, and Psychological Detachment* were related to all

RESTQ-Sport-36 subscales except for *Personal Accomplishment; Mastery* was related to all RESTQ-Sport-36 subscales except for *Personal Accomplishment* and *Self-Efficacy*.

In examining the verbiage used in item construction and when conceptualizing the recovery activities from theoretical and applied perspectives, it would seem logical that some relationships between subscales did not emerge. The RESTQ-Sport-36 subscale of *Personal Accomplishment* can be used as an example, as four of the ARAA subscales were not related to this subscale. The three items that define the *Personal Accomplishment* subscale of the RESTQ-Sport-36 are “...I dealt very effectively with my teammates’ problems”, “...I easily understood how my teammates felt about things”, and “...I dealt with emotional problems in my sport very calmly”. In review of the current literature, there is no evidence to support why these three items would be related to *Sleep, Relaxation, Psychological Detachment, or Mastery*, as described by the ARAA. The ARAA and the RESTQ-Sport-36 were conceptualized differently, and therefore different relationships between subscales exist.

From an applied perspective, the significant positive relationships between many of the subscales of the ARAA and the RESTQ-Sport-36 likely indicate that an athlete’s recovery status can be more fully understood by also considering the recovery activities reported on the ARAA. In providing more directive areas for facilitating recovery, items on the ARAA may add valuable information beyond that which can be gained from utilizing only a recovery status assessment such as the RESTQ-Sport-36. This directive information detailing the process of recovery can help researchers and practitioners to assess and subsequently monitor the recovery activities athletes engage in to facilitate recovery.

### **Limitations and Directions for Future Research**

Strengths of the ARAA include a rigorous content validity process via expert review and cognitive interviews with elite athletes, as well as a robust statistical process to ensure adequate validity and reliability. However, limitations in the methodology prompt directions for future research. First, only one sample of athletes was used to develop and to evaluate the psychometric properties of the

ARAA. It has been suggested that multiple samples should be used throughout the development process to pilot test items, evaluate items via factor analysis, test validity, and then replicate findings (Carpenter, 2018; DeVellis, 2017). Future research should therefore be conducted to replicate current findings in another large sample of athletes, thus confirming the factor structure and psychometric properties of the ARAA and improving assessment stability (DeVellis, 2017). Second, the ARAA was intentionally developed using a sample of elite athletes (i.e., NCAA Division I, professional, Olympic athletes) as these individuals likely have more recovery knowledge and better access to recovery resources as compared to non-elite athletes (Finlay et al., 2021; Tavares et al., 2017). With that, only non-injured athletes were used in the current study as injured athletes may be unable to feel fully recovered due to various physiological and/or psychological processes concomitant to sport injury (Wiese-Bjornstal, 2010). As such, future research must include a validation process in other athlete populations (e.g., NCAA Division I, II, recreational, injured athletes) in order for the ARAA to be generalizable to a broad range of athletes and competition levels. Third, participants of the current study were primarily white/Caucasian NCAA Division I athletes from the United States. As such, future research is warranted to explore the psychometric properties of the ARAA in a more diverse sample of athletes (Salazar et al., 2015; Shadish, 2002). Finally, content and convergent validity were the only tests of validity used in the current study. To provide additional evidence of a psychometrically sound assessment, future research should include discriminant validity as well as utilize integrative methods of external validity, such as a comparison of the ARAA to a physiological measure of recovery (e.g., heart rate variability).

## **Conclusions**

Results of the present study provided a description of the development and validation process of the ARAA, a 56-item assessment of multidimensional recovery activities for athletes. The ARAA fills a necessary gap in the current sport recovery literature in which recovery activities engaged in by athletes can be measured in order to maintain and/or improve the health and performance of athletes. Results

of the current study provide support for the use of the ARAA within a non-injured elite athlete population. It is recommended that future research be conducted to provide additional support for the psychometric properties of the ARAA, as well as enhance the generalizability of findings to other athlete samples.

## Figures & Tables

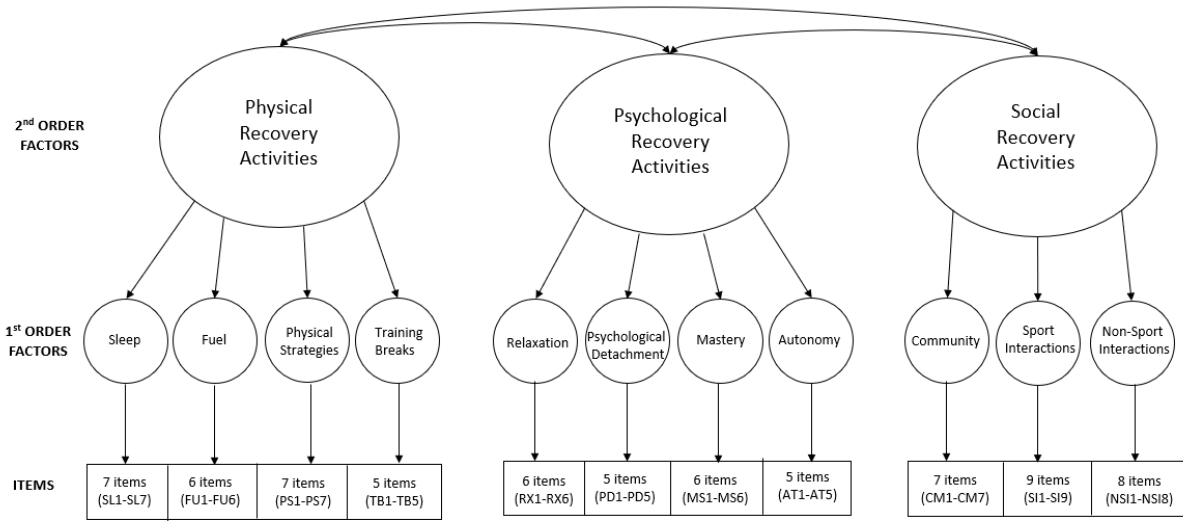


Figure 1. Hypothesized hierarchical factor structure of the ARAA.

