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An Empirical Investigation of the Relationship between Mindfulness, Trait Anxiety, Cognitive Interference and Performance under Pressure in Elite Junior Ice Hockey Players

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Master Thesis in Sport Science

The ability to perform successfully in a pressure situation is a crucial aspect of professional sports, even for world-class athletes is it difficult to achieve optimal performance in decisive situations. There is preliminary evidence that trait mindfulness promotes athletic performance in pressure situations by decreasing competition anxiety.

An issue that has been omitted from previous research is the relationship between mindfulness and performance in an experimental performance situation with pressure induction. The aim of this study is to investigate potential correlations between trait mindfulness, trait anxiety, cognitive interference and performance under pressure.

The current study explored the relationship between trait mindfulness, trait anxiety, cognitive interference and performance under pressure in an experimental design with youth elite male ice hockey players (N = 91, M = 18.23 years, SD = 1.1). The sample completed measures of habitual mindfulness (CHIME), trait anxiety (WAI-T), cognitive interference (TOQS) and absolved an on-ice pressure-induced passing task. Pearson's product moment correlation coefficients were tested.

Contrary to expectations, the findings indicate trait mindfulness does not correlate with performance under pressure. The second question in this research reveal a negative significant correlation between trait mindfulness and cognitive anxiety ($r = -.25$, $p = .02$). Mindfulness correlates also negatively with all TOQS subscales. Furthermore, there was a weak negative correlation between trait anxiety and performance under pressure (somatic anxiety $r = -.08$, $p = .46$, cognitive anxiety $r = -.12$, $p = .28$).

It may be the case therefore, that trait mindfulness has an indirect influence on performance under pressure through trait anxiety. However, a note of caution is due here since the present study may experienced difficulties in measuring habitual mindfulness in junior ice hockey players. Similarly, the validity of the performance measure is questionable. These issues will be important for future research in understanding the relationship between habitual mindfulness, trait anxiety and performance under pressure in youth athletes. Implications and directions for further research are discussed.

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Table of Contents

Abstract

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1 Introduction

‘Under pressure you can perform fifteen percent better or worse’, declares Scott Hamilton, former ice speed skater and American gold medallist at the 1984 Olympic Games. The ability to perform successfully in a pressure situation is a crucial aspect of professional sports. Athletes need to perform on a specific day at a given time at their very best. Until the moment of the starting signal, athletes practice for hundreds of hours, week after week, often at their personal performance limits. It can be a balancing act between practicing at maximum performance but not going over the limit, which could result in injury or overtraining (Meeusen et al., 2013). Thus, professional athletes face various challenges in the field of sports as well as outside of it. One important point in professional sports, therefore, is to perform at the moment in which it really counts.

The significant difference between practice and competition lies in the words pressure and anxiety (Mesagno & Hill, 2013). Athletes who perform at their best only in training might never make it to a podium. In practice, there is always another chance, though not necessarily in a competition. In a competition, there is this one moment that counts, which can lead to great pressure for athletes because of the importance of doing well (Baumeister, 1984). If an athlete doubts his or her ability to cope with pressure, anxiety will probably arise, which can potentially lead to a significant performance drop (Mesagno & Mullane-Grant, 2010). Consequently, there is the major question of what promotes or impairs athletic performance in general, specifically in a pressure situation and which influence has anxiety on athletic performance.

Sports psychologists aim to help athletes with mental strategies for particularly demanding situations. In recent years, a so-called new wave in cognitive-behavioural therapies has evolved and fall under the umbrella of mindfulness-based interventions. There is preliminary evidence that mindfulness might improve athletic performance in pressure situations (Röthlin, Horvath, & Birrer, 2015). The purpose of the current study is to bring together current theories of mindfulness and performance under pressure by investigating the question of successful performance under pressure in a longitudinal experiment.

1.1 The three waves of cognitive-behavioural therapy

Coaches and athletes have turned to sport psychology to gain a competitive advantage - to learn, among other things, ways to manage stress, control concentration or improve confidence (Williams & Straub, 2010). The techniques and strategies used in the field of sports psychology are influenced, in particular, by cognitive-behavioural theories, whose assumptions are identical to cognitive-behavioural therapies (CBT; Dobson & Dozois, 2010). To explain the roots of cognitive-behavioural theories, I use a three-wave metaphor (Hayes, 2004). Hayes defines a wave as a formulation of dominant assumptions, methods and goals, which help organise research and theory.

The earliest behavioural theories emerged in the early 1960s and aimed to change behavior (Dobson & Dozois, 2010), developing from the radical behavioural approach to human problems (Bandura, 1986). This so-called first wave is subsumed under classical conditioning and operant learning (Dobson & Dozois, 2010).

Around the 1960s and 1970s, the field of psychology changed, and the 'cognitive revolution' was a major characteristic of that general change, aiming to change cognitions (Dobson & Dozois, 2010). The second wave of cognitive-behavioural psychology is characterised by a focus on information processing. Perhaps the most influential model was the information-processing model of cognition, which assumes that humans process the information they receive rather than responding to stimuli (Dobson & Dozois, 2010). The second wave of CBT is at present the dominant foundation for psychotherapy worldwide (Kahl, Winter, & Schweiger, 2012). Moreover, in the field of sports, there are techniques influenced by the most common CBT from the second wave. The four basic mental techniques – *imagery*, *goal-setting*, *self-talk* and *physical relaxation techniques* – are used predominantly in sports psychology interventions (Williams & Straub, 2010), and all stem primarily from psychological skills training (PST), which is influenced mostly from CBT (Birrer, Röthlin, & Morgan, 2012). It has been demonstrated that PST has an impact on negative internal states. However, only a limited number of studies have shown a clear performance-relevant impact (Gardner & Moore, 2006; Moore, 2009). It seems that athletes struggle to control cognitive processes by applying traditional PST methods (Birrer et al., 2012).

The third-wave approach is characterised by openness to older clinical traditions, a perspective on contextual change, a focus on function over form and the creation of flexible and effective repertoires, including supplementary features (Hayes, 2004). They build on the first- and second-wave treatments; nevertheless, they appear to be carrying the behaviour

therapy tradition into new territories (Hayes, 2004). Mindfulness is a key feature in third-wave therapy studies. Interest in mindfulness and its enhancement has exploded in recent years (Brown, Ryan, & Creswell, 2007). Scientific evidence of the efficacy of mindfulness-based interventions is so comprehensive that it has been recommended as a common factor in numerous schools of psychotherapy (Martin, 1997). Mindfulness interventions aim to modify the relationship to thoughts and emotions, not like basic mental techniques that aim for the content of thoughts and emotions itself (Birrer et al., 2012). This distinction between mindfulness interventions and basic mental techniques like *imagery*, *goal-setting*, *self-talk* and *physical relaxation techniques* is important since it has a fundamental influence on potential impact mechanisms. Thus, it appears, for instance, that an athlete experiences an important event. In a basic mental technique approach, the athlete tries to change a stressor into something more pleasant. In a mindful approach, an athlete tries to change the relationship with the stressor. For instance, the athlete faces the stressor in a non-judgemental and accepting manner. As a consequence, the stressor is accepted and does not appear as a threat. Therefore, basic mental skills are redundant for that specific athlete since a mindfulness effect happens chronologically prior.

1.2 Conceptualising mindfulness

The concept of mindfulness has its origins in Buddhism and describes an attitude in which attention is consistently focused on the experience of the moment. The teachings of Buddha speak of a pure attention, which means that objects are perceived as they actually are, without judging them hastily or categorising them (Bodhi, 1994). Historically, mindfulness has been called 'the heart' of Buddhist meditation (Bodhi, 1994).

According to Kabat-Zinn (1982), mindfulness is a multidimensional trait and a certain way of directing attention in the present moment in everyday life in an accepting, non-judgemental and non-elaborating manner. Moreover, mindfulness is characterised by a particular attitude (Bishop et al., 2004) that is intentionally open, curious, non-adherent and non-identified with own thoughts, emotions or other inner experiences (Bishop et al., 2004; Kabat-Zinn, 2003; Lau et al., 2006; Walach et al., 2004). Mindfulness is an inherent human capacity; everyone is mindful to a certain degree (Kabat-Zinn, 2003). Thus, mindfulness is a naturally occurring individual difference or dispositional trait (Brown & Ryan, 2003), which can be practiced through mindfulness training (Baer, 2011). Birrer et al. (2012) propose the important distinction between trait mindfulness and mindfulness practice. Trait mindfulness describes

the ability to be mindful in everyday life whereas mindfulness practice has been defined as a technique to foster mindfulness. The current study exclusively investigates the influence of trait mindfulness.

1.2.1 General salutary effects of mindfulness

Psychological research in mindfulness has primarily been focused on the effects of mindfulness training, less on understanding the meaning of mindfulness itself (Brown et al., 2007). For that reason, I firstly reveal empirical evidence for mindfulness training. Kabat-Zinn (1982) took mindfulness out of the religious-spiritual context and established it as a therapeutic method, thus forming the core of Mindfulness-Based Stress Reduction (MBSR) intervention.

Over the past years, a range of mindfulness-based interventions have been developed, for instance, Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002) and Acceptance and Commitment Therapy (ACT; Hayes, Strohsal, & Wilson, 1999). These interventions have primarily focused on the effects of mindfulness practice, mostly as part of a clinical treatment package (Brown et al., 2007). All interventions are multidimensional in nature, and a range of methods are used to enhance mindfulness. For instance, sensory awareness, meta-cognitive skills, observations of thoughts and feelings and modalities encourage an attitude of acceptance of self-relevant events (Brown et al., 2007). These interventions help people deal with numerous forms of psychological stress. Several studies have confirmed the effectiveness of mindfulness-based interventions (Bohlmeijer et al., 2010; Chiesa & Serretti, 2011; Hofmann et al., 2010).

Secondly, I reveal empirical evidence for trait mindfulness. In recent years, mindfulness research has increasingly investigated the mechanisms through which trait mindfulness can have a positive effect on well-being and mental health (Shapiro et al., 2006). Brown and Ryan (2003) were the first authors to empirically demonstrate that trait mindfulness was positively related to desirable states. The authors point out that trait mindfulness is associated with lower levels of emotional disturbance such as depressive symptoms, anxiety and stress. Conversely, trait mindfulness correlates with a higher positive affect and satisfaction with life. Further, empirical research supports the role of mindfulness in well-being. Measures of trait mindfulness correlate significantly with a variety of cognitive and affective indicators of mental health and well-being (Brown et al., 2007).

