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Indirect and Direct Measurement of Anxiety in Sport

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Dedicated to Marcus,
Joshua Alexander and Charlotte Sophia

To Grandma, Carola, Peter & Gerhard
- in memoriam -

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Abstract

Current research on dual process theories proposes that affective, cognitive and behavioural responses result from two different types of information processing: explicit processes and implicit processes. The latter type are usually displayed by indirect measures. Indirect measures in sport psychology have yet to be established, although they hold several advantages compared to direct measures. This work focuses on the indirect measurement of competitive anxiety and sport injury anxiety. In a first study, sport-specific anxiety was investigated by the indirect Implicit Association Test (IAT) – Anxiety related to self-report trait anxiety. In the second study, two newly developed sport-specific IATs were used to investigate competitive anxiety and sport injury anxiety in relation to equivalent self-report measures. In the third study, Control-IATs were analysed as a validity marker of possible influential methodical variances on results of the sport-specific IATs. Results confirm that indirect and direct measures are unrelated and highlight the necessity of sport-specific indirect instruments. Acceptable and stable objectives regarding the newly developed sport-specific IAT measures were found. No indication of methodical variance was found. In conclusion, the newly developed IATs support the application of indirect anxiety measures in sport. Nevertheless, attentional focus and situational context deserve special regard.

Keywords: *Implicit Association Test; Competitive Anxiety; Sport Injury Anxiety*

1 Introduction

Competitions make me nervous. When I go out on the ice, I just think about my skating and not 'I have to do this to win.'. I forget, it's a competition. Skating taught me to set a goal and to block out other things and just focus on this one thing.

- Katarina Witt

1.1 Athletes and anxiety - a controversy?

Today even more than ever, athletes in their sport environment are idealized (Cahill, 2000) as role models for modern society; for children, women and men alike (Bandura, 1986; Biskup & Pfister, 1999).

Idealisation is one, though critical reason why doping in elite sports receives so much attention (Petersen, 2010). For the most part, role models, including athletes, are attributed with positive features, such as courage, bravery, honesty, attractiveness, and good physical as well as mental health (Bricheno & Thornton, 2007). Sport role models are prevalent in the media, to the same extent as starlets and politicians. As modern heroes, athletes should be strong, tough, hard-working and almost supernatural (Biskup & Pfister, 1999; critically: Lines, 2010).

Anxiety, however, is usually perceived as a negative and debilitative personality disposition (discourse regarding the role of anxiety, see Spielberger, 1966). Anxiety makes individuals appear weak and vulnerable. In a study by Jones, Hanton and Swain (1994), at least 15% of athletes experience anxiety symptoms as debilitative to their performance. Additionally, Gulliver, Griffith and Christensen (2012) critically point out that young athletes, who represent a high-risk group for the development of mental disorders, do not even seek help from professionals to overcome their mental problems. A primary barrier to obtaining help is the stigma associated with treatment by a (sport) psychologist. A replicate study by Linder, Brewer, Van Raalte and De Lange (1991), for example, showed the negative halo effects on athletes, who worked with a sport psychologist on their problems compared to athletes who worked on their problems with a coach. This negative halo effect poses pressure on athletes. They do not only have to comply with their own performance requirements but also with those of society as a whole and of competing athletes (see also Martin, 2005).

Thus, while some athletes might mask their anxiety symptoms by simply ignoring them, others might practice continuous self-impression management to avoid coping with symptoms. In fact, while there are several strategies to overcome anxiety (e.g. Freud, 1984), the problem with all of this struggle is that the anxiety remains, and to

overcome it, coping with it has been shown to be best practice (Lazarus, 1985). Anxiety influences every information processing of an individual; including that of athletes in a sport context. Most research on debilitative personality dispositions, such as anxiety, has focused on direct measurement, which often makes it difficult to attain true values about impacts (e.g. Egloff & Schmukle, 2002). Direct measurement refers to test materials and test requirements that are easily recognized as closely related to the personality disposition in question. Self-reports and questionnaires are examples of such direct measures.

Interventions to effectively cope with anxiety, however, depend on clear insights of, and self-critical introspection by, athletes.

1.2 Bridging the gap by indirect measurement

Current research in sport psychology extends beyond direct measurement, which is prone to faking and distortion (Egloff, 2008). Indirect measures, such as the Implicit Association Test (IAT, Greenwald, McGhee & Schwartz, 1998), offer an alternative for the measurement of challenging personality dispositions and attitudes. Indirect measurement, as opposed to direct measurement, means there is not an obvious relation between the test and the personality disposition measured by that test. Thus, faking on an indirect test is supposed to be more difficult (Egloff, 2008). In personality and differential psychology, indirect measures usually focus on shyness (Asendorpf, Banse & Mücke, 2002; Fujii, Sawaumi & Aikawa, 2013), angriness (Schnabel, Banse & Asendorpf; 2006) and self-esteem (Greenwald & Farnham, 2000). Anxiety is a personality disposition which has been measured indirectly by the Implicit Association Test (Egloff & Schmukle, 2002), as well. However, in sport psychological research, indirect measurements with IATs have yet to be extended, especially regarding personality dispositions. Thus far, only few studies exist, and these focus primarily on group processes (Ohlert & Kleinert, 2009) and doping attitudes (Brand, Melzer & Hagemann, 2011).

The current work takes a step toward indirect measurement of sport-specific anxiety. The goal of this work is to advance methods of investigating performance- and self-worth-threatening personality dispositions in a sport psychological context. Anxiety is an emotion which, in the sport context, usually has a negative influence on performance (Jones, Swain & Hardy, 1993; Woodman & Hardy, 2003; Ntoumanis & Biddle, 2000). The interpretation of potentially threatening internal or external stimuli in the context of information processing is a relevant first step.

First, the theoretical background of indirect measurement via the IAT and sport-specific anxiety will be described in detail.

In the empirical part of this work, three studies will be reported on. The first study applied a general indirect anxiety measure (IAT-Anxiety, Egloff & Schmukle, 2002) in a sport-specific context. The goal of this first study was to obtain an overview, as to whether there is a discrepancy between indirectly and directly measured anxiety in

athletes. Another goal of the first study was the application of a general instrument to a specific context, to evaluate the necessity of a sport-specific indirect measure (Allmer, 1999; Gill & Deeter, 1988; Kellmann & Beckmann, 2003).

The second study focused on the development of a sport-specific indirect instrument. Two sport-specific IATs were constructed: one IAT investigated competitive anxiety (Martens, Vealey & Burton, 1990) and the other investigated sport injury anxiety (Williams & Andersen, 1998). In addition to the general IAT-Anxiety (Egloff & Schmukle, 2002), both newly developed instruments were applied to students of sport sciences in a university context. The psychometric properties were analysed in regard to the general indirect and direct instruments as much as the sport-specific direct instruments.

The third study focused on the evaluation of the newly developed indirect sport-specific measures regarding their methodological variance. The first two studies examined the demand of a sport-specific indirect anxiety IAT. Additionally, the validity of the instruments needs to be investigated. To this end, Control-IATs (Rothermund & Wentura, 2004; Rothermund, Wentura, & DeHouwer, 2005) in the research of indirect instruments have been established. In Control-IATs, the valence component is eliminated. Thus, the evaluative associations between the concept categories, which are the major component of an IAT, are mostly ruled out. In the third study, Control-IATs were applied to a student sample. Here it was analysed whether the presented stimuli are valid for the sport-specific anxiety measurement.

The following work closes with a study-specific general discussion regarding the attentional focus in anxiety-related problems and the importance of situational contexts in the application of indirect sport-specific instruments. Limitations of the studies are discussed critically. Finally, prospects for further research are presented in the context of practical applicability.

2 Theoretical Background

We can be blind to the obvious, and we are also blind to our blindness.

- Daniel Kahneman

2.1 Anxiety in sport psychological contexts

In sport psychology, research of athletes' emotions in exercise or competitive situations is an important area of study. This research typically focuses on performance-facilitating emotions and performance-enhancing states. However, emotions with debilitating effects on sport performance, also deserve special regard. In particular, anxiety, stress and emotional strain are among these emotions.

The following subchapters focus on anxiety in sport psychology. Starting with a description of anxiety terminology, the chapter closely examines specific types of anxiety such as competitive anxiety and sport injury anxiety as two of the most known emotions in sport psychological research.

2.1.1 Definitions on anxiety

Lazarus-Mainka and Siebeneick (2000) note that most definitions of anxiety are based on their grounded theories. A clear definition of anxiety can be difficult because it depends on the theoretical basis and as such can differ according to theoretical approach.

According to data of the International Classification of Diseases (ICD-10, Dilling, Mombour & Schmidt, 2015), which is derived from the World Health Organisation, anxiety disorders are categorized as neurotic disorders (F 4) next to stress disorders such as post-traumatic stress disorder (PTSD, F 43.1), dissociative disorders (F 44) and somatoform disorders (F 45). It is notable that anxiety per se is not automatically pathological with the need of psychotherapeutical treatment. The difference between an ICD-10-classification of pathological anxiety and "normal" anxiety depends on (i) the intensity and persistence of symptoms, (ii) the appropriateness of symptoms in the context of their incidence, as much as on (iii) the coping strategies in relation to the relevant situation or the object (Faust, 1995; Öhman, 2008). Additionally, the individual's functionality in performing tasks of daily life have to be considered when defining anxiety as pathological and worthy of treatment. Feelings of anxiety usually are defined by means of three levels: somatic, cognitive and behavioural. Somatically, the individual may experience increasing heartbeat, sweating,

trembling, feelings of choking, higher blood pressure and higher pulse. Cognitively, thoughts of worry, potential failure and lowered self-esteem may dominate thought processes. On a behavioural level, LeDoux (2001, citing Cannon, 1929) notes three reactions to anxiety: fight, flight and freeze. Avoidance of the threatening stimulus (the flight-reaction) is the probably most popular and the one which leads to treatment because it commonly limits the individual's psychosocial development. While the James-Lange-Theory (James, 1884; Lange, 1912) states that an individual's behaviour and physiological arousal triggers the feeling of an emotion, such as anxiety ("I am running away from a bear, my heart is racing, I am feeling physiological aroused by it and thus, I am experiencing anxiety"), Cannon (1929) criticises this aspect in several experiments (Zimbardo, 1995).

A further point in discussions about anxiety in general, and specific domains such as sport, is the distinction between "anxiety" and "fear". In Freud (1920 in Freud, 2014), fear and anxiety are used as synonyms, though Freud (1920 in Freud, 2014) preferred the term "anxiety", as he thought an individual can be afraid of something in both the external and internal worlds. Fear is reportedly solely fixed in the external world (Hall, 1955). Asendorpf (2003) notes, that fear is usually object-specific, while anxiety functions as a non-specific alarm signal. Öhman (2008) points out, that fear and anxiety are states related to a potential threat, both aversive and activating. He suggests that fear "... denotes dread of impending disaster and an intense urge to defend oneself, primarily by getting out of the situation ..." (Öhman, 2008, p. 710). Anxiety, on the other hand, "... denotes apprehensive anticipation of future danger or misfortune accompanied by a feeling of dysphoria or somatic symptoms of tension ..." (Öhman, 2008, p. 710). Öhman (2008) concludes that fear is elicited by a concrete stimulus (post-stimulus), while anxiety is anticipatory to a more or less real threat (pre-stimulus). Regarding the difference between fear and anxiety, Epstein (1972) points out the importance of coping, such as avoidance of or escape from a threat-relevant stimulus. In case of failure of coping attempts, a predominant fear turns into threat-oriented anxiety.

In summary, this work will focus on the term "anxiety". In the next passage, some of the most important theoretical models on anxiety are described.

2.1.2 Theories on anxiety

In psychological research, anxiety as a theoretical construct has been explained among most psychological streams. The following chapter focuses on selected popular examples to give a short overview of the theoretical background.

From a classical psychoanalytical perspective, as proposed by Freud (2014), anxiety primarily functions as an alarm signal to potential dangers facing the ego. In this way, the ego can deal with the anticipated danger. While a person may be aware of the feeling of anxiety, the same person may be unaware of the reasons for the anxiety experience (Hall, 1955). The source of anxiety-related feelings can be in the individual's external and internal worlds. According to Freud (2014), individuals may suffer from reality anxiety, neurotic anxiety and moral anxiety. While reality anxiety is focussed on a source lying in the real world (e.g. being anxious of dogs), neurotic anxiety derives from the id seeing the potential danger coming from obsessions of the id (e.g. uncontrollable urges to act in some way). Moral anxiety derives from the super-ego: Here, the individual fears to be punished for something which is contrary to the ego-ideals (for an overview, see Hall, 1955). According to Freud (1984), several defence mechanisms allow the ego to deal with reality anxiety, neurotic anxiety and moral anxiety (for an overview, see Asendorpf, 2003). Today, the psychoanalytical perspective is considered as a paradigm. While parts of the paradigm, such as types of anxiety, are not empirically verifiable, other concepts, such as that of the defence mechanisms are still of importance in personality and clinical psychology (Asendorpf, 2003).

From a behavioural perspective, according to, for example, Watson (1913), anxiety always is regarded in accordance with a situational event. The individual is in a stimulus–reaction constellation which means that a certain stimulus (*input*) leads to a certain reaction (*output*). A main thesis of the behavioural perspective is that all behaviour is learnt. The environment in which the individual grows up solely forms the individual's development. Instrumental-behavioural psychology goes even a step further, proposing all behaviour is learnt and strengthened (and deleted, respectively). That is, the strengthening of behaviour is formed by consequences following the reactions, which followed inputs given by a situation. According to this

theoretical basis, anxiety as emotion also is learnt. The classical paradigm is as follows: Two stimuli are presented together; a neutral one and an unpleasant one. The unpleasant stimulus evokes a reaction, probably an anxiety reaction. After a few trials of presenting both stimuli together, the neutral stimulus alone evokes the anxiety reaction. If this anxiety reaction is strengthened by, for example, sympathy from another person, then the anxiety reaction will be stronger the next time (Watson & Rayner, 1920; Mowrer, 1947). Davison and Neale (2002) note critically, that the experiments by Watson and Rayner (1920) could not be replicated and thus, the classical learning of anxiety lacks clear evidence. Instead, they point out the possibility that special forms of anxiety may be facilitated by learning in seeing a model experiencing anxiety (Bandura and Rosenthal,1966; see also Mineka & Oehlberg, 2008).

Another perspective is given by Lazarus and Folkman (1984), who propose that anxiety is the result of a two-step process of appraisal and resources of an individual. According to Smith and Lazarus (1990), emotions like anxiety represent an individual's solution to adaptational problems, such as stress or stressful events. As such, "... each emotion expresses a person's appraisal of a person–environment relationship involving a particular kind of harm or benefit ..." (Smith & Lazarus, 1990, p. 611). According to these authors, the core function of anxiety is to avoid potential harm. Important appraisal components involve motivational relevance to the individual, motivational incongruency and low or uncertain anxiety-focused coping potential, at least from the individual's point of view.

One of the current theories regarding a sport psychological view on anxiety is the two-dimensional model of anxiety proposed by Spielberger (1966). Based on Cattell and Scheier (1961), Spielberger distinguishes between the personality trait anxiety and state anxiety. Trait anxiety is described as an individual's general tendency to experience feelings and cognitions of anxiety in situations of potential harm. Spielberger (1966, p. 17) defines trait anxiety as "... a behavioral disposition to perceive as threatening circumstances that are objectively not dangerous and to then respond with disproportionate state anxiety. Highly trait-anxious people usually have more state anxiety in highly competitive, evaluative situations than do people with

lower trait anxiety... ". On the other hand, state anxiety describes the subjective and conscious experience of feelings of anxiety in a certain situation. Spielberger (1966, p. 17) notes, "... state anxiety is a temporary, ever-changing emotional state of subjective, consciously perceived feelings of apprehension and tension, associated with activation of the autonomic nervous system ...". This two-dimensional perspective of anxiety can be assessed by a self-report questionnaire, the State-Trait-Anxiety-Inventory (STAI, Spielberger, Gorsuch, & Lushene, 1970; German Version: Laux, Glanzmann, Schaffner & Spielberger, 1981). Sport psychologists such as Martens (1975) adapted this two-dimensional perspective in explaining the construct of competitive anxiety and its relation to performance in sport.

Along with competitive anxiety in sport, sport injury anxiety has been proposed as another form of sport-specific anxiety. These two types of anxiety will be the focus of the next chapter.

2.1.3 Sport-specific anxiety

Anxiety research in the context of sport is numerous and complex. Foundational work on sport and exercise psychology by Weinberg and Gould (2006, p. 78) define anxiety as "... a negative emotional state in which feelings of nervousness, worry and apprehension are associated with activation or arousal of the body ...". According to Weinberg and Gould (2006), the two-dimensional model by Spielberger (1966) is proposed as theoretical basis for explaining anxiety in sport (see above, chapter 2.1.2). Typically, sport psychologists use self-report instruments to measure trait and state anxiety. These measures tend to be global and multidimensional, focusing on cognitive and somatic state or trait anxiety, respectively. The distinction between cognitive anxiety and somatic anxiety was introduced by Liebert and Morris (1967), who distinguished between a worry component and an emotionality component when describing anxiety (Martens, Burton, Vealey, Bump & Smith, 2007). Moreover, in relation to anxiety in sport, Weinberg and Gould (2006) also cite stress as an essential in the occurrence of anxious feelings. According to these authors, state anxiety in particular is part of a general stress response in an athlete, which occurs "... when there is a substantial imbalance between the physical and psychological

demands placed on an individual and that person's response capability and under conditions in which failure to meet the demand has important consequences ..." (Weinberg & Gould, 2006, p. 81).

Weinberg and Gould (2006) focus on competitive anxiety, when referring to anxiety in sport, as it is one of the most featured types of anxiety with well-documented impacts on performance (Hardy, 1992; Mellalieu, Hanton & Fletcher, 2009). Sport injury anxiety, however, is another form of anxiety, which is known to have negative, that is debilitative, effects on an athlete's performance (Williams, 1996; Williams & Andersen, 1998; Andersen & Williams, 1999; Wiese-Bjornstal, Smith, Shaffer & Morrey, 1998). An athlete suffering from sport injury anxiety has problems achieving optimal performance level in both training and competitive contexts.

2.1.4 Competitive Anxiety and its significance for performance in sport

2.1.4.1 Definition

Because anxiety is usually seen as a debilitative and negative emotion, competitive anxiety in sport is seen in a similarly negative light (Mellalieu et al., 2009, p. 1). An in-depth look at competitive anxiety results in its definition as "... a specific negative emotional response to competitive stressors ..." (Mellalieu et al., 2009, p. 4). Competitive stressors are "... the environmental demands (i.e. stimuli) associated primarily and directly with competitive performance ..." (Mellalieu et al., 2009, p. 4). Following this chapter, we will see, that experiencing competitive anxiety can also lead to a facilitated performance rather than a debilitated one (Jones, 1995).

In addition, Martens et al. (1990) – based on the State-Trait Theory by Spielberger (1966) – distinguish between the competitive anxiety trait (A-trait) and competitive anxiety state (A-state). They define the A-trait as "... a tendency to perceive competitive situations as threatening and to respond to these situations with A-state ..." (Martens et al., 1990, p. 11). A-state is defined as "... an existing or current emotional state characterized by feelings of apprehension and tension and associated with activation of the organism ..." (Martens et al., 1990, p. 9). Based on Liebert and

Morris (1967), two components of state anxiety were introduced (worry and emotionality), which Martens et al. (1990) adopted for their theory on competitive anxiety and their development of a reliable research instrument: cognitive A-state and somatic A-state. Cognitive A-state is defined as being "... manifested in negative expectations about performance and thus negative self-evaluation, both of which precipitate worry, disturbing visual images or both ..." (Martens et al., 1990, p. 120). Somatic A-state is defined as being "... physiological and affective elements of anxiety experience that develop directly from autonomic arousal. Somatic A-state is reflected in such responses as rapid heart rate, shortness of breath, clammy hands, butterflies in the stomach, and tense muscles ..." (Martens et al., 1990, p. 121).

These are likely the most common definitions referring to competitive anxiety. The following chapter will have a look on the most prominent theoretical backgrounds of the construct.

2.1.4.2 Theories of Competitive Anxiety in the Context of Performance in Sport

Over the past 20 years of research on competitive anxiety in the sport context, different models and theories of competitive anxiety have been proposed. Moreover, impacts on performance and the role of competitive anxiety as a personality construct have been developed. Models and theories currently considered as most important for explaining competitive anxiety, are described in the following paragraphs (Mellalieu et al., 2009).

2.1.4.2.1 The Performance-Arousal Model by Yerkes and Dodson

In 1908, Yerkes and Dodson published a study on the relation of a stimulus' strength to the rapidity of habit-formation. Several experiments on mice, who had to decide between a way through a white box in contrast to a way through a black box, followed by an electric shock, were described. Results showed that mice who received medium shocks while entering the black box learnt the required task much

faster than mice who received weak or strong shocks while entering the black box. Yerkes and Dodson (1908, see also Hebb, 1949, 1955; Teigen, 1994) formulated a general correlation based on these results, which states that medium arousal within the individual leads to the best performance in learning. This correlation was studied well and has been even generalized in several studies for decades (e.g. Broadhurst, 1959; Diamond, Campbell, Park, Halonen & Zoladz, 2007). Diamond et al. (2007) and Teigen (1994), however, critically point out that Yerkes and Dodson (1908) promoted a differentiation between simple and difficult tasks, which influenced the performance-arousal relation, whereas Hebb (1955) reduced the arousal and performance model to its well-known inverted U-form, only. Teigen (1994) notes in his overview regarding the significance of Yerkes and Dodson's work (1908) that this differentiation seems to be as crucial to the interpretation and generalisation of the so-called law as the precise analysis of the found results.

At its earliest stage, research on competitive anxiety and performance also focused on the Yerkes-Dodson Law (1908). The idea of poor performance in athletes suffering from competitive anxiety results from the assumption that arousal facilitates performance up to an optimal level. When arousal exceeds this optimal level, performance starts decreasing. This hypothesis is in part reflected in the Multidimensional Model by Martens et al. (1990), which is explained below. In Martens' work, the inverted U-shape model is especially interesting in better understanding the somatic component in competitive anxiety.

Although arousal-performance theories are important for the explanation of competitive anxiety, Mellalieu et al. (2009) consider these theories too simple and lacking in explanation as to why competitive anxiety exists and how it evolves into a lack of performance in motor activity (see Mellalieu et al., 2009, p. 34).

2.1.4.2.2 The Catastrophe Models of Competitive Anxiety

A further development of the physiologic arousal - performance theories on competitive anxiety are the catastrophe models by the workgroup around Hardy (e.g. Fazey & Hardy, 1988; Hardy, 1990, Hardy, 1996, Hardy & Parfitt, 1991). One of

them is the cusp catastrophe model, which will be described here in detail as an example for catastrophe models. The cusp catastrophe model describes the interaction path between physiological arousal and cognitive anxiety levels on performance. In the model, physiological arousal is not equivalent to somatic anxiety as defined by Martens et al. (1990). According to Martens et al. (1990), somatic anxiety influences performance only when the individual becomes preoccupied with these symptoms. In the cusp catastrophe model, physiological arousal is considered to be all physiological events occurring within the individual, which can either influence performance directly (Hardy, 1996; Parfitt, Jones & Hardy, 1990) or indirectly via the individual interpretation of symptoms as facilitating or debilitating (Bandura, 1977). In the cusp catastrophe model, for example, there are two parameters that determine discontinuous changes in behaviour: the asymmetry factor (which is physiological arousal) and the splitting factor (which is cognitive anxiety). Furthermore, in the model there are quite stable regions, called the upper surface and the lower surface. While cognitive anxiety determines the distance between these regions, physiological arousal determines the proximity of a behaviour up to a certain critical behavioural change. According to the model, this means that as long as cognitive anxiety is low, changes in physiological arousal lead to small continuous changes in behaviour. Critical (discontinuous) changes in performance behaviour, however, occur as soon as cognitive anxiety is high and changes in physiological arousal are at a medium level. When cognitive anxiety is high and changes in physiological arousal are either small or high, then changes on performance behaviour are continuous as well (see Hardy, 1996, p. 70ff). These trends underline the interactive character of the cusp catastrophe model in which both cognitive anxiety and physiological arousal result in the particular performance. These findings resemble the effects of cognitive anxiety. As long as physiological arousal is low, increases in cognitive anxiety are considered to be performance-facilitating. However, as soon as physiological arousal is high, increases in cognitive anxiety impair performance behaviour (Hardy, 1996). Thus, whether increases in cognitive anxiety are positive or negative for sport performance depends on the level of physiological arousal within the individual.

In conclusion, an athlete high in cognitive anxiety might show a very good performance because his physiological arousal is low. As soon as physiological arousal increases (up to a medium level), however, performance may drop due to the athlete's experience of high levels of cognitive anxiety. This so-called hysteresis means, when physiological arousal is on an intermediate level and cognitive anxiety is high, performance immediately drops from a high level to a very low level (from the upper surface to the lower surface of behaviour). This discontinuous change in a normally continuous smooth pathway is the main characteristic of the catastrophe model, giving the model its name (see Thom, 1975).

There are several further developments of the cusp catastrophe model, for example the butterfly catastrophe model by Fazey and Hardy (1988). Here, task difficulty and self-confidence are included as bias factors in the model.

In a study by Hardy (1996), both catastrophe models were tested against the Multidimensional Model of Martens et al. (1990). Results showed that the interactive catastrophe models both explained up to 57% of criterion variance while the stable multidimensional model only explained about 7% of criterion variance. Further results highly supported the cusp structure as opposed to the butterfly structure. The authors, however, argue that more research is needed to explain the structure of competitive anxiety, focusing more on the butterfly catastrophe model since the cusp catastrophe model has already been investigated very well (e.g. Hardy, Parfitt & Pates, 1994). These further studies should include especially the ongoing process of performance (for more information see Hardy, 1996).

2.1.4.2.3 The Individual Zones of Optimal Functioning Model

In the individual zones of optimal functioning (IZOF) model, Hanin (2007) describes the following five elements: form (e.g. cognitive or affective components), intensity (as expressed, for example, in psychological instruments), time (temporal dimension in relation to performance), context (e.g. situational antecedents in relation to emotions in sport) and content (e.g. categories of emotional expression). Moreover, two emotional frameworks are described in the IZOF model: the hedonic tone and

the effect emotions have on performance, in this case, anxiety-related performance outcomes. The hedonic tone usually includes positive and negative affect, and it is usually measured in a bipolar manner (Watson & Tellegen, 1985 in Hanin, 2007). In the IZOF model, both positive and negative affect are described as being unipolar with regard to the subjective emotional experience (Hanin, 2007). The effect that emotions elicit on sport performance are mainly described as either debilitative or facilitative (Jones, 1995). Hanin's (1978, 1986, 1989) studies on the effect of anxiety on sport performance highlight the importance of precompetitive anxiety levels, by using athletes' current and recalled self-report anxiety responses. The main focus of these studies was whether precompetitive levels of anxiety were experienced as optimal and useful for athletes. Hanin's model of individual zones of functioning describes a "... tentative optimal range of intensity scores predicting the high probability of individually successful performance ..." (Hanin, 2007, p. 59). In addition, the emotional content of the model consists of four independent factors, namely "positivity – negativity" and "optimality – dysfunctionality". These factors may result in both, negative and positive emotions that can be optimal and functional or dysfunctional and problematic for the athlete's sport performance. A third aspect of the IZOF model is the distinction between *in the zone* and *out of the zone*, which is seen as being of importance for assessment, prediction and optimization of athletic performance. Based on the assumption that each athlete has an optimal level of intensity and a range of optimal anxiety, "... successful performance occurs when current precompetition anxiety is near of within these individually optimal zones ..." (Hanin, 2007, p. 59). If this is not the case and precompetitive anxiety falls outside this range, performance quality decreases. Finally, Hanin (2007) points out the importance of the interaction of optimal and dysfunctional effects, which seem to determine the effect of positive and negative emotions on sport performance.

Multiple empirical studies support the basic character of the IZOF model (see Hanin, 2007, for an overview). However, there are limitations, which lead to the conclusion that individualised zones on a wide range of emotions would generally serve as better predictors to sport performance than anxiety in particular (Hanin, 2007, p. 62). Nevertheless, the model is still a well-recognised theoretical background for explaining emotions, specifically competitive and precompetitive anxiety, and their

relation to performance in sport (e.g. Robazza, Pellizzari & Hanin, 2004; Robazza, Pellizzari, Bertollo & Hanin, 2008).

2.1.4.2.4 The Multidimensional Anxiety Theory

The Multidimensional Anxiety Theory (MAT) proposed by Martens et al. (1990) is a three-factor model, which describes the rather additive function of the three components somatic anxiety, cognitive anxiety and self-confidence on the experience of competitive anxiety and a resulting performance impairment. Somatic anxiety, which describes the impact of physiological symptoms experienced by the athlete, follows a quadratic or inverted U-Form in relation to performance. An increase in somatic anxiety leads to enhanced performance up to a certain point. If somatic anxiety increases further, performance beyond this critical point decreases. Here, differences to the catastrophe models by Hardy and colleagues (Hardy, 1996, Fazey & Hardy, 1988) must be made: in the MAT, somatic anxiety is not equivalent to physiological arousal described in the catastrophe models. Moreover, performance does not drop after the critical point of somatic anxiety to a lower level, instead it slowly decreases related to the impact of somatic anxiety.

The other two components of the MAT, self-confidence and cognitive anxiety, are reported to have a linear relationship to performance. Self-confidence, which is defined by Vealey (1986) as a "degree of certainty athletes possess about their ability to be successful in a sport" (Martens et al., 1990, p. 195) and currently discussed as a resilience factor (Hardy et al., 2010, Mellalieu et al., 2009), shows a positive linear trend. This means that an increase in self-confidence leads to an increase in performance. Cognitive anxiety, which includes all kinds of worries, cognitive concerns about oneself and negative expectations related to a competition (Martens et al., 1990), shows a negative linear trend, meaning increases in cognitive anxiety result in an impairment of the athlete's performance, regardless of the level of somatic anxiety and self-confidence.

In relation to a competition, Martens et al. (1990) propose that somatic anxiety slowly increases in the time before competition, with a peak immediately before

competition. Cognitive anxiety, in contrast, remains fairly stable and high during the period prior to competition.

Empirical evidence supporting this three-dimensional theory and its relationship to performance has been challenged in an overview by Mellalieu et al. (2009, p.35), where the larger number of studies finds only moderate to weak support. In a meta-analysis by Craft, Magyar, Becker and Feltz (2003) and in the work of Woodman and Hardy (2003), no strong relationships were found between the three components and performance outcome.

Another aspect of the theory of competitive anxiety is the differentiation of state and trait described by Martens et al. (1990). In the style of Spielberger's (1971) formulated state–trait theory of anxiety, Martens et al. (1990) define a trait and a state component of competitive anxiety. Competitive trait anxiety is the general tendency to perceive competitive situations as threatful. Athletes usually describe competitive trait anxiety on the three dimensions somatic anxiety, worry and self-confidence as described above. Competitive state anxiety, however, is the perceived impact of competitive anxiety in the immediate situation of a competition. Thus, it is the response to a concrete competitive situation and therefore, differs from a personality disposition. Additionally, two causes of competitive anxiety are included in the model: the uncertainty of the outcome and the importance of the outcome as perceived by the athlete. These two outcome-related components are suggested to influence the perception of threat in different objective competitive situations and thereby, lead to the experience of competitive state anxiety (see Figure 2.1; Martens et al., 1990).

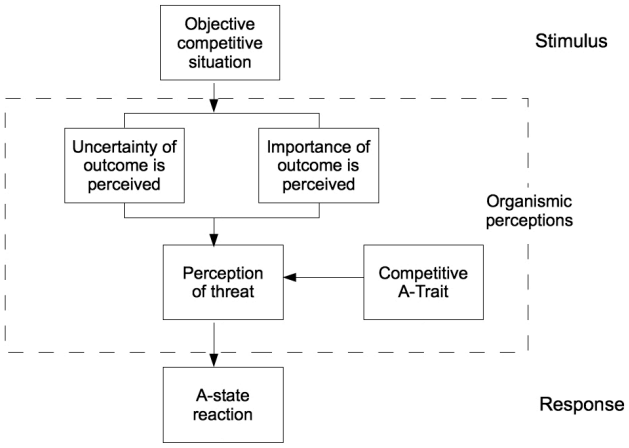

Figure 2.1. A theory of competitive anxiety (illustration from Martens et al., 1990, p. 219).

In general, the theory of competitive anxiety (Figure 2.1) works as follows: an athlete has a tendency to experience anxiety in competitive situations, and perceives these situations as potentially threatening to his/her self-concept (competitive trait anxiety). The athlete experiences anxiety symptoms which can be classified on three dimensions: somatic anxiety, worry and impacts on self-confidence. In the objective situation of a competition, the athlete considers the importance of the outcome and the uncertainty of the outcome. These considerations lead to the perception of threat in the competitive situation. Thus, the athlete experiences competitive state anxiety on a somatic and cognitive level, as well as by concentration problems. The experience of anxiety affects a certain performance outcome: anxiety may impair the sport performance if cognitive anxiety increases and/or somatic anxiety exceeds a moderate level. The athlete's coping processes for handling impending anxiety symptoms are not included in the model.

2.1.4.2.5 Summary on models and theories of competitive anxiety

In conclusion, several different models and theories focus on competitive anxiety in sport psychology. No theory or model, however, completely explains the whole construct. Several aspects of all theories and models have to be considered, when

investigating aspects of construct. One critical point, for example, is that most theories only focus on the anxiety–performance relationship. Even though the impact of competitive anxiety on performance is quite relevant, especially in competitive sports, anxiety–performance relationships can only be investigated in detail, if an athlete really performs despite feeling anxious. However, there may be talented athletes who experience competitive anxiety in a way that symptoms regularly prevent them from participating in competitions. That is, the competitive situation already functions as a trigger to the symptoms of anxiety in these athletes. In psychology, triggers are key stimuli that provoke intensive sensuous, affective and cognitive impressions in an individual. Triggers are especially relevant in the clinical research regarding PTSD (*post-traumatic stress disorder*). However, apart from the clinical perspective, many cues temporarily associated with a certain situation may serve as trigger stimuli to experiences and physiological sensations later on (Ehlers & Clark, 2000). This returns our focus to the question of how the situation of the competition itself is of relevance to the parameter value of competitive anxiety.

In this case, possible relationships between competitive anxiety and other comparable variables must be considered. Divergent paths of research must be taken to obtain a more differentiated view on the construct and its impact on sport. Changing the focus to information–decision process theories and thus, to indirect measurement – as free as possible from faking, impression management and self-deception – may be a chance to obtain a different view on the problematic of the construct.

2.1.4.3 Current Research on Competitive Anxiety

Two different movements are observable in current research on competitive anxiety. The first movement primarily addresses the psychobiological direction, focusing on endocrinological parameters of the competitive anxiety response and the physiological stress reaction before, during and after a competition. Heart rate, blood pressure parameters and other biological measures are, also relevant for recent research, but are not in the focus of this work. The other direction of research on

competitive anxiety deals with psychological, especially cognitive correlates with a focus on methodical devices trying to explain the structure of competitive anxiety and its overlap with other variables.

In the following paragraph, there will be given a short overview of current research in both psychoendocrinological and psychological directions.

2.1.4.3.1 Psychoendocrinological trends

While the main focus of competitive anxiety research has been on psychological aspects since the early 21st century, psychoendocrinological aspects of competitive anxiety are gaining more attention. Ehrlenspiel and Strahler (2012) give an overview of the most researched parameters in sport and exercise sciences. These are cortisol , testosterone, catecholamines such as epinephrine and norepinephrine, and more recently alpha-amylase. Typically, these variables are investigated in relation to general stress in sports, either during training sessions or before, during and after sport competitions. Mazur and Lamb (1980) pioneers in the investigation of hormonal activity in relation to sport competitions. These authors have shown significantly higher testosterone levels in winners over losers after a tennis competition and thus concluded that moods probably play a major role in the hormonal outcome. The Spanish research group led by Alicia Salvador and Ferran Suay has been one of the first to investigate cortisol activity in competitive Judoka (Suay et al., 1999). Their findings show an anticipatory rise in testosterone and cortisol prior to competition. Moreover, significantly higher cortisol levels have been found in winners compared to losers throughout the competition setting. Finally, the relation of hormonal responses to self-efficacy and motivational aspects of winning a competition led this group to conclude that psychological processes are predominantly involved in the human hormonal response pattern. Salvador, Suay, Martinez-Sanchis, Simon and Brain (1999) found support – in their correlational study of testosterone, cortisol and the application of attacks, threats and fights in a judo competition – for a relationship between testosterone and the expression of competitional aggressive behaviour. Filaire, Michaux, Robert and Lac (1999) found significant cortisol changes with increases during competition in a sample of 10 elite

gymnasts during a 4-month training and competition period. Salvador, Suay, González-Bono and Serrano (2003) combined hormonal and psychological variables in comparing judoists in a competition and a resting session. These authors found cortisol and anxiety levels were higher before the competition than in the resting condition, and that a combination of higher hormonal levels and higher motivation to win resulted in a better competition outcome. These findings led to the conclusion of the existence of an adaptive psychobiological response pattern to competition. A meta-analysis by Salvador (2005) summarized results of the hormonal response on competitions and suggested that the hormonal outcome to competition is part of an athlete's coping process, which is influenced by different psychological, biological and stressor-specific variables (see also Steptoe, 1990). In several studies on ballroom dancers, Rohleder, Beulen, Chen, Wolf and Kirschbaum (2007) confirm these considerations about individual stressors (here: social evaluation threat) in documenting that the biological stress response of cortisol is "... not due to the physical strain of dancing, does not habituate across competitions, is dependent on the extent to which the individual is focused on during the evaluation, and is greater in magnitude than the response documented during laboratory stressors ..." (Rohleder et al., 2007, p. 80).

Hormonal responses have been studied not only in relation to competitive anxiety but also to situational factors, such as the location of the tournament ("home advantage"). Carré, Muir, Belanger and Putnam (2006) found significantly higher pre-game testosterone levels in games played at home than before games played in another location. No significant correlation between hormonal markers and components of competitive anxiety were found. However, in the home competition, a higher level in self-confidence was found. Nevertheless, the researchers noted that it is difficult to associate these results with a home advantage per se. Many other factors, especially the performance level of the opponent team, must be considered in further studies.

Filaire, Alix, Ferrand and Verger (2009) combined anxiety component measurement in competitions, winner–loser status and cortisol outcome and found an anticipatory rise in cortisol to competition in both males and females. Findings showed even

higher levels of cortisol in females. Losers, as opposed to winners, showed higher cortisol concentration, higher somatic anxiety scores and higher cognitive anxiety scores. Moreover, Filaire et al. (2009) found a pre-competitional correlation between somatic anxiety and cortisol increase, thus showing a relation between hormonal response and competitive anxiety. This result was previously found in studies by Eubank, Collins, Lovell, Dorling and Talbot (1997) in which they noted that the direction of facilitative versus debilitative anxiety symptoms in relation to a sport event appear to be relevant for hormonal output prior to competition. Salvador and Costa (2009) summarize in a review on competition in general and especially in humans that, for example, regarding winner–loser status, no clear results on hormonal outcomes in relation to psychological constructs have been found. There exist numerous difficulties in the comparison of different studies due to methodological issues. However, the authors stress the importance of cognitive variables and coping strategies in relation to competition.

More recent studies, for example, by Aguilar, Jiménez and Alvero-Cruz (2013), showed significant correlations between somatic anxiety levels and cortisol in pre-post-game analyses in several Rugby competitions. Another study by Arruda et al. (2014) confirmed the home-away results of Carré et al. (2006) and showed that pre-match cortisol and testosterone levels were related to the somatic anxiety component, especially in the home condition. A study by Robazza et al. (2012) focused – along with cortisol, testosterone, salivary alpha-amylase and chromogranin A – on athletes' psychobiosocial states (e.g. Hanin, 2007). Their findings suggest a relation between the four biological markers and predominately pleasant states, perceived as functional, performance-related states prior to competition (Robazza et al., 2012, p. 515). Another conclusion from this study is the suggestion to use more than one biomarker when assessing psychological states prior to, during and post-sport competitions.

Methodically, most of the studies on hormones and stress in sports are still performed pre-post measurement only. Typically, an endocrinological baseline is taken a few days before a sport event. In a few studies, several samples may also be taken during competition (for example Rohleder et al., 2007; Strahler, Ehrlenspiel,

Heene & Brand, 2010). The problem with most of these studies is precisely this procedure. For example, since cortisol is characterized for being prone to physical activity, which may interfere with stress-related, or anxiety-related, hormonal change (Kirschbaum, 1991). Moreover, Strahler et al. (2010) could show difficulties in sample-taking procedures in that athletes do not follow the same competition program in certain competitive sports, such as Ju-Jutsu and Karate. Thus, it is hard to find a similar procedure for all athletes in different kind of sports to make the results comparable to each other. This makes it hard to draw valid conclusions from the obtained data.

Despite problems in measurement techniques, most studies find evidence that a relationship between competition-induced mood states and hormonal responses exists in athletes. These findings, in turn lead to research areas focusing on psychological constructs related to sport competitions. Competitive anxiety is one of these constructs and is related to other psychological constructs. The following paragraph examines these trends.

2.1.4.3.2 Psychological trends

In 1977, Rainer Martens developed the Sport Competition Anxiety Test (SCAT, Martens, 1977), which is an instrument for athletes to measure trait anxiety especially in terms of sport competitive events. Later on, studies focused on the interaction of anxiety and sport events (e.g. Flood & Endler, 1980), the intensity and direction of competitive anxiety (e.g. Jones & Swain, 1992; Jones et al. 1994), anxiety and performance in competition (e.g. Raglin & Turner, 1993) and the influence of affective states on competitive anxiety (e.g. Jones, Swain & Harwood, 1996).

Following this direction, studies on competitive anxiety also focused on its relationship to demographic and personality dispositions in athletes (see Woodman & Hardy, 2001, for a review; Cerin & Barnett, 2006). In a study on perfectionism and competitive anxiety by Stoeber, Otto, Pescheck, Becker and Stoll (2007; see also Hamidi & Besharat, 2010), they found that perfectionism per se is not dysfunctional

with regard to competitive anxiety. A positive correlation to cognitive and somatic anxiety was only found in athletes unable to successfully cope with imperfection. These authors confirmed results of a similar study by Koivula, Hassmén and Fallby (2002), who showed that negative patterns of perfectionism were associated to higher levels of cognitive anxiety and lower self-confidence in elite athletes.

In addition to intensity and direction of anxiety symptoms during competitive sport events, frequency of these symptoms has become an important research focus (Cerin, Szabo, Hunt & Williams, 2000; Cerin, 2004; Hanton, Thomas & Maynard, 2004). In several long-term studies, Hanton et al. (2004), for example, showed changes in intensity and frequency of anxiety symptoms prior to competition. While intensity of anxiety symptoms decreased temporally proximate to before a sport competition, the frequency of anxiety symptoms increased with proximity to the event. As such, the authors conclude that of importance are that these competitive anxiety dimensions are part of a process that develops over time. In addition, Mellalieu, Hanton and O'Brien (2004) found that the interpretation of anxiety symptoms with regard to Jones' (1995) dimensions is merely influenced by competitive experience and sport type. In accordance with previous research (Martens et al., 1990; Hanton, Mellalieu & Young, 2002), a cluster analysis of cognitive and somatic competitive anxiety dimensions in relation to perfectionism and trait anxiety by Martinent and Ferrand (2007) identified five distinguishable clusters of precompetitive anxiety (see Martinent & Ferrand, 2007, p. 6ff) and found higher somatic anxiety and worry levels in athletes with higher scores on intensity and frequency and, additionally on the direction of the respective dimension.

Another research focus centers on coping and skill usage in competitive sport situations (e.g. Gaudreau & Blondin, 2004). A study by Fletcher and Hanton (2001) combined the dimensions intensity and direction of competitive state anxiety with psychological skill usage (relaxation, imagery and self-talk) and found that primarily relaxation skills were used to reduce anxiety symptoms, and thus interpreted these as being facilitative. Other studies focused on the development of instruments on coping strategies in sport competitions, for example the French Inventory of coping strategies during sport competitions (ISCCS; Gaudreau and Blondin, 2002).

