Indirect Measures of Associations and Psychopathology: Applications to Spider Phobia

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Diplom Psychologe Thomas Ellwart

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Gutachter: Prof. Dr. Thomas Goschke (Dresden)

PD. Dr. Mike Rinck (Dresden)

Prof. Dr. Eni Becker (Nijmegen)

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Abstract

The study of cognitive fear networks and associations, indirect experimental paradigms like the Implicit Association Test ('IAT', Greenwald et al., 1998) or the Extrinsic Affective Simon Task ('EAST', De Houwer, 2003) may be helpful, as they promise to assess the structure of specific associations using a performance based approach without having to ask the participant for a verbal report. Three studies investigated the usefulness and characteristics of IAT and EAST from a clinical point of view as well as from a methodological perspective.

The aim of the first study was to measure fear associations towards spiders among spider phobic and non-phobic participants as well as in a group of spider enthusiasts. It was sought to determine whether the IAT is useful to assess fear relevant associations and schemata and to predict anxious behavior. Results indicate that the paradigm is sensitive to the strength of fear relevant associations and able to predict anxious behavior beyond the predictions of direct measures such as questionnaires.

The second study focused on methodological questions about some of the mechanisms that underlie IAT effects. With a newly developed 'masked' IAT, the experiments of Study 2 investigated the influences of individual stimuli and superordinate categories on IAT performance. Besides offering theoretical implications, the results also provide practical, relevant applications for the use of IAT experiments in clinical psychology.

A third study applied the EAST to investigate how different context conditions lead to differential activation of cognitive schemata in fear of spiders. Data suggest that spider fearing participants have activated threat associations towards ambiguous target words (e.g., legs, net), only when the spider concept was primed. Non-fearful participants did not show threat associations with either type of priming. One can conclude that the impact of threat associations depends on the activated context, and that the EAST is suitable for the assessment of fear associations and their current activation level.

The results of this dissertation lead to the conclusion that the performance based methodology of the IAT and EAST is a useful and practical approach to reflect fear associations in phobia indirectly. At this point, the use of indirect measures in clinical psychology is still at its beginning, and requires intensive methodological and theoretical efforts. These paradigms, however, may become useful for possible implications in psychopathology, such as the prediction of treatment outcome and the likelihood of relapse after therapy, or for the identification of cognitive factors of vulnerability.

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1. Introduction

The purpose of this dissertation is the adoption and application of indirect measures of associations in clinical psychology, particularly in anxiety. These indirect, or *implicit* paradigms originate from cognitive and social psychology and are utilized across several domains to estimate constructs like attitudes, self-esteem, and stereotypes without having to ask the participant for a verbal report. It is assumed that these techniques directly tap into cognitive structures by measuring the strength of associations between certain concepts. From a clinical perspective it would be of great interest to use methods which offer a closer look at mental representations in emotional disorders, beyond the use of self-reports.

Looking at the high prevalence rates of anxiety disorders, the first chapter will emphasize the necessity of experimental research in anxiety. The importance and influence of cognition in anxiety disorders will be discussed in the following chapter, including some theoretical approaches that describe cognitive representations in anxiety. It will become apparent why self-reports and classical experimental paradigms are not always useful to reflect on the structure of cognitive representations in clinically orientated research. This leads to the application of indirect tasks in the assessment of cognitive fear representations, investigating if they offer additional information beyond traditional measures.

1.1 Cognitive representations in anxiety

1.1.1 Anxiety disorders

In many etiological theories of anxiety disorders, the focus is on the evolutionary significance of fear. These emotional responses are clearly adaptive in many situations; they mobilize and help one to survive in the face of danger and threats. Anxiety disorders can be viewed as problems that arise in the regulation of these response systems (Barlow, 1988). When anxiety becomes excessive, or when intense fear is triggered at an inappropriate time or place, these response systems can become more harmful than helpful. Anxiety disorders may develop from a complex set of risk factors, including genetics, brain chemistry, personality, and life events and represent the most common mental illness with a life time prevalence of about 25 % (e.g., Kessler et al., 1994). About 9 - 15 % of the adult population suffers from anxiety within one year (e.g., Kessler et al., 1994; Wittchen et al., 1999; Wittchen & Jacobi, 2001). The symptoms of various anxiety disorders overlap considerably. Brown and Barlow (1992) found that 50 percent of the people who met the criteria for an anxiety disorder also met the criteria for at least one other form of anxiety or mood disorder. According to Brown (1996) comorbidity is found at the highest rate for generalized anxiety disorder (82%) and severe cases of panic disorder with agoraphobia (72%), and at the lowest rate for specific phobia (20%).