1.2.2 Mindfulness promotes athletic performance

Despite growing empirical evidence regarding the potential benefits of mindfulness in general psychology, a limited number of studies have investigated the utility of mindfulness in sports. The first reported application and analyses of mindfulness interventions in sports emerged in the mid-190s, with Kabat-Zinn, Beall and Rippe (1985) examining specific applications of mindfulness among collegiate and Olympic rowers. A number of rowers who won a medal at the Olympics claimed that mindfulness training was an important factor in reaching their full potential. This investigation coincided with a gap of several years in the mindfulness and sports literature.

In recent years, there has been an augmentation in mindfulness-based studies in the context of sports settings. Two sports-specific mindfulness-based interventions have been developed and applied: the Mindfulness-Acceptance-Commitment Approach (MAC; Gardner & Moore, 2007) and Mindful Sports Performance Enhancement (MSPE; Kaufman, Glass, & Arnkoff, 2009). Sappington and Longshore (2015) systematically review the efficacy of mindfulness-based interventions in enhanced athletic performance. Based on 19 empirical trials (six case studies, two qualitative studies, seven non-randomised trials and four randomised trials), the review provides preliminary support for the efficacy of mindfulness-based interventions in the enhancement of sports performance.

Mindfulness-based approaches like the MAC (Gardner & Moore, 2007) promote the development of non-judging attention, acceptance of internal thoughts and emotions and a focus of attention on performance-relevant cues (Gardner & Moore, 2004). Moreover, interventions based on mindfulness and acceptance suggest that internal states, for example, anxiety, do not need to be eliminated. This serves as an alternative approach in enhancing athletic performance through a mindful, present-moment acceptance of internal states (Gardner & Moore, 2004). Placing attention on the avoidance of negative internal states is therefore hypothesised as impairing performance. However, acting mindfully in an anxious situation is an alternative response to focusing on the current task (Gardner & Moore, 2004).

Birrer et al. (2012) suggest a number of opportunities regarding how trait mindfulness potentially enhances athletic performance. The authors maintain that mindfulness is related to greater flow experience, less fear and fewer task-irrelevant thoughts. Flow has been of great interest in the scientific literature over the past decades. It is a highly desired mental state in which a person is fully immersed, during physical activity, in a feeling of energised focus, full involvement and success in the process of the activity (Buchanan & Csikszentmihalyi, 1991).

A recent study by Cathcart, McGregor and Groundwater (2014) confirmed that mindfulness was positively related to flow in elite athletes. However, in the present research, we do not focus specifically on the performance-enhancing effects of flow. Birrer et al. (2012) propose that trait mindfulness diminishes experiences of fear. Further research strengthens this hypothesis. Bränström, Kvillemo and Moskowitz (2012) found that higher degrees of trait mindfulness reduced negative emotions. An explanation for this may be that an individual with a high degree of trait mindfulness might become desensitised to unpleasant emotions, which makes such emotions less distressing (Keng, Smoski, & Robins, 2011). According to Hayes and Feldman (2006), mindfulness helps to diminish automatic reactions to negative emotions. They propose that it helps people avoid over-engaging in distressing emotions, which might explain why people are able to maintain appropriate behaviour, for instance, while being anxious.

Considering all of this evidence, it seems that mindfulness potentially enhance athletic performance. The proposition that mindfulness could be influential in decreasing anxiety is of great interest, due its positive effects on enhancing performance (Birrer et al., 2012). Therefore, this paper traces the relationship between trait mindfulness and two other influencing variables on a stronger performance outcome under pressure: less fear and fewer task-irrelevant thoughts.

1.3 Performance under pressure

> It doesn't take much technique to roll a 1.68 inch ball along a smooth, level surface into, or in the immediate vicinity of, a 4.5 inch hole. With no pressure on you, you can do it one-handed most of the time. But there is always pressure on the shorter putts… 90 percent of the rounds I play in major championships, I play with a bit of a shake.
>
> (Jack Nicklaus on golf putting, quoted in Patmore, 1986, p. 75.)

There are situations in sports competitions that are more important than others. For various athletes, even world-class athletes, optimal performance during decisive moments is difficult to achieve (Birrer et al., 2012). Over the past decades, the question of why some athletes fail under pressure while others thrive has remained a popular research topic in sports science (Otten, 2009). However, much of the current literature on performance under pressure pays particular attention to the phenomenon of 'choking under pressure' (Mesagno & Mullane-Grant, 2010; Mesagno & Hill, 2013).

As illustrated in the quote above, professional athletes might have to deal with significant amounts of pressure. Obviously, certain circumstances can change how we feel, how we perceive or how we act. The task remains the same for golfer Jack Nicklaus, regardless of whether he perceives it in entirely different ways. Therefore, what impact does pressure have on a person? The following pages will consider the effects of pressure on human bodies as well as the role that pressure plays in improving or impairing athletic performance.

1.3.1 Defining pressure

Baumeister (1984) defines pressure as 'any factor or combination of factors that increases the importance of performing well' (p. 610). Baumeister and Showers (1986) complement the definition with 'the presence of situational incentives for optimum, maximum, or superior performance' (p. 362). These definitions thus emphasise the importance attributed to performance. If I speak in the following sections about pressure or pressure situations, then is pressure assumed to be perceived as a burden and leading to an increase in anxiety.

1.3.2 Endogenous factors in performance under pressure

There are several endogenous variables affecting performance in pressure situations. The following section defines them and explains how they are used in this paper.

Stress. The term stress is generally broadly defined and describes situations, that are associated with increased demands on a person (Woodman & Hardy, 2001). Gerrig and Zimbardo (2008) describe stress as a reaction pattern of an organism to stimulus events that disturb its balance and ability to cope with these influences. Stimulus events include a wide range of internal and external conditions that, taken together, are called stressors. A stressor is an event that requires a kind of adaptive response from the organism.

A human body initiates different physical responses to stressors. At the center is the hypothalamus, which is involved in a number of emotional reactions (Gerrig & Zimbardo, 2008). For instance, breathing becomes faster and deeper; the heart beats faster; the blood vessels constrict; and blood pressure rises. The autonomic nervous system stimulates adrenaline flow; and the adrenal glands distribute adrenaline and noradrenaline. In turn, other organs are again activated.

Stress Coping. Coping refers to the process of dealing with internal or external requirements experienced as limiting or in excess of the resources of an individual (Lazarus & Folkman, 1984). Stress coping may include behavioral, emotional or motivational reactions and thoughts (Gerrig & Zimbardo, 2008). When we talk about stress, it is important to determine how a situation creates stress. Cognitive appraisal is the cognitive interpretation and judgment of a stressor. It plays a central role in the definition of the situation. Stressors can be interpreted in different ways. What triggers stress for someone might not concern another person (Gerrig & Zimbardo, 2008). Lazarus and Folkman (1984) distinguish two stages of cognitive evaluations of requirements in a typical second wave manner. Primary appraisal describes the initial assessment of the gravity of a request. Once an individual knows what to do, the secondary appraisal assesses the available personal and social resources for dealing with the stressor.

Cognitive appraisal is an example of a stress moderating variable. Stress moderator variables modify the effects of a stressor to a particular stress response. Filter moderator variables modify the usual effects of stressors on the reaction of an individual (Gerrig & Zimbardo, 2008).

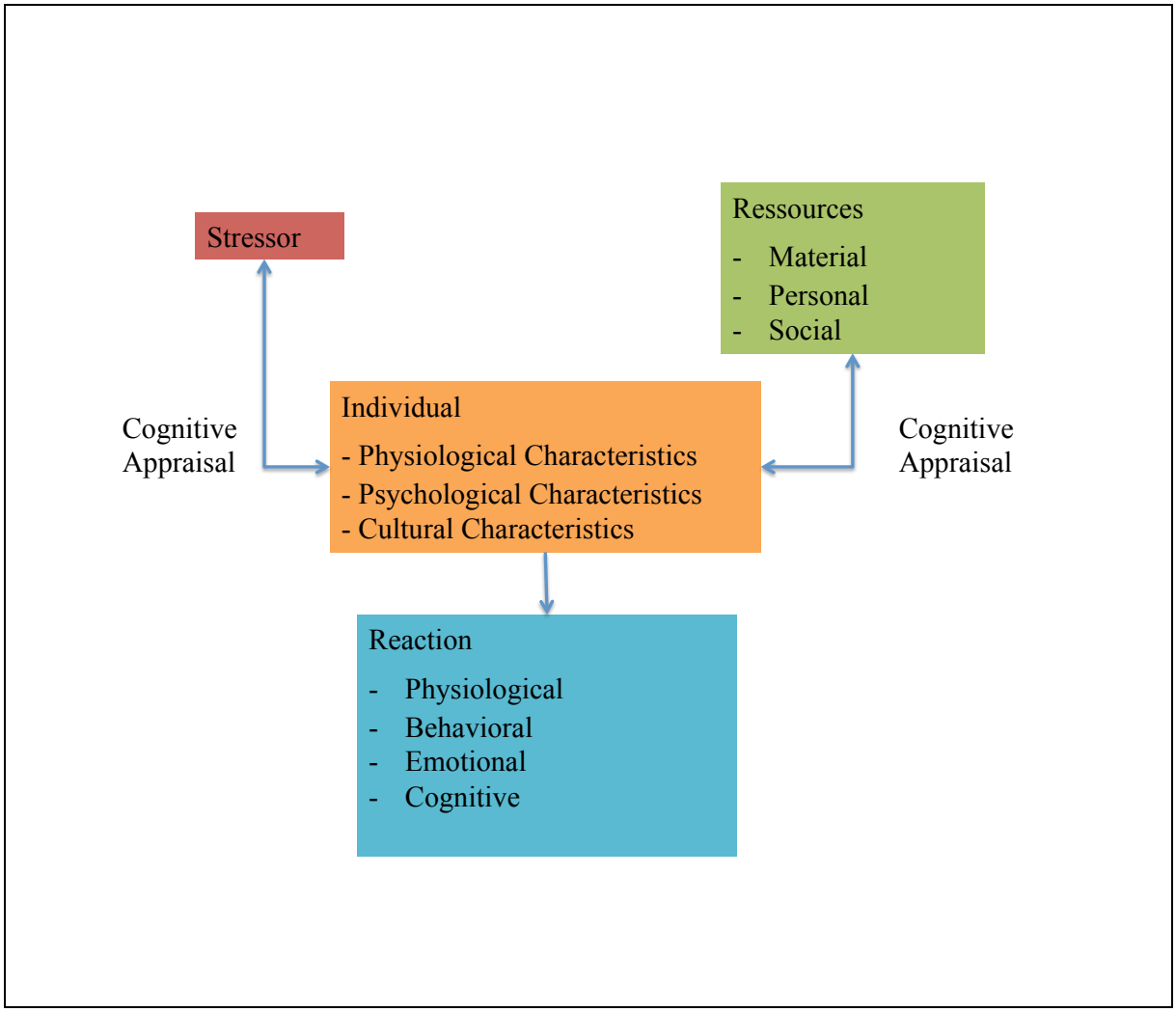

Figure 1: A stress model. Cognitive appraisal of the stressful situation interact with the stressor and the available physical, social and personal resources for dealing with the stressor (Gerrig & Zimbardo, 2008).