Studies have also investigated single components of competitive anxiety, such as worry in a multi-dimensional manner (Dunn & Syrotuik, 2003). Findings here suggest that by applying a confirmatory factor analysis with four dimensions of worry, that worry about situational uncertainties is the strongest predictor of cognitive and somatic competitive anxiety. A study by Hanton, Mellalieu and Hall (2004) focused on the relation between self-confidence and anxiety. Using qualitative retrospective interviews they identified two causal networks in which the interpretation of anxiety symptoms varies due to levels of self-confidence. Lower levels of self-confidence lead to an interpretation of increases in competitive anxiety intensity as being outside the performer's control and as such debilitative to performance. In contrast, high levels of self-confidence lead to a facilitative, control-positive interpretation of symptoms.

Moreover, the development, evaluation and improvement of psychological self-report instruments to investigate competitive anxiety has become more detailed and more concrete. The Sport Competition Anxiety Test (SCAT; Martens, 1977) was one of the first instruments to investigate sport competition anxiety. This test was followed by the Sport Anxiety Scale (SAS; Smith, Smoll & Schutz, 1990; revised version by Dunn, Dunn, Wilson, & Syrotuik, 2000), which investigates trait competitive anxiety dispositions, and the Competitive Sport Anxiety Inventory - 2 (CSAI-2; Martens, Vealey, Burton, Bump & Smith, 1990; revised versions by Cox, Martens & Russell, 2003), which is a self-report inventory that focuses primarily on state competitive anxiety. A German version of both trait and state competitive anxiety, the "Wettkampfangst - Inventar" (WAI; Brand, Ehrlenspiel & Graf, 2009) made it possible to investigate anxiety in athletes performing in competitions beyond English-speaking countries. This inventory combines both state anxiety and personality disposition (see also a French version of the CSAI-2R by Martinent, Ferrand, Guillet & Gautheur, 2010). In addition, an application of the Latent–State–Trait theory (Steyer, Ferring, & Schmitt, 1992; Steyer, Schmitt, & Eid, 1999) to the German inventory of competitive anxiety in its trait version (WAI, Brand et al., 2009) confirmed the validity and reliability of the trait instrument and introduced Latent–State–Trait theory for consideration in further test iterations. Another methodical study by Ehrlenspiel, Graf, Kühn and Brand (2011) tested the

intraindividual stability of competitive anxiety–trait and the intraindividual variability of competitive anxiety–state for the components "somatic anxiety" and "worry/cognitive anxiety", the predictability of competitive anxiety–state by competitive anxiety–trait and the predictability of the increase in competitive anxiety–state by competitive anxiety-trait. As expected, Ehrlenspiel et al. (2011) found good stability of competitive anxiety–trait on both components and increasing competitive anxiety–state over time. Moreover, state anxiety at the day of the competition is widely unaffected by trait anxiety measured 4 days before competition. The authors conclude that the trait–state distinction should still be maintained since a prediction of state anxiety on the day of competition remains influenced by trait anxiety that is measured on the day of competition; the same holds true for the increase in state and trait anxiety (Ehrlenspiel et al., 2011).

In summary, research on psychological aspects of competitive anxiety is manifold and extends beyond different psychological research areas. Clinical sport psychology (e.g. Homayouni, 2012), motivational psychology and differential psychology as well as methodical features and strategies of coping, still play a central role in current research. Some critical remarks, however, must be made below.

2.1.4.4 Summary on competitive anxiety research

In summary, research on competitive anxiety mainly focusses on either neurobiological, such as endocrinological, or psychological areas, such as personality or coping behaviour. Thus far, direct responses to competition have been of importance. As such, direct measures are still currently the most widely applied instruments in experiments and studies. These, however, represent only one part of possible measurement opportunities. As Egloff (2008) points out, psychological constructs measured with self-reports are prone to faking, self-deception and are dependent on an individual's introspective skills. A rather unexplored spectrum of possible instruments for sport psychological research questions is provided by indirect measures such as the IAT (Greenwald et al., 1998), which are supposed to be immune to the above-listed methodical problems.

However, before proceeding beyond the theoretical roots, a second type of anxiety which often occurs in sport contexts will be examined in the following section: sport injury anxiety. The introduction of the sport injury anxiety construct is considered essential to comparing results of closely related, yet independent constructs and thus, serves as argument for expected validity of the indirect instrument in the sport context.

2.1.5 Sport Injury Anxiety

2.1.5.1 Definition

Kleinert (2002a) discusses terminology used to describe sport injury anxiety as opposed to that used to explain fear of injury and concludes that sport injury anxiety is "a widely indefinite concern or worry to sustain an injury in different sport situations" and is seen as "a function of anticipations of potentially risky or harmful situations" (Kleinert, 2002a, p. 5). He also points out the difference between anxiety and fear, as discussed earlier by Hackfort and Schwenkmezger (1993). While most authors use the term "fear of injury", Kleinert (2002a) notes that (i) the high degree of situational ambiguity and type of injury and (ii) the fact that injuries are a major risk to athletes performing in sport events, that act together to distinguish sport injury anxiety from simply fear of injury. Although athletes usually know about risk of injury and anticipate the possibility of being injured, they cannot escape from the sport situation and cannot anticipate the special type of injury (both named characteristics of fear, according to Hackfort and Schwenkmezger, 1993, p. 303). Additionally, Kleinert (2002a) discusses the trait–state variation of sport injury anxiety. In particular, he describes sport injury anxiety as a personality disposition, which "... differs between certain classes of sport situations, which are associated with injury risk or physical harm ..." (p. 3). Furthermore, sport injury anxiety–trait is defined as a function of a relatively stable appraisal of experienced and anticipated potentially risky or harmful situations (Kleinert, 2002a, p. 3).

Other authors, however, refer to the possibly same construct as fear of injury (Magyar & Chase, 1996; Dunn & Syrotuik, 2003; Cartoni, Minganti & Zelli, 2005).

Studies by Dunn and collegues (Dunn & Syrotuik, 2003; Dunn, 1999) underline the possibility of fear of injury and physical harm being associated with the worry component of competitive anxiety along with fear of the unknown, fear of negative social evaluation and fear of performance failure. Magyar and Chase (1996) formulate fear of injury as a "... lack of confidence in the ability to perform successfully in a threatening or taxing situation ..." (p. 1). The perception of risk and the incidence of injury are believed to be the main causes of fear of injury (Magyar & Chase 1996). Additionally, Chase, Magyar and Drake (2005) note that fear of injury in gymnasts results also from the inability to practice and perform in competitions while being injured and the difficulty to return after injury to the regular training and competitive events. Degree of self-efficacy (Bandura, 1997) also appears to be relevant for the experience of fear of injury in gymnasts (Chase et al., 2005).

In reviewing the few studies focusing on sport injury anxiety and while considering fear of sport injury, its definition remains problematic due to lack of concise and clear basic terminology.

2.1.5.2 Theories of Sport Injury Anxiety

The lack of a basic term for sport injury anxiety leads in turn to problematic theoretical groundwork. In intensive research on several databases (Google Scholar, PubMed, ScienceDirect: 14.04.2014), few studies were found to focus on the issue of theoretical explanation. This lack of clarity may be since trait anxiety as a personality disposition, and sport injury trait anxiety as a sport-specific construct, are merely seen as a part in the whole sport injury process (Andersen & Williams, 1988; Kleinert, 2002a). At first, a basic sport injury model will presented. Thereafter, a modified theoretical basis will be discussed, separately.

2.1.5.2.1 The Sport Injury Model

Andersen and Williams (1988; Williams & Andersen, 1998) proposed a widely recognized and rather complex model of sport injuries in athletes (Figure 2.2). Their model was made in response to inconsistent results of previous studies regarding a relation between athlete's personality and sport injuries (e.g. Jackson et al., 1978; cited in Andersen & Williams, 1988). Despite emerging stress-injury research at the time, Andersen and Williams (1988) focused not only on life stress events (e.g. marriage, death of a close relative) but broadened the scope of previous models of explanation along with studies of Passer and Seese (1983): That is, they proposed that multiple moderating variables have an influence on occurrence and prevention of sport injuries.

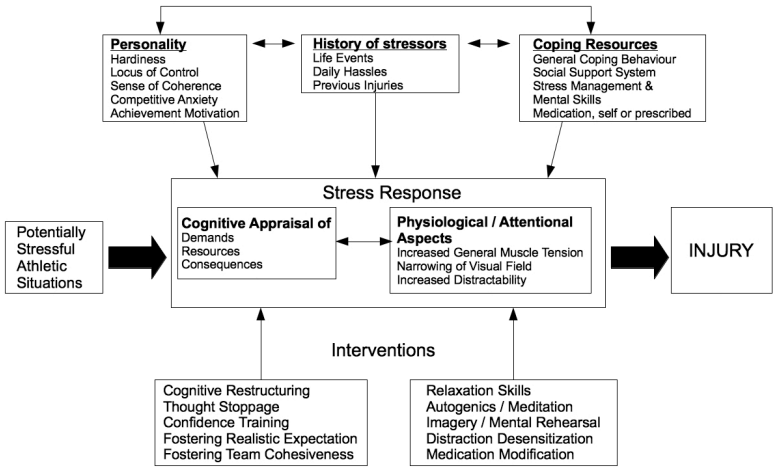

Figure 2.2. The model of stress and athletic injury (illustration from Andersen & Williams, 1988, p. 297).

The following paragraphs describe the process of an athlete in a potentially stressful situation, for example a competition. Thus, an athlete experiences a stress response, which is usually displayed as increased distractibility and decreased concentration, physiological reactions such as increased muscle tension, a narrowed vision field, higher blood pressure, hormonal responses and a racing pulse. Additionally, an athlete cognitively appraises the demands, the athlete's resources to cope with the stress and the consequences of the competition and its outcome. The impact of the stress response is affected by an athlete's personality disposition, such as trait anxiety

components, hardiness, self-efficacy, locus of control, sense of coherence and motivational aspects. Moreover, an athlete's coping abilities influence the impact of the stress response, as well as experienced social support, stress management abilities and negative coping strategies (e.g. medication, drugs, doping substances). Both, coping resources and the athlete's personality act on the so-called history of stressors. The history of stressors means a conglomerate of life events (e.g. marriage), daily hassles (e.g. a cancelled flight, a late taxi) and also previous serious or less serious injuries experienced by the athlete. These three factors – athlete's personality, the history of stressors and the athlete's coping resources – influence the impact of the stress response the athlete experiences in a potentially stressful situation. Andersen and Williams (1988) conclude that the outcome of the stress response has an influence on the risk of experiencing a sport injury. They propose that athletes in a highly stressful situation with personality dispositions which tend to increased stress responses, with rather unsuccessful coping abilities and a stress history of previous injuries and problematic events are at risk. That is, such an athlete will have a higher risk of experiencing a sport injury in that potentially stressful situation than an athlete with the opposite profile. Kleinert (2002a), however, based on his results, discusses Hanin's (2003) proposed individual zones of optimal functioning in relation to sport injury risks and sport injury anxiety being also one component in the athlete's personality.

Andersen and Williams (1988) also focus on injury prevention, and integrate multiple intervention methods that could have an impact on the stress response. These methods include, for example, relaxation techniques, cognitive restructuring, thought stoppage and various other techniques, which have been developed to decrease the stress response to an optimal level, in which the athlete can perform with a minimal risk of sport injury.

Several studies were conducted based on the proposed model (see Williams & Andersen, 1998 for a review). Williams, Tonymon and Andersen (1990, 1991) and Williams (1996) focused primarily on coping resources in the model. They found that coping resources act as moderators regarding the history of stressors. High coping resources were shown to reduce the impact of anxiety states in athletes with

highly negative life event stress. Andersen and Williams (1999) studied 196 athletes from 10 sport categories regarding changes in state anxiety, visual perception, reaction time, life events and social support in prediction of the athlete's risk of sport injury. They found stress of life events to be the only significant predictor of the experience of sport injuries in the whole sample. Moreover, narrowed visual perception and higher life event stress led to more injuries during stress in individuals with low social support. In their critical review, Williams and Andersen (1998) revised their model to include bi-directional interactions between personality, history of stress and coping resources. They proposed an influence of coping resources on personality traits and pointed out the importance of less desirable personality characteristics and a lack of coping resources for an athlete's higher risk to sport injuries (Williams & Andersen, 1998, p. 7ff).

Other authors focused on single aspects of the model. In research of sport injury anxiety, personality seems to be the only aspect of importance for the integration of the construct into a basic theoretical model. In the following section, the modified version will be described.

2.1.5.2.2 Modified version of the stress-injury model

Kleinert (2002a) focused primarily on sport injury trait anxiety as one aspect of personality trait influence. Thus, a modified version of the stress-injury model proposed by Andersen and Williams (original: 1988; new: Williams & Andersen, 1998) was developed, which integrates specifically sport injury trait anxiety in the process of sport injuries (Figure 2.3).

The focus of the revised model (Figure 2.3), according to Kleinert (2002a), is "... the injury-oriented appraisal ..." (p. 4). Here, Kleinert (2002a, p. 4) assumes that "... the relationship between injury anxiety and injury incidence depends on the situational impact of injury anxiety, which is determined by the appraisal of performance demands and the individual's abilities ..." (see also Kelley, 1990; Nideffer, 1981 in Kleinert, 2002a). Moreover, Kleinert (2002a) assumes that high injury anxiety leads to a biased perception of the importance of a situation and the athlete's coping

resources to meet the situational demands. Finally, the modified version specifically highlights the relationship between injury trait anxiety and previous injuries as much as the relation between injury trait anxiety and coping resources directly related to previous sport injuries and their consequences (e.g. pain, medical treatment, rehabilitation). In addition, Kleinert (2002a) formulates intrapersonal relationships between injury trait anxiety and aspects of the athlete's self-concept.

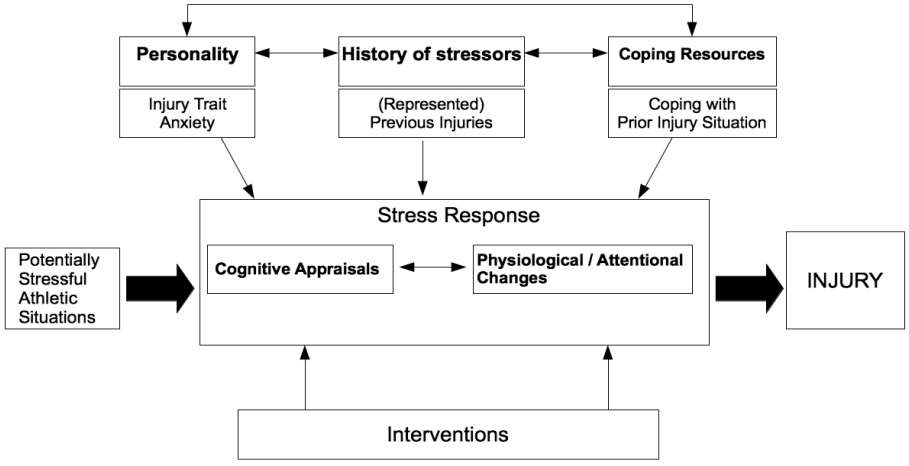

Figure 2.3. Revised version of the stress and athletic injury model (illustration from Williams & Andersen, 1998, p. 7).

Based on these theoretical assumptions, Kleinert (2002a) developed a sport injury anxiety scale as sport-specific methodical basis for the exploration of injury trait anxiety in athletes. The construction of the scale and its related studies will be the focus of the next section, on current and further fields of research.

2.1.5.3 Further Research on Sport Injury Anxiety

In addition to the modification of Anderson and William's model of sport injury (1988), Kleinert (2002a) developed a sport-specific scale for the further investigation of sport injury anxiety in athletes. According to the above-mentioned definition of sport injury anxiety, the Sport Injury Trait Anxiety Scale (SITAS) focuses on two aspects: the anticipation of sport injury anxiety based on experience and the appraisal of anticipated situations. By the end of the model's formation, 22 different situations

had been developed, comprising 22 SITAS items, which load on three factors representing types of sport situations: situations with high importance, situations with low competency and situations with loss of control. Studies applying the SITAS investigated sport injury trait anxiety in relation to sport injury history and occurrence of injuries (Kleinert, 2002b). Kleinert (2002b) found that high injury experience and low injury anxiety were related to more severe injuries compared to other groups, especially high injury experience and high injury anxiety. The latter group showed less severe injuries, albeit with more frequent injuries. Thus, Kleinert (2002b) concluded that sport injury anxiety might have a protective effect, meaning that there might be differences in attention and concentration as well as in anticipation of risk in potentially harmful situations. Consequently, Kleinert (2002b) assumes that sport injury trait anxiety might change a frequently injured athlete's perception and behaviour in sport situations (p. 9). Moreover, the temporal period between the representation of injuries experienced previously and the actual situation seems to be important for the injury occurrence. The longer the period between these two aspects, the higher the protective effect, because the athlete experiences less stress in the actual situation and is more focused on the task and on injury prevention. Finally, Kleinert (2002b) explains his results in the light of Hanin's (2003) model of individual zones of optimal functioning (for more details, see Kleinert 2000b, p. 10).

Another instrument for the evaluation of sport injury anxiety was developed by Cassidy (2006). The Sport Injury Appraisal Scale (SIAS) focuses on mainly two aspects: the athlete must be placed in the context of an injury and the athlete's negative appraisal must be determined by the instrument (Cassidy, 2006, p. 10). The Sport Injury Appraisal Scale consists of 29 items distributed on seven scales: (1) anxiety related to losing athleticism, (2) anxiety related to being perceived as weak, (3) anxiety related to experiencing pain, (4) anxiety related to the loss of social support, (5) anxiety related to reinjury, (6) anxiety related to letting down important others, and (7) anxiety associated with having an impaired self-image. In conclusion, Cassidy (2006) postulates that sport injury anxiety seems to have different facets rather than one general concept. These facets must be considered when investigating sport injury anxiety. Moreover, the SIAS focuses directly on competitive athletes and

addresses limitations of previously developed instruments, such as the SITAS by Kleinert (2002a). The instrument, however, still is rather long in its application and further research on quality criteria must be done.

Focusing on coping styles, Kleinert (2005) postulates the existence of relations between coping with pain and sport injury anxiety. In an explorative design, he distinguishes between three styles of coping with pain: associative, dissociative and undifferentiated. An associative coping style with regard to pain and injury is described by analytic focus on pain and body relaxation. A dissociative coping style with regard to pain and injury is described by techniques of resignation and distraction. The undifferentiated coping style is described by high values on all given coping strategies. Results showed sport injury anxiety functions as a moderator variable between the pain coping style and the occurrence of sport injuries. Finally, Kleinert's (2005) results confirm previous results with regard to potential protective effects of sport injury anxiety.

In her review, Junge (2000) gives an overview of studies focusing on psychological factors (e.g. life events, coping factors and personality determinants) in relation to sport injuries. Criticising the difficulty of comparing all studies due to methodical problems, differences in evaluation strategies and design issues, she summarises all relevant aspects in a model of the influence of psychological factors on sport injuries (Figure 2.4). This model outlines three main influential factors: coping strategies (e.g. social support), psychosocial stressors (e.g. life events) and emotional states (e.g. competitive anxiety).

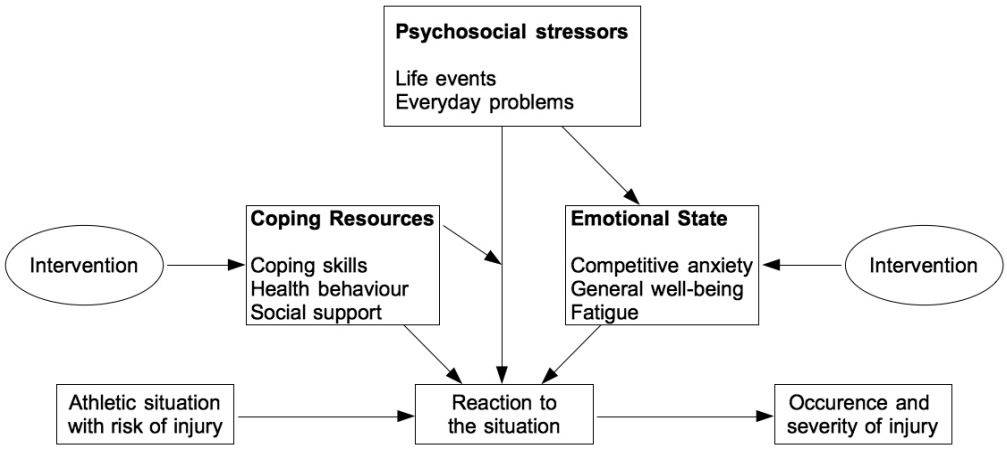

Figure 2.4. Model of the influence of psychological factors on sport injuries (illustration from Junge, 2000, p. 14).

These three components in addition to the situation with risk of injury accumulate in the athlete's reaction to the given situation and thus, the occurrence and severity of sport injuries.

Several other areas of research will be described in less detail for purposes of completeness in the following section. These studies focus primarily on sport injuries in general. Nevertheless, they will be introduced, because most of these studies investigate anxiety as a general personality disposition in relation to sport injuries. One field of research focuses on post-injury measurement and re-injury measurement in relation to trait anxiety. Walker, Thatcher and Lavallee (2010), for example, developed a Re-Injury Anxiety Inventory (RIAI) to measure re-injury anxiety in relation to rehabilitation and re-injury anxiety in terms of returning to training and competition. Wiese-Bjornstal et al. (1998) developed a model of responses to sport injury which integrates cognitive (e.g. self-perceptions), emotional (e.g. feelings of grief) and behavioural (e.g. risk taking behaviour) consequences of sport injuries. Kleinert (2002c) developed a stress re-injury model resulting from the models of Wiese-Bjornstal et al. (1998) and Andersen and Williams (1988).

Another focus of research is on injury rehabilitation. Marcolli (2001), for example, points to the importance of sport psychological counselling following sport injuries.

While current studies still focus on sport injuries, they include general trait anxiety as a personality disposition to highlight athlete's psychosocial risk factors for experiencing sport injuries. In a review by Wiese-Bjornstal (2010), she includes sociocultural and psychological aspects in an overview of sport injury risk, prevention and rehabilitation. Ivarsson, Johnson and Podlog (2013) found that 24% of experienced injuries were predicted by a model that included trait anxiety, negative life-event stress and daily hassles. In this way, they confirm assumptions of Andersen and Williams' (1988) stress-injury model. They also did not use sport-specific sport injury anxiety measures, but they referred to more general personality, stress and coping questionnaires. A recent study by Yang, Cheng, Zhang, Covassin, Heiden and Peek-Asa (2014) investigated the influence of symptoms of depression and anxiety on injury hazard among football players. While depression symptoms were significantly correlated to injury hazard, anxiety symptoms decreased the risk for injury. Thus, these results confirm the results previously found by Kleinert (2002b).

In summary, most of the studies covered here focus on general factors influencing sport injuries, sport injury prevention and sport injury rehabilitation. However, there remains a lack of current research focusing solely on sport injury anxiety. Several possible, thus critical aspects are presented in the following section.

2.1.5.4 Critical Points

First, a precise definition of sport injury anxiety is lacking, that is related to the term or related to its content. Kleinert (2002a) defines the construct as sport injury anxiety because it is not clear and not evolutionarily based (according to a separation of fear versus anxiety by Hackfort and Schwenkmezger, 1993). Other authors, like Dunn and Syrotuik (2003), for example, define it with the same construct as fear of injury, misappropriating the long-term discussion on fear and anxiety.

The first problem mentioned above, generates a second problem. The assumed existence of sport injury anxiety or specific fear of injury as a single construct is based on results of several studies which found a relationship between anxiety and

the prevalence of sport injuries. Here, trait anxiety in particular is viewed as an important risk factor for sport injuries (Andersen and Williams, 1988, Kelley, 1990, Wiliams & Andersen, 1998). A review by Junge (2000) focuses on the influence of personality dispositions on sport injury. Junge (2000) notes that general trait anxiety does not have any significant influence on the prevalence of sport injuries. However, competitive state anxiety seems to be of importance (Hanson, McCullagh & Tonymon, 1992; Petrie, 1993; Passer & Seese, 1983 in Junge, 2000). Hence, the critical remark by Cassidy (2006) that sport injury anxiety has to be seen as a state rather than as a trait variable must be kept in mind, especially with regard to the development of instruments (e.g. Kleinert, 2000a).

Similarly, a third problem results from the first two problems and questions the validity of the construct. Most questionnaires investigate fear of injury, either as a part of worry (Dunn & Syrotuik, 2003) or as a single construct (for example as sport injury anxiety, see Kleinert, 2002a), either by employing several questions within a study (e.g. Cartoni et al., 2005) or several items in its own questionnaire (e.g. Kleinert, 2002a; Cassidy, 2006). Additionally, only direct measures exist for research and these rely on true self-reports and introspection, which are prone to faking, deception and distortion (Egloff, 2008).

In conclusion, we face construct validity problems due to a self-serving definition of the construct by a few existing studies on sport injury anxiety. Thus, it remains unclear, whether we are dealing with a single construct or part of another construct, and maybe a superior one. Nonetheless, for the following empirical part, this work relies on the definition by Kleinert (2002a).

2.1.6 Relation between Competitive Anxiety and Sport Injury Anxiety

The sport injury model by Andersen and Williams (1988) integrates personality as a generally influential factor in sport injury, and places primary focus on competitive anxiety. Kleinert (2002b), however, points to the possibility of sport-specific injury anxiety in competitive athletes. Dunn and Syrotuik (2003) discuss fear of injury in

competitive athletes as part of the "worry" component in the theoretical assumptions of the competitive anxiety construct. Competitive anxiety, however, is merely seen as a single sport-specific construct (e.g. Martens et al., 1990).

The following work relies primarily on the distinction between sport injury anxiety and competitive anxiety, although a relation between both sport-specific constructs is evident.

2.2 The role of attention in the relation between anxiety and performance

In an overview of current theoretical approaches in sport-specific anxiety research, it is striking that attentional processes are hardly considered in explaining sport anxiety-related performance failures. Anxiety research in general, however, highlights the importance of attention in information processing of threat-relevant stimuli (Mogg & Bradley, 1998), which trigger underlying emotional associative networks (Ehlers & Clark, 2000; Schnabel et al., 2006). In turn, this network triggers neurobiological processes (LeDoux, 2000), which lead to somatic, cognitive and behavioural symptoms of anxiety.

The focus of attention therefore appears crucial to information processing (Ouimet, Gawronski & Dozois, 2009), and offers the opportunity to view sport-specific anxiety from another perspective. Attention – which is less affective and more cognitive – pays special tribute to the aspect of "worry" in the Multidimensional Model of Martens et al. (1990). Studies by Martens et al. (1990) found that cognitive anxiety remains more stable and high before a competition, especially compared to somatic anxiety. One explanation might lie in the maintenance of attentional focus to the threat-relevant stimuli that is related to the competition (Ouimet et al., 2009).

A theory that describes the relation between anxiety, attentional focus and performance is the Attentional Control Theory proposed by Eysenck, Derakshan, Santos and Calvo (2009).

The Attentional Control Theory

Threats to successfully achieving a certain goal usually result in anxiety-related feelings and thoughts. In sport, anxious individuals usually worry about a prevailing threat to a certain performance goal (Martens et al., 1990; Dunn & Syrotuik, 2003). They usually engage in different strategies to reduce this state of anxiety to ensure that they achieve their goal (Wilson, Vine & Wood, 2009, p. 336ff). Worry, as one important component in anxiety, has two main effects: on the one hand, it has a

negative interference effect on central executive functioning, such as working memory capacity, because it consumes most attentional resources. Therefore, these resources are no longer available for processing the task at hand. On the other hand, worry is also responsible for increased motivation to overcome the ineffective and aversive state of anxiety (Ouimet et al., 2009). Basically, attentional control theory provides a more concrete idea of anxiety-driven effects on central executive functions.

As Ouimet et al. (2009) propose, the perception of threatening stimuli (for example, a threat to a certain goal in sport) directs attention to the detection of the possible source and to a decision about the response. Both, associative and deliberative components are involved in this information processing, in which anxious individuals prefer threat-related stimuli (Eysenck et al., 2007, p. 338; see also Mogg & Bradley, 1998, Mogg, Bradley, Dixon, Fisher, Twelftree & McWilliams, 2000; Wilson & MacLeod, 2003, Nelson, Purdon, Quigley, Carriere & Smilek, 2015). According to Eysenck et al. (2007), anxiety leads to impaired attentional control functions of inhibition, shifting and updating (Miyake, Friedman, Emerson, Witzki, Howerter & Wager, 2000). Inhibition involves attentional control in resisting disruptions of interference from task-irrelevant stimuli or responses. Shifting involves adaptive changes in attentional control based on certain task-relevant demands. Updating refers to the updating and monitoring of working memory representations (see Eysenck et al., 2007, p. 338ff; Miyake et al., 2000; see also Snyder, Miyake & Hankin, 2015; and in a more critical commentary on executive functions also Heeren, Billieux, Philippot & Maurage, 2015).

Corbetta and Shulman (2002) distinguish between two attentional systems: the goal-directed attentional system and a stimulus-oriented system. The goal-directed attentional system is influenced by expectations, knowledge and, most importantly, by certain goals to be achieved. The stimulus-driven system is prone to respond maximally to salient and outstanding stimuli. Therefore, the goal-oriented system is involved in top-down attentional control, while the stimulus-oriented system is involved in bottom-up attentional control. Typically, both systems interact in a balanced manner (Eysenck et al., 2007; Pashler, Johnston & Ruthroff, 2001).

However, in anxious individuals, the balance of this system is disrupted. To guarantee wide attention in threatening situations (anxiety affects the stimulus-driven system by automatic processing of threat-related stimuli, see Ouimet et al., 2009), the influence of the stimulus-driven system increases whereas the influence of the goal-oriented system decreases. Reduced influence of the goal-directed attentional system, on the other hand, leads to these processes being more affected by salient stimuli.

With regard to the three basic functions of the central executive proposed by Miyake et al. (2000), attentional control theory explains effects of anxiety on processing efficiency. Anxiety reduces attentional control by increasing the probability that central executive processing resources are allocated from task-relevant stimuli to task-irrelevant stimuli to tasks involving inhibition and shifting functions. Eysenck et al. (2007) proposes that anxious individuals would be more distracted by task-irrelevant stimuli. Thus, anxiety decreases the influences of the goal-directed attentional system and leads to an increase of stimulus-driven attentional system. This process results in reduced efficiency due to reduced attentional control and impairment of inhibition and shifting functions of the central executive (see also Baddeley, 1986; Eysenck et al., 2007, p. 339ff). Thereby, attentional resources available for the relevant task demands are reduced and performance might be poorer depending on coping strategies employed to compensate the ineffective processing (Janelle, 2002).

Several studies provide evidence for the theory of attentional control. Wilson et al. (2009), for example, investigated the influence of anxiety on visual attentional control in free throw shooting in Basketball. They confirmed impairment of attentional control by a reduction of the quiet eye gaze in threatening sport situations. While longer quiet eye periods allow the performers an extended duration of programming (*goal-directed attentional control*) in minimising the distraction from other cues (*stimulus-driven control*), shorter quiet eye periods in the high-threat condition reflect the disruption of central executive functions by anxiety and the influence of stimulus-driven attentional control (Wilson et al., 2009, p. 164). This, again, points to the influence of anxiety on the efficiency of attentional control, also in a sport-specific context.

In conclusion, the reviewed studies show that measurement of attentional processes in relation to anxiety in sport-specific contexts, may be possible. Studies have shown evidence for a relationship between personality and executive functions (Eysenck et al., 2007). Attentional focus – as part of the executive functions – can be indirectly measured using threat-relevant stimuli and response reaction times to key stimuli, in terms of faster activation of an associative network (Greenwald et al., 1998; Klauer, Schmitz, Teige-Mocigemba & Voss, 2010, on the impact of executive functions on the methodical variance of the IAT). Before responding to a stimulus, attention has to be led towards the stimulus. Studies with several indirect measures, for example the IAT (Greenwald et al., 1998), have shown stimulus preferences of different task-relevant groups of individuals according to differences in response reaction times. These results underline the relevance of underlying attentional processes (Banaji & Greenwald, 2015, p. 57ff). Highly anxious individuals show a preference towards negative task-relevant stimuli with faster responses in reaction time measures (e.g. Mogg & Bradley, 1998). There is evidence that personality dispositions such as neurotiscm (Fleischhauer, Enge, Miller, Strobel & Strobel, 2013) and trait anxiety (Eysenck et al., 2007) explain unwanted methodical variance in the IAT caused by the affective valence of the stimulus material. The ACT (Eysenck et al., 2007) proposes that trait-anxiety in individuals impairs the executive functions by increasing the impact of stimulus-driven attentional control. This results in faster response reaction times on task-relevant stimuli, which is congruent with the activated associative network (Fleischhauer et al., 2013). The reason for these faster reactions is that the affective valence of task-relevant stimuli might trigger recoding strategies that impact on processing of IAT materials (Schnabel et al., 2006).

In sport psychological research, indirect measurement by the IAT and latent response reaction times in the context of anxiety and threat-relevant stimuli has not yet been implemented, although Egloff (2008) cites several advantages of indirect measures compared to direct measures such as self-report questionnaires. This work will be the first to focus on indirect measurement by IAT in relation to sport-specific anxiety. Thus, indirect measures, especially the IAT, and their importance for attention-controlled information processing will be presented.

2.3 The development of indirect measures

In psychological research, instruments which feature no obvious relation between the tasks and the subject of interest, are usually called *indirect measures*. In his brief chapter about the indirect measurement of anxiety, Egloff (2008) summarizes that the development of indirect measures results primarily from measurement problems in direct measures (e.g. self-report instruments). Self-report instruments like questionnaires, are usually prone to faking or distortion. While faking refers to the deliberate dissimulation of self-report answers, distortion refers to a non-deliberate bias in the responses. Further problems noted by Egloff (2008) are response sets shown by participants who, for example, have the tendency to answer "Yes" on each item, or who follow a certain pattern on agreement and disagreement, or who prefer extreme values. Social desirability and impression management are main constructs associated to these problems of direct measurement (Paulhus, 1984; Musch, Brockhaus & Bröder, 2002; Egloff, 2008).

The development of indirect measures came into focus, to overcome problems in the investigation of personality dispositions and motives in particular. One of the earliest indirect instruments is the Rorschachtest (Rorschach, 1921), which was revised by Ewald Bohm in 1951. The Rorschachtest consists of 10 tablets showing special-painted ink blots, which each offer leeway in their interpretation. Handling of the tablets, comments and reaction times of the participants are noted and evaluated, originally with the aim of detecting schizophrenia in patients. However, most psychologists use the test as a general personality test. Another popular early method of indirect measurement is the Thematic Apperception Test (TAT) by Murray (1943), in which black–white tablets showing scenes with ambiguous content are presented to participants, whose comments are noted and evaluated with a focus on a person's needs (known as *motives*).

Current research on indirect measurement focusses on reaction time assessment. The Implicit Association Test developed by Greenwald et al. (1998) is one such test and will be in the focus of the following work.

Due to the many different theoretical approaches, a definition of brief terms used is essential before proceeding to the next text: In accordance with research by group surrounding Bertram Gawronski (for example, Gawronski, LeBel & Peters, 2007; Hofmann, Gschwendner, Nosek & Schmitt, 2005), the terms *implicit* and *explicit* will be used for describing mental representations and cognitions, whereas the terms *direct* and *indirect* will be used when describing measurement and measurement techniques, if not defined otherwise by the original authors of the studies cited in this work. Thus, the Implicit Association Test (Greenwald et al., 1998) is an indirect measure for the investigation of implicit representations.

Starting with the concrete indirect instruments, it is necessary to first have a look at the underlying processes of indirect measurement. The next chapter will point out the most well-known models and theories regarding social cognition, which were the starting point for the development of indirect measures that followed.

2.4 Models of implicit cognitions

Several models for the indirect measures of social cognition have been developed, which typically propose a two-way processing, and are thus known as *dual-process models*. Smith and DeCoster (2000) list the most prominent models in their overview and describe similarities and differences, distinguishing between rule-based processing versus associative processing (in comparison see also Shiffrin & Schneider (1977) and Schneider & Shiffrin (1977) who distinguish between automatic and controlled processes). Rule-based processing is connected to symbolically represented rules. These rules are posited to be structured by language and logic. Capacity and motivation are two main factors in rule-based processing, and are considered to be conscious processing. In associative processing, on the other hand, similarity and contiguity are of importance in the structure of associations. These associations are learnt through experience. Associative processing occurs automatically. Awareness of processing results are thought to be preconscious (see also Strack & Deutsch, 2004, p. 221; Smith & DeCoster, 2000, p. 111).

Apart from the dual-process models in the core research field of implicit cognition, models about the relationship of indirect and direct measures are of interest. The working model by Hofmann et al. (2005; see also Gschwendner, Hofmann & Schmitt, 2006), for example, focusses on the consistency of indirect and direct measures describing five factors: translation, information integration, explicit assessment, implicit assessment and research design factors.

In the following, the most prominent models related to implicit association testing will be described in detail.

2.4.1 The Two-System Model by Strack and Deutsch

The main problem that Strack and Deutsch criticise in the dual-process models is the lack of behaviour (2004, see the overview by Smith & DeCoster, 2000). Behaviour is not typically integrated in these models of social cognition. In line with the focus of these models, behaviour is seen as the result of judgement or decision-making.

Strack and Deutsch (2004, p. 221) note, that behaviour also occurs without a preceding judgement or decision, provided that it has become habitualized, automated, and in case it is influenced by a motivational component. Therefore, they strongly recommend integrating motivational, cognitive and behavioural components in the dual-process models.

In their two-system model, Strack and Deutsch (2004) assume a synchronous operation of processes, which means that two systems are active in parallel and in competition with each other for the control of a response across a complete duration of time (see Figure 2.5). One basic assumption of the model describes social behaviour as a product of the operation between two distinct systems of information processing: the reflective system and the impulsive system (Strack & Deutsch, 2004, p. 222). In the reflective system, behaviour results from a decision-making process on different stages. Through a process of weighting values and anticipating consequences, the individual decides against the execution of a certain behaviour or goes for its implementation. Behavioural schemata are activated, and behaviour is elicited (*reasoned action*). In the impulsive system, however, perceptual input alone activates behavioural schemata and thus, behaviour. This may be possible without an individual's intention or an initial goal. Motivation and deprivation may work as moderators to this automatic activation (see Figure 2.5).

Both systems usually operate in parallel. Strack and Deutsch (2004) assume that the impulsive systems operates continuously (either in parallel or as a single system), while the reflective system may be disengaged, depending on intensity of input and attention received. Moreover, while the impulsive system does not require high cognitive capacity, the reflective system requires high levels of capacity. Distraction, such as high or low arousal, may interfere with the operation (see Yerkes-Dodson-Law of arousal; Yerkes & Dodson, 1908). Thus, the impulsive system works faster through its associative links than the reflective system, which works through semantic linkage. Regarding the impulsive system, which is important for indirect measurement, Strack and Deutsch (2004) specify that the links between the element of that associative network are stable and change only gradually by learning (p. 223). The spreading of activated links depends on frequency and proximity of prior

activation and defines the strength of links between the elements. Strack and Deutsch (2004) compare this system to a simple memory system.

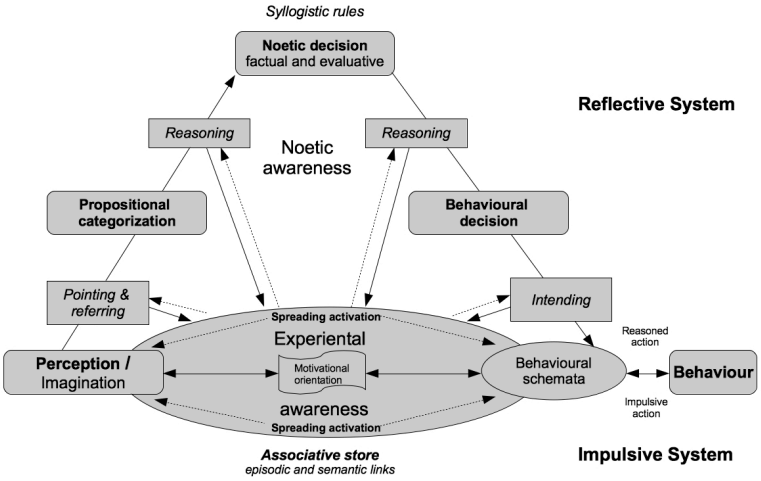

Figure 2.5. Overview of the reflective-impulsive system (illustration from Strack & Deutsch, 2004, p. 239)

What would this mean for the case of competitive anxiety in an athlete? Figure 2.6 shows a possible assumption (for a more detailed excursus on the integration of emotion elicitation within the dual-process theories, see also Smith and Neumann (2005) in their chapter).

For example, an athlete prone to perceive anxiety in competitive sport situations (*competitive trait anxiety*) receives perceptual input about a competition, as soon as he/she enters the location of the competitive event. Perceptual features such as other athletes walking around, the sounds of spectators, the smell of line tartan or gum may activate specific elements of the associative network in the impulsive system. These elements may have been previously paired with other features related to sport competitions in general. Thus, a whole cluster of competition-related elements will be activated. Additionally, possibly threatening aspects of competitions will be activated, as anxious persons usually show an attentional bias towards anxiety-related input (Mathews & MacLeod, 1994). These activated aspects in turn will guide the further information processing and influence behavioural reactions. In an athlete suffering from competitive trait anxiety, all these features might quickly

evoke feelings of state anxiety (see also LeDoux, 1996, 2001, about the "quick way" of affect elicitation through the thalamus); even if the athlete does not know the origin of his feelings.

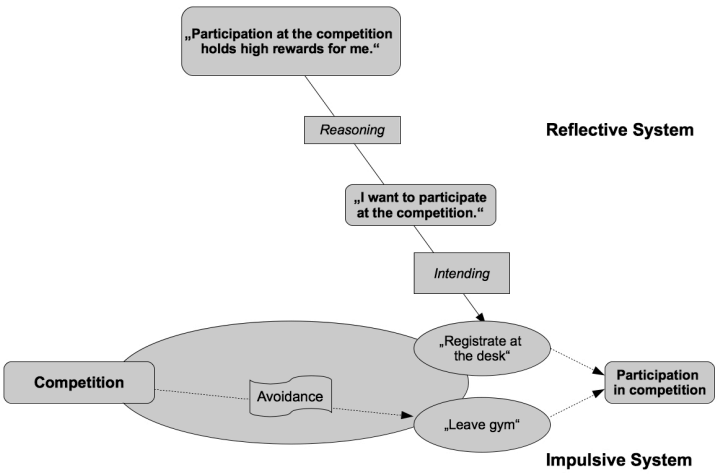

Figure 2.6. Impulsive and reflective activation of competing schemata regarding the participation at a competition in athletes suffering from competitive anxiety (schema adapted from illustration by Strack & Deutsch, 2004, p. 231).

Behaviour, in the end, will be elicited by behavioural schemata. Either by the reflective system or the impulsive system, different behavioural schemata will be activated, which can be compatible or incompatible to each other. As both systems compete to activate a behavioural schema, Strack and Deutsch (2004, p. 230) describe the following example: "... a person who is on a diet may be tempted to eat a second dessert (...); that is, the sight of the dessert impulsively activates behavioral schemata that are directed toward consumption. At the same time, the reflective system has generated a behavioral decision to refrain from eating it. To win the contest, the reflective system can apply knowledge about the mechanism of the impulsive system. Most effectively, it may divert attention from the tempting stimulus ..." However, if the operating conditions of the reflective system are not fulfilled, the impulsive system will gain control over the execution of behaviour.

For athletes suffering from competitive anxiety, this process means that in the competition context, he/she will be aware of feelings of anxiety and the impulse to

avoid the competition (impulsive system). However, the reflective system has generated the decision to participate in the competition under any circumstance, for example, for motivational reasons (Ryan & Deci, 2000). To win the inner contest, the reflective system will start a reasoning process and perhaps redirect attention to other input, such as team partners relying on the athlete or the idea of a "winning feeling" as part of coping processes (Ouimet et al., 2009; Lazarus, 1985; Eysenck et al., 2007). If these new inputs are strong enough, the reflective system will win over the impulsive system and the athlete will participate in the competition.

2.4.2 The MODE Model by Fazio and Olson

In their critical work, Fazio and Olson (2003a) emphasize the lack of theory supporting the general application of indirect measurement techniques. To this end, they define an alternative explanation for the functioning of indirect measures, such as priming and the IAT (Greenwald et al., 1998). In their MODE model (Fazio, 1990; Fazio & Towles-Schwen, 1999; Fazio & Olson, 2003), they focus on relative spontaneous or deliberate processes by which judgements and behaviour are influenced by attitudes. Thus, ***m***otivation and ***o***pportunity serve as ***de***terminants to influence the attitude-to-behaviour process being either spontaneous or deliberate per se (Fazio & Olson, 2003a, p. 301). Spontaneous processing means that an individual's judgements are influenced by attitudes that are automatically activated by perception of the immediate situation. Deliberate processing on the other hand refers to analysed processing, which relies on more effort and cost-benefit estimation. In the process of deliberation, motivation and opportunity (which means time and resources) are of special importance as they are necessary for the individual to engage in effortful processing. The MODE model, further, postulates that all processes do not have to be either spontaneous or deliberate, but rather that mixed processing is possible.