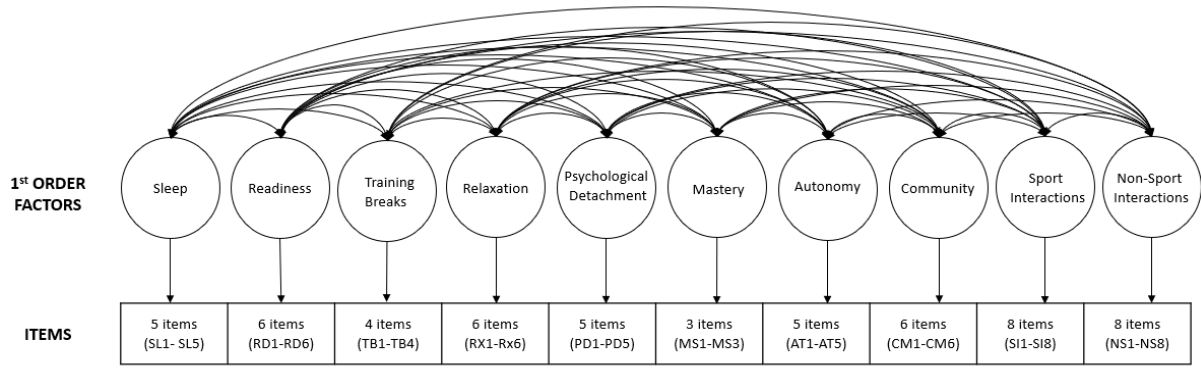


Figure 2. Revised first order factor structure of the ARAA.

Table 2

*Athlete Demographic Characteristics*

Characteristic	n	Percent by Category (N = 265)
Gender		
Male	90	34%
Female	174	65%
Non-binary	1	.03%
Race/Ethnicity*		
Caucasian/White	217	82%
Black/African American	13	5%
Asian	7	3%
Latino/a or Hispanic	10	4%
Pacific Islander	2	.07%
Season Status		
Pre-Season	11	4%
In-Season	166	63%
Off-Season	88	33%
Competition Level		
NCAA Division I	246	93%
Professional (NGB)	17	6%
Olympic	2	.07%
Sports		
American Football	4	2%
Baseball	26	10%
Basketball	15	6%
Cross Country	7	3%
Diving	1	.03%
Field Hockey	1	.03%
Figure Skating	5	2%
Freestyle Skiing	2	.07%
Gymnastics	4	2%
Ice Hockey	10	4%
La Crosse	3	1%
Marathon or Ultra-Marathon Running	1	.03%
Rifle	3	1%
Rowing	1	.03%
Soccer	47	18%
Softball	5	2%
Swimming	25	9%
Tennis	16	6%
Track and Field	61	23%
Volleyball	16	6%
Wrestling	7	3%
Other	5	2%

Note. NCAA = National Collegiate Athletic Association, NGB = National Governing Body.

\*optional question; some missing data

Table 3

*Standardized Parameter Estimates and Standard Errors for Revised Model*

Item	Standardized Estimate	Standard error
<b>Sleep</b>		
SL1	0.649	0.053
SL2	0.594	0.054
SL3	0.537	0.062
SL4	0.660	0.079
SL5	0.597	0.063
<b>Readiness</b>		
RD1	0.714	0.043
RD2	0.766	0.035
RD3	0.580	0.052
RD4	0.758	0.035
RD5	0.634	0.048
RD6	0.772	0.035
<b>Training Breaks</b>		
TB1	0.614	0.064
TB2	0.754	0.070
TB3	0.396	0.054
TB4	0.684	0.059
<b>Relaxation</b>		
RX1	0.767	0.027
RX2	0.857	0.019
RX3	0.835	0.022
RX4	0.831	0.023
RX5	0.547	0.047
RX6	0.701	0.035
<b>Psychological Detachment</b>		
PD1	0.527	0.051
PD2	0.575	0.045
PD3	0.557	0.050
PD4	0.803	0.031
PD5	0.647	0.040
<b>Mastery</b>		
MS1	0.528	0.066
MS2	0.788	0.054
MS3	0.592	0.049
<b>Autonomy</b>		
AT1	0.503	0.049
AT2	0.518	0.044
AT3	0.638	0.043
AT4	0.655	0.040
AT5	0.545	0.048

Community		
CM1	0.572	0.045
CM2	0.465	0.079
CM3	0.529	0.049
CM4	0.695	0.054
CM5	0.387	0.046
CM6	0.535	0.057
Sport Interactions		
SI1	0.698	0.111
SI2	0.544	0.068
SI3	0.768	0.098
SI4	0.775	0.067
SI5	0.495	0.055
SI6	0.771	0.095
SI7	0.609	0.057
SI8	0.616	0.075
Non-Sport Interactions		
NSI1	0.702	0.076
NSI2	0.511	0.057
NSI3	0.656	0.092
NSI4	0.811	0.086
NSI5	0.538	0.081
NSI6	0.722	0.068
NSI7	0.648	0.065
NSI8	0.391	0.073

Table 4

*Model Fit Indices of the ARAA, RESTQ-Sport-36, and Merged Model (ARAA & RESTQ-Sport-36)*

	$\chi^2(df)$	$p$	RMSEA (90% CI)	SRMR	CFI	TLI	$\hat{f}$
ARAA	7274.886(1540)	<0.001	0.047 (.043 – 0.053)	0.076	0.856	0.846	0.900
RESTQ-Sport-36	399.207(12)	<0.001	0.094 (0.84 – 0.105)	0.069	0.877	0.856	0.849
Merged	8770.099(2628)	<0.001	0.038 (0.035 – 0.041)	0.069	0.848	0.836	0.911