Anxiety. According to Spielberger et al. (1970), anxiety is an emotional state or reaction characterised by different intensities, the presence of unpleasant feelings and a pronounced activation of the vegetative nervous system (Woodman & Hardy, 2001). In the psychological literature, anxiety is described as a negative emotional state such as distress (Spielberger et al., 1970). Landers and Arent (2010) propose that levels of anxiety or distress are influenced by perceptions of certainty or uncertainty and whether one can control the situation. Thus, if anxiety levels in the form of a reaction to a competition is high, this can result in impaired performance.

State and trait anxiety. In the concept of anxiety are more differentiations required. Generally, there are two types of anxiety: state anxiety and trait anxiety (Spielberger & Sydeman, 1994). Spielberger (1966) defines state anxiety as 'subjective, consciously perceived feelings of tension and apprehension, associated with […] arousal of the autonomic nervous system' (p. 17). State anxiety refers more to how a person is feeling at the time of a perceived threat and is considered temporary. Furthermore, state anxiety is expected to increase in high-pressure situations (Mesagno & Mullane-Grant, 2010).

Trait anxiety is a general disposition to respond to a variety of situations with high levels of state anxiety (Woodman & Hardy, 2001). Thus, it is a relatively enduring disposition. Competitive trait anxiety is the tendency to respond to competitive situations as threating (Lawrence et al., 2012). Trait anxiety includes somatic and cognitive components. Somatic anxiety describes the physically perceptible component of anxiety and manifests in fear signs such as palpitations, sweaty palms or a sinking feeling in the stomach (Woodman & Hardy, 2001). Cognitive anxiety measures the tendency of athletes to develop self-doubt and specific concerns or to form negative expectations before competitions (Brand, Ehrenspiel, & Graf, 2009).

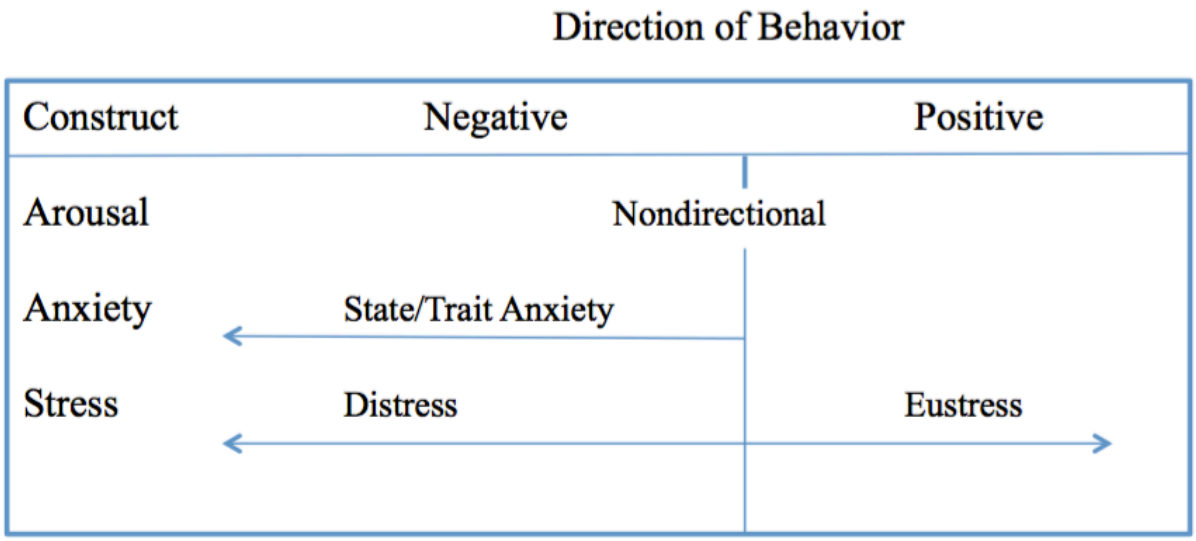

Figure 2: Direction of behaviour for arousal, anxiety, and stress (Landers & Arent, 2010).

Arousal. Arousal is used synonymously with the term activation. Both terms refer to the intensity of behaviour (Duffy, 1957). Duffy (1962) defines arousal as 'the extent of release of potential energy, stored in the tissues of the organism, as this is shown in activity or response' (p. 179). When arousal levels become extremely high, athletes might experience unpleasant emotional reactions. This maladaptive condition is often referred to as stress or state anxiety. However, anxiety, stress and arousal are related but distinct concepts (Landers & Arent, 2010). This paper pays no particular attention to arousal, however, there has been confusion in the research literature resulting from these terms being used interchangeably (Landers & Arent, 2010), hence the importance of defining the term arousal.

1.3.3 Choking under pressure

Choking or choking under pressure in sports is referred to as a negative athletic experience. Although choking has been an issue for more than thirty years, there is still disagreement over the determination of a universally valid definition (Mesagno & Hill, 2013). Baumeister and Showers (1986) define choking as 'the occurrence of suboptimal performance under pressure conditions [...] if one can reasonably be certain that the performer could have done better. [...] Additionally, it is inherent in the definition of choking that the performer wants to perform well' (p. 362). However, Mesagno and Hill (2013) consider this definition to be outdated and propose 'choking as an acute and considerable decrease in skill execution and performance when self-expected standards are normally achievable, which is the result of increased anxiety under perceived pressure' (p. 9). This definition includes the key elements of increased anxiety and substantially decreased performance. Mesagno and Mullane-Grant (2010) emphasise the importance of increased anxiety as choking would fail to occur in the absence of this condition. Nonetheless, choking is an earnest issue in competitive settings (Hill et al., 2010a, 2010b, 2011; Hill & Shaw, 2013) and can cause serious career consequences for athletes in terms of success or failure (Jordet, 2009).

1.3.4 Peak performance under pressure

Not only do some athletes tend not to choke, at times they actually perform better under pressure than usual (Hardy & Parfitt, 1991; Hardy, 1997). Otten (2009) defines clutch performance as any performance increment or superior performance that occurs under pressure circumstances. Privette (1982) defines peak performance as 'behavior which exceeds one's average performance' (1982, p. 242) or 'an episode of superior functioning' (1983, p. 1361).

The mental side of performance seems important, and Krane and Williams (2010) suggest that 40–90% of success in sports is due to mental factors. Otten (2009) shows that perceived control is an important predictor of performance under pressure whereas reinvesting attention leads to greater anxiety (cognitive and somatic), which directly negatively predicts performance under pressure. Krane and Williams (2010) propose, among others, the following psychological characteristics for successful athletic performance: high self-confidence, total commitment, coping ability, attention-focusing, optimistic attitude, emotion control and viewing anxiety as beneficial.

1.3.5 The important role of anxiety

Hence, pressure can either increase or decrease performance. Hardy (1990) points out that a certain amount of anxiety potentially enhances performance through alertness and enhanced effort. However, a high elevation of anxiety usually deteriorates performance since, for instance, muscular tension is too high or concentration is lost (Hill et al., 2010a). Mesagno and Mullane-Grant (2010) emphasise the high influence of trait anxiety regarding the decrease in performance in competitive sports situations. Without high levels of trait anxiety, a considerable performance drop is less likely to happen.

1.3.6 Cognitive interference

Anxiety has further performance diminish effects. One possible consequence is explained with the term cognitive interference. According to Sarason et al. (1990) increases anxiety the probability of responding to test situations with cognitive interference. This finding is supported by empirical evidence by Coy et al. (2011). The ability to maintain attentional focus on a task is required for any type of organised cognitive function. Nevertheless, one's capacity for cognitive processing is limited (Paas et al., 2003). Certain emotions, such as anxiety, can lead to irrelevant thoughts that distract athletes from effective task performance because they expend mental resources that would otherwise support the performance outcome (McCarthy, Allen, & Jones, 2013). Thoughts not related to accomplishing a task are detrimental to concentration (Hatzigeorgiadis & Biddle, 2001). This phenomenon is called cognitive interference and describes disturbances of concentration by task-irrelevant thoughts or performance concerns during a performance (Sarason et al., 1986). Put simply, interfering thoughts detract attention from task relevant cues that require limited cognitive resources. Cognitive interference correlates negatively in youth and adult sports with athletic performance (McCarthy et al., 2013). Therefore, reducing anxiety and its performance

reducing effects is the target of sports psychological interventions (Hatzigeorgiadis, Theodorakis, & Zourbanos, 2004).

1.4 Mindfulness promotes performance under pressure

As we have seen, it is likely that anxiety increases in a pressure situation, which in turn possibly leads to a performance drop (Mesagno & Mullane-Grant, 2010). Röthlin et al. (2015) propose a moderated-mediation model of mindfulness, anxiety and performance delivery in pressure situations. They suggest an impact over two ways: first, trait mindfulness is negatively associated with competition anxiety, that is, negatively associated with performance delivery. Furthermore trait mindfulness buffers the negative effects of anxiety on performance delivery in pressure situations (Röthlin et al., 2015). This hypothesis is supported by empirical research. First, Thienot et al. (2014) found that trait mindfulness is negatively associated with competition anxiety in elite and sub-elite athletes. Second, trait anxiety increases the chance of experiencing state anxiety under pressure (Hanton, Mellalieu, & Hall, 2002), which leads to impaired athletic performance. Third, trait mindfulness is positively associated with stronger performance under pressure situations (Gooding & Gardner, 2009). In other words, the current literature suggests that trait mindfulness could increase performance delivery in pressure situations by decreasing competition anxiety. Therefore, we focus here on the relationship between trait mindfulness, trait anxiety and performance outcome.

1.4.1 Mindfulness diminishes cognitive interference

Existing sports studies have usually focused on the influence of anxiety on external distractions (McCarthy et al., 2013). Knowledge of mechanisms by which internal distractions disturb attentional processes is limited for different reasons. According to Moran (2009), it is easier, for instance, to measure external distractions than internal or self-generated distractions. Likewise, there are only a few validated scales available to measure internal distractions in sports performers (McCarthy et al., 2013).