Moreover, studies by Fazio and colleagues (for an overview, see Fazio & Olson, 2003a, p. 306) found that if motivation and opportunity were rather low, indirect measures showed higher predictability of judgements and behaviours than with motivation and opportunity for engagement in processing being high. Regarding

consistency between implicit[1] and explicit measures, Hofmann et al. (2005) state that high implicit-explicit consistency is expected when neither the opportunity nor the motivation exists to alter an explicit response. This again emphasizes the moderating qualities of motivation and opportunity in the MODE model regarding inconsistent implicit-explicit results.

Furthermore, the MODE model's main assumption is the criticism of the unawareness regarding implicit measurement. Fazio and Olson (2003a) clearly question the fact that implicit attitudes measured by the implicit association test are also unconscious. They state that participants in IATs or other indirect testing procedures may be well aware of negative attitudes regarding a target concept, such as race or gender. Thus, implicit constructs are not necessarily unaware or unconscious constructs. For this reason, and several other reasons, Fazio and Olson (2003a) propose the following: Instead of the construct in question being regarded as implicit, it is the measure that is implicit, because it provides information about participants' attitudes or whatever construct that is to be measured without having to ask them in a direct manner. Therefore, the terms "implicit" versus "explicit" should be labelled "indirect" and "direct", as direct and indirect do not emphasize the unawareness of the construct to be measured.

2.4.3 The model by Hofmann et al. (2005)

According to the dual-process theories noted above, the main assumption of the working model of implicit-explicit consistency described by Hofmann and colleagues (2005) is the structural separation of an attitude or personality disposition into two components: implicit and explicit. The implicit component is considered as associations, which can be activated automatically, unaware, unintentionally, by the use of minimal resources and without the assignment of truth values (see Hofmann et al., 2005, Bargh, 1994, Strack & Deutsch, 2004). The explicit component – being a

[1] This is a common problem in understanding this specific field of research. Research groups differ in their labeling of terms and definitions. While some define the measures as being implicit / explicit, others define the constructs as being implict / explicit. Thus, when summarizing research in this chapter, the definition of the original authors will be used.

propositional format – requires higher mental processing and the assignment of truth values. This means, for indirect measures, it does not matter whether a person considers them as true or false; for direct measures, the difference *true/false* is crucial and influences self-reported responses (Gawronski & Strack, 2004). Both, implicit and explicit representations are thought to act in bi-directionally (see Figure 2.7). Not only does explicit processing influence associative implicit representations, but also propositional higher-order processing is based on implicit representations (Hofmann et al., 2005; Gawronski & Bodenhausen, 2006; Strack & Deutsch, 2004).

In their working model of implicit-explicit consistency, Hofmann et al. (2005) make the distinction between factors influencing implicit and explicit representations and factors that affect implicit (indirect) and explicit (direct) indicators (measures). As depicted in Figure 2.7, implicit-explicit consistency exists between indicators, and not the representations. Therefore, different influences are considered in the model.

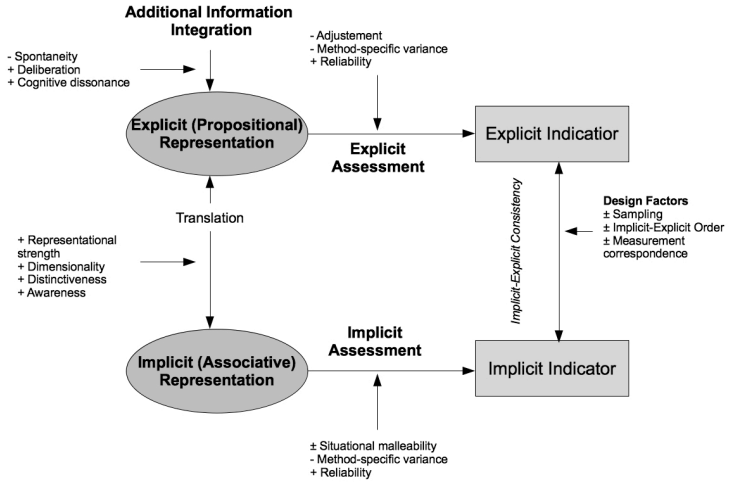

Figure 2.7. The working model of implicit - explicit consistency (illustration from Hofmann et al., 2005, p. 343).

While spontaneity is supposed to have a negative effect on the integration of additional information for explicit representations, deliberating processes and cognitive dissonance should have a positive effect. Representational strength, dimensionality, distinctiveness and awareness should influence the bi-directional relation of implicit and explicit representations.

The assessment itself is affected by adjustment, method-specific variance, situation-specific malleability and reliability. Finally, design factors, such as sampling bias, the order of measures presented to the participant and the measurement correspondence should directly influence implicit-explicit consistency. Hofmann et al. (2005, p. 344) conclude that the "degree of consistency between implicit and explicit indicators is a function of how strongly associative and propositional representations feed into each other and how well the implicit and explicit indicators reflect their laten representations respectively". As such, they have organised the potential moderators of implicit-explicit consistency into five factors: (1) additional information integration for explicit representations, (2) translation between implicit and explicit representations, (3) properties of implicit assessment (e.g. social malleability), (4) properties of explicit assessment (e.g. social desirability concerns) and (5) research design factors such as sampling bias for example. For further reading on the moderator factors, see Hofmann et al. (2005). In general, the working model of implicit-explicit consistency plausibly addresses the idea of existing related interactions between implicit and explicit constructs and the specific requirements for its occurrence.

Excursus: QUAD Model

Next to dual process theories on controlled and automatic processing models, such as those noted above, a different approach is given by Conrey, Sherman, Gawronski, Hugenberg and Groom (2005), whose QUAD model explains information processing and its impact on behaviour. The model is derived from the "C-First" Model of Process Dissociation by Jacoby (1991) and the "A-First" Model of Process Dissociation (Lindsey & Jacoby, 1994), and takes on limitations of the previous model. Both models focus on the role of automatic and controlled components and attempt to disentangle their contributions in the processing of implicit tasks. The multinominal QUAD model's novelty is the introduction of four components: association activation (AC), discriminability (D), overcoming bias (OB) and guessing (G). The AC component (AC or 1 - AC, in the opposite case) is the likelihood of an automatic association to be activated (or in the opposite case, not to

be activated) by an incoming stimulus, for example a picture or a word, such as indirect measures intend to do. The D component (D or 1 - D, in the opposite case) is the knowledge-based likelihood of a response to be correctly determined. Thus, whereas the AC component refers to an automatic process, the D component refers to a controlled process, which is influenced by motivation and the ability to refrain from outer distraction. The OB component (OB or 1 - OB, in the opposite case) is the likelihood of an individual to respond correctly to an upcoming task despite an automatically activated association response impulse. This is supposed to be a controlled process of inhibiting an automatic association, while the D component is a controlled process of directing a correct response. Conrey et al. (2005) describe the OB component as a moderator between automatic and rule-based processes, which are both activated due to the incoming stimulus and compete with each other to gain response control (see Smith & DeCoster, 2000). Finally, the G component (G or 1 - G, in the opposite) is, in lack of further information, the likelihood of an individual to overcome a general response bias, for example, as given in Conrey et al. (2005) to respond with the right hand to a given stimulus on-screen. Figure 2.8 shows the QUAD model in detail.

The advantage of the QUAD model is the possibility of the four components to be estimated statistically in their impact on, for example, the indirect measurement. In several studies (Conrey et al., 2005; Sherman, Gawronski, Gonsalkorale, Hugenberg, Allen & Groom, 2008), the model was confirmed for its applicability to the field of indirect measurement research. Moreover, the model integrated several different approaches to explain the functioning of indirect measurement techniques, such as the IAT (Gawronski, Deutsch, LeBel & Peters, 2008). As such, contemporary research on implicit social cognition and its measurement is unimaginable without the QUAD model.

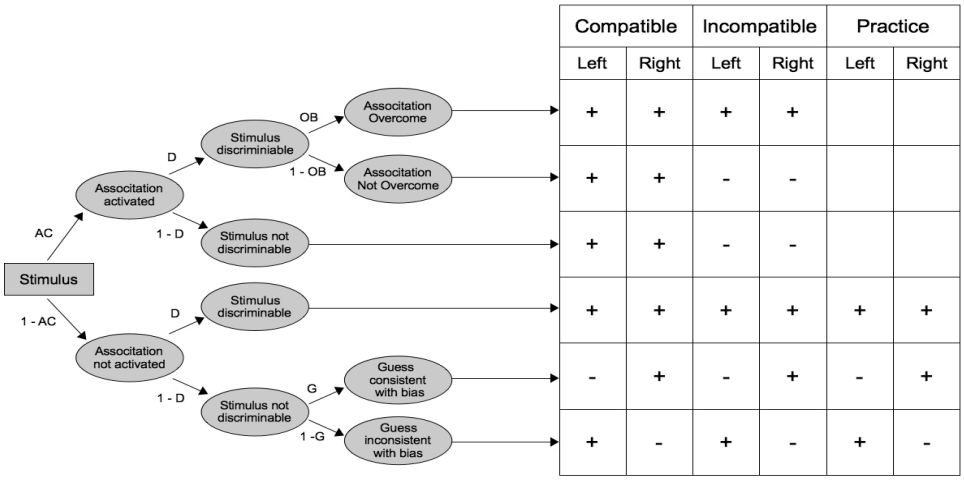

Figure 2.8. Components and their interaction of the multinominal QUAD-model (illustration from Conrey et al., 2005, p. 474).

2.4.5 Conclusion on the theoretical basis for implicit and explicit research

As described above, most theories and models underlying implicit and explicit research objects are dual-processed. They not only focus on explicit and implicit representations, but also discuss the consistency between indirect and direct measures as much as the terms themselves.

Considering affective research in sport psychology, all of the models described thus far are of interest. While Strack and Deutsch's (2004) model explains processing, Fazio and Olsen (2003) discuss measurement and Hofmann et al. (2005) focus on the relation between both measurements. The excursus by Conrey et al. (2005) gives a plausible basis for the functioning of the Implicit Association Test by Greenwald et al. (1998), which will be in the focus of the following chapter.

2.5 The Implicit Association Test

2.5.1 What is it?

The Implicit Association Test (IAT) was introduced by Greenwald et al. (1998) as a possibility for assessing differences in evaluative associations between pairs of social or semantic concepts. The IAT consists of a target concept and an attribute concept. The target or object concept is usually a semantic or social difference, for example, gender (male/female) or ethnicity (white/black). The attribute concept usually refers to positive versus negative adjectives. The first IAT study published by Greenwald et al. (1998) investigated the associative strength between the target concept "flower/insects" and the attribute concept "positive/negative" (see Figure 2.9).

Sequence	Block 1	Block 2	Block 3 + 4	Block 5	Block 6 + 7
Task description	Initial target-concept discrimination	Associated attribute discrimination	Initial Combined Task	Reversed target-concept discrimination	Reversed combined task
Task Instruction	● Insects Flowers ●	● pleasant unpleasant ●	● Insects ● pleasant Flowers ● unpleasant ●	Insects ● ● Flowers	Insects ● ● pleasant ● Flowers unpleasant ●
Sample Items	rose ○ ○ beetle ○ fly orchid ○	○ lucky ○ honor poison ○ grief ○ ○ rainbow hatred ○	○ wasp lily ○ ○ moth hatred ○ ○ peace violet ○ ○ laughter kill ○	○ petunia ant ○ mosquito ○ ○ daisy	○ miracle ○ buttercup hornet ○ sickness ○ ○ marigold tragedy ○ ○ sunrise spider ○

Figure 2.9. Schematic description of the Implicit Association Test "Flower / Insects" (Illustration from Greenwald et al., 1998, p. 1465).

Participants sat in front of an IBM personal computer at a distance of 65 cm to the monitor and had to assign stimulus words, for example, marigold and tulip, to the category "flowers", wasp and bee to the category "insects" and happy and ugly to the attribute concept categories. The first block was the initial target concept discrimination, and the second block was the initial attribute concept discrimination.

The third block included a practice block and a test block of a first combined task. In the combined task, participants had to assign stimulus words either to the category "flower/unpleasant" or to the category "insect/pleasant". The fourth block, which was the reverse discrimination of the target concept, participants changed the response keys of the target concept categories. The final block consisted of a practice block and a test block of a combined task, again. This time, the block included the reverse combination, which means participants had to assign stimulus words either to the category "flower/pleasant" or to the category "insect/unpleasant".

There are some IAT studies, in which authors describe seven blocks instead of five. In these IAT studies, the practice blocks of the combined tasks are counted as single blocks. The following studies in this work will also refer to seven blocks.

2.5.2 Theoretical models of explanation of the IAT effect

The main assumption on indirect measurement in social cognition, according to Greenwald and Banaji (1995), is that traces of past experiences affect performance, even though they are neither conscious nor remembered. The idea of the later developed IAT is based on this theoretical assumption. The performance difference in reaction times between the combination tasks (combined versus reverse-combined) is supposed to measure the strength and direction between the automatically activated associations of stimuli concepts which share the same response key (Greenwald et al., 1998). For example, if the reaction time of the task "flower/positive" and "insect/negative" is faster than the reaction time of the reversed task "flower/negative" and "insect/positive", the idea behind that difference is that the individual who performs the task has a stronger positive association of flowers and a stronger negative association of insects than the reverse. As such, associative strength and the components of the associative network are of primary relevance for the functioning of the IAT.

DeHouwer (2001) argues that the structure of the IAT is similar to stimulus-response compatibility tasks, such as the Simon Task (Craft & Simon, 1970), which will be explained below briefly. According to DeHouwer (2001), an automatic response

activation in the IAT does not depend on the valence of the target category the stimulus word belongs to (e.g. “insect”=negative) but on the valence of the stimulus itself (“wasp”=negative). Delays in the response time of incompatible response assignments are explained by the response conflict occurring in “positive/insect” and “negative/flowers”, which is associated with both positive and negative valence. Thus, the conflict interferes with the correct response selection. However, there is no response conflict if the response assignments are compatible (e.g “positive/flower”), because they are associated with positive valence only, and as such share one response key. In experiments, DeHouwer (2001) confirmed the importance of the valence of the target concept over the valence of the individual stimulus for performing adequately on the IAT. As such, compatibility of the response assignments may be regarded as a relevant feature of the IAT.

Brendl, Markman and Messner (2001) provided evidence for a criterion shift process during IAT performance. These criterion shifts shall indicate a certain difficulty to interpret the specific response pattern of the IAT. The theoretical basis for these shifts are random walk models (e.g. Ratcliff, 1988). Random walk models of processing in response performance tasks start at a neutral time 0 and with each time step, in which participants obtain information of identity and valence of a stimulus, their sampling result of stimuli is shifted in the direction of the information-compatible response until a response threshold is reached. Brendl et al. (2001) discuss models with fixed thresholds as opposed to models with variable thresholds and conclude that the data of their IAT experiments is consistent with random walk models with variable thresholds. The authors assume that “if a new block is more difficult than one performed previously, then participants set a more conservative criterion for responding in that block (i.e. they move their threshold further from the starting point). Similarly, if they recognize that the task is easier, they move their threshold closer to the starting point” (Brendl et al., 2001, p. 764). In the IAT, participants rate the incompatible condition as being more difficult than the compatible condition. Thus, responses should be faster in the compatible condition because a less conservative threshold is used, and more information (valence and identity) is used for processing in the compatible threshold direction. A more conservative criterion, however, is expected to be used in the incompatible condition,

and as such, more time is needed for processing (for more detailed information, see Brendl et al., 2001, p. 765ff).

Mierke (2003), also, notes critically, that the IAT does not measure the strength and direction of attributions but the ratio of the strength between two attributional concepts. Thus, Mierke and Klauer (2001) propose a different theoretical model which explains the IAT effect apart from associative links. Their main assumption is that the IAT effect is based on cognitive processes during the switch between the tasks of the IAT (Mierke, 2003). Switching between the tasks produces significantly higher costs in the incompatible IAT condition (Mierke & Klauer, 2001). These switch-based costs lead to differences in reaction time. Experiments could show an effective reduction of task-switching costs by providing task cues (Mierke & Klauer, 2001).

Rothermund and Wentura (2004) propose figure–ground asymmetries as another theoretical basis for the IAT effect. Here, differences in salience of the given stimulus lead to the IAT effect. If attribute categories differ in salience, participants will find it easier to respond, when salient categories (the figures, Rothermund and Wentura, 2001) share the same response key and non-salient categories share the other response key (the background). Thus, in compatible IAT blocks, where salient categories of both dimensions share one response key, responses are faster than in incompatible IAT blocks, where salience and response direction do not share the same response key.

2.5.3 Alternative indirect measurement

Several other indirect measures have been developed in past years. The IAT is only one and probably the most well-known measure. A good overview of indirect measures is found in Bar-Anan and Nosek (2013).

The next chapter will describe selected alternatives to the IAT, which have been used particularly as measures for investigating implicit affective representations.

2.5.3.1 Extrinsic Affective Simon Task

The Extrinsic Affective Simon Task (EAST; DeHouwer & Eelen, 1998; DeHouwer, 2003) is based on the Simon Effect (Craft & Simon, 1970), which is the relation between an irrelevant feature and a given response. In the Simon task, participants are asked to press the left key, if a red light is presented on a monitor, and the right key, if a green light is presented on a monitor. The position of the light sign (left or right side of the monitor) is irrelevant to the task. Results showed a faster response to the task if the position of the light and the key matched, that is, if the red light showed up on the left side of the monitor (instead of the right side) and thus the participant pressed the left key. As such, the Simon task is a stimulus-response-compatibility task.

DeHouwer and Eelen (1998) adapted the basic structure and added an affective valence to the tasks. They presented positive and negative nouns and adjectives to the participants. Half of the participants were instructed to say "positive" when the presented word was a noun and "negative" when the presented word was an adjective. The other half of the participants fulfilled the reverse task. Participants had to ignore the affective valence of the presented word and focus on the grammatical category only, while fulfilling the task. Results showed that participants were faster when the stimulus valence and the correct response matched (DeHouwer, 2003).

Schmukle and Egloff (2006) adapted the EAST for the personality construct of anxiety. Based on studies with the EAST assessing multiple personality dimensions by Teige, Schnabel, Banse & Asendorpf (2004), they constructed an Extrinsic Simon Task but without the affective valence, which was added by DeHouwer & Eelen (1998). However, both constructed Extrinsic Simon Tasks–Anxiety showed only moderate internal consistencies; both tasks were dissociated for direct self-report measures of anxiety and one of the tasks showed some convergent validity to the compared IAT measure (Egloff & Schmukle, 2002). Schmukle and Egloff (2006) conclude from these results that further research will be essential for implementing the EAST as an indirect measure in personality research areas.

2.5.3.2 Go/No-Go Association Task

The Go/No-Go-Association Task (GNAT) was developed by Nosek and Banaji (2001) to measure implicit social cognition requiring only one target category instead of two contrasting ones as in the IAT (Greenwald et al., 1998). The GNAT is a discrimination task, in which participants have to decide whether a stimulus belongs to a target category and attribute or whether it is simply a distractor stimulus (Nosek & Banaji, 2001). There are two given conditions: In the first condition, participants are required to simultaneously identify stimuli that belong to a specific target category (*fruit*) and a specific attribute (*good*). In the second condition, an alternative attribute is given (*bad*). If, for example, *fruit* is more positively associated, the task of identification and discrimination should be easier and thus faster for the first condition than for the second condition. Nosek and Banaji call this "accuracy" in discriminating the target stimuli from distractors. During the GNAT, participants are seated in front of a monitor and both distractor items and target items are presented. Participants are instructed to press a key (e.g. the space key on the keyboard), if a category item or the evaluative attribute item is presented (go-task). If a distractor item, which belongs neither to the category items nor to the evaluative attribute items is presented, participants should not press a key (no-go-task). The strength of the association determines the discrimination of the signal from noise, in accordance with signal detection theory (Green & Swets, 1966). Thus, differences in the discrimination between the pairings of the tasks reflect the association between the category item and the evaluative attribute item. This association is handled as a measure of automatic attitudes (see Nosek & Banaji, 2001, p. 627-628).

An affective version of the GNAT was implemented in a study of implicit spider fear by Teachman (2007). The GNAT was presented to participants with either high or low fear of spiders. Differences in the speed of classifying the presented stimuli when categories matched or not were assumed to differ between the fear groups. Results supported the task's convergent validity and represented the fear groups according to classification speed. In addition, results of the GNAT were related to a given direct measure assessing explicit, that is, self-reported spider fear. Teachman (2007) concludes that the GNAT is an effective single-target instrument of implicit fear associations.

2.5.3.3 The Stroop Test

The original Stroop Test, first defined in a series of multiple studies by J. R. Stroop in 1935, is a reaction-time experiment and thus, an indirect measure. Study pParticipants are seated in front of two sheets of paper, both showing names of colours: Blue, green, brown, purple and red. The first paper shows all colour names printed in black (RCNb means "**r**eading **c**olour **n**ames printed in **b**lack"); the second paper shows all colour names printed in colour (RCNd means "**r**eading **c**olour **n**ames where colour of print and word are **d**ifferent"). Colour and colour name, however, do not match. For example, if the word is to be read "blue", the word itself is printed in green, purple, brown or red colour. No word is followed by the same word. Each word is printed in each non-matching colour. Participants have to read out the printed words of the first sheet of paper (RCNd) and then the second one printed in black (RCNb) is given to them by the experimenter. Participants have to read out the papers as fast as possible and without making any mistakes. Time is taken by a stopwatch (see Stroop, 1935, for more information). Several alternative experiments have been constructed. In the most famous one, participants are asked to read out the colour of the printed word with non-matching colour and word (the word "red" is printed in the colour "green", for example, and participants have to read out "green" instead of "red"). Results show that reaction time is slower, and participants make more mistakes reading when colour and word do not match.

The Stroop effect describes the difference in time between reading the words printed in the non-matching colour and the words printed in black or, in another version of the Stroop test, the matching colour. The test is described as a measure for the interference of colour stimuli upon reading words. The Stroop effect shows the dominance of automatic processes during reading (see Stroop, 1935; Williams, Mathews & MacLeod, 1996; MacLeod, 2015). Several different theories to explain the Stroop effect have been developed. According to Cohen, Dunbar and McClelland (1990), likelihood and degree of interference is due to the relative strength of processing pathways gained by training (such as reading). Melara and Algom (2003), however, propose two rather perceptual factors (dimensional imbalance and

dimensional uncertainty), which influence the occurrence of Stroop interference. Here, salience and uncertainty of the targets (colour/words) play a major role. Finally, Roelofs (2003) proposed a two-factor model with a focus on different lingual production mechanisms in that of colour naming and word reading, which cause the Stroop interference (for further reading, see MacLeod, 2015).

The emotional Stroop Test replaces colours with words bearing an affective connotation, for example, anxiety-related words, such as "spider" in phobic patients (Lavy, Hout & Arntz, 1993). Results showed that naming the colours of emotional words slowed down reaction times in emotionally disturbed participants (Williams et al., 1996). This result led to the suggestion to use the emotional Stroop Test as a measure for psychopathology and as an explanation for attentional bias in emotional disorders. Williams et al. (1996, p. 21) conclude in their review of studies using the emotional Stroop Test that based on Cohen's connectionist model (Cohen et al., 1990), emotionally disturbed participants lack the ability to override the attentional bias on threat-related words by increasing effort spent on naming the correct colour in the Stroop Test (see also Mathews & MacLeod, 1994, for more detailed information).

2.5.3.4 Priming

Classic priming is one of the most famous and well-researched indirect reaction-time instruments. Positive priming means a facilitated elaboration or identification of a stimulus due to a previous presentation (Anderson, 2001). In contrast, negative priming means a debilitated elaboration or identification of a stimulus due to a previous presentation (see Mayr & Buchner, 2007). Priming involves a stimulus, which can be a word, a picture, a sound, in short "a prime", which is presented before a certain task. Experiments on priming showed that reaction times change due to the prime. For example, Palmer (1975) showed an effect of context on the identification of objects. In a repeated measure design, participants had to identify objects either matching the context, not matching the context or not being presented in context. Results showed that more participants correctly identified the objects after

seeing an appropriate context. Palmer (1975) concluded that context triggers correct identification. As such context serves as a prime for the identification of the objects. In addition, Storbeck and Clore (2008) found that affect moderates such cognitive priming effects: Positive affect led to a priming effect while negative affect inhibited priming. A study by Vohs, Meade and Goode (2006, Kahneman, 2012) found that participants who previously were primed on the word "money" showed to be more independent than non-primed participants. They worked longer on a difficult task, before they asked the experimenter for help. Moreover, they were more selfish and did not help another student who failed to do the task by himself. Several experiments in this series of the study showed the effectivity of priming in the daily life.

Another form of priming, in addition to semantic and contextual priming, is affective priming. Affective priming means that the elaboration of a subsequent prime is influenced by a prime that has previously activated an emotional state. Fazio (2001) provides an overview of research on affective priming. Affective priming, for example, will work best if the latency between the presented prime and the stimulus is less than 300 ms. A latency time of 1000 ms showed no effect (Fazio & Williams,1986; DeHouwer, Hermans & Eelen, 1998). Experiments of affective priming showed effects for words, familiar attitude words, newly learnt words, drawings and "pleasant" versus "unpleasant" coloured photographs, as conducted in studies by Hermans, DeHouwer and Eelen (1994) (for an overview of experiments on affective priming, see Fazio, 2001, pp. 117ff).

2.5.4 Advantages and limitations of the IAT

2.5.4.1 Advantages

Aside from Bargh (1994), who describes several advantages of indirect measurement compared to direct investigation of constructs, Greenwald et al. (1998) describe the IAT as particularly sensitive to automatic evaluative associations. Results of the first IAT studies demonstrate that this procedure is easy to understand and to explain to participants. It shows to have acceptable reliability and validity. Compared to direct

measures, such as questionnaires, results indicate that the IAT seems resistant to self-presentational regulatory mechanisms. Possible effects on self-presentation operations may be attributed to private self-presentation and less to impression management (Greenwald et al., 1998, p. 1476). Additionally, the ability to engage in introspection is less essential. In a critical article, Steffens (2004) investigated the reported main advantage of the IAT: immunity to faking (Greenwald et al., 1998). According to her results, it is indeed possible to fake the IAT results. Nevertheless, the IAT showed to be less susceptible to faking compared to a direct self-report instrument on personality dispositions. Steffens (2004) also states that the IAT was one of few instruments correlating moderately with explicit instruments on related constructs. Finally, Bosson, Swann and Pennebaker (2000) showed the IAT among seven indirect measures being the only one to correlate significantly with directly measured criterion variables.

2.5.4.2 Limitations

The numerous theoretical models of explaining the IAT effect (see chapter 2.3.2) point out one of the main problems with the IAT. It is still unsolved how the IAT effect may be explained in a plausible and concrete manner (Schmukle & Egloff, 2006). In addition, Schmukle and Egloff (2006, p. 149) note several limitations due to the fact, only, that the IAT effect is based on the comparison of responses from two different trial blocks. First, the IAT effect is merely influenced by the order in which the different blocks are presented to the individual (order effect, see Greenwald et al., 1998). Therefore, the order of the block presentation must be considered and tested for an effect within each experiment (Nosek, Greenwald & Banaji, 2005 on order effects; Schnabel, Asendorpf & Greenwald, 2008). Additionally, since the IAT measures relative strengths of associations between two bipolar concepts of a certain trait, in the context of personality assessment it is rather unsatisfying to test only “self/other” concepts of the same trait in relation to each other. Testing different personality dimensions would be more interesting (see also Karpinski, 2004; Pinter & Greenwald, 2005). Moreover, the IAT is only able to assess one dimension of a personality trait per test. Therefore, in the measurement of

several multiple personality dimensions (which is possible, for example, in direct measurement via the PSSI by Kuhl & Kazén, 2009), different yet comparable IATs are essential. However, the specific order of the presented IATs must be considered.

Apart from trends to overcome methodological issues assessment (for example by pen-and-paper IAT implementation, Lemm, Lane, Sattler, Khan & Nosek, 2008; Bardin, Perrissol, Py, Fos & Souchon, 2016), the IAT still has several notable problems with its theoretical background, which must be critically considered (see above).

2.6 Current research using the Implicit Association Test

Studies on the IAT are numerous and manifold (Gawronski & Conrey, 2004). In the following, only some of the current research objects will be noted. Current research using the IAT focuses on research questions of a social psychological, personality psychological or of a clinical nature. In social psychology, the IAT is often used to investigate the constructs of stereotypes (e.g. Banaji & Greenwald, 1995), racism (e.g. Ottaway, Hayden & Oakes, 2001) and prejudice (e.g. Rowatt et al., 2006, on the role of religion and implicit homosexual prejudice). In the psychology of personality, research interests of the IAT focus on anxiety (e.g. Egloff & Schmukle, 2002), shyness (e.g. Asendorpf et al., 2002), self-esteem and self-concept (Greenwald & Farnham, 2000), and anger (e.g. Schnabel et al., 2006). Clinical research focusses, for example, on eating disorders (e.g. Ahern, Bennett & Hetherington, 2008, regarding the association between preference of underweight models and the drive for thinness in young women) and phobias (e.g. Teachman, Gregg & Woody, 2001, on spider phobia). Social anxiety disorder (Glashouwer, Vroling, de Jong, Lange & Keijser, 2013) and the role of positive emotions on overeating (Bongers, Jansen, Houben & Roefs, 2013) also show newly relevant constructs, to name just a few.

Methodological issues regarding the IAT are also in the focus of current research. Yovel and Friedman (2013), for example, present a questionnaire-based IAT (qIAT) and thus try to bridge the gap between indirect and direct measurement of personality. Slabbinck, De Houwer and Van Kenhove (2011) validated the Pictoral Attitude IAT (PA-IAT) as a measure of implicit motives. Bardin et al. (2016) focus on a pen-and-paper variant of the IAT. Regarding psychoneurological research, Williams and Themanson (2011) implicate neurological correlates on the semantic and emotional processing of the IAT.

However, in general research of the IAT in sport psychological research, the Implicit Association is barely in use. Ohlert and Kleinert (2009) evaluated an IAT on affinity for groups. They found acceptable consistencies, albeit only punctual correlations with social well-being (Ohlert & Kleinert, 2009, p. 114). Another research area using the IAT in sport psychology is the one on doping attitudes (Brand et al., 2011). Brand et al. (2011) analyzed and compared measurement properties of two recently

published IATs to a Control-Word-/Non-Word IAT. Results showed less satisfactory measurement properties in pointing to a rather negative doping attitude among athletes. The authors see the main problem of their study in the correct assignment of the stimuli to the target categories. Given that the boundaries between legal supplements and illegal substances have shifted, athletes might have had difficulties identifying the correct category while doing the IAT (Brand et al., 2011). King Chun Chan, Keatley, Tang, Dimmock and Hagger (2018) also focused on indirect and direct assessment of unintentional doping attitudes in relation to athletes' vigilance. These authors found that implicit and explicit positive doping attitudes impact on a behavioural vigilance task regarding unintentional doping with a higher connotation on implicit positive doping attitudes. However, neither implicit nor explicit doping attitude predicted the avoidance of unintentional doping significantly.

Regarding personality research in sport psychology, no application of an IAT was found (ScienceDirect, 12.08.2013). As such, one of the main goals of the following work is to fill this gap of research by adapting the IAT-Anxiety (Egloff & Schmukle, 2002) for sport-relevant anxiety and test its possible benefits for addressing sport psychological questions. Another question of interest in the context of sport psychology and anxiety in sport, which remains to be investigated is whether there are differences in known groups between the direct assessment via self-report questionnaires and the indirect assessment via IAT. Additionally, it is still unclear, in what way an IAT for sport-specific anxiety can be implemented effectively and economically in the sport-relevant context of competitions, for example, to gain maximum insights into reliably unfaked introspection of athletes regarding anxiety in sport. This would be a chance to help coaches and sport psychologists in their work on athletic performance enhancement. As such, this work has kind of an explorative character as it is an adaptation from the general to the context-specific field of research.

2.7 Goals of this work

Having presented the theoretical basics thus far, the following goals for the studies herein have been developed. To date, no recent study has focused on implicit sport-specific anxiety as a construct, although several problems have been discussed considering the application of direct measurement techniques and instruments (see Egloff, 2008). These problems can also be transferred to the direct measurement of sport-specific constructs, as there are many self-reporting inventories that find their application in sport psychology. Indirect measurement techniques, such as the IAT (Greenwald et al., 1998), have already been applied in investigations on sport psychological questions. Petróczi, Aidman and Nepusz (2008) as much as Brand et al. (2011) and King Chung Chan et al. (2018) applied an IAT (Greenwald et al., 1998) in the field of doping attitudes. Recently, a shorter version of the Doping-IAT was developed (Brand, Heck & Ziegler, 2014; Brand, Wolff & Thieme, 2014). Several more sport-specific IATs focus on exercise pleasure in children (Antoniewicz, Wolff & Brand, 2014) and group affinity (Ohlert & Kleinert, 2009). However, sport-specific indirect instruments have not been applied yet on affective constructs, such as anxiety. The present work tries to close this gap by investigating sport-specific anxiety in an indirect manner. As such, the presented work is exploratory in nature.

First, we need an overview of the problematic of anxiety among athletes. Emotion-focused indirect measurement in sport has not been conducted yet. Therefore, direct measures of competitive anxiety and sport injury anxiety will be analysed in their relation to the already existing indirect measure IAT-Anxiety (IAT-A; Egloff & Schmukle, 2002). Anxiety measurement can only be as precise as the anxiety-triggering stimuli. Studies on shorter versions of the IAT (e.g. Brief - IAT by Nosek, Bar-Anan, Sriram, Axt & Greenwald, 2014) emphasise the importance of stimulus material. A general indirect measure of anxiety may provide first insights into the associative network nature of anxiety, also in a sample of athletes. This work will be the basis for further development of the indirect instrument regarding sport-specific measurement.

Based on results of the first study, in a second study two sport-specific indirect instruments similar to the IAT-A (Egloff & Schmukle, 2002) will be developed and applied to a second sample of athletes. This will provide the opportunity to analyse competitive anxiety and sport injury anxiety by sport-specific direct and indirect instruments. Thus, it will be possible to test the newly developed sport-specific stimulus material against general anxiety-related stimulus material. Anxiety-related sport-specific associative networks should be activated more easily by anxiety-related sport-specific stimulus material. Hence, an IAT on sport-specific anxiety should show a stronger relationship to direct sport-specific instruments investigating the equivalent construct making it possible to formulate more precise statements regarding the activated associative network. Results, in turn, make a contribution to the clarification of the constructs competitive anxiety and sport injury anxiety.

The third study focuses on the method of the IAT itself. Validity and reliability of the newly developed IATs will be tested by so-called Control-IATs (Rothermund & Wentura, 2004; Rothermund, Wentura & De Houwer, 2005). Control-IATs include neutral stimulus material, which makes it possible to rule out the possibility of the results being pure incidentally (methodical variance; Mierke & Klauer, 2003). Results are expected to strengthen the validity of the newly developed indirect instruments, ensuring proper use in further research.

3 Empirical part

In the following, three studies are described, which focus on the indirect measurement of competitive anxiety and sport injury anxiety. For each study, a short introduction is given outlining study goals and intentions. Study methods are described in detail, pointing out the study sample, procedure and instruments. In study 2 in particular, the Methods section includes the elaborated development of the sport-specific IATs. Analyses and results will then be presented in the Results section of each study, followed by a short preliminary discussion.

3.1 Introducing the Implicit Association Test - Anxiety to the measurement of sport-specific anxiety: A new perspective?

3.1.1 Theoretical background

Faking and social desirability are common problems in the measurement by self-reports and questionnaires (Egloff, 2008). Especially in the investigation of personality dispositions, which tend to be less helpful to self-worth, these tendencies for bias are well-known. Instruments, such as the Balanced Inventory of Desired Responding (BIDR, Paulhus, 1984), show the impact of self-deception and impression management in the assessment of personality facets. In sport, athletes often benefit from the halo effect of being heroic ideals (Cahill, 2000; Biskup & Pfister, 1999). Competitive anxiety and sport injury anxiety – as common sport-relevant types of anxiety – do not correspond to this pattern. Thus, the assessment of sport-specific anxiety by direct measures such as self-reports or questionnaires, as currently done in sport psychology, features the problem of social desirability. According to Egloff (2008), indirect measures have the potential to adequately deal with these methodical problems. Even though indirect measurement is frequently used in other fields of psychology, such as clinical psychology, social psychology or personality psychology, the indirect investigation of implicitly represented sport-specific emotions has not been established so far (for an overview on current research via the IAT, see chapter 2.5 of this work).

Based on research by Egloff and Schukle (2002), who have shown that the IAT-A is a reliable indirect instrument in the valid measurement of anxiety (which predicts criterion variables above self-report measures), this work focusses on replicating and verifying results regarding their domain-specific applicability. The Two-System-Model by Strack and Deutsch (2004; see chapter 2.4.1 of this work) serves as theoretical background for this approach. Strack and Deutsch (2004) note in their dual-process model that in addition to the reflective direct way of processing information that leads to initiation of a behavioural response, the automatic indirect way of processing behaviour-relevant information is also of relevance. The indirect measure of the IAT-A provides the opportunity to display automatically processed

behaviour-relevant information on the emotion of anxiety. According to Greenwald et al. (1998), the stimulus material activates the associative network in which strength and direction are displayed by performance in reaction-time between response tasks.

Additionally, the following study provides insights into the general potential of indirect anxiety measurement in sport and its psychometric properties in a sport-specific context. The IAT-A, which is not sport-specific, will be applied in relation to sport-specific and general questionnaires assessing anxiety dispositions. Here, the relationship between a general indirect instrument and sport-specific direct instruments will be in focus (Hofmann et al., 2005). Self-deception is assumed to operate as a moderator variable between the directly assessed explicit variables (Egloff & Schmukle, 2002, for further reading).

Since the IAT-A has not yet been applied in the context of emotions in a sport-specific context (Science Direct: 05.06.2018), several research questions were formulated to be answered by the statistical analyses.

The first question addresses the methodical replication of previous research of the general IAT-A (Egloff & Schmukle, 2002) as an indirect measure. Based on this purely methodical question, several more specific explorative research questions have to be investigated.

The IAT and its variants have been applied in several fields of research (Teachman & Woody, 2003; DeHouwer, 2002; Westberg, Lundh & Jönsson, 2007; Weck, Bleichhardt, Witthöft & Hiller, 2011). The second question, therefore, will focus on the application of the IAT-A in the investigation of competitive anxiety and sport injury anxiety as sport-specific domains. The IAT-A's psychometric properties and its relationship to direct general and sport-specific anxiety must be verified regarding its reasonable implementation. Here, it will be of primary interest to discover how results of the implicit concept of anxiety measured by the IAT-A and the explicit concept of anxiety and sport-specific anxiety measured by direct instruments, correlate with each other (Hofmann et al., 2005; Gschwender et al., 2008).

The third question focuses on social desirability as a moderator in indirect-direct measurement (Egloff and Schmukle, 2002). At least 15% of elite athletes experience anxiety symptoms as debilitating and threatening to self (Spielberger, 1966; Jones et al., 1994). With athletes prone to engage in frequent internal and external reflection regarding their attainment of certain ideals (Biskup & Pfister, 1999; Koivula et al., 2002), social desirability might play a special role in the responding of self-reports. Thus, social desirabilities' impact on a possible relationship between direct and indirect measures deserves special attention.

The investigation of known-group effects will complete the first application of the IAT-A in the sport-specific context. A known-groups test on construct validity will show whether the applied measure is able to discriminate between two groups which are known to differ on the variable of interest, e.g. gender on the scale "somatic anxiety" of the WAI-T (Brand et al., 2009). The analysis of known-group effects regarding several demographic factors is a well-known method for the test of methodical adequateness (Banse, Seise & Zerges, 2001; Nosek, Hawkins & Frazier, 2011). The method provides further appraisement regarding the influence of external factors such as gender, participation in competition, kind of sport, squad status, severity of injury and duration of rehabilitation on the results of the direct and indirect measurement. Additionally, the method's application provides the potential to effectively differentiate between pre-known groups and their characteristics. In summary, analysis of known-group effect facilitates the evaluation of the appropriateness of the general IAT-A in its sport-specific application.

Several authors (Allmer, 1999; Gill & Deeter, 1988; Kellmann & Beckmann, 2003) call for the application of sport-specific measures in sport psychology. As known from investigations of clinical disorders such as the PTSD and phobia (e.g. Ehlers & Clark, 2000; Teachmen, Gregg & Woody, 2001), the precise formulation of stimulus material such as pictures, words and sentences may be a trigger to the elicitation of concept-relevant thoughts, feelings and bodily sensations. Within indirect measurement, the Brief-IAT (Sriram & Greenwald, 2009) highlights the significance of suitable precise stimulus material to display key aspects of a concept. The

development of a sport-specific IAT-A would be a consequence of these findings, especially if results of this work support this assumption.

3.1.2 Methods

3.1.2.1 Participants

N = 64 undergraduate students of sports science took part in the study. They had to sign in their name outside the laboratory door and thus, chose time and date of their participation by themselves. There were n = 29 male participants and n = 35 female participants. The mean age of the participants was M_{Age} = 23.67 years (SD = 2.74). The mean age of all males was $M_{AgeMales}$ = 24.93 years (SD = 3.29). The mean age of all females was $M_{AgeFemale}$ = 22.63 years (SD = 1.57). All participants indicated German being their mother tongue. A total of n = 5 participants was left-handed. 12.5% of the sport students considered themselves as elite athletes, 43.8% of the athletes considered themselves as "competition-oriented leisure time athlete" and as much as 43.8% reported themselves being leisure time athletes without competition participation. The athletes engaged in their sport for M = 10.74 years (SD = 5.27). About n = 30 athletes did not participate in any competitions; n = 33 athletes, however, have participated in competitions on a regular base. 71% of the participants considered themselves as being moderately to very experienced in taking part in competitions. While only n = 5 participants reported feeling not healthy, 59.4% of all participants felt stressed at that particular day instead of feeling rested (n = 26 participants). Data of n = 59 participants could be used properly for further analyses.

In line with the university's research guidelines, informed consent was obtained from the participants. For their participation, all students received sweets as reward and, additionally, credit points because taking part in studies is also part of their sport science lectures.

3.1.2.2 Instruments

3.1.2.2.1 Indirect measure

Implicit Association Test – Anxiety

At first, the Implicit Association Test - Anxiety (IAT-A, Egloff & Schmukle, 2002) was administered to the participants. It is an adapted form of the IAT for the measurement of personality traits such as self-consciousness and self-concept (Greenwald & Farnham, 2000). Positive and negative items are defined as attribute concepts in relation to the target concepts "self" and "others". The attribute concepts of the IAT-A are "calmness" (positive) and "anxiety" (negative) which are presented in combination with the target concepts "self" and "others". The categorisation consists of five blocks with two additional training blocks (block 3 and block 6). Participants are instructed to assign the words (stimuli) to the category on the left side or the right side of a computer screen via pressing the response key A (left) or L (right) as quickly as possible. Table 3.1.1 lists all items in the target and attribute concepts.

Table 3.1.1. *Items of the Target and Attribute Concepts in the General Implicit Association Test-Anxiety (Egloff & Schmukle, 2002).*

Category Label Items IAT-A			
Self/Others		Anxiety/Calmness	
Self	Others	Anxiety	Calmness
I	They	Nervous	Relaxed
Self	Them	Afraid	Balanced
My	Your	Anxious	At ease
Me	You	Fearful	Calm
Own	Others	Uncertain	Restful

In the first block, the target concept task is practiced. All participants have to sort stimuli items into the categories "self" and "others". In block 2, the assignment of stimuli to the attribute concepts "calmness"(right response key L) and "anxiety" (left

response key A) takes place, which is followed by a combined assignment of stimuli to the categories "self/anxiety" (left response key A) and "others/calmness" (right response key L) in block 3 (training block) and block 4 (test block). Block 5 is similar to block 2, however, the response keys for the attribute concepts are changed. In block 5, "anxiety" is on the right response key (L) and "calmness" on the left response key (A). In block 6 (training block) and block 7 (test block) a combined assignment of stimuli to the categories "self/calmness" (left response key A) and "others/anxiety" (right response key L) is presented. Figure 3.1.1 shows a schematic overview on all blocks and their content.