Table 5

*Correlations Between ARAA & RESTQ-Sport-36 Recovery Subscales*

Subscale	Being in Shape	Personal Accomplishment	Self-Efficacy	Social Recovery	General Well-Being	Sleep Quality
Sleep	0.494*	0.128	0.424*	0.368*	0.294*	0.507*
Physical Readiness	0.548*	0.189*	0.496*	0.205*	0.317*	0.427*
Training Breaks	0.584*	0.211*	0.480*	0.495*	0.461*	0.542*
Relaxation	0.498*	0.086	0.321*	0.404*	0.363*	0.386*
Psychological Detachment	0.360*	-0.023	0.184*	0.405*	0.320*	0.394*
Mastery	0.239*	0.142	0.120	0.400*	0.355*	0.284*
Autonomy	0.618*	0.391*	0.516*	0.528*	0.520*	0.472*
Community	0.344*	0.505*	0.342*	0.544*	0.408*	0.505*
Sport Interactions	0.571*	0.782*	0.553*	0.682*	0.627*	0.369*
Non-Sport Interactions	0.523*	0.492*	0.433*	0.716*	0.549*	0.405*

Note. \*  $p < 0.05$

Table 6

*Reliability of the ARAA subscales*

Subscale	McDonald's omega ( $\omega$ )
Sleep	0.64
Readiness	0.84
Training Breaks	0.78
Relaxation	0.87
Psychological Detachment	0.73
Mastery	0.60
Autonomy	0.66
Community	0.80
Sport Interactions	0.86
Non-Sport Interactions	0.86

### **Chapter III: Dissertation Conclusions**

The Assessment of Recovery Activities for Athletes (ARAA) was developed to fill a gap in the applied sport performance and sports medicine literature whereby identifying an athlete's recovery status has historically been emphasized over identifying the actions or processes an athlete took to recover. While current recovery assessments such as the Recovery Stress Questionnaire for Athletes (RESTQ-Sport), the Short Recovery and Stress Scale (SRSS), and the Acute Recovery and Stress Scale (ARSS) are used to elicit an athlete's perceptions of physical, mental, and/or emotional stress and recovery, data from these assessments alone are not comprehensive enough to indicate how or why an athlete achieved their stress or recovery status. In an effort to more proficiently translate research to practice, the purpose of the current dissertation research was to develop a clinically relevant assessment that could be used to measure and monitor the recovery activities engaged in by athletes. Monitoring the recovery activities, in turn, allows researchers and practitioners to recognize the recovery activities that promote physical, psychological, and social recovery.

The ARAA was developed through two studies. In Study 1, physical, psychological, and social recovery activity items were generated after a thorough review of the current sport and occupational recovery literature. During this first study, items were also content validated by experts and by elite athletes to determine the relevancy and comprehensibility of the items. Results of Study 1 yielded the retention of 71 recovery activity items. In Study 2, the recovery activity items were distributed to elite athletes and the factor structure was tested using confirmatory factor analysis (CFA) to ascertain the most parsimonious and best-fitting model. Convergent validity and reliability of the assessment were also tested. Results of Study 2 revealed a 56-item, 10-factor model with an additional six individual stress and recovery status items. Furthermore, evidence was obtained to support convergent validity as well as reliability.

## **Implications for Professional Practice**

An athlete's ability to regularly engage in individualized recovery activities remains a notable concern in applied sport psychology and physiology practice (Kellmann et al., 2018; Skorski et al., 2019a), a concern which is further compounded by practitioners' inability to monitor an athlete's recovery activities with a subjective assessment. With the development of the ARAA, we attempted to mitigate these gaps in the scholarly literature, thus advancing applied sport performance and sports medicine practice. First, and unlike previously developed assessments, the ARAA was conceptualized with an emphasis on recovery—a controllable aspect of sport, and not stress—an often uncontrollable aspect of sport (Kallus, 2016). Second, as the ARAA was developed to assess recovery *activities* in addition to recovery *status*, researchers and practitioners will have a monitoring tool that can be used to initially identify an athlete's recovery status and subsequently inform individualized multidimensional recovery interventions for athletes. Finally, information obtained from the ARAA provides a framework for addressing *how* an athlete achieved their indicated recovery status and what modifications may need to be made to the recovery activities to optimize health and performance. Overall, the ability to monitor individualized recovery activities using the ARAA will encourage coaches and practitioners to implement a personalized, rather than a one-size-fits-all, approach to recovery (Beckmann and Kellmann, 2004; Kellmann et al., 2018).

## **Directions for Future Research**

The development of the ARAA creates an opportunity to advance the fields of applied sport performance and sports medicine through the practice of recovery. Historically, monitoring recovery has been an interdisciplinary process whereby both subjective and objective measures of recovery are utilized to gain an understanding of an athlete's recovery status. Given the temporal and financial burdens associated with an interdisciplinary process, and the suggestion that the ARAA could be used as a stand-alone measure of recovery, future research is warranted to validate the ARAA against a well-

known objective measure of recovery such as heart rate variability (HRV). If the ARAA is related to HRV, practitioners could use the ARAA rather than HRV to monitor recovery *and* gain insight for the potential mechanism (i.e., physical, psychological, social) facilitating recovery.

Additionally, there are implications for the ARAA beyond the traditional sport population. The ARAA can be used to inform the development and validation of an assessment designed to assess the processes of recovery in tactical athletes (e.g., firefighters, police officers, etc.). The demands of these professions can often deplete the athletes' resources, therefore these populations would benefit from an occupation-specific assessment to monitor and implement recovery activities.