Röthlin et al. (in press) examined the influence of internal distractions on sports performance, in a validation study of the Thought Occurrence Questionnaire Sport (TOQS; Hatzigeorgiadis & Biddle, 2000). In his analysis of cognitive interference, Röthlin et al. (in press) reveals negative correlations between mindfulness and all TOQS subscales. This finding is in line with the examination of Frewen et al. (2008), which revealed that dispositionally mindful individuals are apparently better able to let go of thoughts than less attentive individuals.

Hence, Röthlin et al. (2015) suggests that individuals with a higher degree of trait mindfulness experience greater control over unpleasant thoughts, possibly report less cognitive interference and can thus turn their attention more quickly towards targeted processes. In view of all that, it seems that mindfulness could diminish cognitive interference, which in turn could promote performance under pressure.

1.5 Summary

Together, these studies provide important insights into the field of mindfulness and performance enhancement under pressure in sports. The described relations are summarized hereafter: In sport competitions situations often occur that lead to increased importance of the performance. For Baumeister (1984), pressure is 'a combination of factors that increases the importance of performing well' (p. 610). If an athlete doubts his or her ability to cope in an important situation of performing well, stress and anxiety develop (Gerrig & Zimbardo, 2008). Mesagno and Mullane-Grant (2010) emphasise the high influence of trait anxiety regarding performance decreases in competitive sport situations. However, there is preliminary evidence that trait mindfulness enhances athletic performance (Thompson et al., 2011). Birrer et al. (2012) propose that mindfulness promotes athletic performance through, among other variables, less fear and fewer task-related thoughts. This finding is in line with the examination of Röthlin et al. (2015), which propose trait mindfulness promotes the ability to perform under pressure, by generally reducing anxiety and cognitive interference (Röthlin et al., in press).

An issue that has been omitted from previous research is the relationship between mindfulness and performance in an experimental performance situation with pressure induction. The aim of this study is to investigate potential correlations between trait mindfulness, trait anxiety, cognitive interference and performance under pressure.

1.6 Purpose and hypotheses

The purpose of this study is to examine the relationship between trait mindfulness and performance outcomes under pressure as well as the relationship with trait anxiety and cognitive interference involving youth elite ice hockey players. The following questions guide the study:

Leading question 1

Is there a significant relation between trait mindfulness and performance outcome in pressure situations?

Leading question 2

Are there significant relations between trait mindfulness, trait anxiety and cognitive interference?

Leading question 3

Is there a significant relation between trait anxiety and performance outcome in a pressure situation?

1.6.1 Hypotheses

Hypothesis 1

H_0 There will be no significant positive correlation between trait mindfulness and performance outcome in a pressure situation.

H_1 There will be a significant positive correlation between trait mindfulness and performance outcome in a pressure situation.

Hypothesis 2a

H_0 There will be no significant negative correlation between trait mindfulness and cognitive anxiety.

H_1 There will be a significant negative correlation between trait mindfulness and cognitive anxiety.

Hypothesis 2b

H_0 There will be no significant negative correlation between trait mindfulness and somatic anxiety.

H_1 There will be a significant negative correlation between trait mindfulness and somatic anxiety.

Hypothesis 2c

H_0 There will be no significant negative correlation between trait mindfulness and cognitive interference.

H_1 There will be a significant negative correlation between trait mindfulness and cognitive interference.

Hypothesis 2d

H_0 There will be no significant negative correlation between cognitive anxiety and cognitive interference.

H_1 There will be a significant negative correlation between cognitive anxiety and cognitive interference.

Hypothesis 2e

H_0 There will be no significant negative correlation between somatic anxiety and cognitive interference.

H_1 There will be a significant negative correlation between somatic anxiety and cognitive interference.

Hypothesis 3a

H_0 There will be no significant negative correlation between cognitive anxiety and performance outcome in a pressure situation.

H_1 There will be a significant negative correlation between cognitive anxiety and performance outcome in a pressure situation.

Hypothesis 3b

H_0 There will be no significant negative correlation between somatic anxiety and performance outcome in a pressure situation.

H_1 There will be a significant negative correlation between somatic anxiety and performance outcome in a pressure situation.

2 Method

2.1 Participants

Ninety-seven male ice hockey players were recruited from six elite junior ice hockey teams in Switzerland. All teams compete at the highest national level of junior ice hockey in Switzerland. Six participants could not participate in the sample as a result of language issues as all questionnaires were written in German. Thus, the final sample consisted of 91 participants. All players were between the ages of 16 and 20 (M = 18.23 years, SD = 1.10). On average, the participants trained for 12 hours per week and played two games each week during the season.

2.2 Study design

To examine the influence of trait mindfulness on performance under pressure, I used an experimental design with two on-ice behavioural measures of performance. Coaches or general managers were asked to participate with their teams in our examination and were accurately informed about the purpose of the study. The coaches told players that they were participating in a sports science study. Players were not informed from the start about the real aim of the study in order to avoid the confounding of variables. The research was conducted in accordance with APA ethical guidelines. Informed consent was obtained from all players, and anonymity was assured. The instructions to participants included a reminder to respond to all items, to answer each question honestly and that the data would be treated confidentially.

The first elicitation was a baseline measurement, followed by a pressure-induced performance situation. The on-ice test was an altered version of the IIHF pass precision test, which was used at the 2012 Youth Olympic Games. The test was altered after consulting with coaches and team managers from the participating teams to determine a moderately challenging, but not overly simplistic, task for experienced players. In order to identify the sought-after characteristics, the participants were asked to fill out the questionnaires between the two experimental situations.

2.3 Performance

At the beginning of the elicitation, players were informed about the sequence of the elicitation, the questionnaires and the first experimental baseline measure on ice. Scores were determined by the accuracy of the shot (hit, post, miss). After all players had completed the

baseline measurement and questionnaires, the second experimental situation was explained in the locker room. The exercise remained constant, but several pressure manipulations were induced. Thus, players were informed about the pressure manipulations just before the beginning of the second elicitation. After all players had completed the high-pressure elicitation, the team assembled in the locker room where the official examination was terminated. Upon completing the data collection, participants were fully debriefed.

2.3.1 Baseline condition

The on-ice experiment consisted of a baseline condition and a pressure-induced condition in a pass precision exercise. Before the start of the first measurement, the athletes were informed in the locker room about the upcoming exercise; however, nothing was communicated about the subsequent pressure inducement. Players were motivated to work in a concentrated manner, giving their best. There were always two players on the ice. The exercise was conducted on both sides of the ice rink, thus, two athletes always performed simultaneously. Meanwhile, all others were in the locker room filling out the questionnaires.

There were five small goals symmetrically located on both sides of the rink. Ten pucks were strung together in the middle of the rink. The players had to pass every target twice in the same order from the blue line. Two obstacles were located in the middle of the passing line in front of two goals, hence, the players had to execute a flip pass. A pass into the goal counted two points; hitting the post earned one point; and a miss yielded zero points. Once a player started to skate, he was not allowed to stop again. Therefore, the exercise was dynamic and close to a real game play situation. During the baseline elicitation, only the two researchers were present on the ice with the two participating players.

2.3.2 Pressure-induced condition

After all players on a team had completed the baseline measurement and filled out the questionnaires, the second experimental situation was explained in the locker room. The order and pairs of players performing the exercise remained similar to those in the first experimental situation. The pressure-induced experiment was identical to the low-pressure phase, with the exception that we induced several pressure manipulations. We used similar pressure manipulations, which have previously been employed in a successful manner (Baumeister, 1984; Beilock & Carr, 2005; Lewis & Linder, 1997). The players were therefore informed that all their teammates would watch their attempts from the bench. Teammates were allowed to cheer and encourage the players on the ice. There were also two cameras positioned on the middle line to film both sides of the rink. An assistant stood behind the

cameras to operate them. Furthermore, the scoring method changed: a pass into the goal was now three points, hitting the post one point and a miss minus one point. This makes a possible difference of four points for one pass. Additionally, we told the players that we were drawing up a ranking list of every participating team, along with a team internal ranking list, and that both would be sent to their parents through the coaches. The videotape was not actually used for further analysis, and we did not send ranking lists to parents. These two manipulations were designed as cover stories for the sole purpose of enhancing the pressure on the players.

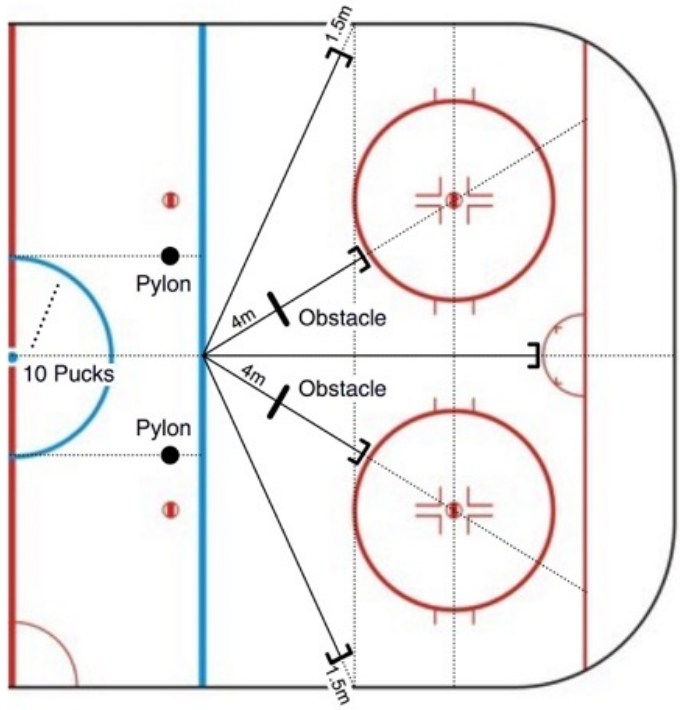

Figure 3: Mirror-symmetric outline of the experimental situation on the ice rink

2.4 Habitual mindfulness

Habitual mindfulness was measured using the 37-item Comprehensive Inventory of Mindfulness Experiences (CHIME) developed by Bergomi, Tschacher and Kupper (2014). The questionnaire is a self-reporting trait mindfulness assessment based on all the aspects of mindfulness included in current mindfulness scales (Bergomi et al., 2014). All items were assessed on a 6-point Likert scale, from 1 = almost never to 6 = almost always, reflecting the past two weeks. This is consistent with the conceptualisation of mindfulness as a (quasi-) disposition, which may change over time (Walach et al., 2004). Sample items include ‘It is easy for me to focus on what I am doing’ and ‘When I have unpleasant thoughts and feelings, I can just notice them without immediately reacting to them’. The CHIME and its eight

subscales have good reliability scores in internal consistency and retest reliability (Bergomi et al., 2014). These include being aware of inner and outer experiences, acting consciously, responding to experiences in an accepting and non-judgemental way, not reacting automatically to experiences and facing experiences in an open and non-avoiding way. In the present sample reliability was acceptable among the 37 items (Cronbach's α = .71).