There are also significant gender differences in several types of anxiety disorders. Pertinent data from several epidemiological studies found that gender differences are particularly large for specific phobias, where women are about 2 to 3 times as likely as men to experience the disorder (e.g., Kessler et al., 1994; Wittchen et al., 1999). In general, specific phobias are the most common type of anxiety disorders. They involve a severe and persistent fear of specific objects, situations or activities, such as fear of animals, heights, storms and illness or injury. Chapter 1.3.1 will discuss the aspects of epidemiology and etiology of simple phobia in detail.

The extremely large number of people suffering from anxiety disorders, in particular from simple phobia, also has a significant impact on economic costs that are associated with the repeated use of healthcare services and/or therapy, and indirect costs because of limited job performance and lack of work. People with an anxiety disorder are three-to-five times more likely to go to the doctor, and six times more likely to be hospitalized for psychiatric disorders than non-sufferers (Anxiety Disorders Association of America, 2003). For example, in the US, the total costs for anxiety disorders represent the highest expenses of all mental illnesses (Rice & Miller, 1995). In the light of the dramatic negative effects of anxiety disorders for personal life as well as for health policy and social concerns there is an urgent need to improve and increase our knowledge about anxiety. In order to understand the etiology and factors that maintain anxiety disorders, one must consider a variety of psychological and biological systems that have evolved for the purpose of triggering and controlling these alarm responses.

Over the last two decades, an increasingly large body of psychological work, both empirical and theoretical, has been developed to investigate cognitive factors on emotional disorders, such as anxiety. There are two theories that have been of particular importance in the development of cognitive approaches to emotional disorders: Beck's schema theory and Bower's network theory.

1.1.2 Theories on cognitive representations in emotional disorders

According to schema theories such as the ones proposed by Beck (Beck, 1976; Beck, Emery & Greenberg, 1985) anxiety is characterized by cognitive structures called 'schemata', a stored body of knowledge about the feared content which interacts with encoding, comprehension, and retrieval of information. It is supposed that schemata in anxiety concern personal vulnerability and danger. The activation of such a schema directly influences the contents of a person's perceptions, interpretations, and memories as well as the behavioral pattern of flight and feeling of anxiety. According to this explanation, an individual with spider phobia is distinguished by having a spider schema which selectively stores fear-related information and details like fear-provoking situations (e.g., basement, wood, autumn), or information about appearance and occurrence of spiders. Confronted with certain internal or external stimuli, the spider schema is activated, and it influences various conceptually driven ('top down') processes, such as attention (e.g., scanning all basement rooms for possible spiders) or interpretation (i.e. dark spots on the wall are interpreted as spiders). The activation of this schema would also activate fearful reaction and avoidance behavior.

A major problem with schema theories exists because relevant schemata can not be detected until activated by appropriate events (Williams, Watts, MacLeod, and Mathews, 1997). Thus, the schemata have to be seen as latent cognitive structures, which get re-activated when the person is confronted with the phobic stimuli. Moreover, Beck's approach is not based on experimentally testable studies, and lacks on clear definitions and predictions. Beck's theory was, however, applied to the therapy of emotional disorders (e.g., Beck, 1976), in order to investigate and change schemata and characteristics of fear during treatment. This approach was evidently quite successful. (e.g., Chambless & Gillis, 1993; Chambless & Ollendick, 2001).