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## APPENDICES

## Appendix A: Demographic Questionnaire

1. Age (continuous)
2. Gender (nominal)
  - a. Male
  - b. Female
  - c. Non-binary
  - d. Other (text box)
3. Race/Ethnicity/Nationality
  - a. Race/ethnicity (nominal)
    - i. White/Caucasian
    - ii. African American
    - iii. Asian
    - iv. Black
    - v. Pacific Islander
    - vi. Native American
    - vii. Other (text box)
  - b. Nationality (nominal)
    - i. American
    - ii. Australian
    - iii. Canadian
    - iv. British or English
    - v. Other (text box)
4. Life status
  - a. Relationship status (nominal)
    - i. Married and living with partner
    - ii. Not married, but living with partner
    - iii. Single
    - iv. Divorced/widow
    - v. Other (open text box)
  - b. Dependents (nominal)
    - i. Yes, I have children/parents/grandparents living in my household under my care.
    - ii. No, I do not have children/parents/grandparents living in my household under my care.
  - c. Academic status (nominal)
    - i. Full-time student
    - ii. Part-time student
    - iii. Non-student
5. Sport (nominal)
  - a. American Football
  - b. Archery
  - c. Badminton
  - d. Baseball

- e. Basketball
  - f. Biathlon
  - g. Climbing
  - h. Combat sports
  - i. Cricket
  - j. Cross Country
  - k. Curling
  - l. Cycling
  - m. Diving
  - n. Equestrian
  - o. Fencing
  - p. Field Hockey
  - q. Figure skating
  - r. Freestyle Skiing
  - s. Gymnastics
  - t. Ice Hockey
  - u. Judo
  - v. Lacrosse
  - w. Marathon or Ultra-marathon running
  - x. Rowing
  - y. Sailing
  - z. Ski jumping
  - aa. Soccer
  - bb. Softball
  - cc. Speed skating
  - dd. Swimming
  - ee. Synchronized swimming
  - ff. Table tennis
  - gg. Tennis
  - hh. Track and Field
  - ii. Trampoline & Tumble Gymnastics
  - jj. Triathlon
  - kk. Ultimate Frisbee
  - ll. Volleyball
  - mm. Water polo
  - nn. Wrestling
  - oo. Weightlifting
  - pp. Other
6. Level of sport (nominal)
- a. NCAA Division III
  - b. NCAA Division II
  - c. NCAA Division I
  - d. Professional sport sanctioned by a National Governing Body (NGB)
  - e. Olympic sport sanctioned by the International Olympic Committee (IOC)

7. Years of experience in current sport (continuous)
8. Years of experience at the current level of sport (continuous)
9. Current participation in training or competition (nominal)
  - a. Pre-season
  - b. In-season
  - c. Off-season
10. Current injury status (nominal)
  - a. Injured
  - b. Not injured
11. Injury history at current level of sport (nominal; option to identify specific injury via text box)
  - a. Mild (i.e., prevented sport participation for less than 7 days)
  - b. Moderate (i.e., prevented sport participation for 7-21 days)
  - c. Severe (i.e., prevented sport participation for more than 21 days)
12. Current mental health concerns (nominal; option to identify specific concern via text box)
  - a. Currently being treatment for a mental health concern
  - b. Not currently being treated for a mental health concern
13. Mental health history (nominal; option to identify specific concern via text box)
  - a. Previously been treated with a mental health concern
  - b. Have never been previously treated with a mental health concern
14. Medical history (nominal & continuous; optional)
  - a. Diagnosed bacterial/viral infection (optional to identify/report)
  - b. Diagnosed inflammatory disease (optional to identify/report)
  - c. Diagnosed auto-immune disease (optional to identify/report)
  - d. Diagnosed endocrine disorders (optional to identify/report)
  - e. Other conditions that influence sport participation (optional to identify/report)
15. Current medications (nominal and continuous; optional)
  - a. Birth control
  - b. Blood pressure
  - c. Anti-anxiety
  - d. Anti-depressant
  - e. Other

## Appendix B: Assessment of Recovery Activities for Athletes (ARAA)

The following items are to be answered on a scale from 0 (*no days*) to 7 (*every day*).

*How many days this week did I...*

1. Go to bed around the same time.
2. Wake up around the same time.
3. Sleep in a cool environment.
4. Sleep in a dark environment.
5. Sleep in a quiet environment.
6. Fuel my body to recover from my sport.
7. Eat the foods I needed to have energy for my sport.
8. Consume the necessary amount of fluids to have pale yellow urine.
9. Replace fluid lost after sport.
10. Implement physical recovery strategies.
11. Do what was necessary to feel physically ready for my sport.
12. Take time for “me”.
13. Make time for a relaxing activity.
14. Engage in activities that reduced my psychological stress or anxiety.
15. Engage in an activity that relaxed me mentally.
16. Engage in a relaxing activity before bed.
17. Engage in an activity that physically relaxed my body.
18. Take time for non-sport activities.
19. Take a mental break from my sport.
20. Focus on non-sport tasks while away from my sport.
21. Engage in a hobby while away from my sport.
22. Mentally switch off from my sport.
23. Engage in a challenging task outside of my sport.
24. Experience something new.
25. Do something out of my comfort zone.
26. Determine my non-sport schedule.
27. Choose my own recovery activities.
28. Control aspects of my sport.
29. Control aspects of my day.
30. Do whatever I wanted, whenever I wanted, during non-sport time.