2.5 Competition anxiety

To identify cognitive and somatic competition anxiety, we used the Wettkampf Angst Inventar Trait (WAI-T; Brand et al., 2009), which is based on the Sports Anxiety Scale (Smith, Smoll, & Schutz, 1990). The WAI-T is a 14-item questionnaire constructed on three subscales: somatic anxiety, concern and concentration disorders. The scores for concern and concentration disorders result in the cognitive anxiety score. For each item, participants rate how often they experience certain feelings before a competition on a 4-point Likert scale, ranging from 1 (*not at all*) to 4 (*very much so*). Sample items for the three subscales include 'Before competitions, I feel nervous' (*somatic competition anxiety*), 'Before competitions, I have self-doubts' (*concern, cognitive competition anxiety*) and 'Before competitions, I become vulnerable about distractions' (*concentration disorder, cognitive competition anxiety*). Reliability among the twelve items was strong (Cronbach's α = .83). Within the two factors, reliability was strong to acceptable in the present sample (somatic anxiety, four items, Cronbach's α = .73; cognitive anxiety, eight items, Cronbach's α = .78).

2.6 Cognitive interference

We assessed cognitive interference using the German form of the TOQS (Hatzigeorgiadis & Biddle, 2000). This questionnaire includes 17 items measuring the degree to which athletes experience cognitive interference from distracting thoughts during competition. These items are associated with three subscales: task-related worries, task-irrelevant worries and thoughts of escape. The subjects rated how often they experienced certain thoughts before a game on a 7-point Likert scale ranging from 1 (*almost never*) to 7 (*almost always*). The items were pre-fixed with the phrase 'During the competition/game, I had thoughts'. The task-related worries subscale contained six items, including 'that we are not going to achieve our goals' and 'that the conditions (weather, temperature, pitch, atmosphere) are no good'. The task-irrelevant worries subscale consisted of five items, for example, 'about personal worries' and 'about what I am going to be doing later in the day'. The thought of escape subscale contained six

items, including ‘about stopping’ and ‘I do not want to take part in this game anymore’. The results showed adequate factorial validity for the psychometric properties of the TOQS (Lane, Harwood, & Nevill, 2005). Reliability among the 17 items relating to competition anxiety was excellent (Cronbach’s $\alpha = .90$). It was high to acceptable within each of the three factors in the present sample (task-related worries, six items, Cronbach’s $\alpha = .85$; task-irrelevant thoughts, five items, Cronbach’s $\alpha = .77$; thoughts of escape, six items, Cronbachs’ $\alpha = .82$).

2.7 Data analysis

Analyses were performed using the SPSS version 23 software for Macintosh (IBM SPSS Statistics 23, IBM Corporation, Armonk, USA). The significance level was set to .05 for all statistical tests. Consequently, a significant difference was at a p-value of $< .05$.

3 Results

3.1 Descriptive statistics

Table 1 summarises the descriptive statistics of all variables. The experimental situation shows the average number of points during the two examinations. The average performance improved in the pressure situation, and variability increased slightly (M = .25, SD = .08). The sample showed an average mindfulness score of 3.86 (SD = .33).

Table 1.

Descriptive Statistics for all Variables

Variables	**M**	**SD**
Experimental Situation (n = 91)		
Points scored Baseline Measurement	4.20	1.50
Points scored Pressure Measurement	4.45	1.58
CHIME (n = 91)		
Habitual Mindfulness	3.86	.33
TOQS (n = 91)		
Thoughts of Escape	1.47	.63
Task-Irrelevant Thoughts	2.09	1.01
Task-Related Worries	2.44	.95
WAI-T (n = 91)		
Somatic Anxiety	1.80	.56
Cognitive Anxiety	1.73	.47

3.1.1 CHIME subscale scores

The CHIME consists of 37 items divided into eight subscales. To obtain a more exact view concerning the mindfulness scores of our sample, they are specifically presented in Table 2. For every subscale, Cronbach's alpha parameters expressed data reliability.

Table 2.

Descriptive Statistics for the CHIME Questionnaire Subscales

N = 91	Aware Int	Aware Ext	Act Aware	Acc NJ	Dec NR	Openness	Relativity	Insight
M	4.37	4.12	4.04	3.5	3.66	3.35	3.71	4.15
SD	0.66	0.89	0.75	0.56	0.63	0.76	0.65	0.67
Minimum	2.0	1.75	2.5	2.2	1.67	1.75	1.25	2.0
Maximum	6.0	6.0	6.0	4.8	5.17	5.25	5.0	5.6
Cronbach's α	0.52	0.62	0.42	0.31	0.71	0.46	0.46	0.47

Note: AwareInt = Awareness of Internal Experiences; AwareExt = Awareness of External Experiences; ActAware = Acting with Awareness; AccNJ = Accepting and Nonjudgmental orientation; DecNR = Decentering and Nonreactivity; Openness = Openness to Experience; Relativity = Relativity of Thoughts; Insight = Insightful Understanding.

3.2 H1: Correlation mindfulness and performance under pressure

Hypothesis 1 assumed that there was a positive correlation between mindfulness and performance outcome in a situation under pressure. To analyse changes between the baseline situation and the pressure situation, the difference between the two performance outcomes was calculated. A minus value indicates performance impairment under pressure. Descriptive statistics are presented in Table 1 and Table 2. The analysis was conducted using the Pearson product moment correlation coefficient. There was a weak negative correlation between mindfulness and performance outcome under pressure. No significant differences were found between mindfulness and performance outcome (r = - .10, p = .37).

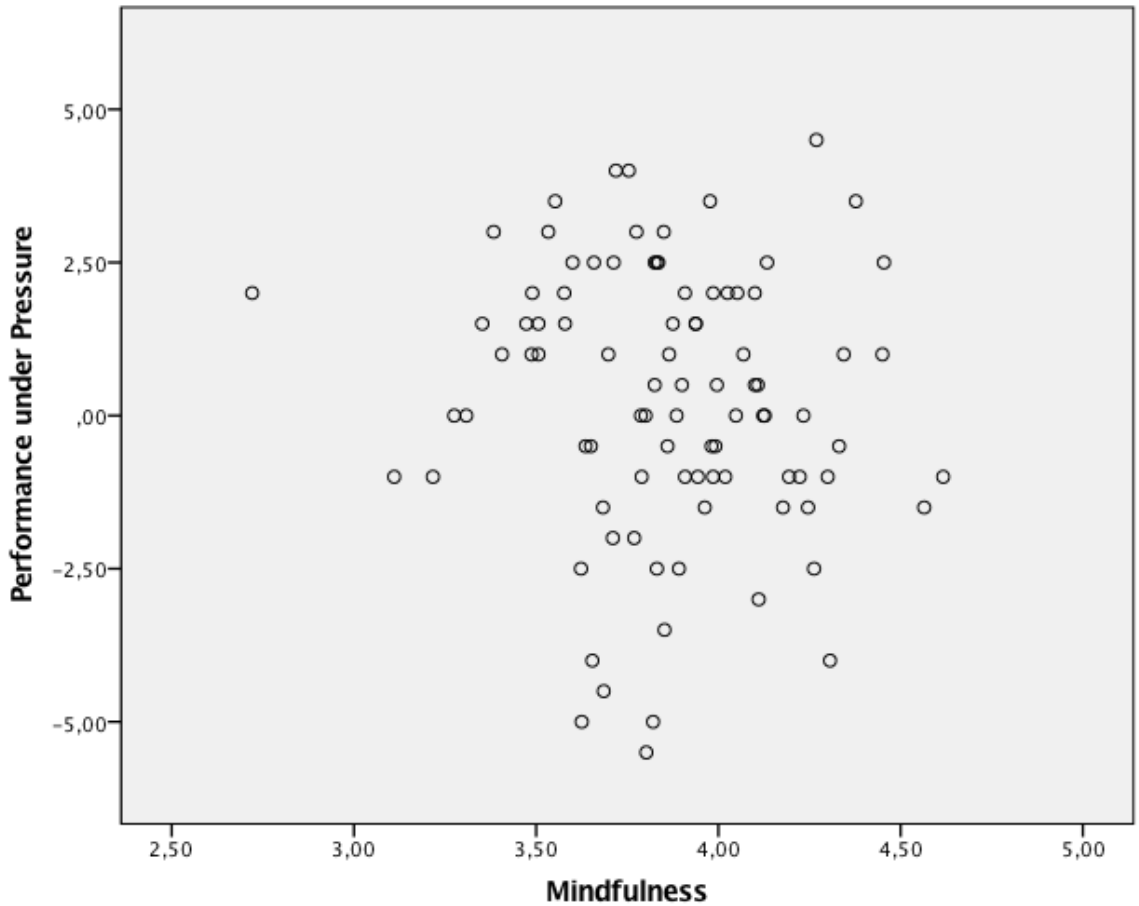

Figure 4: Pearson correlation of mindfulness and performance outcome under pressure

3.3 H2: Correlation analysis, mindfulness and other variables

Hypothesis 2 assumed that there was a negative correlation between mindfulness and trait anxiety and cognitive interference. Pearson's product moment correlation coefficient was used to determine the correlation between the variables. Descriptive statistics are presented in Table 1 and Table 2.

The results, as shown in Table 3, indicate that mindfulness correlated negatively with all other variables except somatic anxiety. There was a significant negative correlation between mindfulness and cognitive anxiety ($r = -.25$, $p = .02$). Furthermore, I found negative correlations between mindfulness and all three items of the TOQS questionnaire: task-related worries, task-irrelevant thoughts and thoughts of escape.

Cognitive anxiety had strong positive correlations with all three items of the TOQS questionnaire: task-related worries, task-irrelevant thoughts and thoughts of escape. These results were significant at the level of $p = .01$.

Somatic anxiety correlated positively moderately to strongly with task-related worries and thoughts of escape. These results were significant at the level of $p = .01$. Furthermore, somatic anxiety correlated moderately positively with task-irrelevant thoughts at a significance level of $p = .05$.

Table 3.

Pearson Correlation Analysis between Variables.