Another enormously influential theory for cognitive research on emotional disorders was Bower's network theory (Bower, 1981; 1987). Based on earlier work about representations of knowledge in memory (Human Associative Memory Network - HAM, Anderson & Bower, 1973), Bower proposed that events are represented as configurations of associative connections or pathways between concepts or nodes that describe the features of the event. When a cue stimulates the network, activation would spread through the entire network, concurrently activating relevant and associated information from long term memory. The important assumption of Bower was, that each distinct emotion (e.g., pleasure, fear) is represented by a specific emotional node in memory linked with many other aspects of this emotion (e.g., behavior, situations, verbal expression, physiology etc.). Based on these assumptions, the theory was set up to explain that learning is biased towards material that is congruent with mood at encoding, and that memory is biased to material, that is congruent with mood at retrieval. According to Bower (1981), a specific mood increases the level of activation of nodes associated with it, and information nodes activated through this will be favored in memory and learning.

Various problems arise, however, when this rather general model is applied in its original sense to describe emotional representation and schemata in anxiety. Bower's network model originated from studying the structure of information in narrative texts, asking questions about the way semantic meaning and emotion is represented in the brain and how emotion may influence processes that are responsible for text comprehension. Nevertheless, there is a crucial difference between a) activating a concept of an emotion and b) activating the emotion itself.

Although Bower and Cohen (1982) explicitly provided nodes for both kinds, it is still not clear that it is appropriate to represent actual emotions in what is essentially a semantic network. It becomes clear that Bowers model falls short and definitely was not designed to function as a comprehensive model of cognitive representations in emotional disorders.

1.1.3 The Bio-Informational Theory and neural basis of fear

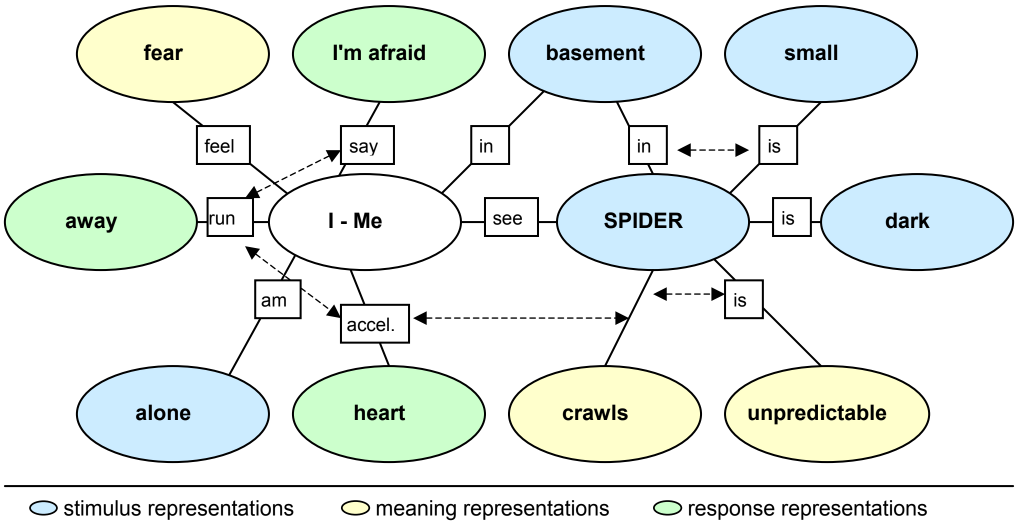
An influential integration of network views with behavioral, cognitive, and psychophysiological aspects of fear was developed in a series of experiments and theory papers by Peter Lang in his 'Bio-Informational Theory' (e.g., Lang, 1977, 1979; Lang, Cuthbert, & Bradley, 1998). Similar to the views of Bower (1981), emotions are coded in memory as networks of mutually activating information units (Lang et al., 1998). However, they differ from other knowledge structures in the brain because of direct connections to the brain's primary motivational system, consisting of neural circuits developed in early stages of evolution in primary cortex, subcortex, and mid brain.