Sequence	Block 1	Block 2	Block 3 + 4	Block 5	Block 6 + 7
Task description	Initial target-concept discrimination	Associated attribute discrimination	Initial Combined Task	Reversed target-concept discrimination	Reversed combined task
Task Instruction	● Me Others ●	● Anxiety Calmness ●	● Me ● Anxiety Others ● Calmness ●	● Calmness Anxiety ●	● Me ● Calmness Others ● Anxiety ●
Sample Items	they ○ ○ self ○ my your ○	○ afraid ○ nervous relaxed ○ balanced ○	○ self they ○ ○ nervous relaxed ○	○ relaxed afraid ○ nervous ○ ○ balanced	○ self ○ relaxed they ○ nervous ○

Figure 3.1.1. Schematic description of the IAT-A (adapted from Egloff & Schmukle, 2002, p. 1443).

The application of the IAT-A lasts about 10 to 20 minutes, depending on the participants' sorting speed. Previously found Cronbach's Alpha reliabilities are between $\alpha = .77$ and $\alpha = .80$ (Egloff & Schmukle, 2002).

3.1.2.2.2 Direct measures

State-Trait-Anxiety Inventory

The State-Trait-Angst-Inventory - Trait (STAI-T, Laux et al., 1981) in the German version of the original English questionnaire by Spielberger et al. (1970) serves as

direct measure of anxiety as personality disposition. The general tendency for experiencing anxiety is determined by twenty items in adjective format. On a four-point Likert-scale (1 = "*almost never*" to 4 = "*almost always*"), participants have to indicate in what way the given items apply to them as true. Before calculating the total score from all items, the negative poled items are recoded. The total score serves as the estimation of the anxiety tendency in relation to norm samples. Internal stability is found with Cronbach's Alpha $\alpha = .90$ (Laux et al., 1981).

Competitive Anxiety Inventory

Another direct instrument presented to the participants was the Competitive Anxiety Inventory - Trait (WAI-T, German version, Wettkampfangst - Inventar, Brand et al., 2009). The WAI-T measures the general tendency to experience anxiety in relation to sport competitions. The WAI-T is based on the English Sport Anxiety Scale (SAS) by Smith et al. (1990). It was translated and evaluated for the application within the German language area (Brand et al., 2009). A somatic component is discriminated from a cognitive component of competitive anxiety (see Liebert & Morris, 1967). The final questionnaire consists of 12 items arranged on three different scales.

Scale 1 measures the somatic anxiety component (e.g. "Before a competition … my heart beats with excitement."). Physiological symptoms such as feeling the heartbeat and sickness in the stomach before or during a sport competition are assessed by four items. Scale 2 measures the cognitive component of competitive anxiety called "worry" by four items (e.g. "Before a competition … I am worried to choke under pressure."). For the German version, reliabilities are found with Cronbach's Alpha $\alpha = .88$ and $\alpha = .82$ for the scales "somatic anxiety" and "worry" (Brand & Graf, 2005). Scale 3 measures problems in concentration by four items (e.g. "Before a competition … I feel disturbed by heckling from the audience."). Because of low internal consistency of the concentration scale (Cronbach's Alpha $\alpha = .67$), only the scales "somatic anxiety" and "worry" are usually evaluated (Ehrlenspiel et al., 2011). In this study, the scale "concentration problems" was not included in the analysis. An

anxiety score for each scale is calculated by summing up all items of that particular scale.

Two additional items (item 13 and item 14) are not assigned to one of the three scales. They measure the direction of the anxiety experience which can be either debilitating or facilitating (Jones, 1995). Both items are usually analysed separately, however, not in this study because they were not of further relevance to the primary aim of the current validity study.

Sport Injury Anxiety Test

The Sport Injury Anxiety Test (SVAT, Kleinert, 2002a) was constructed in consideration of the Stress Injury Model by Andersen and Williams (1988). In addition to that, the concept of appraisal suggested by Smith (1996) was included. The concept proposes four types of appraisal: appraisal of situational demands, appraisal of resources to deal with the immediate situation, appraisal of the nature and likelihood of potential consequences and personal meanings attached to the consequences. Based on this theoretical framework, items presenting four factors have been considered: high situational demands, missing resources to deal with the immediate situation, high potential consequences and high personal meaning. Finally, three scales have been developed of these four factors. They measure the tendency of experiencing anxiety of injury in sport by 22 items.

Scale 1 refers to “low situational competency” (e.g. “I notice that I am not prepared physically well.”) and describes situations in which the athlete’s competencies are probably exceeded, either due to low internal coping resources or due to overly high situational demands. It shows a Cronbach’s alpha of α = .81. Scale 2 refers to “high situational importance” (e.g. “My performance is evaluated by others.”) and focuses on the importance of a situation, which is usually a combination of anticipated consequences and individual situational meaning. It shows an internal consistency of α = .79. Scale 3 determines “situational loss of control” and focuses on the experience of internal or external influenced controllability of the given situation (e.g. “I am dependent on a partner.”) with a Cronbach’s Alpha of α = .72. These

values are rated as acceptable (Kleinert, 2002a). All participants are instructed to answer the items as quickly and as precise as possible on a 6-point Likert scale ranging from 0 = "*no concern at all*" to 5 = "*very strong concern*". All items of each scale are summed up to calculate the final scale score.

Balanced Inventory of Desired Responding

The measurement of the influence of self-deception and impression management as subtypes of social desirability in the athletes' responding was carried out by the German version (Musch et al., 2002) of the Balanced Inventory of Desired Responding (BIDR, Paulhus, 1984). This inventory is based on the 2-factor model of self-deception and impression management by Paulhus (1984). Paulhus (1984) suggests that individuals do not only deceive others in self-reports to appear more attractive (*impression management*), but they also deceive themselves, consciously or unconsciously, to protect parts of their own ego (*self-deception*). Both constructs, self-deception and impression management respectively, are arranged in two scales in the questionnaire, represented by positively and negatively poled items. The scale "self-deception" consists of 10 items (e.g. "I am an absolutely rational thinking individual."); the scale "impression management" consists of 10 Items as well (e.g. "It has already happened, that I exploited somebody."). Items of the German version differ from the English original version. Participants have to indicate on a scale ranging from 1 = "*total rejection*" to 7 = "*total acceptance*" for each item ihow they approve or disapprove the statement. A total of 13 items are recoded before the analysis. All items for each scale are summed up for the calculation of the total scale score (Musch et al., 2002). The internal consistency (Cronbach's Alpha) for the scale "self-deception" is found between α = .61 and α = .66 (Musch et al., 2002). The internal consistency (Cronbach's Alpha) for the scale "impression management" is found between α = .66 and α = .69 (Musch et al., 2002).

3.1.2.3 Demographic Information

Besides age and gender, it was necessary to control possible physiological and psychological influencing parameters. Thus, native language, hand dominance, pre-experience with reaction time experiments and coordinative hobbies, such as playing the piano, were assessed as well. Additionally, participants were asked to answer questions regarding their main sport (kind of sport, duration), the frequency of training and competition, their experience in competitions, squad status, current injuries, current psychic or somatic sickness, daily hassles and status of current fatigue.

3.1.2.4 Procedure

Before the beginning of the study, all participants received an information about the upcoming reaction time experiment and the anonymity of their personal data. They were left unaware about the anxiety context for not being biased. Instead, they were informed that they will do a categorization task by assigning stimuli words to two categories as fast as possible (see Appendix). Afterwards, the Implicit Association Test - Anxiety (IAT-A, Egloff & Schmukle, 2002) was presented. Before each block, an extra sheet with a short introduction to the upcoming task was presented on the screen. During the blocks, all participants were able to ask questions and inform the investigator about possible problems with the presentation.

After having finished the IAT-A, all participants answered the self-report questionnaires containing demographic information, the State-Trait-Anxiety Inventory in its trait-version (STAI-T, Laux et al., 1981), the Competitive Anxiety Inventory (Wettkampfangst-Inventar - Trait, WAI-T, Brand et al., 2009), the Sport Injury Anxiety Inventory (SVAT, Kleinert, 2002a) and the German version of the BIDR (Musch, 2002). They were allowed as much as time as they needed for answering the questionnaires.

Finally, they received a sheet of information on the real purpose of the study (*debriefing*). The investigator answered all questions. Participants were asked to

hand in their approval on the usage of all their data. All participants agreed on the appropriation of their data. Afterwards, all participants were thanked, and they received their reward.

3.1.2.5 Data Reduction

The IAT data were treated according to the procedure of the new scoring algorithm reported by Greenwald, Nosek and Banaji (2003). The steps applied for data reduction are listed in detail in Table 3.1.2 below.

Table 3.1.2. *Improved Scoring Algorithm according to Greenwald, Nosek & Banaji (2003, p. 214)*.

Step	Improved Algorithm
1	Use data from B3, B4, B6 and B7
2	Eliminate trials with latencies > 10,000 ms; eliminate subjects whom more than 10% of trials have latency less than 300 ms
3	Use all trials
4	No extreme-value treatment (beyond Step 2)
5	Compute mean of correct latencies for each block
6	Compute one pooled SD for all trials in B3 & B6; another for B4 & B7
7	Replace each error latency with block mean (computed in Step 5) + 600 ms
8	No log transformation
9	Average the resulting values for each of the four blocks
10	Compute two differences: B6 – B3 and B7 – B4
11	Divide each difference from its associated pooled-trials SD from Step 6
12	Average the two quotients from Step 11

3.1.3 Results

3.1.3.1 Descriptive Statistics

3.1.3.1.1 Indirect Measure

General Anxiety

The IAT-Anxiety shows an average value of D = - .23 (SD = .26). The Kolmogorov-Smirnoff Test tests the response latencies for normal distribution. Kolmogorov-Smirnoff's Z is .65; thus, it is not significant ($p > .05$). A normal distribution of IAT-A response latencies can be assumed. Additionally, skewness and kurtosis were tested. Skewness shows a value of -.05 (SE = .31); kurtosis shows a value of -.72 (SE = .61).

Subsequently, mean values and standard deviations of response reaction times of all blocks were calculated. Paired student t-Tests to test mean value differences between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) were administered. For both, the practice blocks 3 and 6 ($t(58) = 4.38, p < .01$) and the test blocks 4 and 7 ($t(58) = 7.21, p < .01$) mean value differences are significant (Figure 3.1.2). Table 3.1.3 shows all mean values and standard deviations for their respective blocks.

Table 3.1.3. *Mean Values and Standard Deviations for the Blocks 3 and 6 and the Blocks 4 and 7 (N = 59).*

	Descriptives	
Blocks	M	SD
Mean Block 3	761.00	133.09
Mean Block 4	736.67	114.93
Mean Block 6	716.18	123.68
Mean Block 7	674.18	113.54

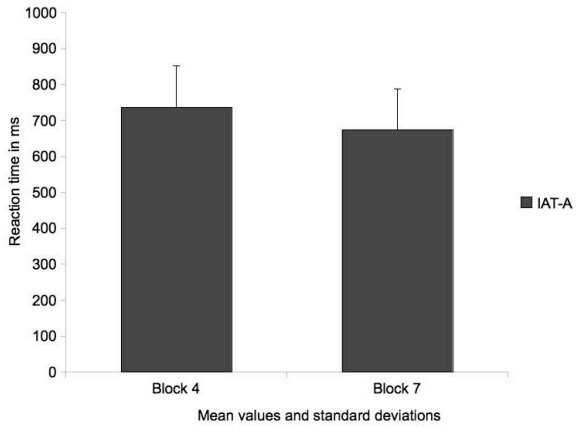

Figure 3.1.2. Significant differences between the test blocks 4 and 7 of the IAT-A.

Internal Consistency

Internal consistency was analysed according to the procedure reported by Egloff and Schmukle (2002; see Bosson et al., 2000). In this procedure, Cronbach's Alpha is conducted as a difference measure of each trial's response latency of the blocks 7 minus the corresponding trial's response latency in Block 4. Cronbach's Alpha is .78 for the IAT-A in the current sample.

Accuracy

For an analysis of learning behaviour, a mean score for each block's missing scores was computed. Within the ACCs (each presented stimulus in the block), a value of either 1 = *passed* or 0 = *missed* was possible. Thus, the mean score provides information about the accuracy of each individual within the blocks, and thus, the learning behaviour. An increase in accuracy is found by the proximity of the mean scores towards 1 (Figure 3.1.3). Table 3.1.4 lists all means and standard deviations. There are significant differences between Block 1 and Block 2 ($t(58) = 3.179, p < .01$) and between Block 2 and Block 7 ($t(58) = - 4.047, p < .01$).

Table 3.1.4. *Mean Values and Standard Deviations for all Blocks regarding Accuracy Values (N = 59).*

	Descriptives	
Blocks	M	SD
Mean Block 1	0.95	0.04
Mean Block 2	0.92	0.07
Mean Block 3	0.92	0.08
Mean Block 4	0.93	0.05
Mean Block 5	0.94	0.06
Mean Block 6	0.95	0.06
Mean Block 7	0.96	0.03

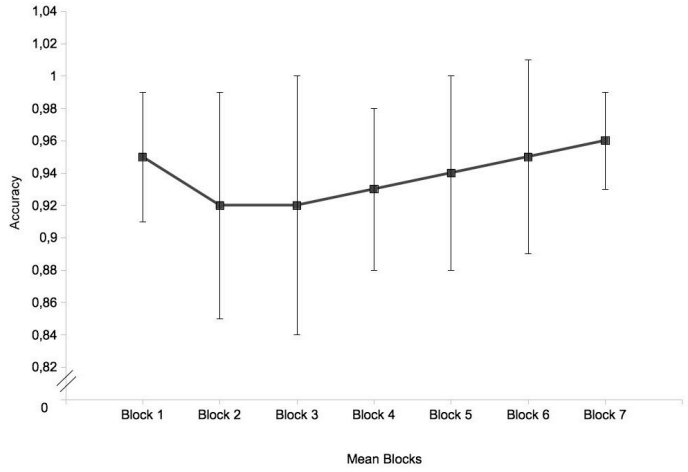

Figure 3.1.3. Average course of the learning behaviour in the IAT-A.

3.1.3.1.2 Direct Measures

General Anxiety

A total of 62 participants completed the State Trait Anxiety Inventory - Trait (STAI-T). Two participants had to be excluded from the analyses due to missing data. Reliability of the STAI-T shows a Cronbach's Alpha of $\alpha = .92$.

Competitive Anxiety

The Competitive Anxiety Scale - Trait was completed by $N = 63$ individuals. One person was excluded from the analyses due to incomplete data (1.6 %). Reliabilities for the scales are as follows: “somatic anxiety” - Cronbach’s Alpha is $\alpha = .82$, “worry” - Cronbach’s Alpha is $\alpha = .83$ and “concentration problems” - Cronbach’s Alpha is $\alpha = .72$. Due to its rather low reliability compared to the other scales, the scale “concentration problems” was excluded from further analyses.

Sport Injury Anxiety

The Sport Injury Anxiety Scale was completed by a total of $N = 63$ participants. One participant was excluded from further analyses due to missing data (1.6 %). Cronbach’s Alpha for all scales is rather low compared to the other instruments: $\alpha = .76$ for “low situational competency”, $\alpha = .76$ for “high situational importance” and $\alpha = .60$ for “situational loss of control”.

Self-Deception and Impression Management BIDR

The German version of the Balanced Inventory of Desirable Responding (BIDR, Paulhus, 1994; Musch et al., 2002) was completed by a total of $N = 64$ participants. All participants were included in further analyses. For the scale “self-deception”, Cronbach’s Alpha is $\alpha = .68$; for the scale „impression management“, Cronbach’s Alpha is $\alpha = .70$.

3.1.3.2 Convergent validity

A significant positive correlation is found between the direct measures of trait-anxiety and the competitive anxiety scale "worry" ($r_{STAI - worry} = .64, p < .001$).

Significant positive correlations are found between the direct measures of trait-anxiety and the sport injury anxiety scale "low situational competency LSC" ($r_{STAI - LSC} = .30, p < .05$), and between trait-anxiety and the sport injury anxiety scale "situational loss of control SLC" ($r_{STAI - SLC} = .36, p < .01$).

Within the direct specific measures, a significant positive correlation is found between the competitive anxiety scales "worry" and "somatic anxiety" ($r_{worry - somatic} = .37, p < .01$). For the sport injury anxiety scales, a significant positive correlation is found between "low situational competency" and "high situational importance" ($r_{LSC - HSI} = .47, p < .001$), between "low situational competency" and "situational loss of control" ($r_{LSC - SLC} = .70, p < .001$), and between "situational loss of control" and "high situational importance" ($r_{SLC - HSI} = .54, p < .001$). All correlations are presented in Table 3.1.5.

Table 3.1.5. *Correlation between the Indirect and Direct Measures (N = 59).*

	IAT-A	STAI	Somatic Anxiety	Worry	LSC	HSI	SLC
IAT-A	--	0.07	- 0.07	0.01	- 0.03	0.004	- 0.05
STAI	--	--	0.16	0.64**	0.30*	0.12	0.36*
Somatic Anxiety	--	--	--	0.37**	0.31*	0.47**	0.25
Worry	--	--	--	--	0.53**	0.37**	0.47**
LSC	--	--	--	--	--	0.47**	0.70**
HSI	--	--	--	--	--	--	0.54**
SLC	--	--	--	--	--	--	–

Note: * $p \leq .05$; ** $p \leq .01$

3.1.3.3 Discriminant validity

Furthermore, discriminant validity between indirect and direct measures was tested by correlations between the IAT effect *D* and the respective direct anxiety measures, trait-anxiety, competitive anxiety and sport injury anxiety. No significant correlation is found between the direct measures and the indirect IAT effect *D*.

3.1.3.4 Self-deception and impression management as moderator variable

The correlational analyses between the direct anxiety measures and the BIDR scales show a significant negative correlation between trait-anxiety and self-deception ($r_{STAI - SD}$ = -.59, p < .01). A significant negative correlation is found between self-deception and the WAI-T scale "worry" ($r_{worry - SD}$ = -.52, p < .01). Significant negative correlations show between self-deception and the sport injury anxiety scales "low situational competency" ($r_{LSC - SD}$ = -.47, p < .01) and "situational loss of control" ($r_{SLC - SD}$ = -.52, p < .01).

The correlational analyses between the indirect anxiety measure IAT-A and the BIDR scales are not significant for both scales, self-deception and impression management.

Because of the correlation found between the self-deception measure and the direct measures, partial analyses have been conducted to further examine the relation between direct and indirect measures under the control of self-deception. Results are not significant for all measures.

3.1.3.5 Known-group effects and relation to demographic variables

To learn about the impact of demographic variables on the IAT effect and thus, attain more information about the nature of the associations of the IAT-A with sport-related variables, several univariate variance analyses and correlational analyses have been

conducted. For comparison, the same variables have been analysed with focus on the direct anxiety measures.

Gender

An univariate variance analysis does not show any significant difference in the IAT effect between men and women ($F(1,59) = 1.406$).

Table 3.1.6. *Mean Values and Standard Deviations of Variance Analysis on the Factor "Gender".*

		Gender	
		Males	Females
IAT *n* = 26 Males *n* = 33 Females	IAT effect	- 0.18 (± 0.27)	- 0.27 (± 0.25)
STAI *n* = 29 Males *n* = 35 Females	STAI-T	39.62 (± 11.38)	39.63 (± 7.68)
WAI-T *n* = 29 Males *n* = 34 Females	Somatic Anxiety *	9.52 (± 2.40)	11.09 (± 3.00)
	Worry	9.14 (± 3.10)	10.00 (± 2.61)
SVAT *n* = 29 Males *n* = 34 Females	SLC	2.07 (± 0.86)	2.21(± 0.78)
	HSI	1.69 (± 0.97)	1.80 (± 0.79)
	LSC	2.45 (± 0.90)	2.73 (± 0.70)

Note: * $p \leq .05$

No significant difference in the trait-anxiety score between men and women is found ($F(1,64) = 0.000$) as well as for all scales of sport injury anxiety ($F_{SLC}(1,63) = 0.500$; $F_{HSI}(1,63) = 0.241$; $F_{LSC}(1,63) = 1.885$). However, regarding somatic anxiety, a significant effect between men and women is found ($F(1,63) = 5.145$, $p < .05$, $\eta^2 = .08$). Regarding worry on the WAI-T scale, there is not found any significant difference between men and women ($F(1,63) = 1.438$). Mean scores and standard deviations regarding the scale "somatic anxiety" can be found in Table 3.1.6.

Level of sport

The level of sport was assessed via a 4-point-scale with 1 = "*competition sport*", 2 = "*competition-oriented leisure time sport*", 3 = "*leisure time sport*" and 4 = "*health sport*". For group analysis, a new variable was constructed integrating level 1 and level 2 (*competition-oriented*) as well as level 3 and level 4 (*not competition-oriented*). An univariate variance analysis does not show any significant group difference in the IAT effect regarding the participation in competitions ($F(1,59) = 0.145$). Regarding the direct measures, significant differences between the groups are found for somatic anxiety ($F(1,63) = 5.486$, $p < .05$, $\eta^2 = .08$), LSC ($F(1,63) = 6.416$, $p < .05$, $\eta^2 = .10$) and SLC($F(1,63) = 4.350$, $p < .05$, $\eta^2 = .07$). Trait-anxiety ($F(1,64) = 0.795$), worry ($F(1,63) = 2.871$) and HSI ($F(1,63) = 0.419$) show to be not significant. Mean scores and standard deviations can be found in Table 3.1.7.

Team versus Individual Sport

An univariate variance analysis between athletes who engage in team sports ($n = 32$) and those who engage in individual sports ($n = 27$) does not show any significant differences regarding their IAT effect ($F(1,59) = 0.40$). For all direct measures, no significant difference between team and individual athletes is found (STAI ($F(1,64) = 0.334$), somatic anxiety ($F(1,63) = 0.764$), worry ($F(1,63) = 0.010$), LSC ($F(1,63) = 0.377$), HSI ($F(1,63) = 0.810$), SLC ($F(1,63) = 0.529$). Mean scores and standard deviations can be found in Table 3.1.8.

Table 3.1.7. *Mean Values and Standard Deviations of Variance Analysis on the Factor "Level of Sport".*

		Level of sport	
		Group 1 "competition-oriented"	Group 2 "not competition-oriented"
IAT *n* = 31 Group 1 *n* = 28 Group 2	IAT-effect	- 0.22 (± 0.27)	- 0.24 (± 0.25)
STAI *n* = 36 Group 1 *n* = 28 Group 2	STAI-T	38.69 (± 8.94)	40.82 (± 10.11)
WAI-T *n* = 36 Group 1 *n* = 27 Group 2	Somatic Anxiety *	9.67 (± 2.81)	11.30 (± 2.61)
	Worry	9.08 (± 2.66)	10.30 (± 3.01)
SVAT *n* = 36 Group 1 *n* = 27 Group 2	SLC *	1.96 (± 0.84)	2.39 (± 0.72)
	HSI	1.69 (± 0.89)	1.83 (± 0.85)
	LSC *	2.39 (± 0.85)	2.89 (± 0.65)

Note: * $p \leq .05$

Table 3.1.8. *Mean Values and Standard Deviations of the Variance Analysis on the Factor "Team- vs. Individual Sport".*

		Team vs. Individual Sport	
		Group 1 "Individual Sport"	Group 2 "Team Sport"
IAT *n* = 27 Group 1 *n* = 32 Group 2	IAT-effect	- 0.24 (± 0.29)	- 0.22 (± 0.23)
STAI *n* = 29 Group 1 *n* = 35 Group 2	STAI-T	40.38 (± 9.49)	39.00 (± 9.52)
WAI-T *n* = 28 Group 1 *n* = 35 Group 2	Somatic Anxiety	10.71 (± 3.07)	10.09 (± 2.64)
	Worry	9.64 (± 3.09)	9.57 (± 2.69)
SVAT *n* = 28 Group 1 *n* = 35 Group 2	SLC	2.06 (± 0.78)	2.11 (± 0.84)
	HSI	1.64 (± 0.81)	1.84 (± 0.92)
	LSC	2.53 (± 0.77)	2.66 (± 0.84)

Competition participation

An univariate variance analysis does not show any significant difference in the indirect anxiety measure between individuals who participate in competitions and those who do not participate in competitions ($F(1,58) = 1.243$). Within the direct measures, only "somatic anxiety" shows a significant difference between the groups ($F(1,63) = 7.095$, $p = .01$, $\eta^2 = .11$). The SVAT scale "low situational competency" shows a marginally significant group difference ($F(1,63) = 3.097$, $p = .08$, $\eta^2 = .49$). All remaining explicitly represented personality variables do not show any significant group results regarding the impact of competition participation (F_{STAI}

(1,63) = 0.054; F_{worry} (1,63) = 1.253; F_{HSI} (1,63) = 1.033; F_{SLC} (1,63) = 1.611). Mean scores and standard deviations can be found in Table 3.1.9.

Table 3.1.9. *Mean Values and Standard Deviations of the Variance Analysis regarding the Factor "Competition Participation".*

		Competition Participation	
		Group 1 "No Competitions"	Group 2 "Competitions"
IAT *n* = 29 Group 1 *n* = 29 Group 2	IAT-effect	- 0.27 (± 0.25)	- 0.20 (± 0.26)
STAI *n* = 30 Group 1 *n* = 33 Group 2	STAI-T	39.57 (± 8.76)	40.12 (± 9.98)
WAI-T *n* = 29 Group 1 *n* = 33 Group 2	Somatic Anxiety *	11.38 (± 2.78)	9.55 (± 2.64)
	Worry	10.10 (± 2.62)	9.30 (± 2.96)
SVAT *n* = 29 Group 1 *n* = 33 Group 2	SLC	2.30 (± 0.71)	2.05 (± 0.87)
	HSI	1.89 (± 0.75)	1.67 (± 0.93)
	LSC	2.81 (± 0.60)	2.46 (± 0.91)

Note: * $p \leq .05$

Severity of injuries and duration of rehabilitation

To attain information about the relation between indirectly measured anxiety and the injuries athletes suffered from in the past, the first injury reported in the questionnaire was considered for further analysis. Especially, duration of rehabilitation and severity, which the athletes put on that injury, were of relevance. A

correlation between duration of rehabilitation and the IAT effect is marginally significant ($r_{DR - IAT}$ = .246, p = .08). No significant correlation is found between duration of rehabilitation and direct anxiety measures ($r_{DR - STAI}$ = .163, $p > .05$; $r_{DR - somatic}$ = -.033, $p > .05$; $r_{DR - worry}$ = -.010, $p > .05$; $r_{DR - LSC}$ = -.219, $p > .05$; $r_{DR - HSI}$ = -.181, $p > .05$; $r_{DR - SLC}$ = -.172, $p > .05$). A correlation between severity of injury and the IAT effect shows no significance ($r_{SI - IAT}$ = .041, $p > .05$). Within the direct measures, severity of injury relates to no anxiety measures ($r_{SI - STAI}$ = -.119, $p > .05$; $r_{SI - somatic}$ = -.083, $p > .05$, $r_{SI - worry}$ = -.172, $p > .05$; $r_{SI - LSC}$ = -.119, $p > .05$; $r_{SI - HSI}$ = -.167, $p > .05$; $r_{SI - SLC}$ = -.094, $p > .05$). Mean values and standard deviations of the factors "duration of rehabilitation" and "severity of injury" are found in Table 3.1.10.

Table 3.1.10. *Mean Values and Standard Deviations of the Factors "Duration of Rehabilitation" and "Severity of Injury".*

	Descriptives		
	N	*M*	*SD*
Duration of Rehabilitation (in weeks)	54	14.77	24.49
Severity of Injury	55	2.67	1.12

3.1.4 Discussion

Indirect measurement provides the opportunity to gain insights into the activation of associative networks in the context of anxiety (Egloff & Schmukle, 2002). However, in current sport psychological research, sport-specific anxiety has not yet been in the focus of indirect measurement.

The study focused on several explorative questions. First, this study tries to replicate results of Egloff and Schmukle (2002). Therefore, the IAT-Anxiety (IAT-A, Egloff & Schmukle, 2002) was administered to a sample of sport students along with general anxiety self-report questionnaires and a scale measuring self-deception and impression management as subscales of social desirability (see Egloff, 2008, on

measurement problems of self-reports). Second, practicality of indirect measurement procedures on a sport-specific domain was investigated. Therefore, the relation between the indirect measure and direct sport-specific self-report measures was examined (Hofmann et al., 2005, Gschwender et al., 2008). Egloff and Schmukle (2002) point out, that anxiety, too, is subjected to introspective limits and response factors in self-reports which is typically displayed by discrepancies between subjective self-report responses and objective responses in behaviour and physiology in personality research. Thus, the additional assessment of self-deception and impression management might help overcoming these disadvantages of direct measures. A third question, therefore, focused on the role of social desirability as moderator in the relation between indirect and direct measures.

Psychometric properties of the direct and the indirect measures

First, results show good internal consistency for the IAT-A in a sport context. These results are consistent with original studies by Egloff and Schmukle (2002) and various other indirect response latency-based measures (e.g. Bosson et al., 2000; Nosek & Banaji, 2001; Schmukle, 2005). Moreover, the IAT-A shows a normal distribution of response latencies.

The IAT effect and significant differences between the practice and test blocks showed expected psychometric results in the application of a general indirect anxiety measure. Results showed significant slower reaction times in the first target combination blocks 3 and 4 than in the reversed target blocks 6 and 7. In this sample, it means that the combination of stimuli “self/anxiety” and “others/calmness” were less represented than the combination of stimuli “others/anxiety” and “self/calmness”. Hence, the activated association of “others/anxiety” and “self/calmness” was stronger and led to faster response reaction times on the presented stimulus words of the relevant category. Consequently, individuals in this sample seem to experience themselves as being more calm than anxious in situations of potential threat.

Considering these results on accuracy values, a significance between the reaction times resulting from a learning effect can be excluded. No significant differences were found between accuracy values of the critical blocks. A significant increase in learning was found at the beginning of the IAT procedure between the first two blocks and in regard to blocks 2 and 7, only. However, no increase was found between the critical blocks 3 and 6 or 4 and 7.

Acceptable, but partially low internal consistencies were found for the direct measures, especially for the self-report measure of sport injury anxiety (compare to: Kleinert, 2002a) and for the competitive anxiety scale "concentration problems". Results of the sport injury anxiety questionnaire will be discussed, considering this aberration. In the case of the competitive anxiety scale, data were analysed only for the scales "somatic anxiety" and "worry" because of low internal consistency values on the scale "concentration problems" (e.g. Ehrlenspiel et al., 2011; Strahler et al., 2011). This focus is supported by Schwenkmezger (1985), who suggests to measure trait-anxiety as a multidimensional construct, primarily by somatic anxiety (*arousal*) and cognitive anxiety (*worry*) (see also Ehrlenspiel et al., 2011).

Construct validity and intercorrelations

Another main research question referred to convergent and discriminant validity as part of the construct validity (Campbell & Fiske, 1959). As expected, values of the self-report instruments of anxiety correlated significantly. Moreover, direct measure scales intercorrelated significantly, too. These results refer to a high convergent validity.

No significant correlation, however, was found between the indirect IAT-A and the direct measures on self-reported trait-anxiety, competitive anxiety and sport injury anxiety. Even though similar constructs were measured in the study, the different methodical aspects of indirect versus direct measurement might seem to prevent a clear correlation (see also Nosek et al., 2011). Hofmann, Gawronski, Gschwender, Le and Schmitt (2005a) found positive, but only low significant correlations between indirect (IAT) and direct (self-report) measures. However, in the present study no

significant correlation was found between self-reported general anxiety and indirect IAT-A. This result is consistent with the one reported by Egloff and Schmukle (2002, p. 1445), who also found no significant correlation between direct and indirect anxiety measures ($r = .24$, $p = .14$). Nosek et al. (2011) point out the possibility that a missing correlation between indirect and direct measures relate to "... different construct-irrelevant influences producing measurement errors ..." (Nosek et al., 2011, p. 4). Regarding this aspect of construct validity, Gschwendner et al. (2006) propose a process model, which postulates boundary conditions for the correlation between indirect and direct instruments (see also chapter 2.4.3 of this work). They assume that indirectly measured implicit data might be stored in associative representations (in accordance with Greenwald & Banaji, 1995), whereas directly measured explicit data might be stored in propositional representations (in accordance with Gawronski, Strack & Bodenhausen, 2009). This suggestion corresponds with classical dual-process models presented in chapter 2.4 of this work. Therefore, Gschwendner et al. (2006) note that a correlation between the IAT and self-report questionnaires should be the product of the *translation* of associatively stored representations into propositionally formatted data. Here, moderator variables might exert their influence. Moreover, additional information might influence this translational process (e.g. from the autobiographical memory). According to Gschwendner et al. (2006), the higher the impact of additional information, the lower the correlation between indirect and direct measures. Finally, as soon as a translational process is finished and a propositional format is available, an *acclimatisation* in accordance with context might take place. In addition, Gschwendner et al. (2006) note that associative representations have to be *activated* to be translated into data which can be measured by reaction-time instruments. An activation, however, is also influenced by various moderators, for example cognitive resources, priming and recency effects. Last but not least, Gschwendner et al. (2006) also point to the importance of methodically and test-conducted moderators, specificity similarity and content similarity (Gschwendner, Hofmann & Schmitt, 2008) in influencing relations between direct and indirect measures. Thus, regarding missing significant correlations between IAT-A and self-reported anxiety measures, the model presented by Gschwendner et al. (2006) gives a rather plausible explanation: the sample of this study consists of sport

students participating in the study between their lessons at the end of the semester. It is possible that a lot more moderators influenced their performance than those which have been controlled by the design of the study. To overcome the influence of methodical moderators, Rothermund and Wentura (2004; Rothermund et al., 2005) recommend the application of control-IATs. Thus, this application will be in the focus of chapter 3.3 of this work.

Social desirability

Another possible moderator variable proposed by Egloff and Schmukle (2002) is social desirability. In this study, the German version of the two-dimensional BIDR (Musch et al., 2002) was applied to the sample. Results showed, despite rather moderate to low reliability (see comment on divergent reliabilities of the BIDR in Steenkamp, de Jong & Baumgartner, 2010), significant negative correlations between the scale "self-deception" and trait-anxiety (STAI), worry (WAI-T), situational loss of control and low situational competence (SVAT). No significant correlation was found for the IAT-A and the BIDR-scales. The scale "impression management" and all direct and indirect measures did not show any significant correlation. This result corresponds to Egloff and Schmukle (2002, 2003) and confirms their results, in which social desirability does not act as a significant moderator to the IAT-A.

Results of this study, however, implicate that social desirability instead seems to have a moderate relation to self-reported anxiety level. Higher self-deceptive enhancement scores correlated with a lower anxiety score. It is possible that this is kind of a defence mechanism in athletes (Freud, 1984). Paulhus (1984) points out that there are individuals who show a high defensiveness towards threatening suggestions. In this study, competitive anxiety and sport injury anxiety seem to act as threatening constructs for athletes who are active in a sport system requiring peak performance (Jones et al., 1994). As such, higher values of self-deception in correspondence with lower values of self-reported anxiety seem rather plausible.

Known-group effects and relations between the measures and sport-relevant variables

Another main aspect of the study was the differentiating potential of the direct instruments but also especially the indirect instrument in known groups (known-group effects, see for example Hattie & Cooksey, 1984; Banse et al., 2001; DasGupta & Greenwald, 2001; Brand et al., 2011; Nosek et al., 2014). First of all, results showed significant differences between males and females on the competitive anxiety scale "somatic anxiety", only. In accordance with results found in previous studies (for example, Martens et al., 1990; Krane & Williams, 1994; Mellalieu, Hanton & Fletcher, 2006), females show higher values of dispositional somatic anxiety than males. In regard to the other direct measures and the IAT, gender did not seem to play a significant role.

A similar result was found regarding the level of sport. Results did not show any significant difference in the IAT effect between individuals who take part in competition-oriented sport compared to individuals taking part in leisure-time sport. A significant difference between the groups was found regarding the scales "somatic anxiety", "low situational competence" and "situational loss of control". Here, as expected, individuals performing sport at a leisure-time level showed higher anxiety values compared to individuals performing sport at a competition-oriented level. Unfortunately, this study does not explore whether there are peak performance dropouts among those individuals who perform at a leisure time level. It might be possible that the higher scores on the scales reported above might have been one of the reasons of having dropped out from a competition-oriented sport level.

Additionally, these results correspond to the influence of competition participation. Here, individuals who do not regularly take part in competitions showed significantly higher scores of somatic anxiety than those who usually take part in competitions. A corresponding marginal significance was also found on the scale "low situational competence". This result once more begs the question as to whether dropouts might be influenced sustainably by anxiety values, especially competitive anxiety and sport injury anxiety (see Martens, 1977; Robinson & Carron, 1982; Choi, Johnson & Kim, 2014; Crane & Temple, 2015).

An interesting, although only marginally significant effect was found for the duration of rehabilitation and the IAT effect. A correlation between the length of rehabilitation and the response reaction time in the IAT-A showed a marginally positive relationship with a .08 significant level. This means, the more positive the IAT effect, the longer the duration of rehabilitation after the first reported injury. To be more concrete, a positive IAT score correlates with higher reaction times (individuals being slower) in the reverse-combined block 7 (self/calmness and others/anxiety) than in the combined block 4 (self/anxiety and others/calmness). Being slower in block 7 means that this specific combination of an implicit association is less represented in the individuals. Thus, being slower in the reaction time of this block (which means, having difficulties associating calmness with oneself) corresponds to individuals having experienced a longer duration of rehabilitation following their first injury. Participants tended to react faster to stimulus words corresponding to anxiety in relation to the self.

Conclusion

The mixed results of the known-group effects on the IAT-A score are unsatisfying and beg the question as to whether a general anxiety inventory, such as the IAT-A, is suitable for the investigation of sport-specific anxiety. In the field of personality and clinical psychology, specific IATs have been constructed for several specific types of anxiety, for example regarding spider phobia and speech phobia (Teachmen et al., 2001, Gschwendner et al., 2008). In sport psychology, a lack of sport-specific IATs is evident. Several sport psychologists, however, highlight the importance of sport-specific instruments for obtaining a valid picture of specific sport topics (Allmer, 1999; Gill & Deeter, 1988; Kellmann & Beckmann, 2003). Studies on the Brief-IAT (Sriram & Greenwald, 2009) underline the importance of specific stimulus material for the activation of the relevant associative network. As sport-specific anxiety takes place in a specific context under special conditions (competitions or the experience of injuries) it seems essential to find sport anxiety-relevant stimulus material for a validated investigation of competitive anxiety and sport injury anxiety by the indirect measure of the IAT. The following study attempts to close this research gap and sets

the goal to construct two implicit association tests for a first indirect investigation of competitive anxiety and sport injury anxiety.

3.2 Sport-specific indirect measurement: development and psychometric properties of two sport-specific Implicit Association Tests

3.2.1 Theoretical Background

In the first study, the IAT-Anxiety (IAT-A) by Egloff and Schmukle (2002), and German versions of the State-Trait Anxiety Inventory (STAI, Laux et al., 1981), the Competitive Anxiety Inventory (WAI-T, Brand et al., 2009) and the Sport Injury Anxiety Test (SVAT, Kleinert, 2002a) were applied to a sample of active sport students. Consistent with previous studies (Egloff & Schmukle, 2002; Gschwendner et al., 2006; 2008), results have shown acceptable reliability and construct validity. As expected, no significant correlation was found between the direct measures and the indirect measure IAT-A, whereas the inter-correlation between the direct measures of trait-anxiety, competitive anxiety and sport injury anxiety were significant. This result corresponds to dual-process theories, which support the idea of indirect measurement because of different modes of activation and information processing (automatic versus reflective, Strack & Deutsch, 2004; see chapter 2.4.1 of this work) and information storage (Gschwendner et al.; 2006; see chapter 2.4.3 of this work).

Additionally, social desirability was shown to have a significant impact in relation to direct measures of trait-anxiety, competitive anxiety and sport injury anxiety. Especially, regarding cognitive anxiety (here: worry), the appraisal of one's own competence and experienced options on controllability of the situation were related to self-deception. These results correspond to Egloff (2008), who points out that faking, social desirability and a lack of introspection tend to bias responses of direct measures in personality psychology. Indirect measurement is supposed to overcome these methodical problems and tends to be an option also in the measurement of sport-specific anxiety.

Several demographic variables for the evaluation of known-group effects have been investigated. With the exception of somatic anxiety, which is higher in female

athletes than in men, and injury duration, which is marginally related to the IAT effect, all other constructs showed neither significant differences between the chosen groups nor significant correlational results. A proper differentiation between known-groups, however, would underline methodical adequacy. Therefore, the stimulus material has shown to be most important to trigger the relevant sport-specific networks, which store the implicitly represented associations on competitive anxiety and sport injury anxiety (Sriram & Greenwald, 2009, Ehlers & Clark, 2000).

Due to satisfying reliability and validity values in diagnostic instruments, Krohne (1996) has already pointed out the importance of construct-specific diagnostic instruments (see also Allmer, 1999; Gill & Deeter, 1988; Kellmann & Beckmann, 2003). Additionally, Krohne and Hock (2007) note that higher instrument specificity might lead to increased validity and thus, more concrete diagnostic results. In sport psychology, however, sport-specific direct instruments such as self-report questionnaires, structured interviews or half-structured interviews are commonly used. Sport-specific indirect measures have been implemented in research on doping attitudes (e.g. Brand et al., 2011) and group affinity (Ohlert & Kleinert, 2009). Especially regarding doping research, the IAT offers the possibility of a less biased investigation methodically, in a sensitive sport context. In their evaluation of personality disposition anxiety, Egloff and Schmukle (2002) showed the importance of indirect measurement also for the field of personality psychology. Research on the experience of anxiety in sport as a less helpful self-worth emotion can also be debilitative to sport performance (Spielberger, 1966; Jones et al., 1994). Further, a sport-specific indirect instrument, which is focused on the investigation of anxiety-related implicit associative networks and information processing of sport anxiety-relevant stimuli, has not been developed yet.

The second study thus attempts to close this gap in the research. Two sport-specific IATs containing sport anxiety-relevant stimulus material will be developed and applied to a sample of active and inactive athletes in a neutral situation; that is, a laboratory situation in the university. Thus, no external anxiety-relevant cues will be present to influence the procedure.

The first study applied a general IAT on anxiety in athletes (IAT-A; Egloff & Schmukle, 2002). The second study focuses on sport-specificity of affective implicit associations. Hence, two new IATs will be developed including both competitive anxiety and sport injury anxiety as sport-specific anxiety dispositions. Both tests will be described in detail, but will be presented separately in their development, results and discussion. Psychometric properties will be reported for both IATs. Thus, a thorough evaluation of reliability and validity values will be possible. An increase in construct validity is expected due to the applied sport-specific stimulus material. In accordance with the first study, direct measures of trait-anxiety, competitive anxiety and sport injury anxiety will be applied to the sample along with the indirect measures. Additionally, possible known-group effects will be tested again by the analysis of demographic variables which have already been described in the first study.

In the following section, the methodical aspects of the second study will be presented in detail. At first, the sample will be described. Subsequently, the development of the sport-specific IATs for the assessment of competitive anxiety and sport injury anxiety will be reported, followed by the description of the direct measures on trait-anxiety, competitive anxiety and sport injury anxiety. Finally, the procedure and data reduction will be explained in this section.

3.2.2 Methods

3.2.2.1 Participants

In the study, N = 136 undergraduate students of sports science (n = 70 male participants and n = 64 female participants, n = 2 provided no data on gender) took part. They had to sign in their name outside the laboratory door; hence, they chose the time and date of their participation by themselves to enable an as far as possible stress-free participation between the lectures. The mean age of the participants was M_{Age} = 24.19 years (SD = 3.91). The mean age of all men was $M_{AgeMales}$ = 24.71 years (SD = 3.00). The mean age of all women was $M_{AgeFemale}$ = 24.06 years (SD = 3.62). About n = 132 participants indicated German as their mother tongue, one participant

indicated Turkish, one participant indicated Egyptian as their mother tongue and two participants provided no data on their mother tongue. Both, they were not excluded from the study because they spoke German fluently enough to fulfill the upcoming task. A total of $n = 5$ participants was left-handed. The athletes engaged in their sport for $M = 10.02$ years ($SD = 5.74$). 10.3 % of the athletes considered themselves as elite athletes and 42.6 % of the athletes considered themselves as "competition-oriented leisure time athlete". 46.3 % of the athletes reported being leisure time athletes without competition participation. A total of $n = 71$ athletes did not participate in competitions; $n = 62$ athletes have participated in competitions on a regular base. 61.8 % of the participants considered themselves as being moderate to very experienced in taking part in competitions. While $n = 24$ participants reported suffering from acute somatic or mental health problems, 56.6 % of all participants felt stressed at that particular day instead of feeling rested ($n = 77$ participants). About 30 participants reported having taken part in a similar study. Data of $n = 134$ participants could be used properly for further analysis.