N = 91	Mindfulness	Cognitive Anxiety	Somatic Anxiety	Task-Related Worries	Task-Irrelevant Thoughts	Thoughts of Escape
Mindfulness	-	-.25*	0.0	-.19	-.18	-.20
Cognitive Anxiety	-.25*	-	.53**	.65**	.47**	.52**
Somatic Anxiety	0.0	.53**	-	.40**	.25*	.41**
Task-Related Worries	-.19	.65**	.40**	-	.51**	.62**
Task-Irrelevant Thoughts	-.18	.47**	.25*	.51**	-	.60**
Thoughts of Escape	-.2	.52**	.41**	.62**	.60**	-

*. Correlation is significant at the level of 0.05 (2-sided). **. The correlation is significant at the level of 0.01 (2-sided).

3.4 H3: Correlation trait anxiety and performance under pressure

Hypothesis 3 assumed that there was a negative correlation between trait anxiety and performance outcome in pressure situations. Trait anxiety includes somatic and cognitive components; therefore, both components were analysed. Descriptive statistics are presented in Table 1. The analysis was conducted using Pearson's product moment correlation coefficient. There was a weak negative correlation between somatic anxiety and performance outcome. No significant differences were found between somatic anxiety and performance outcome ($r = -.08$, $p = .46$). Moreover, there was a weak negative correlation between cognitive anxiety and performance outcome. No significant correlations were found between cognitive anxiety and performance outcome ($r = -.12$, $p = .28$).

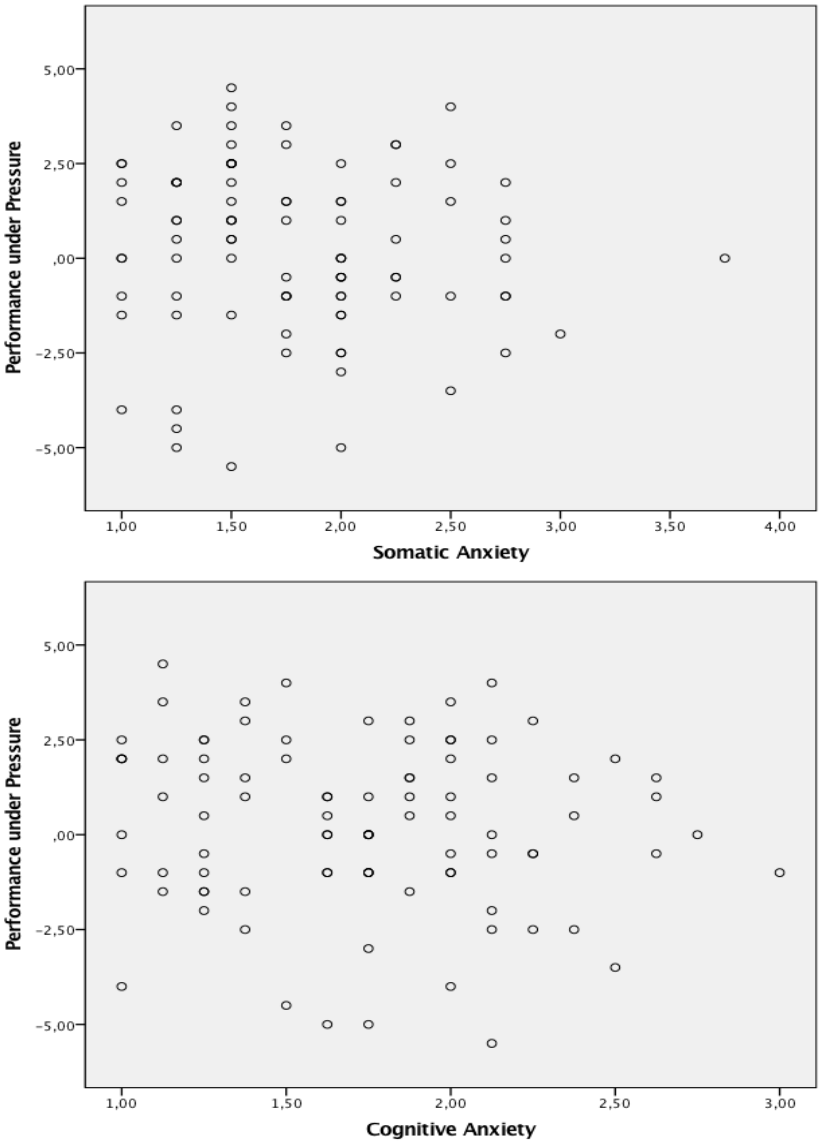

Figure 5: Pearson's correlation: Somatic and cognitive anxiety with performance outcome under pressure

4 Discussion

The purpose of this study was to investigate correlations between trait mindfulness, trait anxiety, cognitive interference and performance in a pressure situation with junior ice hockey players. We therefore examined 91 elite junior ice hockey players. The results are discussed below and are addressed in order of the questions on it.

4.1 Correlation mindfulness and performance under pressure

The first question in this study sought to determine a relationship between mindful junior athletes and performance under pressure. As mentioned in the literature review, mindfulness may improve performance delivery in a pressure situation (Röthlin et al., 2015). We had reason to believe that mindful athletes would perform better under pressure than less mindful athletes. In fact, the results show that there was no positive correlation between trait mindfulness and performance outcome in a pressured experimental situation ($r = -.10$, $p = .37$). Therefore, the alternative hypothesis was rejected. Indeed, mindful athletes performed, on average, slightly weaker under pressure than less mindful athletes ($M = -.24$, $SD = .08$). This finding did not confirm the hypothesis that trait mindfulness correlates positively with performance under pressure.

4.1.1 Measuring mindfulness

One possible explanation for our results concerns the quantification of mindfulness. Johnson et al. (2016) reports that the CHIME might be overly complex in its current form for an adolescent age group and that the items and Likert descriptors need to be modified to be suitable for adolescents. Our sample consists of an average age of 18.23 years ($SD = 1.10$), still an adolescent age group, which would support the argumentation of Johnson et al. (2016).

My data collection itself supports the hypothesis of Johnson et al. (2016) concerning the quantification of mindfulness in adolescent age groups. There were some athlete-related questions concerning words or meanings of sentences they did not understand from the CHIME. To proceed with the assumption that not every athlete asked for verification when he did not understand a question or was ashamed of asking more than once, it is possible that the mindfulness data was biased. Evidence of this argument comes from the CHIME subscales, which showed rather weak Cronbach α scores, indicating weak reliability.

A further possible explanation for our result concerns the direction of understanding and the performance of reverse scored items within the questionnaire. Nine out of 37 CHIME items

are reverse formulated. Bergomi et al. (2014) report significantly higher mean scores of the positive formulated items. The current sample supports this result. The mean score of the positive formulated items (M = 4.0, SD = .45) was significantly higher than the mean scores of the reversed items (M = 3.4, SD = .56, $t(91) = 6.84$, $p < .001$). Johnson et al. (2016) assume that youth reverse scored items interspersed with forward scored items can be confusing. Evidence for this argument also comes from the CHIME subscales, which showed rather weak Cronbach α scores, indicating weak reliability.

4.1.2 Mindfulness scores

The actual study sample of junior athletes showed, in general, relatively low mindfulness scores. Descriptive statistics show an average mindfulness score of 3.86 (SD = .33) whereas the examination (N = 298) of Bergomi et al. (2014) with a general population sample (M = 35.22 years, SD = 12.23) showed an average mindfulness score of 4.25 (SD = .55). Similarly, the current sample show in every CHIME subscale lower average mindfulness scores than the sample (N = 298) of Bergomi et al. (2014). Johnson et al. (2016) assume that mindfulness may be experienced and expressed differently in children, adolescents and adults. It might be possible that there is a relationship between the age and the relatively low mindfulness score of our sample.

4.1.3 Trainings effect

Another interesting finding was that there were more points scored in the pressure condition than in the baseline condition. Generally, athletic performance decreases when pressure is high (Hill et al., 2010). There are several possible explanations for this inverse result, one of which could be a training effect between the baseline and the pressure situation. Although the athletes play at the highest level of junior ice hockey in Switzerland and are highly skilled, the whole experimental situation was new to them during the baseline condition. In the pressure condition that followed, they already knew how everything worked. Hence, it might be that this had a performance promoting effect.

4.1.4 Pressure manipulation

It also seems possible that these results are due to difficulties in constructing an artificial pressure situation. We used pressure manipulations which have been previously successfully utilised, except the monetary incentive. Hence, the experimental situation was supposed to induce pressure on the athletes. However, the performance increase in the pressure situation lends support to the belief that the pressure manipulation might not have been fully

successful. This hypothesis is supported by self-statements of the ice hockey players. After the performance in the pressure situation, every player was asked how much pressure he felt on a 5-point Likert scale. The average value of perceived pressure (M = 2.3, SD = .85) indicates, that pressure probably was too low. However, a note of caution is due here since this pressure scale relies on athlete's perception.

4.1.5 Summary

Taken together, on one hand there is some evidence that the data collection with the CHIME was not able to reliably identify mindfulness in youth ice hockey players. A possible confounding variable could be the age of the players, which could have an influence on the understanding and clarity of the CHIME items. This hypothesis is in line with findings from Johnson et al. (2016). On the other hand, it seems I experienced difficulties in constructing enough pressure for experienced athletes and questionable validity or reliability of the performance measure.

4.2 Correlation analysis, mindfulness and other variables

The second question of this study set out to determine relationships between mindfulness, trait anxiety and cognitive interference in junior ice hockey players.

4.2.1 Correlation mindfulness and trait anxiety

First, we discuss the correlations between mindfulness and trait anxiety. A prior study showed negative correlations between mindfulness and cognitive and somatic anxiety (Röthlin et al., 2015). The current study found a weak significant negative correlation between mindfulness and cognitive anxiety ($r = -.25$, $p = .02$). Therefore, the alternative hypothesis 2a was accepted. However, there was no correlation between mindfulness and somatic anxiety ($r = .0$, $p = .97$). Thus, the alternative hypothesis 2b was rejected.

These results are partly in agreement with those obtained by Röthlin et al. (2015) as this study has been unable to demonstrate a correlation between mindfulness and somatic anxiety. Röthlin et al. (2015) revealed significant negative correlations between mindfulness and cognitive competition anxiety ($r = -.45$, $p = <.01$) as well as between mindfulness and somatic competition anxiety ($r = -.29$, $p = <.01$). These findings suggest, that mindfulness might specifically has an influence on the negative aspects of cognitive anxiety. Röthlin et al. (2015) support that hypothesis, proposing that cognitive anxiety might impair performance under pressure. As mentioned in the literature review, reducing the experience of anxiety is one way

to enhance performance under pressure (Röthlin et al. 2015). In general, therefore, it seems that trait mindfulness might be able to reduce the probability of experiencing anxiety in young ice hockey players.