Although emotions vary widely in their expressions it is argued that emotion's motivational organization has a simple, biphasic structure (e.g., Konorski, 1967). Pleasant emotions are associated with an appetitive system (neural mediation of approach, hunger, or sexual behavior) whereas unpleasant emotions are driven by a defensive system, associated with withdrawal, escape from pain, and defensive aggression. This biphasic structure is consonant with an array of theories that have focused on two broadband motivational systems to regulate approach and withdrawal behavior in response to environmental cues, called the behavioral inhibition system (BIS) and behavioral activation system (BAS) (see Carver & Scheier, 1998; Depue & Collins, 1999; Gray, 1982). The BAS is expected to generate increased approach behavior, motor activity, and feelings of elation, desire, and hope (i.e., appetitive system). In the face of conditioned signals of punishment and novelty, BIS is hypothesized to activate responses of inhibition and avoidance, as well as feelings of anxiety and arousal (aversive/defensive system). It is the latter system that is presumed to be active in human fear and anxiety.

The aversive/defensive motivational system activates behaviors necessary to the survival of individuals and species, such as a general mobilization of the organism, and the development of reflexive approach and withdrawal behavior. It mediates the formation of conditioned associations based on primary reinforcement (Lang et al., 1998). Neurophysiological findings suggest, that the amygdala is a physiological mediator of defensive behaviors and most important for the aversive motivational system (e.g., LeDoux, 1993, 1995).

Neural connections between the sensory and associative cortex to the amygdala (e.g., Herzog & van Hoesen, 1975) indicate that cognitive processes are able to trigger emotional reactions, but are also influenced by emotions. According to Lang, the fundamental emotional network is neural, only partially accessible to consciousness, and consists of three basic types of higher level representations. First there are *meaning* units, which refer to declarative semantic knowledge about the event or situation. On this level information processing does not necessarily involve affect or valence. Second there are *stimulus* units which represent information of perceived sensory information. The third type of representations are *response* units, coding three basic output systems, behavioral acts, physiological mobilization, expressive language. These response units activate output procedures. Figure 1-1 illustrates a possible fear network in spider phobia. Persons with spider phobia would hold specific declarative knowledge about spiders, for instance, that spiders are actually not dangerous and even useful, difficult to find, small, unpredictable, and trigger fear. Contrary to what is found in individuals without spider phobia, these units are closely connected with stimulus units representing situations and sensory stimuli (e.g., dark small sports, basement, wood) and fearful responses like avoidance behavior or physiological arousals. Although language labels are certainly part of the network, the network is not fundamentally language based (Lang et al., 1998).

Figure 1-1. A spider phobic network, showing relevant stimulus, meaning, and response representations



The network can be activated by any input that matches the representations in its assembly. Thus, a dark spot on the white basement wall readily prompts processing of a spider phobic network. Because of the associative connections between the represented units, activation of the network does not depend on a real existing stimulus. Moreover, it can be cued externally by language descriptions, pictures, and other symbolic stimuli remote from the actual context, or internally, by neuromuscular patterns and semantic associations (Lang et al., 1998).

But how do these activated structures refer to conscious feelings of fear or threat? Several theorists have proposed that consciousness has to do with working memory (Johnson-Laird, 1988, Kihlstrom, 1987). When a stimulus comes present, working memory integrates stored representations from different areas of the brain. First, information comes from sensory processing systems (serving as a short-term memory buffer as well as perceptual processor). Explicit knowledge about the stimulus derives from the long-term explicit memory system (associative network). Here the hippocampus plays a crucial role, because it is thought to be necessary for acquisition of declarative or explicit memory, memories that can be verbalized and are available to conscious awareness (LeDoux & Phelps, 2000). Moreover, the hippocampus seems to be important in the evaluation of contextual cues in conditioning or learning (e.g., individuals with spider phobia learned the connection between a specific context and fear). If the immediate stimulus is affectively charged (e.g., it is a spider), sensory and hippocampus-dependent memory systems will be activated; in addition, working memory will become aware of the fact that the fear system of the brain has been activated. The amygdala communicates with working memory network and integrates information about the aversive property of a stimulus or event. In addition, the amygdala projects to nonspecific systems that regulate cortical arousal and controls bodily responses, which then provide feedback that can influence cortical processing indirectly (LeDoux & Phelps, 2000). Because of this independent and automatic fear reaction of the amygdala, an individual with spider phobia may show bodily responses (behavior, autonomic, endocrine) before having processed the stimuli in explicit ways. This dissociation between automatic and uncontrollable expressions of fear and explicit knowledge about the feared stimulus is an important feature in so-called specific phobias, such as fear of spiders. Here individuals with phobias explicitly know that spiders are harmless little animals, however, they report no intentional control about their fearful reaction (see chapter 1.3.1).