All participants were randomly assigned to one of four groups referring to group A, group B, group C and group D. These groups were separated in regard to the sport anxiety construct (competitive anxiety versus sport injury anxiety) and regarding the order of the presented Implicit Association Tests. Table 3.2.1 provides an overview of each group's participants (for further information on the groups, see section *Procedure*).

In line with the university's research guidelines, informed consent was obtained from the participants. For their participation, all students received credit points because the participation in the laboratory studies of the department is a requirement of their sport science lectures. Furthermore, they received sweets as reward.

Table 3.2.1. *Overview of the different Groups' Descriptives.*

	Groups			
	Sport Injury Anxiety		Competitive Anxiety	
	Group A	Group B	Group C	Group D
N total	34	34	34	34
Males	18	14	21	17
Females	16	18	13	17
Age (*M* ± *SD* in years)	24.41 (± 2.91)	20.06 (± 21.16)	24.53 (± 2.84)	24.85 (± 4.70)
Age males	24.22 (± 2.73)	24.43 (± 2.50)	24.52 (± 2.27)	25.71 (± 4.22)
Age females	24.63 (± 3.18)	23.28 (± 2.02)	24.54 (± 3.69)	24.00 (± 5.12)
left-handed (*n*)	2	0	2	1
How long in sport (*M* ± *SD* in years)	9.35 (± 5.76)	8.56 (± 5.71)	12.50 (± 4.89)	9.68 (± 6.01)
Peak-performance (%)	0.0	5.9	20.6	14.7
Competition-oriented leisure (%)	47.1	32.4	50.0	41.2
Leisure (%)	53.0	58.8	29.4	44.1
Competition participation (*n*)	16	13	18	15
Moderately to very experienced in competitions (*n*)	21	17	23	23
Health problems	6	4	7	7
feeling stressed (%)	47.0	73.5	58.8	47.1

3.2.2.2 Instruments

3.2.2.2.1 Indirect measures

Sport-Specific Implicit Association Tests

In the second study, the indirect investigation of competitive anxiety and sport injury anxiety was carried out by two adapted sport-specific versions of the Implicit Association Test - Anxiety (IAT-A, Egloff & Schmukle, 2002). The psychometric construction of the Implicit Association Tests for competitive anxiety and sport injury anxiety is described as follows:

Selection of the target concepts and attribute concepts

First, it was important to find appropriate target concepts and attribute concepts for the sport-specific IATs. In discussion with experts, "self" and "others" were replaced by "competition" and "training" as target concepts for the sport-specific competitive anxiety IAT. This idea results from findings regarding the research on training champions (Marahrens & Keil, 2004) and choking under pressure in sport (Baumeister, 1984; Wang, Marchant, Morris & Gibbs, 2004). Both are psychological circumstances, in which athletes perform well in low pressure situations (such as in training) but are unable to perform at their top level during a competition. In the sport-specific sport injury anxiety IAT, the target concepts of "self" and "others" were replaced by "injured" and "healthy". In accordance with the IAT-A by Egloff and Schmukle (2002), the attribute concepts "anxiety" (negative) and "calmness" (positive) were kept for the new IATs.

Generation of items

In the IAT, appropriate stimuli must be sorted into the relevant target and attribute categories within the single blocks presented in each session. The generation of items for the selection of appropriate stimuli was carried out by the Word Association Test (Ceglarek, 2009). Originally, the Word Association Test was conduced to the

diagnosis of knowledge (Rothe, 2003, 2006). Given a stimulus word, individuals are asked to name (reproduce; Bredenkamp & Erdfelder, 1996) those terms, which are associated with the stimulus word in their memory. Basic concepts regarding "free association" were formulated by Jung (1910).

For the item generation process, 20 participants (n = 10 male, n = 10 female) were asked to produce as many items as they could think of for the stimulus words "competition" and "training". 20 more participants (n = 10 male, n = 10 female) were asked to produce as many items as they can think of for the stimulus words "injured" and "healthy". They had to list the items in a table on a prepared blank paper within ten minutes. If participants were not able to name any more items on the presented stimulus word for another two minutes, that particular Word Association Test was finished, and the other stimulus word was presented. This is called the free, uninterrupted form of the Word Association Test (Woodworth & Schlosberg, 1965). According to Strube (1984), this kind of the Word Association Test is a continuous one, because all named words more or less refer to the stimulus words "competition", "training", "injured" and "healthy". In expert dialogues, the most frequently named 20 items of each stimulus word were chosen to examine their importance for competitive anxiety and sport injury anxiety in a second analysis.

Rating of the items

In a second study, a new sample of N = 20 participants (n = 10 male, n = 10 female) rated the selected 20 items of competitive anxiety. Another sample of N = 20 participants (n = 10 male, n = 10 female) rated the selected 20 items of sport injury anxiety. All participants were instructed to assign each item either to the category "competition" or to the category "training" ("injured" and "healthy" for sport injury anxiety). For example, participants had to assign the item "goblet" to either the category "competition" or the category "training" or, in the case of sport injury anxiety, the item "pain" for either the category "injured" or the category "healthy". After this, they had to rate the appropriateness of the item in regard to the selected category on a 4-point Likert-Scale with 1 = "*not appropriate at all*" to 4 = "*very*

much appropriate". They were instructed to work as fast, as precise and as spontaneous as possible.

Choice of final items

In a final step, all 20 items for both sport-specific IATs were analysed by SPSS Statistics. The analysis of frequencies showed the distribution of the items in the categories "competition" and "training" and the distribution of the items in the categories "injured" and "healthy". Those items were deleted, who did not fit into a category by at least 90 %. Subsequently, those items were deleted, who were rated in a category with more than 80 % as "*not appropriate at all*" or "*almost not appropriate*". Finally, experts selected those five items for each category, which showed the highest percentage classification as "*almost appropriate*"or "*very much appropriate*". All items are described in Table 3.2.2 and Table 3.2.3[2].

Table 3.2.2. *Final Items of the IAT-Competitive Anxiety.*

Category Label Items IAT-CA			
Competition / Training		Anxiety / Calmness	
Competition	Training	Anxiety	Calmness
win	exercise	nervous	relaxed
loser	muscles build-up	afraid	balanced
cup	coach	anxious	at ease
medal	regularity	fearful	calm
referee	repetition	uncertain	restful

[2] The German items are listed in Table 6.5.1 and 6.5.2 in the Appendix.

Table 3.2.3. *Final Items of the IAT-Sport Injury Anxiety.*

Category Label Items IAT-SIA			
injured / healthy		Anxiety / Calmness	
injured	healthy	Anxiety	Calmness
pain	fruit	nervous	relaxed
doctor	movement	afraid	balanced
drugs	fitness	anxious	at ease
rehabilitation	pleasure	fearful	calm
handicap	satisfaction	uncertain	restful

Implicit Association Test–Anxiety

In addition to the sport-specific IATs, the Implicit Association Test-Anxiety by Egloff and Schmukle (IAT-A, 2002) was applied in each group (as described below) of this study. Figure 3.1.1 (see section 3.1) shows a schematic overview of all blocks and their content. The application of the IAT-A usually lasts about 10 to 20 minutes. Its length mainly depends on the participants' speed of sorting. Egloff and Schmukle (2002) reported a Cronbach's Alpha between α = .77 and α = .80 and a test-retest-reliability of r_{tt} = .57.

Supplemental indirect instruments

In addition, Control-IATs (Rothermund & Wentura, 2004; Rothermund et al., 2005) were applied to the participants. These IATs are not of relevance in the statistical analysis in the second chapter. They will, however, be of interest in the third chapter (see 3.3). Here, they are mentioned for the sake of completeness.

3.2.2.2.1 Direct measures

In the second study, the same instruments were applied to the participants as in the first study reported in section 3.1. For the measurement of the personality disposition

of general anxiety, the State - Trait - Anxiety - Inventory by Spielberger et al. (STAI-T, 1970) in its German version (Laux et al., 1981) was applied to all participants of the second study. Again, the Competitive Anxiety Inventory - Trait in its German version (WAI-T, Brand et al., 2009) was utilised for the investigation of the general tendency to perceive competitive sport situations as potential threat. This inventory was applied to two randomised groups of participants. For the investigation of sport injury anxiety, the German Sport Injury Anxiety Test (SVAT, Kleinert, 2002a) was applied to the other two randomised groups of participants (for an overview of all direct instruments, see section 3.1.2; for an overview of the groups, see Table 3.2.1). Due to inacceptable reliability (Cronbach's Alpha α < .60), scales of social desirability were not included into the analyses.

3.2.2.3 Demographic Information

Physiological and psychological factors were investigated: gender, age, native language, hand dominance, pre-experience with reaction time experiments and coordinative hobbies, such as playing the piano. All participants gave sport-specific information about their sport (kind of sport, duration), the frequency of training and competition, their experience in competitions, squad status, current injuries, current mental or somatic sickness, daily hassles and status of current fatigue. These variables are equivalent to those described in the first study (see section 3.1 of this work).

3.2.2.4 Procedure

Before the start of the study, all participants were provided information about the upcoming reaction-time experiments and the anonymity of their personal data. The participants were left unaware about the background of the study so that they would not be biased by its emotional content. Instead they were informed that they would do a categorisation task, in which they would sort stimuli words into two categories as fast as possible.

Subsequently, all participants were randomly divided into four groups in the order of their entrance: group A, group B, group C or group D. Group A and group B were assigned to the content of sport injury anxiety; group C and group D were assigned to the content of competitive anxiety.

The procedure started with the presentation of the IATs on the computer screen.

In group A and C, the sport-specific IAT (sport injury anxiety or competitive anxiety) at first, followed by the general anxiety IAT. At the end, the Control-IATs were presented. In group B and D, the order of the presented IATs was changed to control possible order effects. At first, the general anxiety IAT was presented on the computer screen, followed by the sport-specific IAT (sport injury anxiety or competitive anxiety). At the end, the Control IATs were presented (for an overview of the procedure, see Figure 3.2.1).

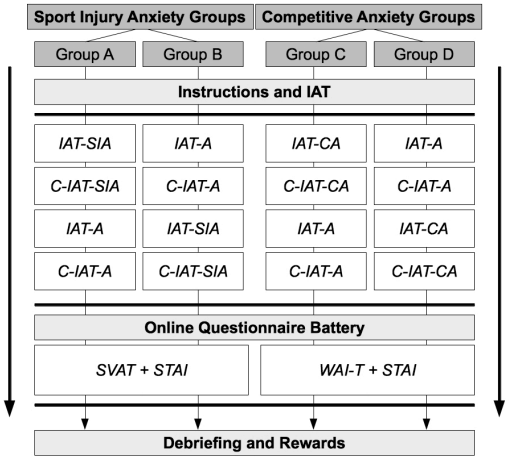

Figure 3.2.1. Overview of the procedure of Study 2.

Before all blocks of each IAT, a short introduction regarding to upcoming task was displayed on the screen. During the whole session, all participants were allowed to ask questions and inform the investigator about problems with the presentation.

After the presentation of the IATs, a group-specific online survey was presented to all participants. All participants were asked to answer the demographic information and the STAI-T (Laux et al., 1981). In sport injury anxiety group A and B, the WAI-

T (Brand et al., 2009) was excluded; in competitive anxiety group C and D, the SVAT (Kleinert, 2002a) was excluded. The participants were allowed as much as time as they needed to answer the self-report questionnaires.

At the end, all participants received a sheet of information on the real purpose of the study (*debriefing*). The investigator answered all questions. All participants agreed on the appropriation of their data. All participants were thanked, and they received their reward.

3.2.2.5 Data Reduction

All IAT data was treated according to the procedure of the new scoring algorithm reported by Greenwald et al. (2003). The steps of the data reduction are listed in detail in Table 3.1.2 presented in section 3.1.

3.2.3 Results

3.2.3.1 Descriptive Statistics

3.2.3.1.1 Indirect Measures

General Anxiety

The IAT-A shows an average value of D = -.37 (SD = .33) for the total sample. The Kolmogorov-Smirnoff - Test for normal distribution of the response latencies shows a Z value of .61. It is not significant ($p > .05$). A normal distribution of IAT-A response latencies can be assumed. The test for skewness and kurtosis shows a value of .14 (SE = .21) for skewness and a value of -.21 (SE = .42) for kurtosis.

Mean values and standard deviations of the response reaction times were calculated for all blocks. Paired student t-Tests to test mean value differences between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) show significant mean value differences for both, the practice blocks 3 and 6 ($t(130) = 9.00$, $p < .01$) and the test blocks 4 and 7

($t(130) = 11.97, p < .01$; see Figure 3.2.2). Table 3.2.4 shows all mean values and standard deviations for the respective blocks.

Table 3.2.4. *Overall Mean Values and Standard Deviations of IAT-A (N = 131).*

	Descriptives	
Blocks	M	SD
Mean Block 3	816.44	125.26
Mean Block 4	782.46	120.74
Mean Block 6	725.04	115.73
Mean Block 7	693.15	99.48

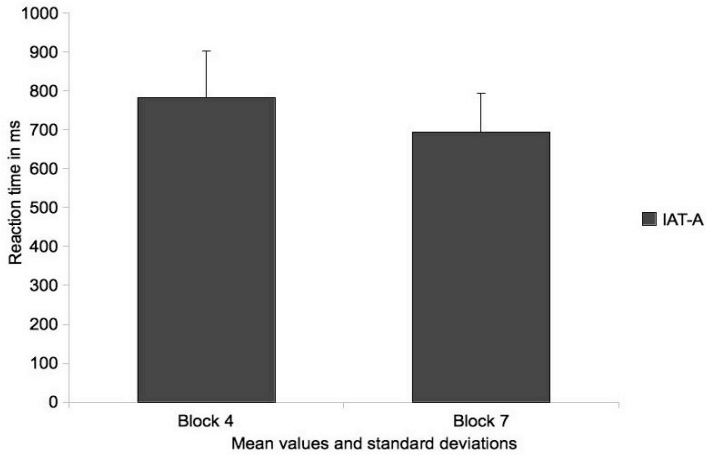

Figure 3.2.2. Significant difference between the test blocks 4 and 7 of the IAT-A.

In addition, IAT scores of the general Implicit Association Test - Anxiety were calculated for each group A, B, C and D separately.

In the sport injury anxiety groups (A and B), the IAT-A shows an average value of $D = -.38$ ($SD = .33$). The Kolmogorov-Smirnoff - Test tested the response reaction times regarding a normal distribution. Kolmogorov-Smirnoff 's Z is .77; it is not significant ($p > .05$). Thus, a normal distribution of IAT-A response latencies can be

assumed. Skewness and kurtosis were tested, as well. Skewness shows a value of .22 (*SE* = .29); kurtosis shows a value of -.25 (*SE* = .58).

Mean values and standard deviations of the response reaction times were calculated for all blocks. Paired student *t*-Tests between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) were applied. For both, the practice blocks 3 and 6 ($t(66) = 6.50, p < .01$) and the test blocks 4 and 7 ($t(66) = 9.48, p < .01$), mean value differences are significant.

In the group A, the IAT-A shows an average value of $D = -.45$ ($SD = .26$). Kolmogorov-Smirnoff's Z is .77; thus, it is not significant ($p > .05$). A normal distribution of IAT-A response latencies can be assumed. Skewness shows a value of -.33 (*SE* = .40); kurtosis shows a value of -1.26 (*SE* = .79).

Mean values and standard deviations of the response times of all blocks were calculated. Paired student *t*-Tests to test mean value differences between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) were applied to the data. Mean value differences are significant for both, the practice blocks 3 and 6 ($t(33) = 6.97, p < .01$) and the test blocks 4 and 7 ($t(33) = 8.89, p < .01$).

In the group B, the IAT-A shows an average value of $D = -.31$ ($SD = .37$). A normal distribution of IAT-A response latencies can be assumed ($Z = .63; p > .05$). Skewness shows a value of .10 (*SE* = .41); kurtosis shows a value of -.58 (*SE* = .80).

Paired student *t*-Tests applied between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) show significant mean value differences for both, the practice blocks 3 and 6 ($t(32) = 3.01, p < .01$) and the test blocks 4 and 7 ($t(32) = 5.21, p < .01$).

In the groups C and D (competitive anxiety group), the IAT-A shows an average value of D = -.37 (SD = .34). Again, the Kolmogorov-Smirnoff - Test tested the response latencies regarding a normal distribution. Kolmogorov-Smirnoff's Z is .56; thus, it is not significant ($p > .05$). A normal distribution of IAT response latencies can be assumed here, too. Skewness shows a value of .06 (SE = .30); kurtosis shows a value of -.09 (SE = .59).

Additionally, mean values and standard deviations of the response reaction times of all blocks were calculated. Paired student t-Tests to test mean value differences between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) were applied, again. For both, the practice blocks 3 and 6 ($t(63) = 6.27$, $p < .01$) and the test blocks 4 and 7 ($t(63) = 7.54$, $p < .01$), mean value differences are significant.

In the group C, the IAT-A shows an average value of D = -.32 (SD = .36). The Kolmogorov-Smirnoff's Z is .64; thus, it is not significant ($p > .05$). A normal distribution of IAT-A response latencies can be assumed. Skewness shows a value of -.06 (SE = .41); kurtosis shows a value of .23 (SE = .80).

Mean values and standard deviations of the response times were calculated for all blocks. Paired student t-Tests between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) show significant mean value differences between the practice blocks 3 and 6 ($t(32) = 3.67$, $p < .01$) and the test blocks 4 and 7 ($t(32) = 4.03$, $p < .01$).

In the group D, the IAT-A shows an average value of D = -.42 (SD = .31). Kolmogorov-Smirnoff's Z is not significant (Z = .49; $p > .05$). A normal distribution of IAT-A response latencies can be assumed. Skewness shows a value of .08 (SE = . 42); kurtosis shows a value of -.48 (SE = .82).

Mean values and standard deviations of the response reaction times were calculated for all blocks. Paired student t-Tests to test mean value differences between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) were executed on the data. Mean value differences are significant for both, the practice blocks 3 and 6 ($t(30) = 5.35$, $p < .01$)

and the test blocks 4 and 7 ($t(30) = 7.10$, $p < .01$). Table 3.2.5 shows an overview of the means and standard deviations of the blocks, considering the single groups A, B, C and D and the construct specific paired groups A + B and C + D (see also Figure 3.2.3).

Table 3.2.5. Mean Values and Standard Deviations of IAT-A (N = 131).

	Descriptives			
	Test Blocks		Practice Blocks	
Group	Block 4 *M* (*SD*)	Block 7 *M* (*SD*)	Block 3 *M* (*SD*)	Block 6 *M* (*SD*)
Sport Injury Anxiety				
A (*n* = 34)	770.17 (± 126.13)	669.29 (± 105.15)	801.90 (± 127.56)	697.00 (± 107.14)
B (*n* = 33)	797.50 (± 97.15)	715.11 (± 98.02)	840.71 (± 104.74)	778.26 (± 133.94)
A+B (*n* = 67)	783.63 (± 112.78)	691.86 (± 103.53)	821.01 (± 117.63)	737.02 (± 126.94)
Competitive Anxiety				
C (*n* = 33)	763.12 (± 152.71)	695.72 (± 110.29)	788.79 (± 147.38)	702.88 (± 107.48)
D (n = 31)	800.50 (± 97.80)	693.22 (± 79.50)	835.97 (± 114.45)	722.75 (± 96.99)
C+D (*n* = 64)	781.23 (± 129.44)	694.51 (± 95.86)	811.64 (± 133.55)	712.50 (± 102.21)

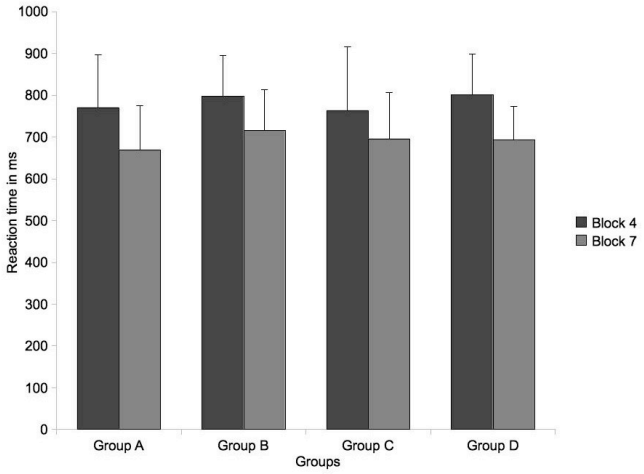

Figure 3.2.3. Significant differences between the test blocks 4 and 7 of the IAT-A.

The same analyses have been executed on the sport-specific Implicit Association Tests. The results are listed in the following. In addition, accuracy and order effects were included in the analysis because it is the first application of the newly developed sport-specific IATs.

Competitive Anxiety

The IAT-Competitive Anxiety (IAT-CA) shows an average value of D = .42 (SD = .37). The response latencies were tested for normal distribution by Kolmogorov-Smirnoff's Z value, which is .49; thus, it is not significant ($p > .05$). A normal distribution of IAT-CA response latencies can be assumed. Again, skewness and kurtosis were tested. Skewness shows a value of -.17 (SE = .30); kurtosis shows a value of -.18 (SE = .59).

Mean values and standard deviations of the response reaction times were calculated for all blocks. Paired student t-Tests between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) show significant mean value differences for both, the practice blocks 3 and 6 ($t(63) = -8.12, p < .01$) and the test blocks 4 and 7 ($t(63) = -7.13, p < .01$; see Figure 3.2.4). Tables 3.2.6 shows all mean values and standard deviations for the respective blocks.

Table 3.2.6. *Mean Values and Standard Deviations of the IAT-CA (N = 64).*

	Descriptives			
	Test Blocks		Practice Blocks	
Competitive Anxiety	Block 4 *M* (*SD*)	Block 7 *M* (*SD*)	Block 3 *M* (*SD*)	Block 6 *M* (*SD*)
Group C (*n* = 33)	746.70 (± 93.72)	841.90 (± 147.24)	764.92 (± 99.20)	926.93 (± 137.70)
Group D (*n* = 31)	722.58 (± 97.90)	821.36 (± 127.89)	754.43 (± 96.80)	875.93 (± 152.05)
Group C+D (*n* = 64)	735.01 (± 95.76)	831.95 (± 137.50)	759.84 (± 97.41)	902.22 (± 145.95)

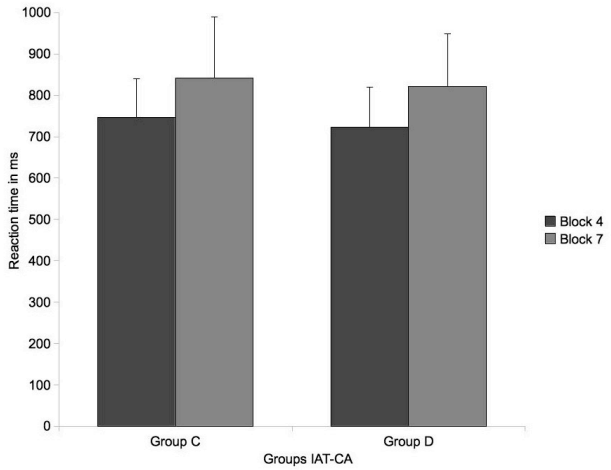

Figure 3.2.4. Significant mean values differences between the test blocks 4 and 7 of the IAT-CA.

Accuracy

For an analysis of learning behaviour, a mean score for each block's missing scores was computed. Within the ACCs, a value of either 1 = *passed* or 0 = *missed* was possible. The mean score informs about the accuracy of each individual within the

blocks, and thus, the learning behaviour. Because the Mauchly's Test of Sphericity shows to be significant (Mauchly's $W = .23$; $p \leq .00$), the df-values are corrected via Greenhouse-Geisser. Over all blocks, the accuracy seems to be instable ($F(247,4) = 6.24$; $p \leq .00$; $\eta^2 = .09$), which means there are significant accuracy values due to an outlier effect in block 6 (see below). There is a range in accuracy between .87 and .93 ($M_{All} = .92$, $SD_{All} = .07$) (Figure 3.2.5). Table 3.2.7 lists all mean values and standard deviations. There are significant differences between practice block 6 and block 2 ($p \leq .01$), block 3 ($p \leq .00$), block 4 ($p \leq .00$), block 5 ($p \leq .00$) and block 7 ($p \leq .01$). The relevant blocks, however, are non-significant within the single pairwise comparisons ($p < .05$). Thus, block 6 shows to be an outlier compared to the other blocks.

Table 3.2.7. *Accuracy Values of the IAT-CA (N = 64).*

	Descriptives	
Blocks	M	SD
Mean Block 1	0.93	0.13
Mean Block 2	0.92	0.07
Mean Block 3	0.93	0.07
Mean Block 4	0.93	0.08
Mean Block 5	0.92	0.08
Mean Block 6	0.87	0.11
Mean Block 7	0.92	0.07

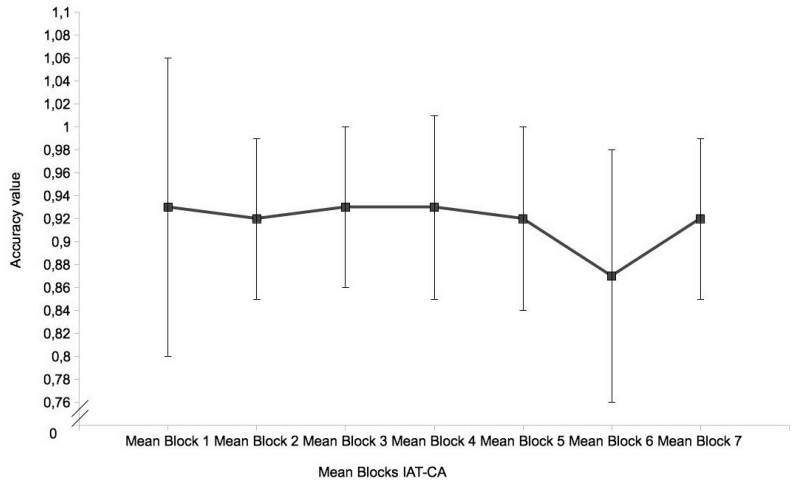

Figure 3.2.5. Average course of learning behaviour in the IAT-CA.

Order effects

To test for possible differences between the groups C and D, both groups were analysed separately, too. In group C, the IAT-CA shows an average value of D = .46 (SD = .33). Kolmogorov-Smirnoff's Z is .54; thus, it is not significant ($p > .05$). A normal distribution of IAT-CA response latencies can be assumed. Skewness shows a value of -.27 (SE = .41); kurtosis shows a value of -.30 (SE = .80).

Mean values and standard deviations of response reaction times of all blocks were calculated. Paired student t-Tests between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) find significant mean value differences between the practice blocks 3 and 6 ($t(32) = -8.21, p < .01$) and the test blocks 4 and 7 ($t(32) = -4.87, p < .01$).

In group D, the IAT-CA shows an average value of D = .38 (SD = .40). A normal distribution of IAT response latencies can be assumed (Kolmogorov-Smirnoff's Z = .43; $p > .05$). Skewness shows a value of -.01 (SE = .42); kurtosis shows a value of -.12 (SE = .82).

Mean values and standard deviations of response reaction times were calculated via paired student t-Tests for all blocks. For both, the practice blocks 3 and 6 ($t(30) = -4.13, p < .01$) and the test blocks 4 and 7 ($t(30) = -5.16, p < .01$) mean value

differences between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) are significant.

A student *t*-Test between the groups C and D has been executed in order to analyse possible group differences in the IAT effect of the IAT-CA due to a varied order of the applied Implicit Association Tests. Results show no significant group difference in the IAT effect between group C and group D ($t(62) = 0.88$; $p = .38$).

Sport Injury Anxiety

The IAT-SIA shows an average value of $D = 1.08$ ($SD = .31$). Kolmogorov-Smirnoff's Z is 1.07; thus, it is not significant ($p > .05$). A normal distribution of IAT-SIA response latencies can be assumed. Additionally, skewness and kurtosis were tested. Skewness shows a value of -1.74 ($SE = .30$); kurtosis shows a value of 5.61 ($SE = .58$).

Mean values and standard deviations of response reaction times were calculated for all blocks. Paired student *t*-Tests analysed the mean value differences between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7). Significant mean value differences are found between both, the practice blocks 3 and 6 ($t(65) = -18.91$, $p < .01$) and the test blocks 4 and 7 ($t(65) = -16.90$, $p < .01$; see Figure 3.2.6). Tables 3.2.8 shows all mean values and standard deviations for the respective blocks.

Table 3.2.8. *Overall Mean Values and Standard Deviations of the IAT-SIA.*

	Descriptives			
	Test Block		Practice Block	
Sport Injury Anxiety	Block 4 *M* (*SD*)	Block 7 *M* (*SD*)	Block 3 *M* (*SD*)	Block 6 *M* (*SD*)
Group A (*n* = 33)	677.01 (± 78.97)	1060.21 (± 176.95)	701.44 (± 105.72)	1213.22 (± 159.15)
Group B (*n* = 33)	679.82 (± 115.85)	970.96 (± 211.49)	740.16 (± 151.73)	1082.32 (± 175.92)
Group A+B (*n* = 66)	678.41 (± 98.39)	1015.58 (± 198.63)	720.80 (± 131.21)	1147.77 (± 179.04)

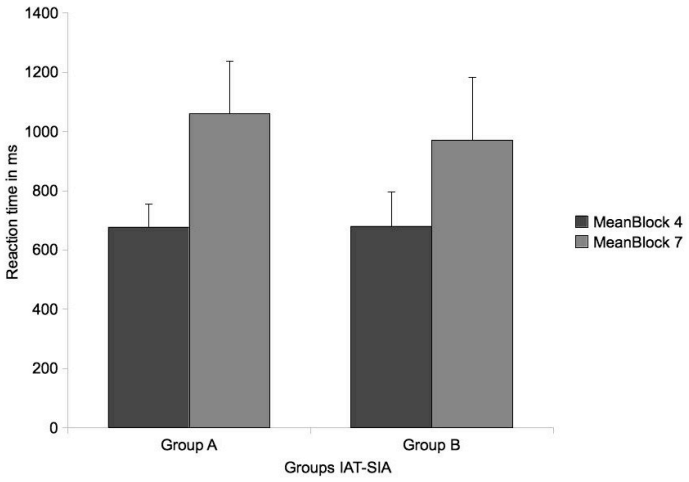

Figure 3.2.6. Significant differences between the test blocks 4 and 7 of the IAT-SIA.

Accuracy

For an analysis of learning behaviour, a mean score for each block's missing was computed. Within the ACCs, a value of either 1 = *passed* or 0 = *missed* was possible. The mean score provides information about the accuracy of each of the individuals within the blocks, which is equivalent to the learning behaviour in-between the blocks. An increase in accuracy was found by the proximity of the mean scores

towards 1 (Figure 3.2.7). Accuracy values range between .77 and .96 (M_{All} = .91, SD_{All} = .05). Since Mauchly's Test of Sphericity shows to be significant (Mauchly's W = .06; $p \leq .00$), the df-values were corrected via Greenhouse-Geisser. The accuracy over all blocks seems to be instable ($F(202,3) = 72.66$; $p \leq .00$; $\eta^2 = .52$). Block 6 and 7 show to be significant different from all other blocks on a p = .00 level, which makes them outlier regarding their accuracy values. Table 3.2.9 lists all means and standard deviations.

Table 3.2.9. *Accuracy values of the IAT-SIA (N = 66).*

	Descriptives	
Blocks	*M*	*SD*
Mean Block 1	0.93	0.07
Mean Block 2	0.94	0.06
Mean Block 3	0.96	0.05
Mean Block 4	0.96	0.04
Mean Block 5	0.93	0.08
Mean Block 6	0.77	0.14
Mean Block 7	0.84	0.11

Order Effects

In the group A, the IAT-SIA shows an average value of D = 1.21 (SD = .20). Kolmogorov-Smirnoff's Z is .59; thus, it is not significant ($p > .05$) and a normal distribution of IAT-SIA response latencies can be assumed. Again, skewness and kurtosis were tested. Skewness shows a value of -.55 (SE = .41); kurtosis shows a value of -.17 (SE = .80).

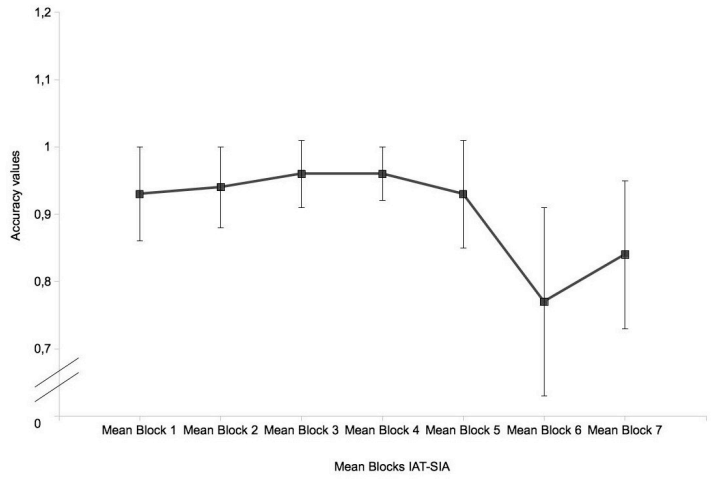

Figure 3.2.7. Average course of learning behaviour in the IAT-SIA.

Mean values and standard deviations of response reaction times were calculated for all blocks and paired student *t*-Tests analysed the mean value differences between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7). Mean value differences are significant for both, the practice blocks 3 and 6 ($t(32) = -19.05$, $p < .01$) and the test blocks 4 and 7 ($t(32) = -14.66$, $p < .01$).

The IAT-SIA in the group B shows an average value of $D = .96$ ($SD = .35$). A normal distribution of IAT-SIA response latencies can be assumed (Kolmogorov-Smirnoff 's $Z = 1.14$; $p > .05$). Skewness and kurtosis were tested. Skewness shows a value of -1.63 ($SE = .41$); kurtosis shows a value of 4.45 ($SE = .80$). These values result from a single outlier, which shows an IAT-SIA effect of $D = -.33$. However, there is no reason to eliminate this single participant from further analysis. This result will be discussed in the Discussion section.

Mean values and standard deviations of response reaction times were calculated. Paired student *t*-Tests analysed the mean value differences between the initial combined task (practice Block 3 and test Block 4) and the reverse-combined task (practice Block 6 and test Block 7) and find significant mean value differences for both, the practice blocks 3 and 6 ($t(32) = -11.41$, $p < .01$) and the test blocks 4 and 7 ($t(32) = -10.28$, $p < .01$).

Another student *t*-Test analysed possible group differences in the IAT effect of the IAT-SIA due to a varied order of the Applied Implicit Association Tests between the groups A and B. Results show a significant difference in the IAT effect between group A and group B ($t(64) = 3.56; p = .00$). This is not due to the single outlier pointed out above as the following *t*-Test between the groups A and B excluded from this outlier shows: $t(63) = 3.59; p = .00$.

3.2.3.1.2 Direct Measures

A total of $n = 133$ participants completed the State Trait Anxiety Inventory in its trait version. Due to missing data, $n = 3$ participants were excluded from the analysis (2.2 %). In group A and group B, $n = 65$ participants completed the STAI-T with $n = 3$ participants being excluded from the analysis due to incomplete data. The Sport Injury Anxiety Test SVAT was completed by a total of $n = 68$ participants (group A and group B). In group C and group D, all $n = 68$ participants completed the STAI-T and the WAI-T for competitive anxiety.

3.2.3.2 Convergent validity

Convergent validity was measured by Pearson product-moment correlations between the direct sport-specific and general anxiety measures as well as between the indirect sport-specific and general IATs.

Regarding the direct measures, results do not show any significant correlations between the scales of the Sport Injury Anxiety Test as sport-specific measure and the State - Trait - Anxiety Inventory as a general anxiety measure ($p > .05$ for all scales). As opposed to this, competitive anxiety and general anxiety in the direct measures show significant positive correlations on all three subscales ($r_{STAI\ -\ worry} = .42, p < .001$; $r_{STAI\ -\ somatic} = .37, p < .01$; $r_{STAI\ -\ concentration} = .29, p < .05$). Between the subscales of the direct measures, the Sport Injury Anxiety Test SVAT shows the following significant inter-correlations: $r_{LSC\ -\ HSI} = .41, p < .01$; $r_{LSC\ -\ SLC} = .70, p < .001$; $r_{HSI\ -\ SLC} = .55, p < .001$. Significant correlations also show between the subscales of the

Competitive Anxiety Scale WAI-T: $r_{\text{somatic - worry}} = .70, p < .001$; $r_{\text{somatic - concentration}} = .35, p < .01$; $r_{\text{worry - concentration}} = .51, p < .001$.

Regarding the indirect measures, no significant correlations show between the IAT-A and the IAT-CA ($r_{\text{IAT-A - IAT-CA}} = .01, p > .05$). However, a significant negative correlation is found between the IAT-A and the IAT-SIA ($r_{\text{IAT-A - IAT-SIA}} = -.32, p < .01$).

3.2.3.3 Discriminant validity

Correlational analyses between the IAT effects *D* of the IAT-A, the IAT-CA, the IAT-SIA and the self-report anxiety measures, trait anxiety, competitive anxiety and sport injury anxiety, respectively, were applied to test the discriminant validity between the indirect and the direct measures. There is a significant positive correlation between the indirectly and the directly measured general anxiety ($r_{\text{IAT-A - STAI}} = .21, p < .05$). This result is contrary to the results found in the first study of this work. A first-order partial correlation controlling the factor "gender" was executed, because gender has significant impacts on the direct anxiety measures of general anxiety and competitive anxiety (see below "gender"). Results, however, show that the factor "gender" only has minor influences on this significant positive correlation ($r_{\text{IAT-A - STAI}} = .18, p < .05$).

No significant correlation is found between the sport-specific direct and indirect measures of sport injury anxiety. There is no significant correlation between the indirect and the direct measures of competitive anxiety. Furthermore, direct sport-specific SVAT and WAI-T and indirect IAT-A do not show any significant correlation. The sport-specific indirect measures IAT-CA and IAT-SIA appear to be distinct from their direct counterparts WAI-T and SVAT (for a figural overview, see Figure 3.2.8).

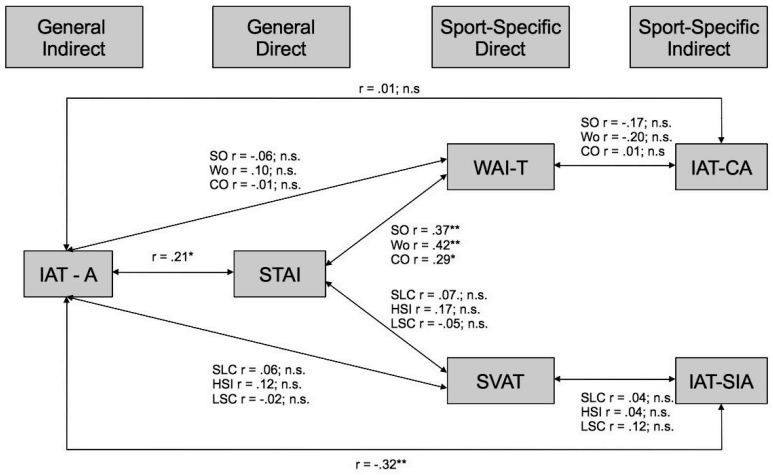

Figure 3.2.8. Figural overview of the correlations between the direct and indirect instruments.

3.2.3.4 Known-group effects and relation to demographic variables

Univariate variance analyses were applied to analyse possible influencing factors which allow the discrimination of known groups. These variables were equivalent to those in study 1 (see chapter 3.1): gender, level of sport, affiliation to team or individual sport, impact of competitions and impact of injuries.

Gender

A univariate variance analysis on the factors "gender" and the IAT effect *D* of the IAT-A for general anxiety shows no significant differences between male and female participants across all groups ($F(1,127) = 0.193$; $p = .66$). Both sport-specific IATs were analysed regarding a possible difference between males and females. The univariate variance analysis on the factors "gender x IAT-SIA" shows no significant difference between male and female participants ($F(1,62) = 2.706$; $p = .11$). Additionally, a significant impact of "gender" in regard to the IAT-CA is not found in the univariate variance analysis ($F(1,62) = 0.684$; $p = .41$).

Regarding the possible impact of gender on the direct anxiety measures, an additional univariate variance analysis shows a significant difference between male

and female participants on anxiety ($F(1,129) = 8.353$; $p < .01$; $\eta^2 = .06$), indicating a small effect with females showing higher values of trait anxiety than males.

Univariate variance analysis of differences between males and females regarding their sport-specific sport injury anxiety scale "low situational competency" show no significance ($F(1,64) = 0.137$; $p = .71$). Results on the scales "high situational importance" ($F(1,64) = 1.977$; $p = .17$) and "situational loss of control" ($F(1,64) = 0.575$; $p = .45$) show no significance.

A different picture appears regarding the impact of gender on competitive anxiety. Here, men and women show significant differences on the WAI-T scales "somatic anxiety" ($F(1,66) = 16.566$; $p < .001$; $\eta^2 = .20$) and "worry" ($F(1,66) = 5.062$; $p < .05$; $\eta^2 = .07$). This result indicates that female athletes experience small to medium higher levels of somatic and cognitive anxiety than male athletes. The third scale "concentration problems" shows no significant differences regarding the factor "gender" ($F(1,66) = 0.340$, $p = .56$). Mean values and standard deviations are in Table 3.2.10.

Level of sport

For the assessment of the sport level, participants indicated on a scale to which of the four sport groups they currently belong: 1 = "*competition sport*", 2 = "*competition oriented leisure time sport*", 3 = "*leisure time sport*" and 4 = "*health sport*". Afterwards, the groups were redefined because of their inhomogenous group sizes. The groups of sport levels were reduced from four groups to two groups: "competition sport / competition-oriented leisure sport" ($n = 72$) and "leisure - time sport / health sport" ($n = 63$).

Regarding the indirect measures, a univariate variance analysis on the factors "sport level" and "IAT-A" for general anxiety shows no significant difference between the groups ($F(1,128) = 0.595$; $p = .44$). In addition, there shows no significant difference between the sport level groups, neither for IAT-SIA ($F(1,63) = 0.149$; $p = .70$) nor for IAT-CA ($F(1,62) = 0.008$; $p = .93$).

Table 3.2.10. *Mean Scores and Standard Deviations of the Variance Analysis regarding the Factor "Gender".*

		Gender	
		Males	Females
IAT-A *n* = 68 Males *n* = 61 Females	IAT-A effect	- 0.37 (± 0.35)	- 0.39 (± 0.30)
IAT-CA *n* = 37 Males *n* = 27 Females	IAT-CA effect	0.46 (± 0.34)	0.38 (± 0.41)
IAT-SIA *n* = 31 Males *n* = 32 Females	IAT-SIA effect	1.15 (± 0.26)	1.03 (± 0.35)
STAI *n* = 69 Males *n* = 62 Females	STAI-T**	37.33 (± 9.49)	42.16 (± 9.60)
WAI-T *n* = 38 Males *n* = 30 Females	Somatic Anxiety*	9.03 (± 2.82)	11.67 (± 2.43)
	Worry**	8.29 (± 3.32)	10.10 (± 3.26)
	Concentration Problems	7.05 (± 2.68)	7.40 (± 2.09)
SVAT *n* = 32 Males *n* = 34 Females	SLC	2.77 (± 1.05)	2.58 (± 0.94)
	HSI	2.63 (± 0.95)	2.30 (± 0.96)
	LSC	3.27 (± 1.03)	3.17 (± 1.04)

Note: * $p \leq .05$; ** $p \leq .01$

Table 3.2.11. *Mean Values and Standard Deviations of the Variance Analysis on the Factor "Level of Sport".*

		Level of Sport	
		Group 1 "competition-oriented"	Group 2 "not competition-oriented"
IAT-A *n* = 68 Group 1 *n* = 62 Group 2	IAT-A effect	- 0.36 (± 0.33)	- 0.40 (± 0.31)
IAT-CA *n* = 40 Group 1 *n* = 24 Group 2	IAT-CA effect	0.42 (± 0.33)	0.43 (± 0.43)
IAT-SIA *n* = 27 Group 1 *n* = 38 Group 2	IAT-SIA effect	1.07 (± 0.40)	1.10 (± 0.24)
STAI *n* = 71 Group 1 *n* = 61 Group 2	STAI-T	38.69 (± 10.19)	41.08 (± 9.67)
WAI-T *n* = 43 Group 1 *n* = 25 Group 2	Somatic Anxiety	9.91 (± 2.59)	10.68 (± 3.49)
	Worry	8.95 (± 3.12)	9.32 (± 3.88)
	Concentration Problems	7.32 (± 2.25)	7.16 (± 2.76)
SVAT *n* = 29 Group 1 *n* = 38 Group 2	SLC	2.74 (± 0.91)	2.59 (± 1.06)
	HSI	2.63 (± 0.94)	2.31 (± 0.97)
	LSC	3.23 (± 0.79)	3.23 (± 1.18)

The univariate variance analysis calculated on the direct measures shows the following results: regarding trait anxiety, there are no significant differences between the sport level groups ($F(1,130) = 1.896$; $p = .17$). In addition, there shows no significant difference between the sport level groups regarding the sport injury anxiety scales "low situational competency" ($F(1,65) = 0.000$; $p = 0.99$), "high situational importance" ($F(1,65) = 1.822$; $p = .18$) and "situational loss of control" ($F(1,65) = 0.336$; $p = .56$). No significant differences between the sport level groups are found regarding the competitive anxiety scales (somatic anxiety: $F(1,66) = 1.088$, $p = .30$; worry: $F(1,66) = 0.182$, $p = .67$; concentration problems: $F(1,66) = 0.014$, $p = .91$). Mean values and standard deviations are in Table 3.2.11.