The following items are to be answered on a scale from 0 (*never*) to 4 (*always*).  
*Over the past week I...*

31. Used my non-sport time to physically recover.
32. Physically relaxed when away from my sport.
33. Allowed my body to rest.
34. Saved energy for myself.
35. Helped someone.
36. Used social media to participate in community activities or social causes.
37. Offered support to someone.
38. Expressed my gratitude to someone.
39. Listened when someone was sharing an important part of their day or life.
40. Gave back to my community.
41. Had a conversation with my coach that made me feel understood as a person.
42. Had fun with someone connected to my sport.
43. Had a conversation with my coach that made me feel understood as an athlete.
44. Was able to communicate effectively with coaches or staff.
45. Provided support to teammates or other athletes.
46. Was able to discuss concerns or conflicts with coaches or staff.
47. Was able to communicate effectively with teammates or other athletes.
48. Was able to discuss concerns or conflicts with teammates or other athletes.
49. Made time for family or friends not connected to my sport.
50. Showed gratitude to the important people in my life.
51. Had a good time with someone not connected to my sport.
52. Had a meaningful interaction with someone outside my sport.
53. Asked for help from my friends and family.
54. Was able to communicate effectively with people outside my sport.
55. Provided support to my non-sport friends and family.
56. Used social media in a positive way.

Independent stress and recovery status items.

The following items are to be answered on a scale from 0 (*never*) to 10 (*extremely*).

*When thinking about the last 7 days...*

1. Rate your level of physical stress (e.g., feeling physically exhausted, sore, sluggish).
2. Rate your level of physical recovery (e.g., feeling physically energetic, rested, ready).
3. Rate your level of psychological stress (e.g., feeling mentally drained, overloaded, unmotivated).
4. Rate your level of psychological recovery (e.g., feeling mentally energetic, attentive, focused).
5. Rate your level of social stress (e.g., experiencing interactions there were negative or challenging, feeling alone or unsupported).
6. Rate your level of social recovery (e.g., experiencing interactions that were positive, feeling cared for or supported, having a sense of belonging).

### Appendix C: Recovery-Stress Questionnaire for Athletes (RESTQ-Sport-36)

Items are answered on a scale from 0 (*never*) to 6 (*always*)

*In the past 7 days/nights:*

1. I was in a good condition physically.
2. I was tired from work.
3. I slept restlessly.
4. I had a good time with my friends.
5. I was convinced that I had trained well.
6. I dealt very effectively with my teammates' problems.
7. I was angry with someone.
8. I had muscle pain after performance.
9. I felt happy.
10. I felt that I wanted to quit my sport.
11. I felt down.
12. The breaks were not at the right time.
13. Other people got on my nerves.
14. Parts of my body were aching.
15. I visited some close friends.
16. I easily understood how my teammates felt about things.
17. I was fed up with everything.
18. I fell asleep satisfied and relaxed.
19. I was convinced I performed well.
20. Too much was demanded of me during the breaks.
21. I felt burned out by my sport.
22. I was overtired.
23. My body felt strong.
24. I was in good spirits.
25. I felt frustrated by my sport.
26. I felt depressed.
27. My muscles felt stiff or tense during performance.
28. I laughed.
29. I was dead tired after work.
30. I was annoyed by others.
31. I was in a good mood.
32. I had the impression there were too few breaks.
33. I dealt with emotional problems in my sport very calmly.
34. I recovered well physically.
35. I had a satisfying sleep.
36. I was convinced that I could achieve my performance at any time.

## Appendix D: IRB #21.156 Approval Form



Department of University Safety & Assurances

**Melody Harries**  
IRB Administrator  
Institutional Review Board  
Engelmann 270  
P. O. Box 413  
Milwaukee, WI 53201-0413  
414-662-3544

### New Study - Notice of IRB Exempt Status

**Date:** December 9, 2020

[uwm.edu/irb](http://uwm.edu/irb)  
[harries@uwm.edu](mailto:harries@uwm.edu)

**To:** Barbara Meyer  
**Dept:** Occupational Science & Technology

**CC:** Carly Wahl

**IRB #:** 21.156

**Title:** Development of an Assessment of Recovery Activities for Athletes

After review of your research protocol by the University of Wisconsin – Milwaukee Institutional Review Board, your protocol has been granted Exempt Status under **Category 2** as governed by 45 CFR 46.104(d).

This protocol has been approved as exempt for three years and IRB approval will expire on **December 8, 2023**. Before the expiration date, you will receive an email explaining how to either keep the study open or close it. If the study is completed before the expiration date, you may notify the IRB by sending an email to [irbinfo@uwm.edu](mailto:irbinfo@uwm.edu) with the study number and the status.

Any proposed changes to the protocol must be reviewed by the IRB before implementation, unless the change is specifically necessary to eliminate apparent immediate hazards to the subjects. You are responsible for adhering to the policies and guidelines set forth by the UWM IRB, maintaining proper documentation of study records and promptly reporting to the IRB any adverse events which require reporting. You are also responsible for ensuring that all study staff receive appropriate training in the ethical guidelines of conducting human subjects research.

You must also adhere to UWM and UW System Policies, and any applicable state and federal laws governing activities which are independent of IRB review/approval (e.g., [FERPA](#), [Radiation Safety](#), [UWM Data Security](#), [UW System policy on Prizes, Awards and Gifts](#), state gambling laws, etc.). When conducting research at institutions outside of UWM, be sure to obtain permission and/or approval as required by their policies.

Contact the IRB office if you have any further questions. Thank you for your cooperation, and best wishes for a successful project.

Respectfully,

A handwritten signature in black ink that reads "Melody Harries".