4.2.2 Correlation mindfulness and cognitive interference

The second correlation in this analysis was between mindfulness and cognitive interference. In reviewing the literature, Frewen et al. (2008) report that trait mindfulness helps in the reduction of the frequency of worrisome thoughts. A study of Röthlin et al. (in press) reveals weak significant negative correlations between mindfulness and all TOQS subscales (task-related worries r = -.50, task-irrelevant thoughts r = -.19, and thoughts of escape r = -.35, p = <.01).

The results of this study demonstrated also weak but non-significant negative correlations between mindfulness and all three subcategories of the TOQS questionnaire (task-related worries r = -.19, task-irrelevant thoughts r = -.18, and thoughts of escape r = -.20). Thus, this study has been unable to demonstrate a significant relationship between trait mindfulness and cognitive interference. The alternative hypothesis 2c was rejected. Nonetheless, the current results go in line with the findings of Röthlin et al. (in press). Mindfulness could be an effective ressource in reducing cognitive interference and in turn increase the probability to perform under pressure.

4.2.3 Trait anxiety and cognitive interference

Third, we analysed trait anxiety and cognitive interference. Following cognitive interference theory (Sarason et al., 1990), anxiety increases the probability of responding to stress with cognitive interference. A study of Coy et al. (2011) supports this idea. Hatzigeorgiadis and Biddle (2000, 2008) reveal positive correlations between all TOQS scales and cognitive competition anxiety. The results of this study are in line with these previous studies: Cognitive anxiety has strong positive significant correlations with task-related worries (r = .65), task-irrelevant thoughts (r = .47) and thoughts of escape (r = .52). The alternative hypothesis 2d was accepted.

Similarly, somatic anxiety has weak to moderately significant correlations with task-related worries (r = .40), task-irrelevant thoughts (r = .25) and thoughts of escape (r = .41). The alternative hypothesis 2e was also accepted. In summary, it can be said that between trait anxiety and cognitive interference, there is a moderate to strong significant positive correlation. These results are so far important since both variables – trait anxiety and

cognitive interference – usually negatively affect athletic performance (Moran, 2009; Woodman & Hardy, 2001).

4.2.4 Summary

Taken together, despite these promising results, questions concerning the influence of mindfulness remain pertinent. Somatic anxiety did not correlate with mindfulness whereas cognitive anxiety just weakly correlated with mindfulness. These results could not entirely support the findings of Röthlin et al. (2015). It may be the case that there were difficulties measuring mindfulness, as explained in the chapter above. The correlations between trait anxiety and cognitive interference support the current literature (Coy et al., 2011; Hatzigeorgiadis & Biddle, 2000, 2008; Sarason et al., 1986).

4.3 Correlation trait anxiety and performance under pressure

Third, I sought to determine a relationship between trait anxiety and performance under pressure in junior ice hockey players. A certain level of anxiety could positively affect athletic performance (Hardy, 1990). However, it generally weakens performance when pressure is high (Hill et al., 2010). Mesagno and Mullane-Grant (2010) emphasise the high influence of trait anxiety regarding a decrease in performance in a competitive sports situation. Hence, we had reason to believe that trait anxiety would negatively influence performance under pressure.

Contrary to expectations, this study did not find a significant difference between cognitive anxiety and performance outcome. However, the analysis revealed a weak negative correlation, between cognitive anxiety and performance outcome ($r = -.12$, $p = .28$). Nonetheless, the alternative hypothesis 3a was rejected.

Likewise, the current study found a weak negative correlation between somatic anxiety and performance outcome; no significant relationship was found between somatic anxiety and performance outcome ($r = -.08$, $p = .46$). Therefore, the alternative hypothesis 3b was also rejected.

Several reports have shown that trait anxiety has an impairing effect on performance under pressure (Baumeister & Showers, 1986; Hill et al., 2010; Mesagno & Mullane-Grant, 2010). Röthlin et al. (2015) propose that cognitive anxiety is negatively associated with performance delivery in demanding situations. These studies differ partially from the findings presented

here. Although there was a weak correlation, following the literature is trait anxiety supposed to have more influence on performance under pressure (Hill et al., 2010).

A likely explanation arguably concerns pressure manipulation. It is likely that we experienced difficulties by putting enough pressure on the players. All athletes in this study sample play ice hockey at the highest possible junior level in Switzerland. Therefore, they are likely very experienced. Hence, they had already experienced many pressure situations in their career. Lazarus and Folkman (1984) suggest in a second wave approach two stages in the cognitive evaluation of requirements. The primary appraisal describes the initial assessment of the gravity of a request, in our case the pressure situation. The secondary appraisal assesses the personal and social resources that are available to deal with the stressor. As mentioned, our study sample consists of very experienced junior ice hockey players. Thus, their personal resources and experience could enable them to cope with the stressors directed at them. In general, therefore, it seems that not enough feelings of anxiety were aroused, which could have affected their performance. This hypothesis is supported by the self-statements of the players, who reported a low average value of perceived pressure (M = 2.3, SD = .85).

4.4 Limitations

Although the current study was carefully designed, methodological limitations should be discussed.

4.4.1 Statistical analysis

Röthlin et al. (2015) propose that trait mindfulness indirectly influences performance under pressure through mediation and moderation. The actual study only applied Pearson's correlations and was not able to support all current views represented in the literature. It is possible, therefore, that indirect influences of trait mindfulness, such as mediation or moderation, on performance under pressure were overlooked.

4.4.2 Generalisability

The subjects were exclusively junior ice hockey players. Johnson et al. (2016) suggest that mindfulness may be experienced and expressed differently in children, adolescents and adults. As a result, this study does not claim to be representative of children or adults. Furthermore, the sample comprised only male athletes. Hence, this study has no legitimation for both sexes. Additionally, the study sample was exclusive to ice hockey players, unlike other studies, for

instance Röthlin et al. (2015), which examined athletes from 23 different sports. Therefore, the results from this examination are valid for a relatively small population.

4.4.3 Internal validity

As discussed above, it is possible to hypothesise that we had difficulty measuring trait mindfulness. Although Bergomi et al. (2014) reveal good reliability (internal consistency and retest-reliability) in a general population with the CHIME questionnaire, it is possible that adolescent samples experience difficulty understanding all items, as proposed by Johnson et al. (2016). Thus, it is important to bear in mind the possible bias in these responses.

Another key factor is the experimental performance situation with pressure induction. As discussed earlier, it may be the case that the current experimental situation was not able to put as much pressure on the sample as it could be experienced in a competitive situation. The current study conducted no pressure manipulation checks. Hence, there is no empirical evidence of the strength of the impact of pressure manipulation.

4.5 Further research

Further research will need to address these limitations. The current study tested performance in a pressure situation with junior athletes. Future research should measure behaviour in different pressure situations or even try to create an experiment in a competitive situation. It would also be interesting to measure biological parameters in a baseline and in a pressure situation in terms of the impact of pressure manipulation. It might for instance be beneficial to take salivary samples to measure differences in stress hormones.

It will also be important to conduct further examinations on the relationship between trait mindfulness and performance under pressure. The CHIME questionnaire provides eight subscales: inner awareness, outer awareness, acting with awareness, openness, acceptance, decentring/non-react, insight and relativity. Future research should look at possible relationships between these eight subscales and performance under pressure.

4.6 Applied implications

This is the first study known by the author to examine trait mindfulness and performance under pressure in an experimental situation with youth athletes. In our society, there are many different fields, besides sports, in which people need to perform under pressured circumstances. Therefore, it is important to know what helps performance in such crucial

moments. However, these results do not provide support for the hypothesis that trait mindfulness promotes performance under pressure. Nonetheless, the current study provides important knowledge, which could be helpful for further mindfulness examinations in sports or in other fields of research.

5 Conclusion

There is empirical evidence suggesting that trait mindfulness promotes performance under pressure. However, this study was just partly able to support this view in an experimental situation under pressure hockey players. The present study of elite junior ice hockey players indicates that there is no correlation between habitual mindfulness and performance outcome under pressure. It could be the case, that mindfulness is experienced and expressed differently in adolescents and adults athletes. Nevertheless, the current study revealed a significant negative correlation between habitual mindfulness and cognitive anxiety. Furthermore, mindfulness correlates negatively with all TOQS subscales. Hence, habitual mindfulness may promote successful performance under pressure through buffering the detrimental effects of anxiety in situations under pressure.

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Appendix A – CHIME Questionnaire

Fragebogen zur Achtsamkeit

Dieser Fragebogen umfasst Aussagen, die sich auf verschiedene Aspekte der Achtsamkeit im Alltag beziehen. Bitte antworten Sie spontan, ohne lange darüber nachzudenken. Es gibt keine „richtigen“ oder „falschen“ und keine „guten“ oder „schlechten“ Antworten. Ihre persönliche Erfahrung ist uns wichtig. Bitte beantworten Sie jede Frage.