Team sport versus individual sport

Univariate variance analyses were conducted on the indirect and the direct measures of anxiety in order to investigate possible differences between participants which engage either in team sport ($n = 67$) or in individual sport ($n = 67$). Results on the IAT-A show no significant differences between team sport and individual sport ($F(1,127) = 0.111$; $p = .74$). The same results are found for the indirect sport-specific measures of the IAT-SIA ($F(1,62) = 0.029$; $p = .87$) and the IAT-CA ($F(1,62) = 2.386$; $p = .13$).

The following results show regarding the direct anxiety measures: there is no significant difference between team and individual sport participants regarding general anxiety ($F(1,129) = 0.319$; $p = .57$).

Table 3.2.12. *Mean Values and Standard Deviations of the Variance Analysis regarding the Factor "Team vs. Individual Sport".*

		Team vs. Individual Sport	
		Group 1 "Individual Sport"	Group 2 "Team Sport"
IAT-A *n* = 64 Group 1 *n* = 65 Group 2	IAT-A effect	- 0.39 (± 0.33)	- 0.37 (± 0.32)
IAT-CA *n* = 27 Group 1 *n* = 37 Group 2	IAT-CA effect	0.51 (± 0.40)	0.36 (± 0.33)
IAT-SIA *n* = 37 Group 1 *n* = 27 Group 2	IAT-SIA effect	1.08 (± 0.27)	1.10 (± 0.37)
STAI *n* = 65 Group 1 *n* = 66 Group 2	STAI-T	40.11 (± 9.12)	39.14 (± 10.50)
WAI-T *n* = 30 Group 1 *n* = 38 Group 2	Somatic Anxiety	10.80 (± 3.09)	9.71 (± 2.78)
	Worry	8.83 (± 3.92)	9.29 (± 2.95)
	Concentration Problems	6.97 (± 2.43)	7.39 (± 2.44)
SVAT *n* = 37 Group 1 *n* = 29 Group 2	SLC	2.63 (± 1.07)	2.73 (± 0.91)
	HSI	2.35 (± 0.88)	2.61 (± 1.06)
	LSC	3.14 (± 1.12)	3.32 (± 0.91)

No significant differences between both groups regarding sport injury anxiety are found (LSC: $F(1,64) = 0.516$, $p = .48$; HSI: $F(1,64) = 1.217$, $p = .27$; SLC: $F(1,64) = 0.175$, $p = .68$). Between the groups, no significant results are found on the competitive anxiety scales. Neither regarding somatic anxiety ($F(1,66) = 2.334$; $p = .13$), nor worry ($F(1,66) = 0.300$; $p = .59$) nor concentration problems ($F(1,66) = 0.517$; $p = .48$), team and individual sport participants differ significantly. Mean values and standard deviations are found in Table 3.2.12.

Competition participation

The impact of competition was analysed with a univariate variance analysis between the group of participants, which reported to participate frequently in competitions and participants, which reported not to participate frequently in competitions. Results of the indirect measures are not significant (IAT-A: $F(1,126) = 1.070$, $p = .30$; IAT-SIA: $F(1,63) = 0.714$, $p = .40$; IAT-CA: $F(1,60) = 0.040$, $p = .84$).

Regarding the direct measures of anxiety, the groups show no significant differences of their trait anxiety score ($F(1,128) = 1.798$, $p = .18$). The scales of sport injury anxiety also show no significant result (low situational competency: $F(1,65) = 0.179$, $p = .67$; high situational importance: $F(1,65) = 0.285$, $p = .59$; situational loss of control: $F(1,65) = 0.043$, p = .84). Regarding competitive anxiety, no significant differences are found between athletes which frequently take part in competitions and athletes which do not frequently take part in competitions (somatic anxiety: $F(1,64) = 1.768$, $p = .19$; worry: $F(1,64) = 0.218$, $p = .64$; concentration problems: $F(1,64) = 0.040$, $p = .84$). Mean values and standard deviations are found in Table 3.2.13.

Table 3.2.13. *Mean Values and Standard Deviations of the Variance Analysis regarding the Factor "Competition Participation".*

		Competition Participation	
		Group 1 "Competitions"	Group 2 "No competitions"
IAT-A *n* = 59 Group 1 *n* = 69 Group 2	IAT-A effect	- 0.34 (± 0.33)	- 0.40 (± 0.32)
IAT-CA *n* = 31 Group 1 *n* = 31 Group 2	IAT-CA effect	0.43 (± 0.31)	0.41 (± 0.43)
IAT-SIA *n* = 27 Group 1 *n* = 38 Group 2	IAT-SIA effect	1.05 (± 0.39)	1.11 (± 0.25)
STAI *n* = 61 Group 1 *n* = 69 Group 2	STAI-T	38.48 (± 10.11)	40.77 (± 9.38)
WAI-T *n* = 33 Group 1 *n* = 33 Group 2	Somatic Anxiety	9.73 (± 2.64)	10.70 (± 3.26)
	Worry	8.94 (± 3.16)	9.33 (± 3.67)
	Concentration Problems	7.09 (± 2.39)	7.21 (± 2.53)
SVAT *n* = 29 Group 1 *n* = 38 Group 2	SLC	2.63 (± 0.96)	2.68 (± 1.04)
	HSI	2.52 (± 1.02)	2.39 (± 0.93)
	LSC	3.17 (± 0.92)	3.27 (± 1.10)

Severity of injuries and duration of rehabilitation

Again, it was important to gather information about the injuries the athletes have suffered from in the past in order to analyse impacts on the indirect and direct anxiety measures. In accordance with the first study (see section 3.1), the first reported injury was relevant for the analysis regarding the duration of rehabilitation and the severity.

Correlational Pearson product-moment analyses were conducted to find out possible relations between severity of the injury, duration of rehabilitation and the measure of anxiety. Only participants of the groups A and B were considered for the analysis because of the sport anxiety-specific group division. About $n = 50$ athletes provided valid information about their first injury.

Regarding the IAT-A and the IAT-SIA, no significant correlations show between duration of rehabilitation and the general and sport-specific anxiety ($r_{DR - IAT-A} = -.07$, $p = .62$; $r_{DR - IAT-SIA} = -.06$, $p = .66$). For the direct anxiety measures, no significant correlation is found neither regarding duration of rehabilitation and all scales of sport injury anxiety ($r_{DR - LSC} = .08$, $p = .58$; $r_{DR - HSI} = .15$, $p = .31$; $r_{DR - SLC} = -.07$, $p = .64$) nor regarding duration of rehabilitation and trait-anxiety ($r_{DR - STAI} = -.20$, $p = .17$).

Table 3.2.14. *Mean Values and Standard Deviations of the Factors "Duration of Rehabilitation" and "Severity of Injury".*

	Descriptives		
	N	*M*	*SD*
Duration of Rehabilitation (in weeks)	51	11.94	16.65
Severity of Injury	51	2.90	1.20

A correlation between the severity of the injury and the indirect anxiety measures is not significant for both, the IAT-A and the IAT-SIA ($r_{SI - IAT-A} = -.12$, $p = .40$; $r_{SI - IAT-SIA} = .20$, $p = .17$). Neither trait anxiety ($r_{SI - STAI} = -.18$, $p = .22$) nor sport injury anxiety ($r_{SI - LSC} = .11$, $p = .44$; $r_{SI - HSI} = -.07$, $p = .62$; $r_{SI - SLC} = .08$, $p = .91$) show a

significant relation to the severity of the first reported injury. Mean values and standard deviations are found in Table 3.2.14.

3.2.4 Discussion

The main focus of second study was the psychometric development and evaluation of two sport-specific IATs in regard to their functionality and applicability in sport psychological research on competitive anxiety and sport injury anxiety. So far, the implicit affective valence of sport-specific anxiety is not represented in sport psychology, though IATs have already been applied to sport-specific fields of research (Brand et al., 2011; Ohlert & Kleinert, 2009). However, the indirect measurement of sport-specific anxiety provides new opportunities to gain insights into automatic information processing within an athlete's associative anxiety networks (Strack & Deutsch, 2004). Thus, a new spectrum of intervention possibilities for coaches and sport psychologists might be acquired with a better understanding of and knowledge about associations between anxiety-relevant stimuli.

The newly developed IATs focus on competitive anxiety (IAT-CA) and sport injury anxiety (IAT-SIA). Therefore, a new sample of university sport students was recruited. Participants completed both direct self-report questionnaires (STAI, WAI-T, SVAT) and the newly developed indirect IATs. In addition, the general IAT on trait anxiety (IAT-A) was applied.

Known-group effects

In accordance with the explorative pilot study (see section 3.1), all demographic variables were analysed for possible known-group effects (known-group approach, see Banse et al., 2001; Fiske & Macrae, 2012). This step was essential for attaining insights into the possible impacts of variables on the evaluation of the newly developed IATs (see Greenwald & Nosek, 2001; Nosek, Banaji & Greenwald, 2002; Gawronski & Payne, 2010) and for determining the capability of the IATs to differentiate between already known groups. Gender, for example, is a popular impact variable and needs to be controlled – unless it is a goal of the study to analyse

a separate gender effect (see for a discussion Schiebinger, 2014). Previous studies have shown that female athletes usually show higher values on scales of competitive anxiety than male athletes, especially regarding somatic and cognitive anxiety (e.g. Martens et al., 1990; Mellalieu et al., 2009). In the recent study, these results were confirmed by female participants' higher scores on the somatic and worry components in the direct WAI-T. This result was, however, not found in the scale "concentrations problems", which might be due to low internal consistency of the scale (see Brand et al., 2009). A similar known-group gender result was found for trait anxiety (Egloff & Schmukle, 2003). These authors note, that women do not only score higher in directly measured trait anxiety (via the STAI), but also score higher in two indirect tests: the IAT-A and the Emotional Stroop Test. In addition, women generally have a higher life-time risk of developing anxiety disorders; furthermore, anxiety disorders are more prevalent in females (Kessler et al., 1994; McLean, Asnaani, Litz & Hofmann, 2012). While results of this study confirm these findings on the State-Trait Anxiety Inventory, no significant differences were found between males and females on the Sport Injury Anxiety Test.

Despite Egloff and Schmukle's (2002) result, in which a gender effect was also observed on the indirect measure, in the current study, no differences were found between males and females on the IAT-A, the IAT-CA and the IAT-SIA. These results were also found for all the other analysed demographic groups (competition-oriented vs. non-competition-oriented, team sport vs. individual sport; participation in competition; duration of rehabilitation and severity of injury). No significant differences were found between groups.

In conclusion, it is possible, that all three IATs on anxiety (whether sport-specific or not) do not adequately differentiate between a-priori known-groups. These findings are consistent with studies on addictive behaviour (see Swanson, Rudman & Greenwald, 2001, for example). Gawronski and Payne (2010) note, that a known-group differentiation can only be as strong as its a-priori differentiation. Regarding sensitive topics such as anxiety, these a-priori differentiations ought to be modified more precisely in indirect measurement. This methodical consideration should be the focus of additional research on the assessment of implicit emotions in sport.

Psychometric analysis of the IATs

All IATs were analysed sequentially in their specific groups A, B, C, D and in the combined groups A+B and C+D. The IAT-Anxiety was applied to all groups. Results showed a normal distribution of the IAT response latencies with a significant IAT effect. The IAT effect was negative for all groups. All groups showed similar significant differences between the combined tasks. In the first combined block, the stimulus pairings were "self/anxiety and "others/calmness", whereas in the second combined block, the stimulus pairings were "self/calmness" and "others/anxiety". Response reaction time latencies were faster in the second combined task. This result implies that participants of this sample reacted faster to the combination of "self" and "calmness", which indicates a stronger representation of calmness in relation to self, and a stronger, more automatic association. Thus, the current sample consists of less anxious participants regarding dispositional trait-anxiety values.

Additionally, the sample was analysed regarding their specific anxiety group. Individuals were randomly added to groups according to their entry in the computer room. In groups A and B, the newly developed IAT-Sport Injury Anxiety was applied to participants; in groups C and D, the newly developed IAT-Competitive Anxiety was applied.

Results in both groups showed a normal distribution of IAT response latencies and a significant positive IAT effect. Both the IAT-SIA and the IAT-CA do not reflect results of the general IAT-Anxiety, which is quite interesting especially with regard to the convergent validity analysis which will be discussed later in this passage. For both the IAT-SIA and the IAT-CA, results show faster reactions to the stimulus pairings "injured/anxiety" and "healthy/calmness" and "competition/anxiety" and "training/calmness" than to their reverse-combined pairings. In both samples, the relevant target items were more represented in relation to anxiety than in relation to calmness. Thus, participants might be more anxious in relation to sport-specific concerns such as sport competitions and sport injuries.

Accuracy values

A stable increase in learning behaviour measured via the accuracy values was not found in the IAT-SIA or in the IAT-CA.

Order effects

The possibility of order effects is another relevant factor that must be controlled when several similar tests are executed in a study. Order effects result when a methodical variation is inferred with a construct variation. This means, an effect, such as an IAT effect, would only be relevant due to a varied order but not due to a stimulated change in the person's associative representations. For example, a similar study by McFarland and Crouch (2002) applied six IATs to their sample and controlled possible order effects by dividing their IATs into three subsets, with six possible IAT orders in the end. In addition, they had six more different orders of their additional materials. In the end, 36 different order possibilities were given in their study. Results of their study, however, only showed minimal order effects. Nevertheless, in the present study, for both, the IAT-SIA and the IAT-CA, order effects also were analysed, because both groups completed the task in divergent orders.

In the IAT-SIA, significant differences between groups A and B were found. In group A, the sport-specific IAT was applied before the general IAT-A; in group B, the sport-specific IAT was applied after the general IAT-A. Results showed a significant higher IAT effect in group A than in group B. Even though, in group B, a significant outlier was found (which had a negative IAT effect of $D = -.33$), the significant difference between the groups was not influenced due to this outlier. Both groups, however, showed a positive IAT effect, so the direction of the results stays the same.

No significant order effect was found for the IAT-CA groups.

Due to the fact that differences between groups only existed in the IAT-SIA but not in the IAT-CA groups, this effect was probably coincidentally than due to a

systematic effect. Thus, regarding the study of McFarland and Crouch (2002), no relevant order effects can be determined in the study.

Convergent and discriminant validity

Regarding the convergent validity of the indirect measures, the sport-specific IATs and the general IAT-Anxiety showed an inconsistent patterns. Cunningham, Preacher and Banaji (2001, p. 164) describe convergent validity as "the extent to which measures that are designed to tap the same constructs correlate with each other". Fazio and Olsen (2003), for example, critically discuss very small correlations between different indirect measures (see also Bosson et al., 2000). Cunningham et al. (2001) and also found low bivariate correlations between their indirect measures (IAT vs. evaluative priming). However, in a confirmatory factor analysis, the authors could find significant and greater correlations between the latent construct variables than between the bivariate correlations. Gawronski (2002) pointed out a low convergent validity between IAT measures tapping the same construct. In accordance with these studies, it is plausible that the IAT measures – here anxiety, which only differs in its context (sport vs. no sport) – at least show a mild correlation. Negative correlations between the IAT-Anxiety and the IAT-SIA were significant, whereas correlations between the IAT-Anxiety and the IAT-CA were not significant. Previous results, which found relations between the indirect measures due to their presumably close associative network, cannot be confirmed by implication in this study. Banse et al. (2001), who found rather low correlations between two IATs, both measuring implicit attitudes towards homosexuality, suggests several explanations, such as procedural differences (order of the IATs), motivational factors or changes in the measured construct (e.g. in the completion of the self-report questionnaires or the control IATs). Rudolph, Schröder-Abé, Schütz, Gregg and Sedikides (2008) also underpin the current results of rather low to inconsistent results between IAT measures. They point out the influence of more subtle factors, such as structural features (e.g. salience of the stimuli as proposed by Rothermund and Wentura, 2004; see also chapter 3.3. of this work).

Regarding convergent validity of the direct measures, significant correlations between the STAI-T and the competitive anxiety scales were found in the current study. These findings are in accordance with several previous studies (for example Brand et al., 2009, Strahler et al., 2010, for an overview Martens et al., 1990; Mellalieu et al., 2009), in which a significant correlation shows a close relationship between general trait anxiety and competitive anxiety. No significant results, however, were found between the STAI-T and the sport injury anxiety scales. This finding is consistent with Kleinert (2002a) who found very low correlations between general anxiety via STAI and the scales of the Sport Injury Anxiety Test.

These findings of convergent validity measures in-between the indirect measures and in-between the direct measures must also be appraised with regard to the theoretical background given by Hofmann et al. (2005; see chapter 2.4.3). These authors point out the independency of explicit versus implicit associations measured by direct versus indirect instruments.

Therefore, results of the convergent validity in the current study are underlined by results of the discriminant validity. Sport-specific direct and indirect measures do not show any significant correlation. Inconsistently, general anxiety measures show a rather low correlation. This result is not completely contrary to results found in previous studies (see Bosson et al., 2000). Egloff and Schmukle (2002) found a weak but positive correlation between direct and indirect anxiety measures (see also Greenwald & Farnham, 2000). These authors discuss weak to missing significant correlations between indirect and direct measures in the context of social desirability- and bias-related factors.

Krause, Back, Egloff and Schmukle (2011), on the other hand, point out that correlations between different types of instruments increase when measures are more detailed and more specific regarding the relevant construct. This is in accordance with Bosson et al. (2000), who conclude that indirect measures seem to be context-sensitive. Further, indirect measures' specificity and concreteness with regard to reliable results might be more dependent on the method. Differences in the direction of IAT effects between the IAT-A and the sport-specific IATs, as shown in the

current results, implies possible differences in information processing and activation of the associative networks with regard to stimulus material. Here, a sample, which seems to be rather insensible to dispositional anxiety stimuli (negative IAT effect *D* on the IAT-A), is nevertheless affected by sport-specific anxiety-relevant stimulus material (positive IAT effect *D* on the IAT-CA and the IAT-SIA). Hence, this also points out the importance of adequate stimulus material for the activation of sport-specific anxiety-related associative networks (Sriram & Greenwald, 2009). These newly developed indirect measures deserve further research before they are abandoned as unreliable and insufficiently valid for the investigation of personality dispositions.

In conclusion, the second study described the development and the analysis of two new sport-specific IATs. Both IATs were shown consistent with previous studies with regard to their value criteria and their psychometric measures. Finally, these results again highlight the importance of context specificity in the development and measurement of sport-specific constructs.

3.3 Coincidence or intention? - Confirmation of the validity by the exclusion of methodical variance

3.3.1 Theoretical Background

In previous chapters of the empirical part, two different studies were described. Both studies showed first convincing results for valid application of IATs in a sport-specific context. First, the well-used IAT-Anxiety (IAT-A; Egloff & Schmukle, 2002), which indirectly measures the personality disposition of anxiety, was applied along with sport-specific direct self-report measures of anxiety. Acceptable results were shown in a sample of athletes. Once again, results also confirmed the influence of social desirability on the self-report questionnaires and pointed to the necessity of indirect measurement in the context of sensitive topics. Therefore, in the second study, two sport-specific IATs investigating Competitive Anxiety and Sport Injury Anxiety were developed. In a second sample of athletes, results showed positive IAT effects (contrary to results of the IAT-A in the first study) and acceptable convergent and discriminant validity.

Mierke and Klauer (2003) note critically that an IAT effect may also result from pure coincidence. Therefore, these authors suggest supplementally testing the IAT with regard to its methodical variance. This means, similar results would also be shown if the IAT was based on another theoretical background than the one proposed by Greenwald et al. (1998). In the case of this work, this approach will be pursued in the third part of the study that follows. Here, the figure–ground concept proposed by Rothermund and Wentura (2004; Rothermund et al., 2005) will be considered in the explanation of expected IAT effects.

Rothermund and Wentura (2004) also point out the importance of methodical variance in the application of IATs and its impact on the IAT effect. Whereas Greenwald et al. (1998) explain the IAT effect by a close cognitive association between the determined concepts and thus, faster response reaction times within one target combination compared to another target combination, Rothermund and Wentura (2004, Rothermund et al., 2005) note that figure–ground asymmetries may

account for the found IAT effects. Figure–ground asymmetries focus on the salience of the presented stimuli. Thus, in compatible blocks, salient categories sharing one response key will lead to faster response reaction times.

In the theoretical background of the current work, figure–ground asymmetries as an explanation of the IAT effect have already been described in detail (see section 2.5.2). Rothermund and Wentura (2004) note that salience features would be more important in the interpretation of IAT effects than nominal features such as valence of the presented stimuli proposed by Greenwald, Nosek, Banaji and Klauer (2005). While several additional studies of both research groups were presented to highlight both lines of argument, a final explanatory model of the IAT effect has not yet been found.

Recent studies provide further evidence of validity of the IAT effect being explained by the strength of associations (as proposed by Greenwald et al., 1998). Neurophysiological research on semantic and emotional correlations, for example, showed differences in the event-related potentials (ERP) between compatible tasks of an IAT and incompatible tasks (O'Toole & Barnes-Holmes, 2009; Williams & Themanson, 2011). Other studies found significant effects of late-positive potentials (Hurtado, Haye, González, Manes & Ibánez, 2009). Forbes et al. (2012) investigated compatible and incompatible IAT blocks and their relation to lesion and ERP. Not only did they find more positive ERP in compatible blocks than in incompatible blocks, they also found differences in the activated brain areas due to congruency. Forbes et al. (2012) conclude that "...these data provide concrete evidence that the IAT effect is based, at least in part, upon automatic processing and thus provides a valid index for the strength of intrinsic associations forged through experience and socialization processes ..." (Forbes et al., 2012, p. 16). A study by Salemink, Friese, Drake, Mackintosh and Hoppitt (2013) found that working memory capacity might have an impact on implicit or explicit biases of social anxiety threat. Again, these results support the hypothesis that the IAT effect results from more than just a methodical variation.

Corresponding to this theoretical discussion, the second study did not focus on the development and evaluation of two new sport-specific IATs on anxiety, only. The second study also considered the explanatory model of Rothermund and Wentura (2004) in its design and investigated the methodical validity of the newly developed sport-specific IATs, IAT-SIA and IAT-CA. Therefore, three Control-IATs were developed in parallel, which tested the methodical variance of general and sport-specific IATs. In a Control-IAT, the valence of the stimulus words in the attribute category were eliminated and replaced by words free of valence (non-words and neutral words, see section 3.3.2 below).

The aim of this different evaluation of the data was to strengthen the construct validity of the newly developed IATs. Therefore, a new study was not designed. The sample and its variables will be analysed in a different direction with a clear methodical focus. It is not the intention of this study to evaluate which one of the different theoretical approaches explaining IAT effects might be correct, or whether it was salience or a valence effect. Instead, the intention of this part of the study is to determine whether the IAT also shows reliable and valid results based on another methodical background, that is: in a word/non-word combination. If the IAT effect results from methodical variance only, then a correlation between the regular IAT and the corresponding Control-IAT will appear. Accordingly, the third part of the study accounts for increased incremental validity of the newly developed sport-specific IATs of Competitive Anxiety and Sport Injury Anxiety.

3.3.2 Methods

3.3.2.1 Participants

The sample of this separate analysis was identical to the sample described in study 2 (see section 3.2.2). Additional participants were not recruited.

3.3.2.2 Instruments, Design and Procedure

The selection of instruments in the third analysis is identical to the one described in study 2 because a new study was not designed for the separate analysis of the methodical variance. The direct and indirect instruments are described in section 3.2.2. The demographic information of the participants is also described in section 3.2.2.

In addition to those instruments and in reference to Rothermund and Wentura (2004), three Control-IATs were newly developed. Their construction is described in detail in the next passages.

Selection of target and attribute items

In a Control-IAT according to Rothermund and Wentura (2004), it is essential that the categories do not differ due to salience. Thus, the attribute items must be replaced by neutral words and non-words. Non-words are considered to be words without a semantic notion. They are not associated with a positive or negative valence (see DeHouwer, 2002). Rothermund and Wentura (2004) published lists of neutral and non-word stimuli, which they have used in their studies. All items for the word/non-word condition are displayed in Table 3.3.1[3].

In the Control-IAT-Anxiety (C-IAT-A), the target category persisted "self/others", however, the attribute category was replaced by "word/non-word" stimuli. In the Control-IAT-Competitive Anxiety (C-IAT-CA), the target category was "competition/training" and the attribute category was replaced by "word/non-word". The Control-IAT-Sport Injury Anxiety (C-IAT-SIA) consisted of the target category "injured/healthy" and the attribute category "word/non-word".

[3] The German items of the Control-IAT are found in Table 6.5.3 in the Appendix.

Table 3.3.1. *All Items of the Word / Non-Word IAT (Rothermund & Wentura, 2004).*

Category Label Items Control-IAT	
Neutral word	Non-word
Table	Reschlet
Paper	Timpf
House	Agdat
Bed	Balort
Closet	Sedlor

The design was identical to study 2 described in section 3.2.2.

The procedure also was identical to the one of study 2. In the groups A and B, only the Control-IATs for general anxiety and sport injury anxiety were applied (that is C-IAT-A and C-IAT-SIA); in the groups C and D, only the Control-IATs for general anxiety and competitive anxiety were applied (that is C-IAT-A and C-IAT-CA). All Control-IATs were applied to the participants after they had completed the regular IAT tasks. This means, in the groups A and C, the sport-specific C-IAT was applied after the sport-specific IAT; and the C-IAT-A was applied after the general IAT-A. In the groups B and D, the general IAT-A was applied at first, then the corresponding Control-IAT-A. Afterwards, the sport-specific IAT was applied followed by the corresponding sport-specific Control-IAT.

An overview of the blocks including the Control-IATs is shown exemplary for the C-IAT-A in Figure 3.3.1. In block 3 (practice) and block 4 (test), the non-word category is combined with the relevant target category (e.g. “self/non-word” (C-IAT-A), “competition/non-word” (C-IAT-CA), “injured/non-word” (C-IAT-SIA). In block 6 (practice) and block 7 (test), the attribute category is “word” and the target category is the irrelevant equivalent “others/training/healthy”.

Sequence	Block 1	Block 2	Block 3 + 4	Block 5	Block 6 + 7
Task description	Initial target-concept discrimination	Associated attribute discrimination	Initial Combined Task	Reversed target-concept discrimination	Reversed combined task
Task Instruction	● Me Others ●	● Non-word word ●	● Me ● Non-word Others ● word ●	● word Non-word ●	● Me ● word Others ● Non-word ●
Sample Items	they ○ ○ self ○ my your ○	○ agdat ○ timpf table ○ house ○	○ self they ○ ○ agdat closet ○	○ paper sedlor ○ timpf ○ ○ table	○ self ○ paper they ○ reschlet ○

Figure 3.3.1. Overview of blocks of the C-IAT-A.

3.3.2.3 Data Analysis

The data analysis was carried out by SPSS 17.0. It was identical to the analysis carried out previously in study 1 and study 2. Again, all IAT data were analysed according to the procedure of the new scoring algorithm reported by Greenwald et al. (2003). The steps applied for data reduction are listed in detail in Table 3.1.2 which is found in section 3.1.2.

3.3.3 Results

3.3.3.1 Descriptives

3.3.3.1.1 Analysis of the Control-IATs

Control-IAT-Anxiety

Across the total sample, an average IAT effect value of D = -.32 (SD = .34) is found for the Control-IAT-Anxiety. The Kolmogorov-Smirnov - Test on the response latencies shows a Z = .55 which is not significant (p > .05). A normal distribution of the IAT response latencies is assumed. Additionally, the tests for skewness and kurtosis show mean values of -.57 (SE = .42) for kurtosis and .05 (SE = .21) for skewness.

Table 3.3.2. *Overall Mean Values and Standard Deviations of the C-IAT-A (N = 131).*

	Descriptives	
Blocks	M	SD
Mean Block 3	759.58	129.63
Mean Block 4	699.46	108.44
Mean Block 6	668.42	94.93
Mean Block 7	646.54	84.76

In accordance with the previous studies, mean values and standard deviations for all C-IAT-A blocks were calculated. Paired *t*-Tests between the initial combined task (block 3 and block 4) and the reverse-combined task (block 6 and block 7) show significant mean value differences for both, the practice blocks 3 and 6 ($t(130) = 8.94, p < .001$) and the test blocks 4 and 7 ($t(130) = 7.68, p < .001$; Figure 3.3.2). Mean values and standard deviations are displayed in Table 3.3.2.

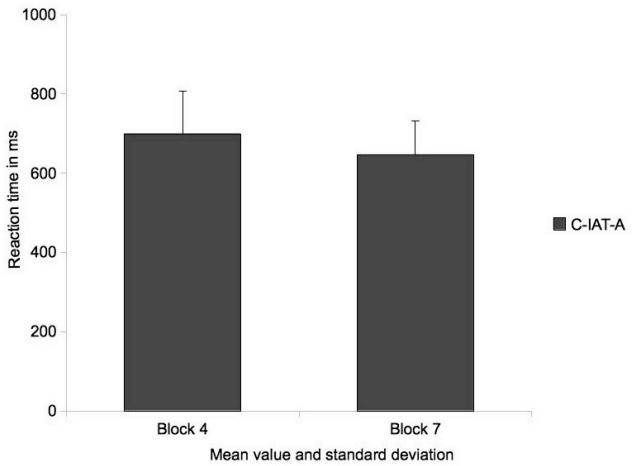

Figure 3.3.2. Significant mean value differences between the test blocks 4 and 7 in the C-IAT-A.

Accuracy

In order to analyse the learning behaviour in the reaction times of the Control-IAT-A, mean values and standard deviations of the missings were calculated for each block. The ACC values are between 0 = *missed* and 1 = *passed*. Therefore, the mean scores provide information about the accuracy of each participant. Hence, each participants' learning behaviour during a IAT - session can be evaluated. By applying a multivariate variance analysis with repeated measures on the factor "block", the Mauchly's test shows a violation of sphericity. Thus, degrees of freedom (*df*) were corrected via Greenhouse-Geisser-correction. Significant differences between the blocks are found ($F(5,649) = 9.31$; $p \leq .001$; $\eta^2 = .06$). Accuracy values seem instable and show a range between .93 and .96 ($M_{All} = .95$, $SD_{All} = .04$). Table 3.3.3 lists all mean values and standard deviations; Figure 3.3.3 shows the average course of the learning behaviour. Pairwise comparisons find significant differences between the following blocks: blocks 1 and 2 ($p \leq .00$), blocks 1 and 3 ($p \leq .05$), blocks 1 and 7 ($p \leq .05$), blocks 2 and 3 ($p \leq .00$), blocks 3 and 4 ($p \leq .00$), blocks 3 and 5 ($p \leq .00$) and blocks 3 and 7 ($p \leq .00$). Single pairwise comparisons between the critical blocks do not show any significant differences in the accuracy values.

Table 3.3.3. *Accuracy values of the C-IAT-A.*

	Descriptives	
Blocks	*M*	*SD*
Mean Block 1	0.94	0.07
Mean Block 2	0.96	0.05
Mean Block 3	0.93	0.07
Mean Block 4	0.96	0.05
Mean Block 5	0.95	0.06
Mean Block 6	0.95	0.07
Mean Block 7	0.96	0.05

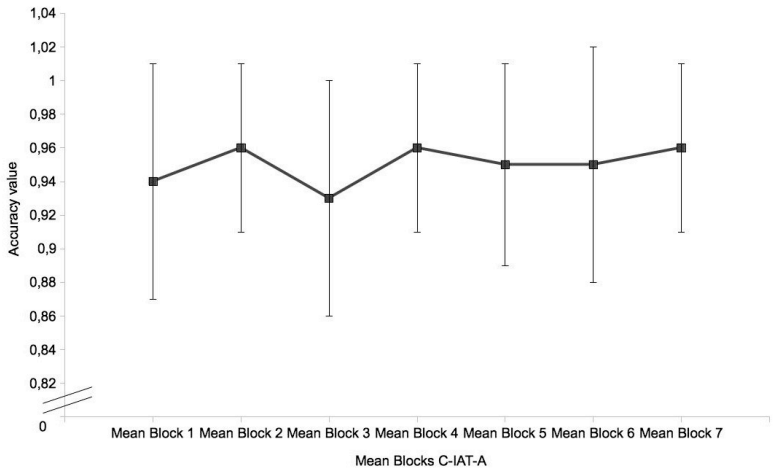

Figure 3.3.3. Average course of the learning behaviour in the C-IAT-A trial.

Order effects

In reference to the studies reported previously, IAT values and results of the *t*-Tests for all groups will be reported as follows.

In group A, the IAT effect of the C-IAT-A shows an average value of D = -.32 (SD = .38). The Kolmogorov-Smirnov - Test on the normal distribution of the response latencies is not significant (Z = .55; p > .05). A normal distribution of IAT response latencies can be assumed for this group. Skewness shows to be -.03 (SE = .40) and kurtosis of the IAT response latencies shows to be -.78 (SE = .79) in this group.

Mean values and standard deviations were calculated for all blocks. Paired *t*-Tests between the combined task and the reverse-combined task show significant mean value differences for both, the practice blocks 3 and 6 ($t(33) = 4.61$, $p < .001$) and the test blocks 4 and 7 ($t(130) = 3.58$, $p < .001$; see Figure 3.3.4). Mean values and standard deviations are displayed in Table 3.3.4.

In group B, the average IAT effect of the C-IAT-A shows a value of D = -.35 (SD = .36) with a Kolmogorov-Smirnov Z of .65, which is not significant (p >.05). Thus, in group B, too, a normal distribution of the IAT response latencies can be assumed. In this group, response latencies show a skewness of .12 (SE = .41) and a kurtosis of 1.22 (SE = .80).

Mean values and standard deviations were calculated for all blocks in this group, too. Paired *t*-Tests between the combined task and the reverse-combined task find significant mean value differences for both, the practice blocks 3 and 6 ($t(32) = 4.94$, $p < .001$) and the test blocks 4 and 7 ($t(32) = 4.17$, $p < .001$; see Figure 3.3.4). Means and standard deviations are displayed in Table 3.3.4.

Table 3.3.4. *Mean Values and Standard Deviations of C-IAT-A for all Groups in separate (N = 131)*.

	Descriptives			
	Test Block		Practice Block	
Group	Block 4 *M* (*SD*)	Block 7 *M* (*SD*)	Block 3 *M* (*SD*)	Block 6 *M* (*SD*)
Sport Injury Anxiety				
A (*n* = 34)	695.72 (± 114.71)	644.37 (± 78.46)	763.46 (± 133.34)	661.87 (± 93.75)
B (*n* = 33)	702.03 (± 102.41)	647.47 (± 69.52)	779.78 (± 140.09)	683.94 (± 102.81)
A+B (*n* = 67)	698.83 (± 108.04)	645.90 (± 73.64)	771.50 (± 135.92)	672.74 (± 98.19)
Competitive Anxiety				
C (*n* = 33)	708.87 (± 130.29)	642.85 (± 107.48)	739.77 (± 122.17)	655.30 (± 95.27)
D (*n* = 31)	690.82 (± 83.61)	651.86 (± 82.73)	754.89 (± 124.43)	173.06 (± 88.89)
C+D (*n* = 64)	700.12 (± 109.70)	647.21 (± 95.64)	747.09 (± 122.52)	663.90 (± 91.94)

In group A and B together, the IAT effect of the C-IAT-A shows an average value of $D = -.33$ ($SD = .37$) and a Kolmogorov-Smirnov *Z*-value of .79. The *Z*-value is not

significant ($p >$. 05), thus, a normal distribution of response latencies in the sample of group A and B can be assumed. Skewness shows an average value of .04 (SE = .29) and kurtosis shows an average value of -.98 (SE = .58).

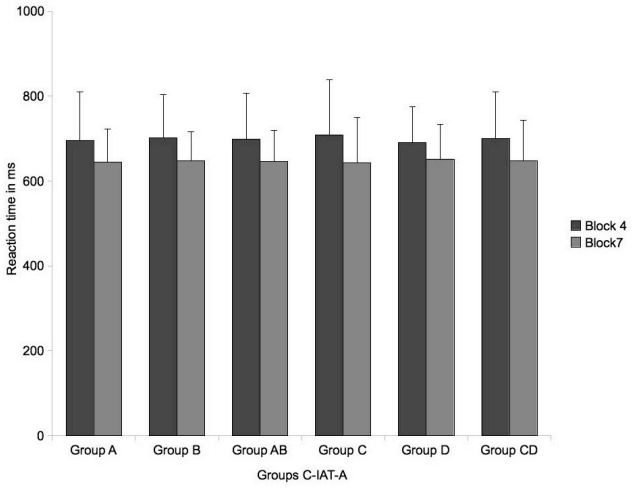

Figure 3.3.4. Significant mean value differences between the test blocks 4 and 7 of the C-IAT-A in all groups.

Mean values and standard deviations of group A + B were calculated across all blocks of the C-IAT-A. Paired *t*-Tests between the initial combined task and the reverse-combined task show significant differences for both, the practice blocks 3 and 6 ($t(66) = 6.76$, $p < .001$) and the critical test blocks 4 and 7 ($t(66) = 5.49$, $p <$. 001; see Figure 3.3.4). Mean values and standard deviations can be found in Table 3.3.4.

A student *t*-Test was applied for investigating possible differences of the average C-IAT-A values between the groups A and B. There are no significant differences between the groups ($t(64) = 0.44$; $p = .66$).

In group C + D, the IAT effect of the C-IAT-A shows an average value of D = -.30 (SD = .30). Kolmogorov-Smirnov's Z-value of .45 is not significant ($p > .05$) and a normal distribution of IAT response latencies in the sample of both groups C and D

can be assumed. Skewness and kurtosis in the groups C and D show to be .16 (*SE* = .30) for skewness and .12 (*SE* = .59) for kurtosis.

Mean values and standard deviations were calculated of all blocks. Significant mean value differences between the combined task and the reverse-combined task can be found for both, the practice blocks 3 and 6 ($t(63) = 5.84$, $p < .001$) and the test blocks 4 and 7 ($t(63) = 5.33$, $p < .001$; see Figure 3.3.4) by paired *t*-Tests. Mean values and standard deviations are displayed in Table 3.3.4.

Finally, both groups, C and D, were analysed separately in accordance with the groups A and B. In group C, an average IAT effect of the C-IAT-A shows a value of $D = -.33$ (*SD* =.27). The Kolmogorov-Smirnov - Test for normal distribution of the IAT response latencies is not significant ($Z = .52$, $p > .05$). Skewness shows to be .15 (*SE* =.41) and kurtosis shows a value of .09 (*SE* =.80).

Mean values and standard deviations of all blocks were calculated. Paired *t*-Tests find significant differences between the combined task blocks (block 3 and 4) and the reverse-combined task blocks (block 6 and 7) in both, the practice blocks 3 and 6 ($t(32) = 4.59$, $p < .001$) and the critical test blocks 4 and 7 ($t(32) = 4.30$, $p < .001$; see Figure 3.3.4). All mean values and standard deviations are displayed in Table 3.3.4.

In group D, the IAT effect shows an average value of $D = -.26$ (*SD* = .33) and a Kolmogorov-Smirnov *Z*-value of $Z = .43$ that is not significant ($p > .05$). Thus, a normal distribution of response latencies can be assumed also in this group. Additionally, skewness and kurtosis of the response latencies were calculated and show a value of .05 (*SE* = .42) for skewness and a value of .11 (*SE* = .82) for kurtosis.

Mean values and standard deviations of all blocks were calculated. Paired *t*-Tests between the critical blocks of the combined task (block 3 and 4) and the reverse-combined task (block 6 and 7) find significant mean differences in the response latencies between both the practice blocks 3 and 6 ($t(30) = 3.67$, $p < .01$) and the test blocks 4 and 7 ($t(30) = 3.21$, $p < .01$; see Figure 3.3.4). All mean values and standard deviations are shown in Table 3.3.4.

Possible differences between group C and group D in the average C-IAT-A effect were analysed in an independent student *t*-Test. No significant differences between the groups are found ($t(62) = -0.92$; $p = .36$).

Control-IAT-Competitive Anxiety

The IAT effect of the Control-IAT for Competitive Anxiety (C-IAT-CA) shows an average value of $D = .17$ ($SD = .31$). The Kolmogorov-Smirnov's Z is .37 and not significant ($p > .05$), thus, a normal distribution of response latencies is assumed for this Control-IAT. Skewness and kurtosis for the response latencies were tested and show values of -.07 ($SE = .30$) for skewness and -.33 ($SE = .59$) for kurtosis.

Table 3.3.5. *Overall Mean Values and Standard Deviations of the C-IAT-CA (N = 64).*

	Descriptives	
Blocks	*M*	*SD*
Mean Block 3	747.57	119.05
Mean Block 4	684.91	98.90
Mean Block 6	682.75	125.17
Mean Block 7	731.69	128.48

In accordance with the Control-IAT-A, means and standard deviations for all blocks of the C-IAT-CA were calculated, too. Paired student *t*-Tests between the critical combined and reverse-combined blocks show significant mean differences in the response latencies between the practice blocks 3 and 6 ($t(63) = -2.59$, $p < .05$) and the test blocks 4 and 7 ($t(63) = -4.44$; $p < .01$; Figure 3.3.5). All mean values and standard deviations are displayed in Table 3.3.5.

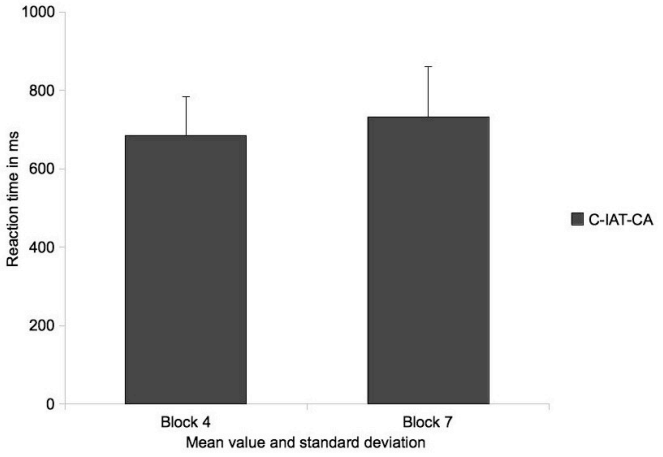

Figure 3.3.5. Significant mean value differences between the test blocks 4 and 7 of the C-IAT-CA.

Accuracy

Learning behaviour across all participants and IAT - blocks was analysed. Mean score values were calculated based on the rate of missings in each block (ACC value was either 0 = *missed* or 1 = *passed*). The Mauchly's Test of Sphericity shows to be significant (Mauchly's $W = .48$; $p \leq .01$), thus, sphericity seems to be violated and therefore, results of the General Linear Model were adjusted via Greenhouse-Geisser-Correction. The ACC values show a mean score range between .91 and .95 ($M_{All} = .94$, $SD_{All} = .05$). The accuracy across all blocks seems to be instable ($F(5,299) = 7.80$; $p \leq .00$; $\eta^2 = .11$); thus, accuracy values show significant differences across the process of the IAT - session. Table 3.3.6 shows all mean scores and standard deviations.

There are significant differences between block 2 and practice block 6 ($p \leq .01$), practice block 3 and test block 4 ($p \leq .05$), test block 4 and practice block 6 ($p \leq .01$), block 5 and practice block 6 ($p \leq .01$) and block 6 and test block 7 ($p \leq .01$). Differences in the ACC mean scores of the relevant blocks 4 and 7 are not significant within the single-pairwise comparisons ($p > .05$) (Figure 3.3.6).