Melody Harries  
IRB Administrator

# CURRICULUM VITAE

## CARLY A. WAHL, M.S.

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### GENERAL INFORMATION

University of Wisconsin-Milwaukee  
Department of Rehabilitation Sciences & Technology  
3409 N. Downer Ave.  
Milwaukee, WI 53201

### FORMAL EDUCATION

University of Wisconsin-Milwaukee, Milwaukee, Wisconsin (2022)  
Doctor of Philosophy, Health Sciences  
Specialization: Sport & Performance Psychology  
Minor: Educational Statistics & Measurement  
Advisor: Barbara B. Meyer, Ph.D., CMPC  
Dissertation Title: *Development of an Assessment of Recovery Activities for Athletes*  
Preliminary Examination Grant Title: *Development of the Assessment of Sleep Experiences in Firefighters*

Georgia Southern University, Statesboro, Georgia (2017)  
Master of Science, Kinesiology  
Specialization: Sport & Exercise Psychology  
Advisor: Brandonn S. Harris, Ph.D., CMPC  
Thesis Title: *Goal Orientation, Motivational Climate, and Exercise as Predictors of Eating Disorder Risk Factors Among College Students*

University of Wisconsin-Oshkosh, Oshkosh, Wisconsin (2015)  
Bachelor of Science, Kinesiology- Strength & Conditioning  
Minor: Psychology  
Graduated Summa Cum Laude

### PROFESSIONAL EXPERIENCE

- Lecturer, Department of Kinesiology, University of Wisconsin-Milwaukee (2018-2021)
- Graduate Teaching Fellow, College of Health Sciences, University of Wisconsin-Milwaukee (2018-2021)
- Graduate Student Sport Psychology Consultant (2016-Present)
- Participant, Arizona Diamondbacks' Developmental Program in Mental Skills (2020)
- Student Delegate, Association for Applied Sport Psychology (2018-2020)
- Graduate Teaching Assistant, Department of Health Sciences & Kinesiology, Georgia Southern University (2015-2017)

### PEER-REVIEWED PUBLICATIONS

1. Marciniak, R.A, **Wahl, C.A.**, & Ebersole, K.T. (2022). Autonomic nervous system response to far-infrared sauna exposure in firefighters. *Annals of Work Exposures and Health*, 66(3), 356-367. doi: 10.1093/annweh/wxab088
2. Gnacinski, S.L., Meyer, B.B., & **Wahl, C.A.**, (2021). Psychometric properties of the RESTQ-Sport-36 in a collegiate student-athlete population. *Frontiers in Psychology: Movement Science and Sport Psychology*, 12(671919). [https://doi: 10.3389/fpsyg.2021.671919](https://doi.org/10.3389/fpsyg.2021.671919)
3. **Wahl, C.A.**, Gnacinski, S.L., Nai, M., & Meyer, B.B. (2020). Psychological predictors of perceived stress and recovery in sport. *Sport, Exercise, and Performance Psychology*, 9(3), 292–307. <https://doi.org/10.1037/spy0000175>
4. **Wahl, C.A.**, Harris, B.S., Langdon, J.L., Riggs, A.J., & Meyer, B.B. (2019). Goal orientation, motivational climate, and exercise as predictors of eating disorder risk factors among college students. *Journal of American College Health*, 69(2), 168-175. <https://doi.org/10.1080/07448481.2019.1657431>

### PEER-REVIEWED PUBLICATIONS IN PROGRESS

1. **Wahl, C.A.**, Marciniak, R.A., Meyer, B.B. & Ebersole, K.T. (in progress). *Influence of call volume on perceptions of stress and recovery in active-duty firefighters*. Target: *Journal of Occupational Health Psychology*

### PEER-REVIEWED CHAPTERS

1. **Wahl, C.A.** & Meyer, B.B. (in press). Case Solution: Back into the Breach. In S. Castillo, C. Wooding, D. Barba, & S. Chroni. *Building Consulting Skills: An International Case Study Collection*

### PROFESSIONAL DEVELOPMENT PUBLICATIONS

1. **Wahl, C.**, Gretton, T., Belt, E., Saylor, S., & Wolch, N. (2020). Young Writer's Corner: Failing forward- Lessons learned from mental performance consultants. *Association for Applied Sport Psychology Newsletter*. Retrieved from: <https://appliedsportpsych.org/members/aasp-newsletters/january-2020/young-writers-corner-failing-forward-lessons-learned-from-mental-performance-consultants/>

### PRESENTATIONS AT ACADEMIC & PROFESSIONAL MEETINGS

1. Marciniak, R.A., **Wahl, C.A.**, & Ebersole, K.T. (July, 2022). Relationships between health and fitness measures and fire suppression workload in active-duty firefighters. Poster to be presented at the National Strength and Conditioning Association annual conference, New Orleans, LA.
2. **Wahl, C.A.**, Ebersole, K.T., & Meyer, B.B. (June, 2022). Perceptions of stress, recovery, and engagement in recovery activities among injured and non-injured NCAA athletes. Poster to be presented at the American College of Sports Medicine annual conference, San Diego, CA.