Bitte beziehen Sie die Aussagen auf die letzten zwei Wochen.

		fast nie	selten	eher selten	eher häufig	häufig	fast immer
1	Wenn sich meine Stimmung verändert, nehme ich das sofort wahr.	O_1	O_2	O_3	O_4	O_5	O_6
2	Im Auf und Ab des Lebens bin ich mir gegenüber warmherzig.	O_1	O_2	O_3	O_4	O_5	O_6
3	Ich bemerke im Alltag, wenn eine bestimmte Situation erst durch meine negative Einstellung ihr gegenüber schwieriger wird.	O_1	O_2	O_3	O_4	O_5	O_6
4	Es ist mir klar, dass sich meine Bewertungen von Situationen oder Personen leicht verändern können.	O_1	O_2	O_3	O_4	O_5	O_6
5	Beim Sitzen oder Liegen nehme ich meine Körperempfindungen wahr.	O_1	O_2	O_3	O_4	O_5	O_6
6	Ich muss darüber schmunzeln, wenn ich sehe, wie ich mir manchmal die Dinge als viel komplizierter vorstelle, als sie eigentlich sind.	O_1	O_2	O_3	O_4	O_5	O_6
7	Ich gehe hart mit mir selber um, wenn ich Fehler mache.	O_1	O_2	O_3	O_4	O_5	O_6
8	Wenn ich belastende Gedanken oder Vorstellungen habe, fühle ich mich relativ schnell danach wieder ruhig.	O_1	O_2	O_3	O_4	O_5	O_6
9	Ich nehme Farben und Formen in der Natur deutlich und bewusst wahr.	O_1	O_2	O_3	O_4	O_5	O_6
10	Ich zerbreche oder verschütte Dinge aus Unachtsamkeit oder weil ich an anderes denke.	O_1	O_2	O_3	O_4	O_5	O_6
11	Ich sehe meine Fehler und Schwierigkeiten, ohne mich zu verurteilen.	O_1	O_2	O_3	O_4	O_5	O_6
12	Es fällt mir leicht, mich darauf zu konzentrieren, was ich tue.	O_1	O_2	O_3	O_4	O_5	O_6
13	Wenn ich belastende Gedanken oder Vorstellungen habe, kann ich sie einfach bemerken, ohne gleich auf sie zu reagieren.	O_1	O_2	O_3	O_4	O_5	O_6
14	Wenn ich mit anderen Personen spreche, nehme ich wahr, welche Gefühle ich dabei erlebe.	O_1	O_2	O_3	O_4	O_5	O_6
15	Wenn ich es mir selber unnötig schwer gemacht habe, kann ich das mit einer Spur Humor wahrnehmen.	O_1	O_2	O_3	O_4	O_5	O_6
16	In schwierigen Situationen kann ich einen Moment innehalten, ohne sofort zu reagieren.	O_1	O_2	O_3	O_4	O_5	O_6
17	Im Alltag werde ich durch viele Erinnerungen, Bilder oder Träumereien abgelenkt.	O_1	O_2	O_3	O_4	O_5	O_6

		fast nie	selten	eher selten	eher häufig	häufig	fast immer
18	Wenn ich Auto oder Zug fahre, bin ich mir meiner Umgebung, z.B. der Landschaft, bewusst.	O_1	O_2	O_3	O_4	O_5	O_6
19	Ich versuche beschäftigt zu bleiben, damit mir bestimmte Gedanken und Gefühle nicht bewusst werden.	O_1	O_2	O_3	O_4	O_5	O_6
20	Wenn ich in Gedanken und Gefühlen gefangen bin, dauert es nicht lange, bis ich das merke und mich wieder davon distanzieren kann.	O_1	O_2	O_3	O_4	O_5	O_6
21	Ich achte auf Empfindungen wie zum Beispiel Wind in meinem Haar oder Sonnenschein auf meinem Gesicht	O_1	O_2	O_3	O_4	O_5	O_6
22	Ich versuche mich abzulenken, wenn ich unangenehme Gefühle erlebe.	O_1	O_2	O_3	O_4	O_5	O_6
23	Im Alltag ist mir bewusst, dass viele Gedanken Interpretationen sind, die nicht unbedingt der Realität entsprechen.	O_1	O_2	O_3	O_4	O_5	O_6
24	Ich kann darüber schmunzeln, wenn ich sehe, wie ich aus einer kleinen Schwierigkeit ein Problem gemacht habe.	O_1	O_2	O_3	O_4	O_5	O_6
25	Ich kann meine Gedanken und Gefühle beobachten, ohne mich in ihnen zu verstricken.	O_1	O_2	O_3	O_4	O_5	O_6
26	Beim Lesen muss ich Abschnitte wiederholt lesen, weil ich an etwas anderes gedacht habe.	O_1	O_2	O_3	O_4	O_5	O_6
27	Ich nehme Geräusche in meiner Umgebung, wie z.B. zwitschernde Vögel oder vorbeifahrende Autos, bewusst wahr.	O_1	O_2	O_3	O_4	O_5	O_6
28	Ich nehme meine Gefühle und Gedanken wahr und kann sie gleichzeitig mit etwas Distanz betrachten.	O_1	O_2	O_3	O_4	O_5	O_6
29	Ich nehme Veränderungen in meinem Körper deutlich wahr, z.B. schnelleres oder langsameres Atmen.	O_1	O_2	O_3	O_4	O_5	O_6
30	Ich mag es nicht, wenn ich ärgerlich oder ängstlich bin und versuche, solche Gefühle beiseite zu schieben.	O_1	O_2	O_3	O_4	O_5	O_6
31	Mir ist im Alltag bewusst, dass meine Sicht der Dinge subjektiv ist und den Tatsachen nicht entsprechen muss.	O_1	O_2	O_3	O_4	O_5	O_6
32	Auch wenn ich einen grossen Fehler gemacht habe, gehe ich mit mir auf eine verständnisvolle Art um.	O_1	O_2	O_3	O_4	O_5	O_6
33	Wenn ich Schmerzen habe, versuche ich diese Wahrnehmung möglichst zu vermeiden.	O_1	O_2	O_3	O_4	O_5	O_6
34	Es ist mir im Alltag bewusst, wie ich mich gerade fühle.	O_1	O_2	O_3	O_4	O_5	O_6
35	Es ist mir im Alltag bewusst, dass sich eigene Meinungen, die ich zur Zeit sehr ernst nehme, deutlich verändern können.	O_1	O_2	O_3	O_4	O_5	O_6
36	Ich nehme mir meine Fehler und Schwächen übel.	O_1	O_2	O_3	O_4	O_5	O_6
37	Wenn ich mir unnötig das Leben schwer mache, wird mir das bald danach klar.	O_1	O_2	O_3	O_4	O_5	O_6

Appendix B – TOQS Questionnaire

Thought Occurence Questionnaire

Im Folgenden findest du eine Reihe von Gedanken wie sie während eines Wettkampfes/Spiels vorkommen können. Bitte gib an wie oft die aufgeführten Gedanken im Allgemeinen bei dir vorkommen.

Während dem Wettkampf/Spiel habe ich Gedanken ...

		fast nie	selten	eher selten	manch-mal	eher häufig	häufig	fast immer
1	..., dass ich aufgeben möchte.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
2	... an andere Aktivitäten (z. B einkaufen, Kaffee trinken, TV schauen)	O_1	O_2	O_3	O_4	O_5	O_6	O_7
3	... an vorausgegangene Fehler, die ich machte.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
4	..., dass ich nicht mehr an diesem Wettkampf/Spiel teilnehmen möchte.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
5	... daran, was ich später am Tag machen werde.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
6	..., dass ich einen schlechten Tag habe.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
7	..., dass ich hier raus will.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
8	... an persönliche Sorgen (z.B. Schule, Arbeit, Beziehungen).	O_1	O_2	O_3	O_4	O_5	O_6	O_7
9	..., dass die Bedingungen (Wetter, Temperatur, Feld Atmosphäre) nicht gut sind.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
10	... ans aufhören.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
11	... an Freunde.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
12	..., dass ich heute meine Ziele nicht erreichen werde.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
13	..., dass ich die Schnauze voll habe.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
14	... daran, was ich tun werde, wenn ich nach Hause komme.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
15	..., dass ich diesen Wettkampf/dieses Spiel nicht gewinnen werde.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
16	..., dass ich es nicht mehr aushalte.	O_1	O_2	O_3	O_4	O_5	O_6	O_7
17	... dass die Gegner besser sind als ich.	O_1	O_2	O_3	O_4	O_5	O_6	O_7

Appendix C – WAI–T Questionnaire

WAI-T

Auf der nächsten Seite sehen Sie 14 Aussagen, die manchmal vorkommende Gedanken und Gefühle von Sportlerinnen und Sportlern vor Wettkämpfen ausdrücken. Bitte lesen Sie jede Aussage durch und markieren Sie jenes Kästchen rechts der jeweiligen Aussage, das Ihre eigenen Gedanken und ihre eigene Gefühlslage vor Wettkämpfen am besten beschreibt.

Manche Sportler geben es nur ungern zu, nervös zu sein oder irgendwelche Befürchtungen zu haben. Jedoch sind solche Gedanken und Gefühle selbst unter Profisportlern nichts Ungewöhnliches. Wir bitten Sie deswegen, im Fragebogen Ihre wahren Reaktionen preiszugeben.

Halten Sie sich nicht zu lange an einzelnen Aussagen auf. Bitte wählen Sie ohne lange abzuwägen jene Antwort aus, die am besten beschreibt, wie Sie für gewöhnlich vor Wettkämpfen denken und fühlen.

Es keine richtigen oder falschen Antworten.

Beispiel:

Im folgenden Beispiel ist in der Antwortspalte das zweite Kästchen von links angekreuzt. Dies würde bedeuten, dass Sie vor Wettkampfsituationen für gewöhnlich ein wenig aufgeregt sind.

Vor Wettkämpfen…	**gar nicht**			**sehr**
1) … bin ich aufgeregt.	☐ gar nicht	☒	☐	☐ sehr

Bitte blättern Sie nun um und beginnen Sie mit der Beantwortung der Fragen.

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Vor Wettkämpfen…	gar nicht			sehr
1) … fühle ich mich nervös.	☐ gar nicht	☐	☐	☐ sehr
2) … habe ich Selbstzweifel.	☐ gar nicht	☐	☐	☐ sehr
3) … habe ich Bedenken, dass ich weniger gut abschneide, als ich eigentlich könnte.	☐ gar nicht	☐	☐	☐ sehr
4) … bin ich anfällig für Ablenkungen.	☐ gar nicht	☐	☐	☐ sehr
5) … fällt es mir schwer, mit meinen Gedanken beim Wettkampf zu bleiben.	☐ gar nicht	☐	☐	☐ sehr
6) … bin ich besorgt, unter Druck zu versagen.	☐ gar nicht	☐	☐	☐ sehr
7) … pocht mein Herz vor Aufregung.	☐ gar nicht	☐	☐	☐ sehr
8) … habe ich ein flaues Gefühl im Magen.	☐ gar nicht	☐	☐	☐ sehr
9) … achte ich auf Reaktionen von Zuschauern.	☐ gar nicht	☐	☐	☐ sehr
10) … fühle ich mich zittrig.	☐ gar nicht	☐	☐	☐ sehr
11) … habe ich Bedenken, ob ich mein Ziel erreichen werde.	☐ gar nicht	☐	☐	☐ sehr
12) … stören mich Zwischenrufe aus dem Publikum.	☐ gar nicht	☐	☐	☐ sehr

13) Eine körperlich spürbare Aufgeregtheit vor Wettkämpfen empfinde ich für gewöhnlich eher als...	☐ leistungs-hemmend	☐	☐	☐	☐ leistungs-fördernd
14) Sorgenvolle Gedanken vor Wettkämpfen empfinde ich für gewöhnlich eher als...	☐ leistungs-hemmend	☐	☐	☐	☐ leistungs-fördernd

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