Table 3.3.6. *Accuracy Values of the C-IAT-CA.*

	Descriptives	
Blocks	*M*	*SD*
Mean Block 1	0.94	0.08
Mean Block 2	0.95	0.05
Mean Block 3	0.93	0.07
Mean Block 4	0.96	0.05
Mean Block 5	0.95	0.06
Mean Block 6	0.91	0.08
Mean Block 7	0.94	0.06

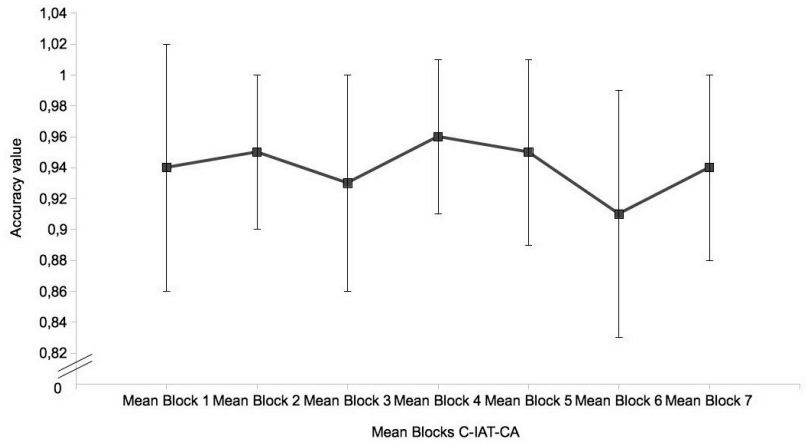

Figure 3.3.6. Average course of the learning behaviour in the C-IAT-CA trial.

Order Effects

In line with previous results, the IAT effects of the groups C and D are also described for each of the groups separately.

In group C, the Control-IAT-CA shows an average value of D = .20 (SD = .25) with Kolmogorov-Smirnov's Z-value of .48. This result is not significant, thus, a normal distribution of the response latencies of the C-IAT-CA in group C is assumed. Also, skewness and kurtosis were tested and shows values of .32 (SE =.41) for skewness and -.09 (SE = .80) for kurtosis.

Mean scores and standard deviations for all blocks were calculated. Paired student t-tests compared the mean response reaction times between the initial combined task (practice block 3 and test block 4) and the reverse-combined task (practice block 6 and test block 7) and find significant mean value differences between both the practice blocks 3 and 6 ($t(32) = -3.15, p < .01$) and the relevant test blocks 4 and 7 ($t(32) = -3.57, p < .01$).

The analysis in group D shows an average value of the IAT effect of D = .13 (SD = . 36) with a Kolmogorov-Smirnov's Z-value of .56. The Z-value is not significant (p >.05), thus, a normal distribution of response latencies is assumed also for this group. Skewness and kurtosis were calculated and show values of -.04 (SE = .42) for skewness and -.79 (SE = .82) for kurtosis.

Mean scores and standard deviations were calculated for all blocks of the C-IAT-CA. Paired student t-Tests between the combined task (blocks 3 and 4) and the reverse-combined task (blocks 6 and 7) find significant differences of the mean values between the critical test blocks 4 and 7 ($t(30) = -2.66, p < .05$), only. Mean value differences between the practice blocks 3 and 6 are not significant ($t(30) = -1.03, p = .31$).

Finally, paired t-Tests compared the average IAT effects of the C-IAT-CA due to a varied order of the applied Implicit Association Tests between group C and D and find no significant group difference ($t(62) = 0.94; p = .35$).

All means and standard deviations are found in Table 3.3.7 (see also Figure 3.3.7).

Table 3.3.7. *Mean Values and Standard Deviations of the C-IAT-CA for the Groups C and D.*

	Descriptives			
	Test Block		Practice Block	
Competitive Anxiety	Block 4 *M* (*SD*)	Block 7 *M* (*SD*)	Block 3 *M* (*SD*)	Block 6 *M* (*SD*)
Group C (*n* = 33)	688.31 (± 95.29)	741.40 (± 137.28)	156.29 (± 123.50)	801.74 (± 125.68)
Group D (*n* = 31)	681.28 (± 104.05)	721.36 (± 119.79)	738.29 (± 115.43)	762.52 (± 123.42)

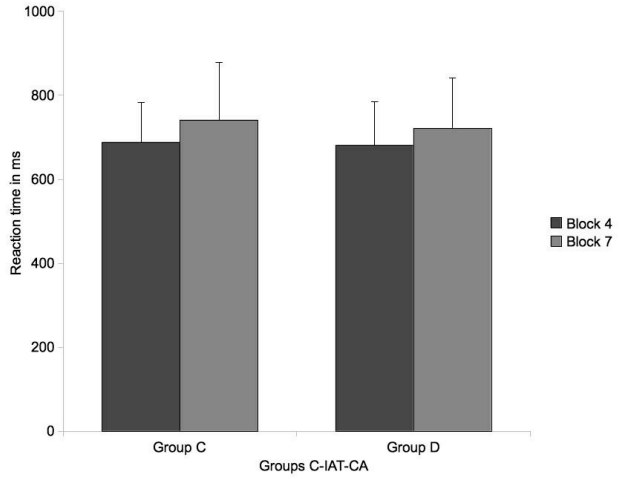

Figure 3.3.7. Significant differences of Blocks 4 and 7 for both groups of the C-IAT-CA.

Control-IAT-Sport Injury Anxiety

For the Control - IAT of Sport Injury Anxiety (C-IAT-SIA), the average IAT effect of the C-IAT-SIA shows an average value of $D = .67$ ($SD = .31$). The Kolmogorov-Smirnov-Test tested the response latencies concerning a normal distribution and finds an average Z-value of .55, which is not significant ($p > .05$). Thus, a normal distribution of response latencies is assumed also for this Control-IAT. Skewness and kurtosis were tested. There are values of -.06 ($SE = .29$) for skewness and -.31 ($SE = .58$) for kurtosis.

Mean scores and standard deviations were calculated for all blocks. Paired student t-Tests between the initial combined task (blocks 3 and 4) and the reverse-combined task (blocks 6 and 7) find significant mean value differences between both, the practice blocks 3 and 6 ($t(66) = -9.42$, $p < .01$) and the relevant test blocks 4 and 7 ($t(66) = -13.62, p \leq .01$; Figure 3.3.8). All means and standard deviations are displayed in Table 3.3.8.

Table 3.3.8. *Overall Mean Values and Standard Deviations of the C-IAT-SIA (N = 67).*

	Descriptives	
Blocks	*M*	*SD*
Mean Block 3	709.76	127.79
Mean Block 4	648.91	94.08
Mean Block 6	900.62	167.68
Mean Block 7	803.91	147.40

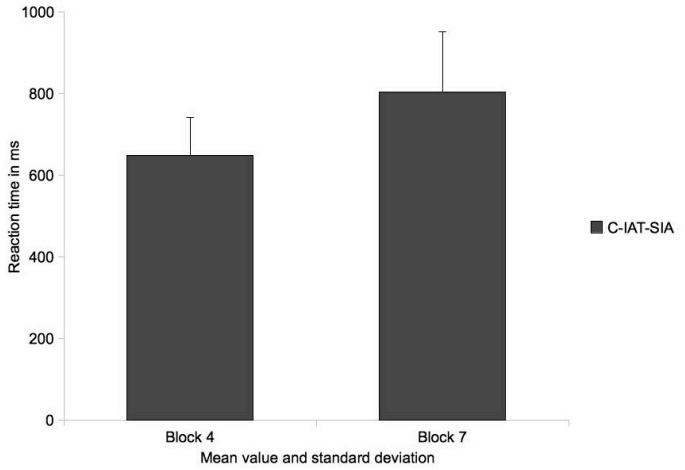

Figure 3.3.8. Significant mean value difference between the test blocks 4 and 7 of the C-IAT-SIA.

Accuracy

Analysing the learning behaviour, mean scores and standard deviations of the accuracy values were calculated for all blocks. Thus, the ACC value can be either 0 = *missed* or 1 = *passed*. Since the Mauchly's Test of Sphericity shows to be significant (Mauchly's $W = .32$, $p < .01$), adjusted results via Greenhouse-Geisser-correction are reported. The mean scores show a range between .91 and .97 ($M_{All} = .95$, $SD_{All} = .03$), thus, accuracy values show to be rather instable (Figure 3.3.9). The General Linear Model finds significant differences in the accuracy values between the blocks ($F(4,294) = 13.21, p \leq .00; \eta^2 = .17$). Significant differences show between the following blocks: block 1 and practice block 6 ($p \leq .01$), block 1 and test block 7 ($p \leq .05$), block 2 and practice block 6 ($p \leq .01$), practice block 3 and block 6 ($p \leq .01$), test block 4 and practice block 6 ($p \leq .01$), test block 4 and test block 7 ($p \leq .01$), block 5 and block 6 ($p \leq .01$) and finally, block 6 and block 7 ($p \leq .01$). Mean scores and standard deviations are displayed in Table 3.3.9.

Table 3.3.9. *Accuracy Values of the C-IAT-SIA (N = 67).*

	Descriptives	
Blocks	*M*	*SD*
Mean Block 1	0.97	0.05
Mean Block 2	0.97	0.04
Mean Block 3	0.96	0.05
Mean Block 4	0.97	0.03
Mean Block 5	0.95	0.06
Mean Block 6	0.91	0.08
Mean Block 7	0.94	0.07

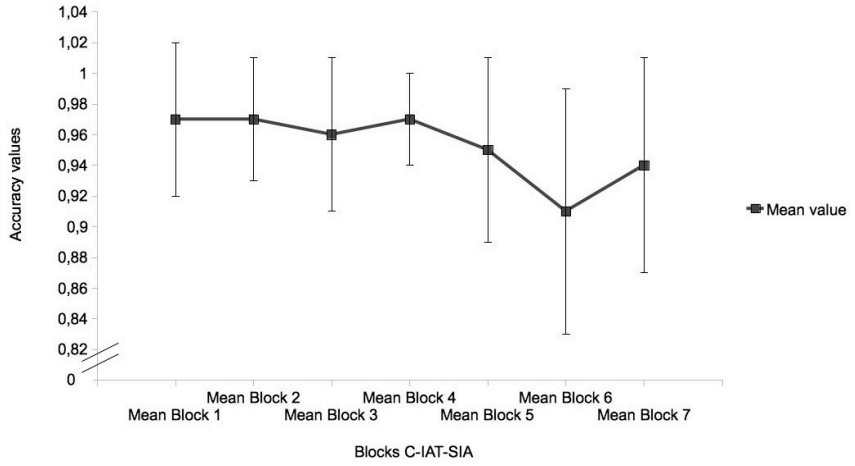

Figure 3.3.9. Average course of the learning behaviour in the C-IAT-SIA trial.

Order effects

Additionally, the IAT effects and their relevant descriptives were calculated for each sport injury anxiety group separately. In group A, the average IAT effect shows a value of D = .73 (SD = .26) with a Kolmogorov-Smirnov Z = .62, which is not significant (p >.05). Thus, a normal distribution of the response latencies is assumed

in this group. Skewness and kurtosis show a value of .35 (*SE* =.40) for skewness and a value of -.27 (*SE* = .79) for kurtosis.

Mean scores and standard deviations were calculated for all blocks of the C-IAT-SIA in group A. Paired student *t*-Tests of the response latencies between the initial combined task (block 3 and 4) and the reverse-combined task (block 6 and 7) find significant mean value differences between both, the practice blocks 3 and 6 ($t(33) = -8.54$, $p \leq .01$) and the critical test blocks 4 and 7 ($t(33) = -10.81$, $p \leq .01$).

For group B, the average IAT effect shows a value of $D = .61$ ($SD = .35$) with a Kolmogorov-Smirnov *Z*-value of .41, which is not significant ($p > .05$). A normal distribution of response latencies is assumed also in this group. Additionally, skewness and kurtosis were calculated. They show values of .01 (*SE* = .41) for skewness and -.68 (*SE* = .80) for kurtosis.

Mean scores and standard deviations were calculated for all blocks in this group B, too. Paired student *t*-Tests analysed possible mean value differences between the combined task and the reverse-combined task. Significant results are found between both, the practice blocks 3 and 6 ($t(32) = -5.33$, $p \leq .01$) and the critical blocks 4 and 7 ($t(32) = -8.53$, $p \leq .01$).

Table 3.3.10. *Mean Values and Standard Deviations of the C-IAT-SIA for the Groups in separate*.

	Descriptives			
	Test Block		Practice Block	
Sport Injury Anxiety	Block 4 *M* (*SD*)	Block 7 *M* (*SD*)	Block 3 *M* (*SD*)	Block 6 *M* (*SD*)
Group A (*n* = 34)	637.40 (± 69.68)	798.23 (± 130.54)	698.18 (± 116.65)	902.67 (± 145.99)
Group B (*n* = 33)	660.77 (± 113.85)	809.76 (± 164.84)	721.71 (± 139.14)	898.50 (± 189.75)

Due to varied order of the presented Control-IAT-SIA in the groups A and B, *t*-Tests analysed possible group differences between the IAT effects. Results are not significant ($t(65) = 1.62, p = .11$). All mean scores and standard deviations are displayed in Table 3.3.10 (see Figure 3.3.10).

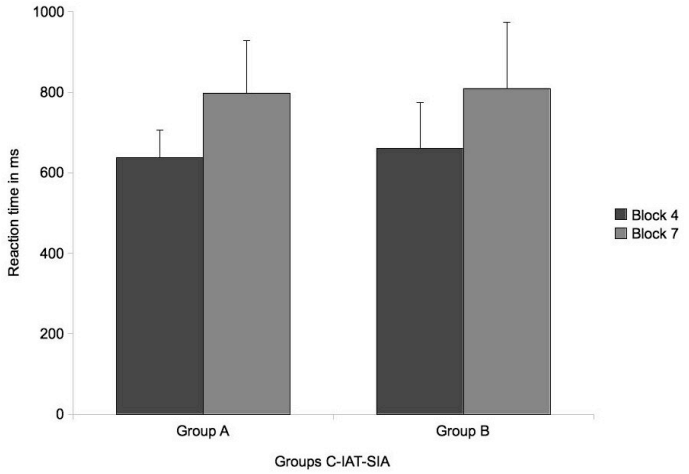

Figure 3.3.10. Significant mean value differences between the test blocks 4 and 7 for both groups of the C-IAT-SIA.

3.3.3.1.2 Reliability of the Implicit Association Tests and their Control-IATs

In the next step of the analysis of the methodical variability of the newly developed sport-specific IATs, the general IAT - Anxiety and their corresponding Control-IATs, the internal consistency of all IATs was calculated. In accordance with Egloff and Schmukle (2002), a difference measure for each trial's response latency of the critical blocks 7 minus block 4 was generated. Cronbach's Alphas were calculated from these difference scores (see Egloff & Schmukle, 2002, p. 1445).

For the general IAT-A, a reliability of Cronbach's Alpha $\alpha = .71$ is found. Specifically, for the group "sport injury anxiety" (group A and B), an internal consistency of $\alpha = .70$, and for the group "competitive anxiety" (group C and D), an internal consistency of $\alpha = .72$ is found. Reliability of the general IAT-A is considered acceptable.

The sport-specific IAT-CA shows a reliability of Cronbach's Alpha α = .77. The sport-specific IAT-SIA shows a reliability of Cronbach's Alpha α = .76. Both internal consistencies are considered acceptable, especially with regard to the sample size.

In addition, internal consistencies were also calculated for all the Control - IATs. The reliability of the Control-IAT-A shows a Cronbach's Alpha of α = .71. In the group "Sport Injury Anxiety" (group A and group B), the internal consistency of the C-IAT-A shows a Cronbach's Alpha of α = .76. In the group "Competitive Anxiety" (group C and group D), a Cronbach's Alpha of α = .61 is found for the C-IAT-A. Apart from the reliability coefficient in the group "Competitive Anxiety", reliability of the Control-IAT-A is considered acceptable.

Regarding the sport-specific Control-IATs, the C-IAT-CA shows an internal consistency of α = .65. The C-IAT-SIA, however, shows an internal consistency of α = .69. With respect to the small sample size of each sport-specific Control-IAT, both reliability values are still considered acceptable.

3.3.3.2 Demographic variables

Univariate variance analyses examined possible influences of demographic variables on the IAT effects: gender, level of sport, affiliation to team or individual sport, impact of competitions and impact of injuries.

Gender

An univariate variance analysis regarding the factors "gender" as independent variable and the Control-IAT-Anxiety *D* as dependent variable finds no significant difference in the response latencies between male and female athletes ($F(1,126) = 0.02$, $p > .05$, $\eta^2 = .00$). Regarding the sport-specific Control-IATs, similar results of the univariate variance analysis are found. Results show no significant difference between men and women in the response latencies of the Control-IAT-SIA ($F(1,63) = 2.36$, $p > .05$, $\eta^2 = .04$) and no significant differences in the response latencies of

males and females regarding the Control-IAT-CA ($F(1,62) = 0.19$, $p > .05$, $\eta^2 = .00$). All means and standard deviations are found in Table 3.3.11.

Table 3.3.11. *Mean Scores and Standard Deviations of the Variance Analysis regarding the Factor "Gender".*

		Gender	
		Males	Females
C-IAT-A *n* = 68 Males *n* = 60 Females	C-IAT-A effect	- 0.33 (± 0.34)	- 0.32 (± 0.34)
C-IAT-CA *n* = 37 Males *n* = 27 Females	C-IAT-CA effect	0.16 (± 0.34)	0.19 (± 0.26)
C-IAT-SIA *n* = 31 Males *n* = 34 Females	C-IAT-SIA effect	0.74 (± 0.34)	0.62 (± 0.29)

Level of Sport

The individual sport level has been assessed on a 4-point-Likert-scale on which each athlete chose which sport level group fits best: 1 = "*competition sport*", 2 = "*competition oriented leisure time sport*", 3 = "*leisure time sport*" and 4 = "*health sport*". Due to the small group sizes, the four groups were reduced to two groups: "competition sport / competition-oriented leisure sport" ($n = 68$) and "leisure - time sport / health sport" ($n = 61$) for the computation of the univariate variance analysis. Mean scores and standard deviations are found in Table 3.3.12.

Regarding the Control-IAT-A, a significant group difference in the average C-IAT-A - effect is not found ($F(1,127) = 1.32$, $p > .05$, $\eta^2 = .01$). No significant group difference in the average IAT score is found regarding the Control-IAT-CA ($F(1,62) = 0.77$, $p > .05$, $\eta^2 = .01$). A marginally significant results of the univariate variance analysis is found regarding the Control-IAT of sport injury anxiety ($F(1,64) = 3.15$,

$p = .08, \eta^2 = .05$), which indicates possible differences in the response latencies between "competition-oriented" and "leisure-time sport" athletes.

Table 3.3.12. *Mean Values and Standard Deviations of the Variance Analysis on the Factor "Level of Sport".*

		Level of Sport	
		Group 1 "competition-oriented"	Group 2 "not competition-oriented"
C-IAT-A *n* = 68 Group 1 *n* = 61 Group 2	C-IAT- A effect	- 0.29 (± 0.33)	- 0.36 (± 0.34)
C-IAT-CA *n* = 40 Group 1 *n* = 24 Group 2	C-IAT-CA effect	0.20 (± 0.30)	0.13 (± 0.31)
C-IAT-SIA *n* = 28 Group 1 *n* = 38 Group 2	C-IAT-SIA effect	0.75 (± 0.29)	0.61 (± 0.32)

Team or Individual Sport

A univariate variance analysis tested possible differences in the Control-IAT response latencies between the groups "team sport" versus "individual sport". Results show no significant group differences in the mean IAT effect of the Control-IAT-A ($F(1,126) = 0.64, p > .05, \eta^2 = .01$). Regarding the sport-specific Control-IATs, the univariate variance analysis on the groups "team sport" versus "individual sport" finds no significant mean score difference in the response latencies, neither regarding the Control-IAT-SIA ($F(1,126) = 0.37, p > .05, \eta^2 = .01$) nor regarding the Control-IAT-CA ($F(1,62) = 0.01, p > .05, \eta^2 = .00$). Mean values and standard deviations are found in Table 3.3.13.

Table 3.3.13. *Mean Values and Standard Deviations of the Variance Analysis regarding the Factor "Team vs. Individual Sport".*

		Team vs. Individual Sport	
		Group 1 "Individual Sport"	Group 2 "Team Sport"
C-IAT-A *n* = 63 Group 1 *n* = 65 Group 2	IAT-A effect	- 0.35 (± 0.35)	- 0.30 (± 0.32)
C-IAT-CA *n* = 27 Group 1 *n* = 37 Group 2	IAT-CA effect	0.17 (± 0.39)	0.17 (± 0.23)
C-IAT-SIA *n* = 37 Group 1 *n* = 28 Group 2	IAT-SIA effect	0.65 (± 0.35)	0.70 (± 0.26)

Competition participation

The impact of regular competition participation on the IAT effect of the Control-IATs was analysed via univariate variance analysis. Results show no significant difference in the response latencies between athletes, who participate regularly in competitions and athletes, who do not participate regularly in competitions. There is no significant difference regarding the general C-IAT-A ($F(1,125) = 1.35$, $p > .05$, $\eta^2 = .01$), the sport-specific C-IAT-SIA ($F(1,64) = 1.36$, $p > .05$, $\eta^2 = .02$) and the sport-specific C-IAT-CA ($F(1,60) = 0.78$, $p > .05$, $\eta^2 = .01$). Mean values and standard deviations are found in Table 3.3.14.

Table 3.3.14. *Mean Values and Standard Deviations of the Variance Analysis regarding the Factor "Competition Participation".*

		Competition Participation	
		Group 1 "Competitions"	Group 2 "No competitions"
IAT-A *n* = 59 Group 1 *n* = 68 Group 2	IAT-A effect	- 0.29 (± 0.35)	- 0.36 (± 0.32)
IAT-CA *n* = 31 Group 1 *n* = 31 Group 2	IAT-CA effect	0.21 (± 0.31)	0.14 (± 0.30)
IAT-SIA *n* = 28 Group 1 *n* = 38 Group 2	IAT-SIA effect	0.73 (± 0.27)	0.63 (± 0.34)

Severity of sport injuries and duration of rehabilitation

Regarding the assessment of methodical variance of the Control-IAT, knowledge about possible impacts of sport injury variables is also of importance. Therefore, duration of rehabilitation and perceived severity of the injuries were analysed with Pearson-Product-Moment-correlations. Only athletes of group A and group B were included in the analysis because they completed the sport injury anxiety questionnaire. Valid information was provided by $n = 50$ athletes. In the analysis, the first reported injury was considered regarding duration of rehabilitation and severity. Participants without any injury were excluded from this analysis (see section 3.2.2).

Correlational analyses between duration of rehabilitation and the indirect Control-IATs find no significant correlation, neither for the C-IAT-A ($r_{DR - C\text{-}IAT\text{-}A} = .15$, $p > .05$) nor for the C-IAT-SIA ($r_{DR - C\text{-}IAT\text{-}SIA} = -.08$, $p > .05$). Regarding severity of injuries and the indirect Control-IATs, similar results are found. There is no significant correlation between severity of injury and neither the C-IAT-A ($r_{SI - C\text{-}IAT\text{-}A}$

= - .01, $p > .05$) nor the C-IAT-SIA ($r_{SI - C\text{-}IAT\text{-}SIA} = -.19, p > .05$). Mean values and standard deviations are found in Table 3.3.15.

Considering these results, duration of rehabilitation and perceived severity of the injury have no relation to the response latencies of the Control-IATs.

Table 3.3.15. *Mean Values and Standard Deviations of the Factors "Duration of Rehabilitation" and "Severity of Injury".*

	Descriptives		
	N	*M*	*SD*
Duration of Rehabilitation (in weeks)	51	12.21	16.64
Severity of Injury	51	2.90	1.20

3.3.3.3 Validity and methodical variance of the Control-IATs

Pearson's product-moment correlations were computed to test the methodical relationship between the Implicit Association Tests and their corresponding Control-IAT. No significant correlation between the general IAT-A and the Control-IAT-Anxiety is found ($r_{IAT\text{-}A - C\text{-}IAT\text{-}A} = .07, p = .41$). A marginally significant positive correlation on a $p = .059$ level is found between the sport-specific IAT-CA and the C-IAT-CA ($r_{IAT\text{-}CA - C\text{-}IAT\text{-}CA} = .24; p > .05$). A significant positive correlation is found between the sport-specific IAT-SIA and the Control-IAT-SIA ($r_{IAT\text{-}SIA - C\text{-}IAT\text{-}SIA} = .32; p = .01$).

3.3.3.4 Further known-group effects

3.3.3.4.1 Regular participation in competitions

A first group was selected by the regularity of participation in sport competitions in order to test the Control-IATs regarding methodical variance. Therefore, all participants were separated into those, who regularly participate in competition and

those, who do not participate in competition. It was assumed, that athletes who are active in competition would show an active semantic concept of anxiety in sports. Hence, the semantically reduced Control-IAT would not show any significant correlation with the conventional semantic IAT. Correlations between the C-IAT and the IAT would indicate methodical variance in terms of the proposed figure-ground effect (Rothermund & Wentura, 2004).

N = 62 athletes (n = 32 females and n = 30 males) were assigned to the group of active participants of competitions. Their mean age was M_{Age} = 23.71 (SD = 2.47). About n = 17 participants took part in individual sport, n = 45 were team players. They participated in their sports on an average of M = 12.23 years (SD = 5.01). 21 % of the group considered themselves as elite athletes; 75 % considered themselves as participating in "competition-oriented leisure-time sport"; n = 2 participants took part in "leisure-time / health sport". 91.9 % considered themselves as being "very experienced / rather experienced" in competitions. N = 15 participants were currently suffering from an injury.

In the group of inactive participants of competitions, valid information was provided by n = 70 participants (n = 39 men; n = 31 women). The mean age of all participants was M_{Age} = 25.07 years (SD = 3.84). N = 49 participants were assigned to individual sports, n = 21 participants took part in team sports. They participated in their sports on an average of M = 8.30 years (SD = 5.47). As expected, no elite athletes were found in this group, but 10.0 % considered themselves as participating in "competition-oriented leisure-time sport"; 85.9 % participants took part in "leisure-time / health sport". 62.8 % considered themselves as being "not experienced / rather not experienced" in competitions. N = 3 participants were currently suffering from an injury. Mean values and standard deviations of both groups are presented in Table 3.3.16.

Product-moment correlations between the groups were computed. Regarding the active group, no significant correlation shows, neither between the IAT-A and the Control-IAT-A ($r_{IAT\text{-}A \text{ - } C\text{-}IAT\text{-}A}$ = .05; p = .75) nor between the IAT-CA and the Control-IAT-CA ($r_{IAT\text{-}CA \text{ - } C\text{-}IAT\text{-}CA}$ = .16; p = .39). Additionally, no significant

correlation is found between the IAT-SIA and the Control-IAT-SIA ($r_{\text{IAT-SIA - C-IAT-SIA}}$ = .34; p = .08). This result corresponds to the hypothesis described in the previous passage.

Table 3.3.16. *Mean Values and Standard Deviations of the Correlation between the IAT and the corresponding C-IAT in the Groups of Active and Inactive Competitive Athletes.*

	Regular Competitions	
	Group 1 "Active Competition"	Group 2 "Inactive Competition"
IAT-A *n* = 59 Group 1 *n* = 68 Group 2	- 0.34 (± 0.33)	- 0.40 (± 0.32)
IAT-CA *n* = 31 Group 1 *n* = 31 Group 2	0.43 (± 0.31)	0.41 (± 0.43)
IAT-SIA *n* = 27 Group 1 *n* = 38 Group 2	1.05 (± 0.39)	1.11 (± 0.25)
C-IAT-A	- 0.29 (± 0.35)	- 0.36 (± 0.32)
C-IAT-CA	0.21 (± 0.31)	0.14 (± 0.30)
C-IAT-SIA	0.73 (± 0.27)	0.63 (± 0.34)

Regarding the group of athletes who do not participate regularly in competitions, results of the product-moment-correlations show no significant correlation between the IAT-A and the C-IAT-A ($r_{\text{IAT-A - C-IAT-A}}$ = .04; p = .76). For the sport-specific IATs, no significant correlation is found between the IAT-CA and the C-IAT-CA ($r_{\text{IAT-CA - C-IAT-CA}}$ = .31; p = .09). Regarding the Sport Injury Anxiety IATs, however, a significant correlation is found between the IAT-SIA and the C-IAT-SIA ($r_{\text{IAT-SIA - C-IAT-SIA}}$ = .37; p = .02).

3.3.3.4.2 Regular competition participation and experience in sport injuries

In a second validity analysis, a new sample was selected: only those participants were included into sample who took part in competitions frequently and who had experience in sport injuries (thus, only group A and B were selected for the analyses). Therefore, a new variable was computed and only participants matching this variable were selected for the analysis. About n = 23 participants were selected into this group with n = 10 males and n = 13 females. Their mean age was M_{Age} = 23.35 (SD = 2.48). Most of them were active in team sport (n = 17), only n = 6 engaged in individual sports. They participated in their sport on the average of M = 11.74 years (SD = 4.64). 87 % engaged in competition-oriented leisure-time sport, only 2 participants were elite athletes, one participant engaged in leisure-time / health sport. 87 % considered themselves as being "very experienced / rather experienced" in competitions.

The mean duration of rehabilitation of the first reported injury was M = 13.93 weeks (SD = 22.69). 69.9 % of the athletes were fully recovered from injury. On a scale from 1 = "*harmless*" to 5 = "*severe*", n = 16 athletes ranked their injury ≥ 3. Mean values and standard deviations for this sample are displayed in Table 3.3.17.

A Pearson's product-moment correlation was run and shows the following results for this selected sample: there is no significant correlation neither between the IAT-A and the C-IAT-A ($r_{IAT - C\text{-}IAT}$ = -.08; p = .71) nor between the IAT-SIA and the C-IAT-SIA ($r_{IAT\text{-}SIA - C\text{-}IAT\text{-}SIA}$ = .33; p = .15). As expected, the results underline the assumption, that those athletes who participate regularly in competitions and have experience in sport injuries also have an active semantic concept of anxiety in sport; therefore, there is no correlation with a semantically reduced IAT.

Table 3.3.17. *Mean Values and Standard Deviations of the Correlation between the IAT and the corresponding C-IAT in the Groups of Active Injury-Experienced Athletes and Inactive Injury-Experienced Athletes.*

	Regular Competitions	
	Group 1 "Active / Injury Experience"	Group 2 "Inactive / Injury Experience"
IAT-A *n* = 22 Group 1 *n* = 27 Group 2	- 0.36 ± 0.34	- 0.45 ± 0.33
IAT-SIA *n* = 21 Group 1 *n* = 27 Group 2	1.02 ± 0.42	1.15 ± 0.22
C-IAT-A	- 0.38 ± 0.37	- 0.42 ± 0.33
C-IAT-SIA	0.70 ± 0.29	0.67 ± 0.36

3.3.3.4.3 No regular participation in competitions and experience in sport injuries

In addition, a third group was selected based on their competition participation and their experience in sport injuries (again, only participants of group A and group B were selected): those, who were not regularly participating in competitions but who had experience with sport injuries. About $n = 27$ participants were selected into this group with $n = 15$ males and $n = 12$ females. Their mean age was $M_{Age} = 23.78$ years ($SD = 2.33$). Most of them were active in individual sport ($n = 20$), only $n = 7$ engaged in team sports. They participated in their sport about $M = 7.65$ years ($SD = 5.57$). Only $n = 2$ athletes engaged in competition-oriented sport, 92.6 % of the participants engaged in leisure-time / health sport. 53.8 % considered themselves as being "very experienced / rather experienced" in competitions while 46.2 % considered themselves as "very unexperienced / rather unexperienced". The mean duration of rehabilitation of the first reported injury was $M = 10.88$ weeks ($SD = 9.58$). 74.1 % of the athletes were fully recovered from injury. On a scale from 1 =

"*harmless*" to 5 = "*severe*", n = 15 athletes ranked their injury ≥ 3. Means and standard deviations are displayed in Table 3.3.17.

Results of the product-moment correlation show a significant negative correlation between the IAT-Anxiety and the Control-IAT-Anxiety ($r_{\text{IAT-A - C-IAT-A}} = -.43$; $p = .03$). A significant positive correlation was found between the IAT-SIA and the Control-IAT-SIA ($r_{\text{IAT-SIA - C-IAT-SIA}} = .46$; $p = .02$).

The groups "active / no injuries" and "inactive / no injuries" received no detailed analysis due to small sample sizes ≤ 10.

3.3.4 Discussion

The goal of the third study was to identify methodical variance in the newly developed IATs of Competitive Anxiety and Sport Injury Anxiety as proposed in the figure–ground model of Rothermund and Wentura (2004, Rothermund et al., 2005). The figure–ground model provides a different explanation on the IAT effect. It focuses on salience and familiarity of the stimuli as an explanation, which is contrary to Greenwald et al. (2004), who explain the IAT effect by close cognitive associations between the determined concepts. The analysis of methodical variance is of special importance regarding the interpretation of the results found in the chapter 3.2 of this work. The current analysis interrogates whether the newly developed IATs also provide valid results independent of the valence of presented stimuli.

Greenwald et al. (1998) assume that the IAT effect D is solely association-based. Rothermund and Wentura (2004, Rothermund et al., 2005), however, propose a figure–ground effect (figure–ground asymmetries), which explains the IAT effects as method-biased by salience and familiarity (Mierke & Klauer, 2003). Therefore, Rothermund and Wentura (2004) developed the Word-/Non-Word-IAT, which is independent of valence. The current study applied the Word-/Non-Word-IAT (here: Control-IAT) to the sample. In the current study, three Control-IATs were developed. Correlations between the Control-IAT and the standard IAT (IAT-A, IAT-SIA, IAT-CA) would be not significant or rather small, if the IAT effect

functioned according to the assumptions of Greenwald et al. (1998). Results would not only appear because of methodical variance. Therefore, the current analysis additionally investigated the construct validity of the newly developed IATs.

Psychometric analyses

Results of the current study do not show any differences regarding standard methodical values (IAT effect, response latencies, order effects). No relevant results were found regarding the impact of the demographic variables gender, team sport and individual sport, participation in competitions, level of sport and occurrence of sport injuries. Reliability of the IATs and Control-IATs were computed and showed acceptable values (Cronbach, 1951).

Analysis of the methodical variance

Correlations between the IATs and their corresponding Control-IATs showed inconsistent results regarding methodical variance. No correlation was found between the IAT-A and C-IAT-A. Regarding sport-specific IATs, the IAT-CA and the C-IAT-CA showed a marginally significant correlation; the IAT-SIA and the C-IAT-SIA showed a clearly significant correlation. These inconsistent results point to methodical variance due to salience and familiarity as proposed by Rothermund and Wentura (2004). According to the figure–ground effect, the valenced sport-specific stimuli seem to find more attention within the sample of athletes, especially regarding sport injury anxiety. Therefore, a more differentiated analysis of the method for known-groups was conducted with a focus on competition activity and sport injuries.

Associative networks and mood-congruent representations can be automatically activated by emotional states (Bower, 1981). Emotional states can be influenced by internal and external stimuli, and trait-anxiety in particular leads to the allocation of visual attention towards a potential threat (MacLeod & Mathews, 1988). Therefore, the associative emotional network related to sport-specific stimuli of competitions

and sport injuries may be activated more easily in active than in inactive athletes because they may be confronted more often with corresponding stimuli (which might trigger the relevant emotional states and memories, Ehlers & Clark, 2000; Hebb, 1949). During the IAT process, in which target congruent stimuli are displayed, these implicit representations may be more present (Bower, 1981; for a discussion of the network-theory, see Eysenck, 1992, pp. 23ff). Therefore, several groups of athletes were selected. In additional known-group analyses, the current activity in competition participation and previous experience in sport injuries seem to make a significant difference regarding the methodical variance.

Active athletes

In accordance with Bower's theory of the emotional associative network (1981), no significant correlations between the IATs and the C-IATs were found in the active group. Valence-free stimuli material did not trigger the emotional associative network. Athletes, who are active in competitions, as well as athletes active in competitions with experience in sport injuries, seem to have an active semantic script of potential sport anxiety-related stimuli. This associative network might be activated by congruent stimuli when completing the IAT. Therefore, activation of the sport anxiety network will not occur when completing the non-semantic non-word Control-IAT. This finding corresponds with Greenwald et al.'s (1998) hypothesis of the associative character of the IAT, in which the IAT effect is based on close cognitive associations. In line with the argumentation of Rothermund and Wentura (2004), who propose figure–ground asymmetries as causal for the IAT effect, anxiety-stimuli would be possibly more salient and therefore, active athletes would show faster reaction times in the valence-based IAT than in the valence-free Control-IAT. Regarding the differing results between inactive and active athletes, use of this theoretical approach to explain the IAT effect in active athletes is rather inappropriate (see also Brand et al., 2011).

Inactive athletes

In inactive athletes, significant correlations were not found between the IAT-A and the C-IAT-A, and between the IAT-CA and the C-IAT-CA. Significant correlations, however, were found between the IAT-SIA and the sport-specific Control-IAT-SIA. Additionally, inactive athletes with experience in injuries also showed significant correlations between both the IAT-A and the C-IAT-A, and the IAT-SIA and the C-IAT-SIA. These rather inconsistent results support the assumption that inactive athletes do not have a stable active semantic associative network. In the absence of a concept about the presented content, semantic stimuli are more or less loosely activated while presented, depending on the intra-individually relevant salience and familiarity of the stimuli (see Rothermund & Wentura, 2004). This, however, is not the definition of an associative network (Greenwald et al., 1998; Bower, 1981). Therefore, with regard to these results, Rothermund and Wentura's (2004) theory about the IAT effect simply being a construct of salience asymmetry seems to be more appropriate. Because the IAT effect may be explained by factors which are based on the method of the IAT itself, methodical variance can be assumed in the group of inactive athletes.

Relevance of the results regarding the validity of the newly developed sport-specific IATs

First, the third study inspires us to think differentially about the regular analysis of validity: the IAT effect might as well be a construct of methodical variance (Mierke & Klauer, 2003). This assumption was shown regarding different groups; here, active athletes versus inactive athletes. Results showed that in active athletes, no methodical variance can be assumed, whereas in inactive athletes methodically biased results are more likely.

This finding points to construct validity itself. Results of the third study clearly correspond to inconsistent results of the first two studies (chapters 3.1 and 3.2). The sport-specific constructs of competitive anxiety and sport injury anxiety in particular show lower reliabilities compared to the general personality disposition of trait

anxiety. These constructs, which have been in the focus of research for a long time, are still discussed in terms of their theoretical basis. Dunn and Syrotuik (2003), for example, focus on the component "worry" separated from the complete construct of competitive anxiety. They differ between four different factors, which they call "fear of social evaluation", "fear of performance failure", "fear of the unknown" and "fear of injury/physical danger". In their considerations, sport injury anxiety becomes integrated as a part of competitive anxiety (here: "fear of injury/physical danger"). This approach, however, not only results in the question of whether sport injury anxiety is part of the competitive anxiety construct or a separated construct itself. It revives the rather unclear discussion about the concepts of "fear" and "anxiety" (for further discussion, see Hackfort and Schwenkmezger (1993) and Kleinert (2002)).

Additionally, these results correspond to the discussion about the correlation between indirect and direct measures (that is, implicit and explicit mental representations) in study 2. Hofmann et al. (2005) notes that the likelihood of a significant correlation between the IAT and direct self-report measures not only increases due to spontaneity in answering self-report measures. It also is more likely due to an increasing correspondence between measures. A lack of correspondence between measures reduces the correlation between direct and indirect measures (see Hofmann et al., 2005, p. 1382). In the current study, methodical variance was found in constructs that are still not as clear as the concept of general anxiety, with regard to reliability and validity. These findings are supported by Hofmann et al. (2005).

In conclusion, two final thoughts arise from the last analysis on methodical variance: First of all, this study contributes significantly to incremental validity on the sport-specific IATs because it concretises aspects of its methodical variance. Secondly, this study shows that in the application of the IAT, methodical variance is not more likely to occur in individuals with inactive associative networks of the construct, but also in constructs that are less clear and less detailed regarding their specific theoretical background.

4 General Discussion

The goal of this work was to identify and concretise the position of implicit representations of anxiety in sport using an indirect method in comparison to explicit representations of anxiety in sport by using self-report questionnaires as a direct method.

Greenwald et al. (1998) and Egloff (2008) underline the importance of valid replies to psychological instruments: that is, free from impression management, self-deception, faking and a lack of introspection. Therefore, several indirect instruments, for example the IAT (Greenwald et al., 1998), were developed. Greenwald et al. (1998) focused mainly on social psychological topics, whereas Egloff and Schmukle (2002) introduced the IAT-Anxiety to investigate personality dispositions. Several different psychological theories of social cognition served as theoretical background to the functionality of the indirect method of measurement.

The current work is based on dual-process theories (for an overview see chapter 2.4 of this work) and focuses specifically on the application of an IAT in relation to sport-specific anxiety. Whereas the IAT has been already applied in the sport context of anti-doping (Brand et al., 2009; King Chun Chan et al., 2018) and group processes (Ohlert & Kleinert, 2009), affect-connoted constructs such as competitive anxiety and sport injury anxiety were not in the focus of the current implicit and explicit research in sport.

4.1 Three investigations of sport-specific anxiety by Implicit Association Tests

In the first study, the IAT-Anxiety (IAT-A) by Egloff and Schmukle (2002) was applied as an indirect instrument along with the German version of the Competitive Anxiety Inventory (WAI-T, Brand et al., 2009) and the German version of the Sport Injury Anxiety Test (SVAT, Kleinert, 2002a) as direct instruments to a sample of athletes. Results were satisfying with regard to the IAT effect and its basic psychometric properties. Reliability of the direct measures of anxiety were acceptable, except for the sport injury anxiety scales with Cronbach's Alpha ranging between .76 and .60 (Cronbach, 1951). This result might be due to either the rather small sample or poor inter-relatedness between the items of the scales or to the possibility that some of the items contribute to the overall scale inadequately (Tavakol & Dennick, 2011). Additionally, social desirability measured via the German version of the BIDR (Musch et al., 2002) showed rather low reliability, which might be due to the small sample size. This, however, is in accordance with Musch et al. (2002), who found rather low corresponding values of internal consistency (Cronbach's Alpha = .64 and .66) in their studies on the construction of the German BIDR. Moreover, results of social desirability were shown to have an impact on self-reported anxiety levels, whereas no relation was found between social desirability and the indirect measure of anxiety.

Correlations between the direct data were significant on all measures, pointing to a satisfying convergent validity and corresponding to current research on general and sport-specific anxiety. No significant correlation was found between indirect and direct measures. This result corresponds to results of current research, which found only small correlations if any at all (for an overview see Hofmann et al., 2005). For a more detailed discussion of study 1 results, see the relevant chapter in section 3.1.4.

In addition to these basically construct-conform results, the first study points out the necessity of a sport-specific instrument for a sport-specific field of research by the inconsistent results of known-group analyses (see also Allmer, 1999; Gill & Deeter, 1988; Kellmann & Beckmann, 2003; Hänsel, Baumgärtner, Kornmann & Ennigkeit,

2016). Studies on the Brief-IAT (Sriram & Greenwald, 2009) propose the importance of construct-specific stimulus material. Therefore, in a second study, two sport-specific IATs based on the IAT-A by Egloff and Schmukle (2002) were newly developed to give more precise information about sport injury anxiety and competitive anxiety: the IAT-Competitive Anxiety (IAT-CA) and the IAT-Sport Injury Anxiety (IAT-SIA). Along with direct measures of trait anxiety, competitive anxiety and sport injury anxiety, these IATs were applied to a new sample of 136 athletes. Results showed sufficient reliability and IAT effects. In addition, correlational analyses also found inconsistent results regarding the validity measures. Nevertheless, this result is acceptable with regard to discussion of the relation between indirect and direct measures (see Hofmann et al., 2005). However, both IAT results show overall accordance with previous similar studies (see chapter 2 of this work). Moreover, the results highlight the importance of situational context specificity and precision of the construct-specific stimulus material in the development of new instruments.

The goal of the third study was to investigate whether the IAT effects of study 2 were coincidental due to methodical variance (Mierke & Klauer, 2001). Therefore, another theoretical model for the explanation of the IAT effect was assumed. Whereas Greenwald et al. (1998) explain the IAT effect by close cognitive associations on a specific construct, Rothermund and Wentura (2004) explain the IAT effect by salience and familiarity of the stimulus material (figure-ground-effect). Thus, valence-free Control IATs (Rothermund & Wentura, 2004; Rothermund et al., 2005) were additionally applied to the sample in study 2. Results were analysed regarding construct validity of the sport-specific IATs. The outcome underlines the incremental validity of the newly developed IATs by showing the importance of clarity and concreteness of psychological constructs with regard to methodical variance in the indirect measurement.