3. Marciniak, R.A., **Wahl, C.A.**, & Ebersole, K.T. (June, 2022). Relationships between physiological workload and autonomic nervous system recovery from fire suppression in active-duty firefighters. Poster to be presented at the American College of Sports Medicine annual conference, San Diego, CA.
4. **Wahl, C.A.**, Marciniak, R.A., Meyer, B.B., & Ebersole, K.T. (2022, April). Influence of uniform base layer on perceptions of stress, recovery, and sleep in career firefighters. Podium presentation at the Regional National Occupational Research Agenda (NORA) Young/New Investigators Symposium, Salt Lake City, UT.
5. Marciniak, R.A., **Wahl, C.A.**, Ebersole, K.T. (2022, April). Quantifying workload in active-duty firefighters. Podium presentation at the Regional National Occupational Research Agenda (NORA) Young/New Investigators Symposium, Salt Lake City, UT.
6. Mendelsen, B.J., Marciniak, R.A., **Wahl, C.A.**, & Ebersole, K.T. (2022, April). Relationship between body composition, aerobic capacity, and step test workload in firefighter recruits. Poster presentation at the National Strength and Condition Association Great Lakes Regional Conference, Waukesha, WI.
7. **Wahl, C.A.** & Meyer, B.B. (2021, October). *Development of an assessment of recovery activities for athletes*. Poster presentation at the Association for Applied Sport Psychology annual conference, Virtual.
8. Marciniak, R.A., **Wahl, C.A.**, & Ebersole, K.T. (2021, July). *Influence of base layer uniform and body composition on autonomic nervous system response in firefighters*. Poster presentation at the National Strength and Conditioning Association annual conference, Orlando, FL.
9. **Wahl, C.A.**, Marciniak, R.A., Ebersole, K.T. & Meyer, B.B. (2021, June). *Relationship between objective and subjective measures of stress and recovery in firefighters*. Poster presentation at the American College of Sports Medicine annual conference, Virtual.
10. Marciniak, R.A., **Wahl, C.A.**, Ebersole, K.T., & Meyer, B.B. (2021, June). *Examination of maximal task internal workloads in active-duty firefighters*. Poster presentation at the American College of Sports Medicine annual conference, Virtual.
11. **Wahl, C.A.**, Marciniak, R.A., Ebersole, K.T. & Meyer, B.B. (2020, October). *Influence of call volume on perceptions of stress and recovery in active-duty firefighters*. Lecture presented at the Association for Applied Sport Psychology annual conference, Virtual.
12. **Wahl, C.A.**, Marciniak, R.A., Tesch, C.S., Meyer, B.B., & Ebersole, K.T. (2020, May). *Association between perceived recovery and heart rate in a submaximal and maximal task in firefighters*. Poster intended to be presented at the American College of Sports Medicine annual conference, San Francisco, CA. (Conference cancelled).
13. Marciniak, R.A., **Wahl, C.A.**, Tesch, C.S., & Ebersole, K.T. (2020, May). *Examination of two different balance tests in active-duty firefighters*. Poster intended to be presented at the American College of Sports Medicine annual conference, San Francisco, CA. (Conference cancelled).
14. Marciniak, R.A., **Wahl, C.A.**, Ebersole, K.T. & Meyer, B.B. (2020, April). *Influence of exercise prior to sauna exposure on strength and power in firefighters*. Lecture presented at the National Strength and Conditioning Association Wisconsin State Clinic, Waukesha, WI.
15. **Wahl, C.A.**, Gnacinski, S.L., & Meyer, B.B. (2019, October). *Examining differences in athletes' perceptions of perceived stress and recovery between NCAA divisions*. Poster presentation at the Association for Applied Sport Psychology annual conference, Portland, OR.
16. Gnacinski, S.L., Meyer, B.B., **Wahl, C.A.**, Nai, M., & Brenner, V. (2019, October). *A systems-based approach to recovery intervention in elite sport environments*. Symposium presented at the Association for Applied Sport Psychology annual conference, Portland, OR.

17. **Wahl, C.A.**, & Nai, M. (2019, October). *Evidence-based methods of recovery for coaches*. Lecture as part of a symposium presented at the Association for Applied Sport Psychology annual conference, Portland, OR.
18. **Wahl, C.A.**, Gnacinski, S.L., Nai, M., & Meyer, B.B. (2018, October). *Toward a novel measure of stress and recovery: Development and preliminary validation of items*. Poster presentation at the Association for Applied Sport Psychology annual conference, Toronto, CA.
19. Nai, M., Gnacinski, S.L., **Wahl, C.A.**, & Meyer, B.B. (2018, October). *Development and preliminary validation of a new recovery measure: Coach input*. Poster presentation at the Association for Applied Sport Psychology annual conference, Toronto, CA.
20. **Wahl, C.A.**, Gnacinski, S.L., Nai, M., & Meyer, B.B. (2018, April). *Predictors of perceived acute stress and recovery responses in athletes*. Poster presentation at the Midwestern Psychological Association, Chicago, IL.
21. Nai, M., Gnacinski, S.L., **Wahl, C.A.**, & Meyer, B.B. (2018, April). *Examination of the relationship between POMS and RESTQ-Sport*. Poster presentation at the Midwestern Psychological Association, Chicago, IL.

### **RESEARCH GRANTS**

1. **Wahl, C.A.**, Ebersole, K.T., & Meyer, B.B. *An exploration of the psychological and physiological recovery activities used by firefighters*. National Institute for Occupational Safety and Health (NIOSH) Great Lakes Center for Occupational Health and Safety, Pilot Project Grant. Amount requested: \$19,911. Funded
2. **Wahl, C.A.**, Meyer, B.B., & Ebersole, K.T. *Determining validity of the Assessment of Recovery Activities for Athletes using heart rate variability*. Association for Applied Sport Psychology, 2021 Collaborative Research Grant. Amount requested: \$3,873.25. Not funded
3. **Wahl, C.A.**, & Meyer, B.B. *Validation and measurement invariance of the Volitional Process of Recovery Questionnaire*. University of Wisconsin-Milwaukee, College of Health Sciences, Student Research Grant Award. Amount requested: \$2,000. Not funded

### **CORE COURSES TAUGHT**

1. KIN 550 (Co-Instructor)- Psychological Aspects of Human Movement, University of Wisconsin-Milwaukee. Fall 2018, 2019, 2020, 2021
2. CHS 100 (Graduate Teaching Fellow)- College of Health Sciences Freshman Seminar, University of Wisconsin-Milwaukee. Fall 2018, 2019, 2020, 2021

### **PHYSICAL ACTIVITY COURSES TAUGHT**

1. KINS 1412 Swimming: Introduction to Swimming, Georgia Southern University. Fall 2015, Spring 2016, Fall 2016, Spring 2017
2. KINS 2412- Swimming, Georgia Southern University. Fall 2015, Spring 2016, Fall 2016, Spring 2017
3. KINS 1414- Swimming: Fitness, Georgia Southern University. Fall 2015, Spring 2016, Fall 2016, Spring 2017
4. KINS 1114- Body Conditioning, Georgia Southern University. Fall 2015, Fall 2016
5. KINS 1515- Fitness for Life: Weight Management, Georgia Southern University. Spring 2016, Fall 2016