The bio-informational theory offers a useful model to describe cognitive representations in anxiety. Besides the representation of declarative knowledge and stimulus features it also integrates psychophysiological processes and response behavior. There is strong experimental support that the amygdala plays a central role integrating aversive and defensive responses and storing emotionally significant material in the emotional memory system (LeDoux, 1993, 1995). This integration of cognitive and biological aspects is most important to understand cognitive, physiological, and behavioral aspects of fear.

Based on the theories of Beck and Bower and the continuative aspects of Lang's bio-informational theory I use the term fear schema to refer to maladaptive fear-related cognitive structures that can be activated automatically. Posner and Warren (1972) offered a useful definition of cognitive structures, writing, "When we say a structure exists in memory, we are really saying that one item will activate another in a quite direct and simple way, even perhaps when the subject does not intend for it to occur. If we had methods to tap structure uninfluenced by conscious search, we might reflect the structure of memory more simply," (p.34). Following the statement of Posner and Warren, it would be challenging and important for anxiety research, to apply methods that help analyze and evaluate maladaptive schemata. This would not only help to understand cognitive particularities in anxiety, it could also be applied detecting factors of vulnerability and examining fear schema change following treatment.

1.2. The assessment of cognitive structures and associations

As concluded in the previous chapter, the assessment of cognitive structures and associations in anxiety would be of great importance and interest in clinical research. The following chapter addresses the most common approaches to test such schemata. Copious research has been done on biased information-processing in anxiety, a cognitive phenomenon that is ascribed to maladaptive fear schemata. Another way to assess thoughts and cognitions in anxiety is the use of self-reports. Based on the insufficiencies of the biased processing approach and self reports, indirect association tests are introduced as a relatively new and useful alternative to tap on schemata.

1.2.1 Biased information processing in anxiety

Schema and network models lead to a tremendous amount of research and were used to predict biased processing in emotional disorders. When present in anxiety, maladaptive schemata and fear networks may lead to selective processing of anxiety-related information in several areas. In perception there may be improved attention to or higher distraction by threat cues. In interpretation and judgment, ambiguous cues as may be seen as threatening. Better recall of fear-related information is often an affect on memory.

Because the important schemata are distorted towards danger and vulnerability or loss and failure, patients with anxiety often preferably attend to feared stimuli, for instance, to words or pictures expressing fear-related contents. With regard to memory processes, correspondingly general predictions are made: Anxious patients may exhibit better memory for stimuli related to their schema and show improved recall of threatening information. However, the empirical evidence for attentional and memory biases appears inconsistent.

Regarding attentional biases for threatening information, one has to distinguish between two important processes: enhanced detection of fear stimuli and distractibility caused by threatening material. Enhanced detection was shown in a number of studies, but only when there was competing other information. This enhancement effect was also restricted to early stages of attention allocation at short presentation durations, compared to longer ones (e.g., Bradley, Mogg, & Millar, 2000; Hermans, Vansteenwegen, & Eelen, 1999; Mogg, Millar, & Bradley, 2000). The few studies in which patients with anxiety were asked to detect a single threatening stimulus, however, suggest that there are hardly any 'profits' gained from the attentional bias in terms of enhanced detection. Results indicating the 'costs' in terms of higher distractibility caused by threatening stimuli are more consistent (e.g., Lavy, van den Hout & Arntz, 1993; Thorpe and Salkovskis, 1997; Rinck, Reinecke, Ellwart, Heuer, and Becker, 2003).