4.2 The relation between implicitly and explicitly represented sport-specific constructs

One of the most relevant results of this work focuses on the relation between implicitly and explicitly represented sport-specific constructs. In the first study, general trait anxiety as a personality disposition was measured twice: indirectly by the IAT-A by Egloff and Schmukle (2002) and directly by applying the STAI-T by Spielberger et al. (1970) in a German-translated version (Laux et al., 1981). In the second study, competitive anxiety and sport injury anxiety were measured directly by questionnaires and indirectly by newly developed IATs. In both studies, inconsistent results of the correlation between indirect and direct data were found. Gschwendner et al. (2006) propose a plausible model which explains the relation between implicit and explicit constructs (see also Hofmann et al, 2005; Figure 2.7 in chapter 2). In this model, they suggest theory-, method- and experiment-based moderator effects on the relation between implicit and explicit constructs. Whereas method-based moderator effects may be due to low reliabilities of the applied instruments, experiment-based moderator effects may focus on the distinct correspondence between the data (Gschwendner et al., 2006, p. 74). A theory-based moderator may be the motivation to control prejudices (e.g. Banse & Gawronski, 2003; Hofmann, Gschwendner & Schmitt, 2005b) with high correlations between indirectly and directly measured data in individuals being low in their motivation to control prejudices. Another possible theory-based moderator may be spontaneity (Hofmann et al., 2005b) with higher correlations between indirect and direct data in more spontaneous replying behaviour. Another study by Ranganath, Smith and Nosek (2008) showed a better model fit of direct and indirect data loading on one factor than on separated factors when instruments were applied under time pressure. Wittenbrink, Judd and Park (2001) showed higher correlations between IAT data and direct measures when individuals were shown a prejudice-congruent video film to activate the relevant scripts before answering the prejudice IAT (see also Gschwendner et al., 2006). These results correspond to results of active versus inactive athletes regarding IATs in study 3 (see chapter 3.3.3). The activation of construct-congruent scripts by

construct-congruent stimulus material in the presentation of the IATs seems to be of relevance and points to the importance of situational context.

An overview given by Blair (2002) shows the importance and influence of context variables on the IAT effect itself. Blair (2002) proposes the influence of four factors on automatic responses to stereotypes (contradictory: see Bargh (1997) on the uncontrollability of automatic processes due to a certain trigger): self and social motives, specific strategies such as suppression (e.g. Gollwitzer & Schaal, 1998), the configuration of stimulus cues (e.g. a change of context cues, see Macrae, Bodenhausen & Milne, 1995) and the perceiver's focus of attention.

In the model of early social information processing, Blair (2002) proposes that the individual's motives in the situation are essential for the further information processing. Some of the motives are always present to the individual. Other motives are only available in several specific situations. These motives are supposed to influence the automatic information processing in an indirect way, for example, by influencing the individual approach to a certain situation and thus, the individual focus of attention on a cue or a stimulus. In such a way, the automatic processing will be adapted, and the focus of attention may be drawn towards or away from a cue (Blair, 2002, p. 257). The influence of the social context (Macrae et al., 1995) and the strategies to counter certain attitudes modulate the automatic processing in a similar way. However, Blair's model (2002) is focused on stereotypes. Personality dispositions like anxiety should still be explored based on this theoretical model. The influence of attentional focus on automatic processing will be of relevance in the consideration of this work.

4.3 Information processing in the context of anxiety as emotional construct

Whereas different dual-process theories try to explain the relation between indirect and direct measures, Ouimet et al. (2009) state that these theories might not sufficiently explain emotional constructs and their cognitive biases during information processing in a given situation (see also Sherman et al., 2008). Anxiety serves as personality disposition and it can be clinically relevant (for example, spider phobia). Cognitive biases in information processing are of significance especially in the context of anxiety and clinically relevant anxiety disorders. From the perspective of a personality disposition, trait anxiety is defined as the tendency to interpret stimuli in a rather threatening manner based on the idea that anxious individuals see their world as being threatening. To be consistent, these individuals confirm their world view in the selective interpretation of stimuli as threatening (Spielberger, 1971; Beck, 1967). Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg and van Ijzendoorn (2007) conclude in their meta-analysis about selective attentional processes that anxious individuals pay more attention to threatening stimuli (see also Mogg et al., 2000, for non-clinical individuals). In stimulus interpretation-biased processes, research has repeatedly shown differences in anxious and non-anxious individuals regarding their interpretation of ambiguous stimuli (see also above Spielberger, 1971; Beck, 1967). Anxious individuals tend to show a more negative and threatening interpretation of ambiguous stimuli (see also Martens et al., 1990 for competitive anxiety). Research on anxiety found a higher tendency to develop clinically relevant disorders in individuals with higher trait anxiety, especially early-onset, which seems to be related to a biased system of information processing (Beck, Emery & Greenberg, 1985; Leonardo & Hen, 2008, on the developmental aspects of anxiety). The current work adds to this research by showing similar correlations between sport-specific anxiety and trait anxiety. Additionally, response reaction times differ depending on the presented valued stimuli. The response reaction time is supposed to relate to speed of information processing and strength of automatically activated construct-relevant associations (Greenwald et al., 1998). Before a response to a stimulus is elicited, the individual has to pay attention to the stimulus (here:

potentially threat-related stimuli of the IATs). Therefore, attentional biases and situation-specific factors cannot be ignored in the context of information processing during the application of the IAT.

4.3.1 A multi-process model of information processing

Eysenck (1992) highlights the importance of individual differences in the processing of threat-related stimuli, which would make them vulnerable to anxiety. Especially, regarding the correlation between trait anxiety as personality disposition and sport-specific competitive anxiety and sport injury anxiety (Brand et al., 2009; Strahler et al., 2010; Kleinert 2002a), Ouimet et al.'s (2009) model of anxiety vulnerability seems interesting. This model proposes an explanation regarding the relation between indirect and direct anxiety measures in the processing of information. Based on the information processing model by Beck and Clark (1997), Ouimet et al. (2009) conclude, that usually both, automatic and strategic components are active during the information processing of threat-relevant stimuli (see McNally, 1995; Sherman et al., 2008). According to Ouimet et al. (2009), dual-process theories contribute to all stages of processing threat-related stimuli. The proposed multi-process model of information processing by Ouimet et al. (2009) integrates all four stages (see Figure 4.1).

As can be seen from Figure 4.1, both systems – automatic/associative and strategic/deliberative (Strack & Deutsch, 2004) – contribute to selective attentional processes and cognitive biases in the interpretation of potentially threatening stimuli. Ouimet et al. (2009) conclude that all four stages of information processing are relevant for selective attentional biases in anxious persons. The main claim of the multi-process model of cognitive vulnerability to anxiety is: "...that individual differences in the two kinds of processes may be responsible for cognitive biases at different stages of processing threat-relevant stimuli, thereby contributing to the development and maintenance of various types of anxiety disorders..." (Ouimet et al., 2009, p. 464).

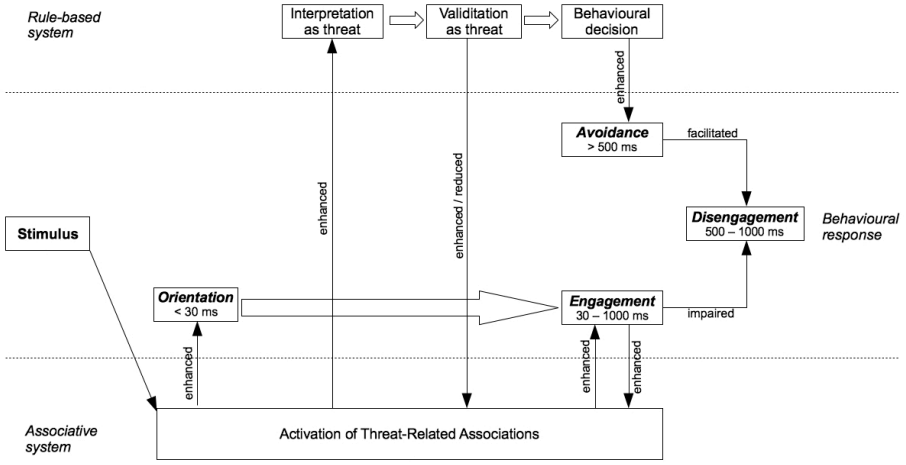

Figure 4.1. Multiprocess model of cognitive vulnerability to anxiety (illustration from Ouimet et. al. 2009, p. 465).

Orientation

In the model, a stimulus enters the sensory system of an individual. In the orientation stage that follows, the individual pays attention to the stimulus. The stimulus activates corresponding concepts in the individual's associative network. Regarding dual-process theories, this stage is located in the associative implicit system and thus, is unintentional and rather unconscious. Studies have shown evidence for the capture of cognitive resources at this stage (McNally, 1995; for an overview see also LeDoux, 2001). The strength of the individual's associative network is the central individual and thus differentiating factor, contributing to vulnerability of developing and maintaining anxiety at this stage of attentional orientation.

Interpretation and validation

During threat interpretation and validation stages, the rule-based system is activated. According to the dual-process theories, the associative and rule-based systems act in parallel. Inputs from the associative system are automatically interpreted and appraised by the rule-based system (Strack & Deutsch, 2004). According to Ouimet et al. (2009), here again the strength of the associative network (see also Fazio, 2001; Greenwald et al., 1998) serves as an important individual factor in the interpretation

of a stimulus as threatening to the organism. Gawronski, Geschke and Banse (2003) underline Ouimet et al.'s (2009) approach to interpretation. They state that interpretation involves cognitive strategic processes which are also influenced by activated associations outside of conscious awareness. Interpretation of the incoming information as "threatening" or "not threatening" is important in this process. Even though interpretation and validation processes are rather fast, they are still controllable in terms of the interpretation being invalid, regarding additional information. In individuals with anxiety disorders, this is especially true. Ambiguous stimuli which enter the system lead to rapid orientation, due to a highly aware associative network, which automatically activates threat-related associations and immediately interprets simuli as threatening (e.g. Ouimet et al., 2009, Yoon & Zinbarg, 2007; Amin, Foa & Coles, 1998; Miers, Blöte, Bögels & Westenberg, 2008). Validation of an interpretation may confirm or disconfirm the truth of the interpretation or lead to a new interpretation (Gawronski & Bodenhausen, 2006). Depending on the result, this process has an impact on the behavioural decision.

Avoidance, attentional engagement and attentional disengagement

Validation of a threat can enhance or reduce the activation of threat-related associations in the associative system. In the rule-based system, a valid interpretation of a stimulus as threatening will lead to avoidance behaviour, because the system wants to reduce the continuous activation of threat-related associations in order to return to strategic behaviour (similar to "I have seen it, I know it but I have to calm down in order to avoid panic."). The validation of being true, however, also leads to direct enhancement of the associative network, akin to a continuous feedback loop. This activation of threat-related associations leads to enhanced attentional engagement with the stimulus (similar to "Be careful! Watch the stimuli! Stay awake!"). Studies have shown that the negation of a stimulus as threatening does not lead to reduction of activation but rather to further enhancement of the activation of associative thoughts (see Gawronski et al., 2008; Wegner, 1994). Wegner (1994, in line with Lazarus & Folkman, 1984) proposes that the third possibility of validation, that is, the reappraisal of a stimulus, seems to be the best way to cope with upcoming

fear and overcome fear responses by using the rule-based system effectively. Rule-based strategies of reinterpretation of a stimulus reduce the activation of the associative network (e.g. Mitchell, Nosek & Banaji, 2003) because they find alternative explanations of the fear response, reduce behavioural responses of the system and lead to a reduction of attentional engagement.

Attentional disengagement is defined as a "... joint product of (a) enhanced engagement responses elicited in the associative system and (b) ineffective avoidance responses generated by the rule-based system ..." (Ouimet et al., 2009, p. 466). The associative system directs attention impulsively towards a stimulus while the rule-based system directs behavioural responses away from the stimulus (*attentional conflict*). This conflict becomes especially evident in the context of threat-relevant stimuli because individuals tend to pay attention to threatening inputs in order to keep up with the fear response and respond effectively to the stimulus. This sequence of events continuously enhances the conscious decision to avoid attention to the stimulus (Ouimet et al., 2009). Ouimet et al. (2009) propose that anxious individuals might have more problems with ineffective attentional disengagement than with enhanced attentional engagement. In accordance with studies by Hofmann, Gschwendner, Friese, Wiers and Schmitt (2008) as well as Strack and Deutsch (2004), which focus on impacts of working memory capacity and physiological arousal in interactions between rule-based and associative systems, Ouimet et al. (2009) conclude that three aspects are important for information processing of anxiety-relevant stimuli: the activation of threat-related associations, the invalidation of threat via reappraisal and the effectiveness of executive control.

Thus, this model not only integrates different stages of information processing, it also proposes individual differences in rule-based and associative systems of dual-process theories in information processing of anxiety. These differences focus on the strength of the threat-related associative network, the effectiveness of strategies to reappraise threat-related inputs and aspects of executive functioning such as physiological arousal or working memory capacity. In this way, symptoms of anxiety are linked to the core of information processing.

4.3.2 Contribution of this model to the current study

The multi-process model of information processing by Ouimet et al. (2009) proposes the integration of the interaction of associative and deliberative components of dual-process theories into the four stages of information processing, in the context of intra-individual anxiety. Selective attentional processes and attentional biases are of importance in the interpretation of stimuli. The current studies showed differences between individuals in their response reaction times due to the presented stimuli, which were either target-congruent or -incongruent. Anxious individuals showed faster response reaction times on threat-related stimulus material which suggests valid operation of the newly developed sport-specific IATs. In the interpretation of the IAT effect, associative strength of the activated target-network (Greenwald et al., 1998) and figure-ground effects regarding salience and familiarity of the stimulus material (Rothermund & Wentura, 2004) point to the relevance of attentional focus and selective attentional processes regarding the selected stimulus material of the IAT.

In the orientation stage of information processing (see theory above), attention and attentional focus are of particular importance. According to Ouimet et al. (2009), information processing is influenced by selective attention and biased interpretation of ambiguous information. As proposed by MacLeod and Mathews (1988), anxious individuals preferentially focus their attention on threat-related stimuli. Ouimet et al. (2009) summarised that ineffective disengagement from threat-related stimuli (which could be due to deficient strategies of reappraisal and problems focusing on other stimuli) appears to be a major problem in anxious individuals. Such individuals detect and assimilate threat-related stimuli faster (*automatic system*), and thus consciously want to disengage from them (*deliberative system*). Attentional focus, however, remains on these stimuli to prepare for effective coping (*automatic system*). The imbalance between the automatic and deliberative systems probably causes faster response reaction times in the recognition of stimuli, which is measured by the IAT procedure.

4.3.3 Impact of dysbalance on performance in sport

Physical and mental reactions on a behavioural level are not measured by the IAT procedure. Regarding performance in sport competitions, individuals might remain in a state of dysbalance without being able to perform well. This, in turn, might cause worse performance outcomes (Wilson, Vine & Wood, 2009; Janelle, 2002). The athletes' attentional focus would be evaluated in the automatic system to remain on the potentially threatening stimulus, whereas the goal to perform well and re-appraise the potentially threatening cue as being less threatening (*re-interpretation and positive coping in the deliberative system*) would be less in the attentional focus. Ouimet et al.'s (2009) theory describes reduced capacity of working memory as essential for vulnerability to anxiety. Reduced capacity of working memory in combination with a rapid associative network in anxious individuals with inadequate coping strategies might explain dysfunctional performance. That is, no working memory capacity remains for the relevant task of an effective initiation of motor activity.

Therefore, attentional focus and factors related to vulnerability to anxiety described above are linked to sport performance in anxious individuals. This means that the impact of attentional focus (which in the IAT means the faster realisation of threat-related stimulus words and an elicited response) is important for performing well even in states of anxiety in the sport context.

4.4 Attentional control in anxious individuals

In their theory of attentional control, Eysenck et al. (2007) propose a balanced interaction between two systems: the goal-directed and stimulus-directed attentional systems. The switch from goal-directed to stimulus-driven attentional control is essential in threatening situations to detect sources of potential threat and to react effectively (*validation* and *re-appraisal*). Therefore, attentional control might be seen as a coping process in the face of potential threats. In anxious individuals, the coping function of attentional control (directing and re-directing the attentional focus) is disrupted due to impacts of anxiety on central executive functions. Goal-directed and stimulus-driven attentional systems are out of balance. In this case, attentional focus appears to be wider and stimulus-driven. The associative network is activated, and the system is continuously engaged with the threatening stimulus (Ouimet et al., 2009). Therefore, attentional focus rests on the threatening stimulus (*stimuli-driven attentional control*). In highly anxious individuals, the switch between the associative system (*network*) and the deliberative system (*validation* and *re-appraisal*) is dysbalanced, as well (Ouimet et al., 2009). Therefore, the main problem might not only be the dysbalance of the two systems of information processing as proposed by Ouimet et al. (2009), but the switch between these two information processing systems (compare to the remarks on task-switches causing the IAT effect by Mierke (2003) and Mierke and Klauer, 2001). If the interaction between the information processing systems of associative and deliberative functioning is disrupted (or imbalanced), coping strategies like re-appraisal will not be activated because attentional focus and thus, attentional control rest on the potentially threatening stimuli.

According to Greenwald et al. (1998), the association between stimulus words is stronger in congruent target categories, and individuals react faster. According to Ouimet et al. (2009), this is also true in anxiety-related information processing. Thus, in incongruent tasks, attentional focus still remains on the congruent stimuli. A switch between the tasks requires more energy, and is combined with higher costs in the executive functions (Mierke & Klauer, 2001). "...This ability to switch attention from one stimulus to another, however, is hypothesized to be particularly difficult for

anxious individuals if the engaged stimulus is threat-relevant ..." (Ouimet et al., 2009, p. 461ff). Salemink, van Hout and Kindt (2007) confirm this hypothesis in their experiments with highly and less anxious persons. While reaction time responses of anxious individuals do not differ between neutral and congruent stimuli, difficulty in reacting towards incongruent stimuli is revealed in the anxious group. Therefore, in the current IAT-Anxiety, anxious athletes react slower in responding to the incongruent stimulus categories. This is because anxious athletes have more difficulty disengaging from threatening stimuli and activating goal-oriented attentional control to overcome the dysbalanced state, and fulfil the required task (Ouimet et al., 2009; Eysenck et al., 2007; Wilson et al., 2009). Deliberative information processing can not be activated in the dysbalanced state although this would be essential for a faster reaction to incongruent stimulus words. This means that the dysbalanced state of engagement and disengagement is maintained. In the IAT, anxious athletes react slower in the incongruent task. During competition, they show poorer performance because their attentional focus remains fixed on the threatening stimuli entering their information processing system (*stimulus-driven attentional control*). It is impossible for these individuals to redirect their attentional focus, get out of the dysbalanced state and activate their coping strategies to overcome the threatful situation of a competition by re-appraising the stimuli (Ouimet et al., 2009; Lazarus & Folkman, 1985). In the current study, this was confirmed not only by slower reactions of anxious athletes in the incongruent tasks, but also by significant differences in the accuracy values of the tasks.

In conclusion, the current work supports the work by Mierke and Klauer (2001), suggesting that problems in switching between incongruent and congruent tasks are displayed clearly by differences in response reaction times between anxious and not-anxious athletes.

4.4.1 Attentional focus and its consequences regarding the Implicit Association Test

Regarding the IAT, it is important to remember that there are stimulus cues which tend to direct attentional focus. Results of the IAT show to be a highly sensitive

reaction of anxious individuals to anxiety-relevant stimuli. Anxiety-relevant stimulus material is perceived in a more selective and thus faster manner by rather anxious individuals, which is the general idea of the IAT-Anxiety (Egloff & Schmukle, 2002). This is also shown in the results of the current work – in active athletes who should have a mental script of sport-specific anxiety and in inactive athletes, who should not have a mental script of sport-specific anxiety (see chapter 3.3). These results highlight the importance of the stimulus material when presenting the IAT. The work of Wilson et al. (2009) confirms this in showing the influence of threatening stimuli and potentially threatening situations on visual attentional control. Further, this assumption corresponds to Blair (2002), who proposes the influence of context variables on the IAT effect. Macrae et al. (1995; see also Macrae, Hood, Milne, Rowe and Mason, 2002) emphasize that stimulus material and context variables that direct attentional focus of individuals participating in the IAT are essential and have to fit the situation. Concretely, it is important to know the relevant situation (competition or sport context in which sport injury anxiety appears) and relevant stimulus cues that might trigger anxiety when investigating competitive anxiety or sport injury anxiety with the IAT.

Therefore, attentional control in the implementation of the IAT seems to be of special relevance. The context situation in which the IAT is presented, is as important as the stimulus cues, because attentional control is directed by certain internal or external cues which might have an influence on performance of the IAT. The effect of cues on performance depends on the individual's ability to cope with the potentially threatening stimuli that enter the information processing system. As described above, anxious individuals appear to have problems in information processing of threatening stimuli. In the application of the IAT, it was possible to show group effects of anxious versus non-anxious individuals. Regarding the IAT effect, both inter-individual differences and intra-individual differences must be considered. The stimulus material of the IAT causes the IAT effect, representing the strength of the associative network and the interaction between the two information processes.

Nevertheless, associative strength and thus, significance of the IAT effect are also moderated by the situation in which the stimulus material is presented, depending on whether the individual has an active script of the material in the relevant situation or not (Gschwendner, Hofmann & Schmitt, 2008). Results on anxiety by Gschwendner et al. (2008) showed the context-sensitivity of the IAT by higher 2-week stability when the assessment took place in a context-congruent background. Thus, context features of stimulus presentation also influence effectiveness of the IAT. As Gschwendner et al. (2008, p. 76) state: "... The associative network contains associations of different strengths that can only be measured if they are activated. Different contextual constraints may activate different information for a given object...".

In conclusion, IAT method allows measurement of the strength of associative links by context-specific anxiety-triggering stimulus cues. Therefore, the IAT captures automatically running cascades of anxiety. These might be associative cognitive anxiety patterns with a possible impact on cognitive competencies (such as working memory and attention), but also on physiological, motivational and volitional processes. Via the IAT, it is possible to detect these associative automatic anxiety patterns and make this knowledge available for the development of practical coping strategies. Therefore, a fruitful extension might be to modify the IAT methodically, also considering context-sensitivity of the IAT.

4.4.2 Options for the modification of the Implicit Association Test

The possibility to modify the IAT begins with the selection of stimulus material. In the current work, the stimulus material was rated by sport experts after applying the Word Association Test to a sport sample of active athletes (Ceglarek, 2009; compare also to Teachman et al. (2001) for a more detailed description on stimulus material in an IAT-A of spider phobia; Fazio & Olson, 2003; Olson & Fazio, 2004). Individuals were chosen randomly. It remained unclear if they participated in competitions or if they had experienced sport injuries previously.

Nevertheless, there are other possibilities to select stimulus material, for example by physiological markers. Several psychophysiological measures have been used to test predictions of neuronal processes of anxiety, already employed in part, in sport contexts: heart rate variability (Blásquez, Font & Ortís, 2009; Chalmers, Quintana, Abbott & Kemp, 2014), cognitive pupillary response (Wilson, Smith, Chattington, Ford & Marple-Horvat, 2006), gaze behaviour (Janelle, 2002; Behan & Wilson, 2008), event-related potentials (e.g. Fox, Derakshan & Shoker, 2008), galvanic skin resistance (Tremayne & Barry, 1990) and neuroendocrine stress hormones (Ehrlenspiel & Strahler, 2012). Additionally, test theory standards in item selection could be subject to more attention (Rost, 1996). Easy, medium and difficult items should not only be considered but also be counterbalanced in the presentation of stimuli. Moreover, the positive primacy effect (Asch, 1946) should be respected just as the strength of the associative network itself.

Aside from changing the selection and modification of stimulus material, the personalization of the IAT is also an option for modification in the method. Olsen and Fazio (2004) introduced methodical changes to the IAT procedure. They critically propose that the current IAT procedure might be contaminated by extra-personal associations. Karpinski and Hilton (2001) contributed to the implicit-explicit-dissociation discussion by suggesting that the IAT is influenced by environmental associations, which comprise culturally shared but not necessarily individually accepted information about a certain target (see in Olson and Fazio, 2004, p. 654). Thus, Olson and Fazio (2004) conclude that the IAT effect might be biased by these extra-personal associations, because the information stored in memory which might be incongruent with an individual's personally held attitudes, would be also associated with the presented stimulus combination and thus, it might cause a faster response reaction time. To overcome contamination of the IAT, Olson and Fazio (2004) propose the personalization of the IAT by replacing the value category "pleasant/unpleasant" with "I like/I do not like". Several experiments by Olson and Fazio (2004) aiming to analyse the changed procedure showed positive results (critically: Nosek and Hansen, 2008). Nevertheless, more research is essential regarding a valid personalization of the IAT procedure.

The Brief-IAT (introduced by Sriram & Greenwald, 2009) is another possibility to modify the standard IAT procedure concerning economy. This test is supposed to reduce spontaneous response variation of individual respondents. Instead of four categories, the BIAT requires individuals to focus on two category-response mappings only. In the procedure, stimulus items are presented to individuals, who are instructed to memorise two category stimulus items and reply to them with a "focal" response key if the items fit one of the categories. If they do not fit one of the two categories, individuals must reply by pressing an alternative "non-focal" response key. Faster reactions to stimulus items are expected if there is congruency between the combined task and the individual's internal attitudes. With 80 trials and two blocks, a significant reduction in administration time is achieved in the specific situation compared to the standard IAT (Sriram & Greenwald, 2009, p. 283). Regarding its economy and expenditure of time, the modified BIAT serves as a methodical alternative to the standard IAT, and can be administered with better efficiency in a realistic sport-specific setting such as a competition.

A further and final possibility to modify the IAT procedure and thus limit the influence of extra-personal associations is the application of a pen-and-paper variant (Lemm et al., 2008; Bardin et al., 2016). By using a paper-and-pencil variation (p&p) of the IAT, the whole method is simplified. That is, less equipment is needed in its application and it can be applied instantly in a relevant situation, such as during a competition when attentional focus is on competitive stimuli. Several paper-and-pencil versions have already been applied (see Bardin et al., 2016, for an overview). Saporito, Ryan and Teachman (2011) even combined a version of the Brief-IAT (Sriram & Greenwald, 2009) with the paper-and-pencil application. Bardin et al. (2016) note the advantage of a p&p version: "... A p&p version could therefore provide a quick and easy tool for testing large groups of people simultaneously without the above-mentioned limitations of the p&p versions of the IAT, the IAT-P or BIAT ..." (p. 34). Bardin et al. (2016) criticise the lower precision of the p&p versions, but they also point to new perspectives gained with these simplified versions, because they are cheap, easy to run and need less equipment for their application (see also Vargas, Sequakaptewa & von Hippel, 2005). Also, the fact that p&p instructions are provided orally might lead to fewer problems in comprehension

and understanding. Thus, a p&p version provides more certainty regarding optimal administration of the IAT. Additionally, using apps on smartphones and tablets might provide the opportunity for a faster and less complicated assessment.

Nevertheless, given all possibilities to modify methods of the IAT procedure, results still highlight the importance of external stimuli in the situational context. Therefore, more significance should be attributed to the situational context of the IAT's application when interpreting IAT effects. Attentional focus is not only internally, but also externally directed on every stimulus that potentially enters the information processing system, as Gschwendner et al. (2008) underline in their study on anxiety and context-sensitivity. The situational context might influence the execution of the IAT more than expected. Finally, regarding the IAT the situational context contributes to the assessment of temporary instable context-dependent personality states instead of temporary stable context-independent constructs in the sense of personality traits (Gawronski & Bodenhausen, 2006; Gschwendner et al., 2008).

4.5 Limitations of the current work

This work is currently the first one which focuses on the indirect measurement of competitive anxiety and sport injury anxiety via IAT (Greenwald et al., 1998, Egloff & Schmukle, 2002). Therefore, it was an explorative study without concrete hypotheses. Instead, several research questions and assumptions regarding the psychometric properties, known-group differences and correlations between the variables were statistically analysed. Thus, no hypotheses were confirmed or declined. After the investigation of the sport-specific anxiety via a general IAT-Anxiety (Egloff & Schmukle, 2002), sport-specific IATs with anxiety-relevant stimulus material were developed and analysed. This was a new method in the sport psychological domains of competitive anxiety and sport injury anxiety. Therefore, it would have been difficult to express concrete hypotheses. This work focuses on the application of the IAT method, its psychometric properties and its advantages in the indirect measurement of anxiety in the sport context. Concrete hypotheses which focus on the construct of anxiety in sport measured by the IAT-CA or the IAT-SIA were subordinated and can be in the focus of possible follow-up studies.

Another limitation of this work is the sample. Although the sample size of each study is sufficient, the sample consists of a rather homogenous group of mostly undergraduate sport students. They needed credit points for their graduation and had to participate in one of the studies. Nevertheless, each sample corresponds with the valid norms of the randomised sampling procedure. Additionally, all students showed interest in the nature of the study after having completed the tasks. Follow-up studies, however, should consider a more heterogenous sample, probably outside the university context on a more voluntary and less obligatory basis.

A third limitation of this work is the length of the IAT procedure in the second study. By completing four IATs (two IATs about anxiety and their corresponding Control-IATs), the procedure stressed the participants' mental ability to focus on the task. Participants enrolled in the study from morning to afternoon, before and after their courses. Although they stated to feel fit and focused, previous studies highlight circadian influences on cognitive performance tasks (Blatter & Cajochen, 2007). Concentration may have varied in relation to participation time and thus, influenced

the task outcome (see also the results of accuracy values in section 3.3.3). Reduction of the IAT length (e.g. by using the Brief-IAT or the pen-and-paper version) should be considered, especially in samples with a high pensum of stress. Stress level monitoring would be possible by additional application of biological stress markers.

The sample who developed and rated the stimulus items of the new IATs consisted of forty persons, only. Although these experts were chosen randomly, the size itself might not have been sufficient to develop stimulus words which were precise enough to represent the constructs of competitive anxiety and sport injury anxiety. The choice of stimulus words might be more important regarding the individualization of the IAT procedure in follow-up studies. According to the test theory, test quality criteria such as the item difficulty should find more consideration in the item selection. The item selection in the IAT development is of fundamental importance to get valid results. Therefore, it should be operationalised with a higher precision than it was done in previous studies and in the current work.

4.6 Future research

Although this work attempts to introduce the IAT method in the context of sport anxiety, there are still aspects which are open to further application and exploration of IATs in sport. Whereas overall test quality criteria and psychometric properties were sufficiently investigated to confirm the stability and validity of the sport-specific IATs, predictive validity and retest validity of the results yet have to be analysed in follow-up studies (see also Egloff and Schmukle, 2002; 2003).

A new study should be conducted to test the IATs regarding behavioural correlates, for example psychophysiological markers and social psychological effects. The correlation between IAT outcomes and performance results in training or competitions might also be of interest regarding behavioural variables. In this work, investigation outside the laboratory condition was considered being too widespread. Nevertheless, results highlight its relevance. Neurophysiological correlates such as event-related potentials or neuroendocrinological measurement might also provide further evidence regarding validity and attentional focus (Eysenck et al., 2007; Ouimet et al., 2009; Williams & Themanson, 2010). Alpha oscillations serve as correlate for trait anxiety (Knyazev, Savostyanov & Levin, 2004); alpha band reactivity seems to be a robust phenomenon in the reflection of cognitive performance (Klimesch, 1999).

Further studies might investigate the practicality of paper-and-pencil sport-specific IATs in regard to situational context and attentional focus. Several studies have found advantages of paper-and-pencil versions compared to standard IAT procedures (Vargas et al., 2005). Therefore, the application of this shortened procedure might be the chance of a more precise view on situational arousal of emotions regarding sport injury or competition.

Additionally, this work highlights the importance of therapeutic aspects in clinical sport psychology. Based on the results of this study, the focus of sport psychological interventions is closely related to the cues, which trigger anxiety symptoms in sport situations. The attentional control theory points out the importance of a shift in the attentional focus. The stimulus-driven attentional control and its associative

automatic processing should be disrupted. The attentional focus should be re-directed to the relevant goal (for example, the performance task in a competition). There are several intervention techniques in the practical work with anxious athletes. Relaxation techniques deriving from the mindfulness-acceptance-commitment therapy (e.g. Kabat-Zinn, 2004, Gardner & Moore, 2007) are one possibility to cope with stimulus-driven attentional control and help individuals to shift from automatic to deliberative information processing and thus, re-direct attention to the task-relevant goal. The cognitive behavioural therapy (Beck, 2011; Beck, 1970) also helps to disrupt the automatic associative processing and to strengthen the strategic deliberative processing in coping with threatening cues. Beckmann and Elbe (2011) describe several sport-specific mental-training interventions on attentional focus which are well-established in current clinical sport psychology. The present work might provide new ideas in the development of further coping strategies.

4.7 Conclusion

In summary, this present work is a first approach to measure competitive anxiety and sport injury anxiety indirectly via IATs (Egloff & Schmukle, 2002; Greenwald et al., 1998). Indirect measurement provides the opportunity to measure sensitive constructs with minimized impact of faking or lack of introspection – problems which are often criticised in the direct measurement by self-report questionnaires (Egloff, 2008). Anxiety is such a sensitive construct, especially in athletes (Spielberger, 1966; Jones et al., 1994; Biskup & Pfister, 1999).

The first study applied the general IAT-Anxiety to a sport-specific sample, however, results emphasize the necessity of sport-specific indirect instruments along with direct measures of sport-specific anxiety and trait anxiety. In the second study, the sport-specific IATs of competitive anxiety and sport injury anxiety were developed and applied to a larger athlete sample. The IATs show significant and valid results regarding the test quality criteria and confirm a general practicality in current research, even regarding their methodical variance by the application of valence-free Control-IATs.

However, further studies still must analyse predictive validity, retest validity and applicability regarding situational context and participant's attentional focus. Even the application in clinical sport psychological therapy should be of further interest, for example by personalization or a modification of procedure.

Finally, anxiety in sport is not a run-down in automatic cascades, but still a personality disposition which is manageable by adequate coping strategies. Hence, this work provides an additional valid methodical approach in understanding and coping with sport-specific anxiety.

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6 Appendix

6.1 Questionnaire of Study 1

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Teilnehmer – Nummer: __ __ __

Bitte beantworte den folgenden Fragebogen, *nachdem* Du die Studie am Computer beendet hast.

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Allgemeine Fragen

1. Wie alt sind Sie? _____ (in Jahren)

2. Welches Geschlecht haben Sie? männlich ( ) weiblich ( )

3. Welches ist Ihre Muttersprache? _____

4. Welche Sportart betreiben Sie hauptsächlich? _____

5. Wie lange betreiben Sie diese Sportart? _____ (in Jahren)

6. Betreiben Sie diese Sportart als:
- ❍ Leistungssport?
- ❍ wettkampforientierten Freizeitsport?
- ❍ Freizeit-/Breitensport?
- ❍ Gesundheitssport?

7. Nehmen Sie regelmäßig an Wettkämpfen teil? ❍ ja ❍ nein

8a. Auf welchem (höchsten) Wettkampf-Niveau üben Sie Ihre Sportart derzeit aus? *(nur 1 Kreuz)*

- ❍ Höchstes nationales Niveau (etwa: 1. Bundesliga)
- ❍ Zweit höchstes nationales Niveau (etwa: 2. Bundesliga)
- ❍ Dritt höchstes nationales Niveau (etwa: Regionalliga)
- ❍ Viert höchstes nationales Niveau (etwa: Oberliga)
- ❍ Sonstiges darunter liegendes Wettkampf-Niveau

ODER

Gegebenenfalls ist ihre Sportart nicht in Ligen, sondern in Bundeskadern organisiert:

8b. Welchem Kader gehören Sie derzeit an? *(nur 1 Kreuz)*

- ❍ A-Kader
- ❍ B-Kader
- ❍ C-Kader
- ❍ D-Kader
- ❍ Sonstiger Kader

9. Würden Sie sich als wettkampferfahren beschreiben?

❍	❍	❍	❍
sehr unerfahren	eher unerfahren	eher erfahren	sehr erfahren

10. Gehen Sie regelmäßig einer Tätigkeit nach, die ein gewisses Maß an Koordina-

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tion benötigt (z.B. Klavier spielen) ? O ja O nein

Wenn ja, welcher? _____

11. Sind Sie Links- oder Rechtshänder? O rechts O links

12. Bestehen zur Zeit Verletzungen (besonders der Schultern, Arme und Hände)?
O ja O nein

Wenn ja, welche?

_____

13. Bestehen zur Zeit psychische oder somatische Erkrankungen?
O ja O nein

Wenn ja, welche?

_____

14. Womit haben Sie heute Ihre Zeit verbracht?

_____

15. Ist heute etwas Außergewöhnliches passiert? O ja O nein

Wenn ja, was? _____

16. Wie ausgeruht fühlen Sie sich?
O sehr ausgeruht
O eher ausgeruht
O eher gestresst
O sehr gestresst

- VIELEN DANK FÜR DEINE TEILNAHME! -

6.2 Debriefing of Study 1

Universität Potsdam

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Worum ging es in dieser Studie?

Liebe Teilnehmerin, lieber Teilnehmer,

die Untersuchung zielt darauf ab, die Tendenz zum Erleben von Angst mit Hilfe verschiedener Methoden zu messen. Wir möchten hierbei die Wirkzusammenhänge zwischen direkt geäußerter und indirekt gemessener Angst über die Reaktionszeit beschreiben. Dies ist notwendig, da viele Menschen sich ihrer Tendenz, in Situationen eher ängstlich zu reagieren, nicht immer bewusst sind. Daher bereitet ihnen die Einschätzung ihrer Ängstlichkeit in einer direkten Befragung mittels Fragebogen eher Schwierigkeiten. Aus diesem Grund ist für eine genaue Forschung die Identifizierung solcher unbewussten und unbeabsichtigten Verzerrungstendenzen notwendig.

Die Untersuchung beschränkt sich deshalb darauf, eine praktikable Methode zur sportspezifischen Messung von Ängstlichkeit zu entwickeln.

Alle Ergebnisse sind anonymisiert erhoben worden. Eine nachträgliche Zuordnung der Daten zu einzelnen Personen ist nicht möglich. Desweiteren werden alle Daten selbstverständlich streng vertraulich behandelt.

- **Hast Du noch Fragen an den/die Versuchsleiter/in?**
- **Falls Du keine Fragen oder Einwände gegen die Untersuchung hast, erklärst Du dich einverstanden, dass Deine anonymisierten Daten für eine Auswertung verwendet werden!**

Vielen Dank für deine Teilnahme!

Dipl.-Psych. Katharina Strahler

6.3 Questionnaire of Study 2 and 3

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Bitte beantworte den folgenden Fragebogen, *nachdem* Du die Studie am Computer beendet hast.

Allgemeine Fragen

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4. Welche Sportart betreiben Sie hauptsächlich? _____

5. Wie lange betreiben Sie diese Sportart? _____ (in Jahren)

6. Betreiben Sie diese Sportart als:

- O Leistungssport?
- O wettkampforientierten Freizeitsport?
- O Freizeit-/Breitensport?
- O Gesundheitssport?

7. Nehmen Sie regelmäßig an Wettkämpfen teil? O ja O nein

8a. Auf welchem (höchsten) Wettkampf-Niveau üben Sie Ihre Sportart derzeit aus? *(nur 1 Kreuz)*

- O Höchstes nationales Niveau (etwa: 1. Bundesliga)
- O Zweit höchstes nationales Niveau (etwa: 2. Bundesliga)
- O Dritt höchstes nationales Niveau (etwa: Regionalliga)
- O Viert höchstes nationales Niveau (etwa: Oberliga)
- O Sonstiges darunter liegendes Wettkampf-Niveau

ODER

Gegebenenfalls ist ihre Sportart nicht in Ligen, sondern in Bundeskadern organisiert:

8b. Welchem Kader gehören Sie derzeit an? *(nur 1 Kreuz)*

- O A-Kader
- O B-Kader
- O C-Kader
- O D-Kader
- O Sonstiger Kader

9. Würden Sie sich als wettkampferfahren beschreiben?

O	O	O	O
sehr unerfahren	eher unerfahren	eher erfahren	sehr erfahren

10. Gehen Sie regelmäßig einer Tätigkeit nach, die ein gewisses Maß an Koordination benötigt (z.B. Klavier spielen) ? O ja O nein

Wenn ja, welcher? _____

11. Sind Sie Links- oder Rechtshänder? ○ rechts ○ links

12. Bestehen zur Zeit Verletzungen (besonders der Schultern, Arme und Hände)?
○ ja ○ nein

Wenn ja, welche?

_____

13. Bestehen zur Zeit psychische oder somatische Erkrankungen?
○ ja ○ nein

Wenn ja, welche?

_____

14. Womit haben Sie heute Ihre Zeit verbracht?

_____

15. Ist heute etwas Außergewöhnliches passiert? ○ ja ○ nein

Wenn ja, was? _____

16. Wie ausgeruht fühlen Sie sich?
○ sehr ausgeruht
○ eher ausgeruht
○ eher gestresst
○ sehr gestresst

17. Haben Sie bereits an einer Studie mit Zuordnungsaufgaben teilgenommen?
○ ja ○ nein

Wenn ja, wann, bei wem und welcher Art war diese Studie?

_____

6.4 Debriefing of Study 2 and 3

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Worum ging es in dieser Studie?

Liebe Teilnehmerin, lieber Teilnehmer,

die Untersuchung zielt darauf ab, die Tendenz zum Erleben von Wettkampfangst, Verletzungsangst und Ängstlichkeit im Allgemeinen mit Hilfe verschiedener Methoden zu messen. Wir möchten hierbei die Wirkzusammenhänge zwischen direkt geäußerter und indirekt gemessener Angst über die Reaktionszeit beschreiben. Dies ist notwendig, da viele Menschen sich ihrer Tendenz, in Wettkämpfen oder nach Verletzungen eher ängstlich zu reagieren, nicht immer bewusst sind. Daher bereitet ihnen die Einschätzung ihrer Ängstlichkeit in einer direkten Befragung mittels Fragebogen eher Schwierigkeiten. Aus diesem Grund ist für eine genaue Forschung die Identifizierung solcher unbewussten und unbeabsichtigten Verzerrungstendenzen notwendig.
Die Untersuchung beschränkt sich deshalb darauf, eine praktikable Methode zur sportspezifischen Messung von Ängstlichkeit zu entwickeln und Zusammenhänge zwischen spportspezifischer Angst und allgemeiner Tendenz zur Angst zu untersuchen.
Alle Ergebnisse sind anonymisiert erhoben worden. Eine nachträgliche Zuordnung der Daten zu einzelnen Personen ist nicht möglich. Desweiteren werden alle Daten selbstverständlich streng vertraulich behandelt.

- **Hast Du noch Fragen an den/die Versuchsleiter/in?**
- **Falls Du keine Einwände gegen die Untersuchung hast, erklärst Du dich einverstanden, dass Deine anonymisierten Daten für eine Auswertung verwendet werden!**

Vielen Dank für deine Teilnahme! ☺

Dipl.-Psych. Katharina Strahler

6.5 German Items of the sport-specific IATs

Table 6.5.1. *German Items of the IAT-Competitive Anxiety*.

Kategorie Label Items IAT-CA			
Wettkampf/Training		Angst/Gelassenheit	
Wettkampf	Training	Angst	Gelassenheit
Sieg	Übung	nervös	entspannt
Verlierer	Muskelaufbau	aufgeregt	ausgeglichen
Pokal	Trainer	ängstlich	gelassen
Medaille	Regelmäßigkeit	furchtsam	ruhig
Schiedsrichter	Wiederholungen	unsicher	gelöst

Table 6.5.2. *German Items of the IAT-Sport Injury Anxiety*.

Kategorie Label Items IAT-SIA			
verletzt/gesund		Angst/Gelassenheit	
verletzt	gesund	Angst	Gelassenheit
Schmerzen	Obst	nervös	entspannt
Arzt	Bewegung	aufgeregt	ausgeglichen
Medikamente	Fitness	ängstlich	gelassen
Rehabilitation	Freude	furchtsam	ruhig
Einschränkung	Zufriedenheit	unsicher	gelöst

Table 6.5.3. *German Items of the Word / Non-Word Control-IAT (Rothermund & Wentura, 2004)*.

Kategorie Label Items Kontroll-IAT	
Neutrales Wort	Kein Wort
Tisch	Reschlet
Papier	Timpf
Haus	Agdat
Bett	Balort
Schrank	Sedlor