### **COURSES GUEST LECTURED**

1. KIN 350- Psychological Aspects of Sport and Exercise, University of Wisconsin-Milwaukee. October, November 2018, 2019, 2021
2. ED PSYCH 101- Foundations of Academic Success, University of Wisconsin-Milwaukee. October 2019, 2021
3. KIN 200- Introduction to Kinesiology, University of Wisconsin- Milwaukee. October 2017

### **RELEVANT EMPLOYMENT**

1. Laboratory Assistant, Human Performance and Sport Physiology Laboratory, University of Wisconsin-Milwaukee. May 2019-Present
  - Assists in conducting physiological tests (e.g., VO<sub>2</sub> max tests, functional balance tests, etc.) and analyze data for research involving integrative performance within firefighters
2. Facilitator, Office of Health Promotion & Wellness, University of Wisconsin-Milwaukee. August 2017-Present
  - Facilitates alcohol and other drug brief screenings and interventions; assists in program evaluation

### **PROFESSIONAL DEVELOPMENT**

1. Participant, Arizona Diamondbacks' Developmental Program, Mental Skills. October 2020-December 2020.

### **APPLIED EXPERIENCE**

1. Psychology Intern, Center for Dependency, Addiction, and Rehabilitation (CeDAR), Anschutz Medical Campus; Aurora, CO. May 2016-August 2016
2. Strength & Conditioning Intern (Olympic Sports), University of Notre Dame Athletics. January 2015-June 2015
3. Strength & Conditioning Clinical Rotation, University of Wisconsin-Oshkosh. March 2014-December 2014
4. Strength & Conditioning Clinical Rotation, Kaukauna School District. June 2014-December 2014

### **SERVICE & LEADERSHIP EXPERIENCES**

1. University Service
  - Health Promotion Coordinator Search and Screen Committee Member (2021)
  - Treasurer of Sport Psychology & Performance Excellence Club at UW-Milwaukee (2019-present)
  - Judge for the UW Badger State Science & Engineering Fair (2020)
  - Invited presenter for Student-Athlete mental health workshops at UW-Milwaukee (2019-2020)
  - Invited presenter for BullD.O.G.S in Healthcare summer program at Drake University (2018)
  - President of Sport & Exercise Psychology Club at Georgia Southern University (2016-2017)

2. Community Service
  - Combine and fitness assistant for the Milwaukee Fire Academy (2018-present)
  - Invited presenter for an integrated Peer Fitness Team workshop for the Milwaukee Fire Department (2019)
  - Deliver sport psychology consultation to:
    - Milwaukee Fire Academy (2021-present)
    - Local area wrestling academy (2020-present)
    - Local area high school swimming athlete (2020-present)
    - Local area high school lacrosse athlete (2019-present)
    - Local area collegiate track & field athlete (2018-2020)
    - Local area high school cross country athlete (2019-2020)
    - Local area master's tennis athlete (2019)
    - Collegiate swimming & diving team (2016-2017)
3. Professional Organization Service- Association for Applied Sport Psychology (AASP)
  - Chairperson for the *Science & Practice* student initiative (2020)
  - Student liaison to the *Science to Practice* executive committee (2020)
  - Prepared for and co-hosted the *Best Practices of the Scientist-Practitioner Model* webinar (2020)
  - Annual Conference abstract reviewer (2020-2022)
  - Chairperson for the *Best Practices in Consulting* student initiative (2019)
  - Student delegate for the *Student Challenge* student initiative (2019)
4. Professional Memberships
  - Association for Applied Sport Psychology (AASP): 2015-Present
  - Midwestern Psychological Association (MPA): 2017-Present
  - American Academy of Sports Medicine (ACSM): 2019-Present
  - National Strength and Conditioning Association (NSCA): 2020-Present

### **FELLOWSHIPS & ASSISTANTSHIPS**

1. Distinguished Graduate Student Fellowship. (2018-2019). Graduate School, University of Wisconsin-Milwaukee. Awarded: Full tuition + \$15,000 stipend + \$1,000 travel grant
2. Graduate Teaching Assistantship. (2015-2016, 2016-2017). Department of Health Sciences and Kinesiology, Georgia Southern University. Awarded: Full tuition + \$7,750.00 stipend

### **MERIT-BASED ACADEMIC SCHOLARSHIPS**

1. Chancellor's Graduate Student Award- Health Sciences. (Fall 2021). University of Wisconsin-Milwaukee. Awarded: \$3,000
2. Graduate Student Excellence Fellowship. (Fall 2020). Graduate School, University of Wisconsin-Milwaukee. Awarded: \$2,000.
3. Chancellor's Graduate Student Award. (Fall 2019, Fall 2020). College of Health Sciences, University of Wisconsin-Milwaukee. Awarded: \$2,000
4. Chancellor's Graduate Student Award. (2017-2018). Department of Kinesiology, University of Wisconsin-Milwaukee. Awarded: \$12,959.00

### **TRAVEL AWARDS**

1. Graduate Student Travel Award. (Fall 2020). Student Appropriations Committee, University of Wisconsin-Milwaukee. Awarded: \$1,600.50
2. Graduate Student Travel Award. (Fall 2020). Student Appropriations Committee, University of Wisconsin-Milwaukee. Awarded: \$1,300.00
3. Graduate Student Travel Award. (Spring 2020). Student Appropriations Committee, University of Wisconsin-Milwaukee. Awarded: \$685.00
4. Graduate Student Travel Award. (Fall 2019). Student Appropriations Committee, University of Wisconsin-Milwaukee. Awarded: \$646.10
5. Graduate Student Travel Award. (Fall 2015, 2016). Graduate School, Georgia Southern University. Awarded: \$800.00

### **OTHER AWARDS**

1. AASP 2020 Conference Student Abstract Award (2020). Association for Applied Sport Psychology. Awarded: \$250; free virtual conference student registration in 2020; free student membership in 2021