The empirical evidence regarding memory biases in anxiety disorders has been reviewed by Coles and Heimberg (2002). Looking at memory effects one has to distinguish between explicit and implicit memory tests. Explicit tests require conscious recollection of previous experiences or knowledge (e.g., a list of verbal materials), that is, the participant is explicitly asked to recall or recognize the information presented earlier. In implicit memory tests, however, previous experiences affect current behavior in the absence of conscious recall of those experiences (for reviews, see Roediger, 1990; or Schacter, 1996). According to Coles and Heimberg (2002) explicit memory biases for threatening information depend on the anxiety disorder investigated: there is support for a bias in panic disorder, posttraumatic stress disorder, and obsessive-compulsive disorder, but not in generalized anxiety disorder (GAD) and social phobia (SP). Regarding implicit biases in anxiety, there is relatively consistent evidence for biases in each of the anxiety disorders.

Other empirical research concentrated on other information-processing biases, such as interpretation bias (Mathews & Macintosh, 2000), judgmental bias (Tomarken, Mineka, & Cooks, 1989), inference bias (e.g., Hirsch & Mathews, 2000), and higher order processes such as deductive reasoning (e.g., de Jong, Mayer, & van den Hout, 1997).

Looking at the complex and heterogeneous pattern of results, network and schema theories fail to predict this large number of empirical data. One of the limitations of theories of Beck, Bower, and Lang is that neither makes distinction between different levels of cognitive processing. There has been growing convergence in the idea that a theory of cognitive processing in emotion needs more than one level of cognition. In this respect conscious, non-conscious, and automatic aspects of cognition must also be included.

In recent years several clinical models have been suggested to explain selective information processing in anxiety (e.g., Teasdale & Barnard, 1993; Mogg & Bradley, 1998; Williams et al., 1997; Mathews & Macintosh, 1998). On a much more complex basis, however, these approaches rather meet the requirements to explain biased processing in emotional disorders.

On the other hand, schema and network theories were not developed to explain the heterogeneous pattern of information processing. Moreover, it seems doubtful that cognitive processes in memory and attention offer a satisfying and comprehensive picture of the structure of stored fear-related information in memory. At this point it can be stated that cognitive processes which are described above are functionally related to an underlying maladaptive schema or network (e.g., Mansell, 2000) and definitely tap into some aspects of cognitive representations in anxiety. Nevertheless, they provide rather indirect information with respect to the hypothesized schemata and fear networks itself.

1.2.2 Measuring cognitive representations through self-reports

The previous chapter pointed out that testing elements of a fear network, traditional cognitive paradigms are circumspect because they investigate how cognitive structures affect information processing (e.g., memory and attention). Assessing how specific anxiety disorders affect information processing, these paradigms offer little information about the structure of fear networks and schemata. A different and probably common way to look at schemata is to ask people, by using interviews and questionnaires. Dysfunctional beliefs are usually directly measured by self-report instruments (e.g., Thorpe & Salkovskis, 1995). As an example, specific fear questionnaires like the 'Fear of Spider Questionnaire' (Szymanski & O'Donohue, 1995) or the 'Spider Phobia Questionnaire' (Watts & Sharrock, 1984) do not only ask questions about behavior and reactions when confronted with a spider, but also self-related questions about cognitions and associations towards spiders (e.g., 'If I saw a spider now, I would think it will harm me.'; 'When watching television do you think more about the danger of there being a spider in the room than about the program?'). Although these measures are useful tools in diagnosis and fear research and show strong correlations with fear behavior, there are also clear limitations in using them to assess dysfunctional associations and schemata.

First, self-reports are susceptible to deception and self-presentation strategies. For instance, it is assumed that men are less willing to talk about fears than women (Bekker, 1996). Mack and Schroeder (1979) asked a group of girls and a group of boys about their fear of injection in a questionnaire and later conducted a behavior assessment test to measure fearful behavior. Results indicated that two groups did not differ in the behavior assessment test from each other. Boys, however, reported significantly less fear of injection in the questionnaire. Moreover, other than reports about actual behavior, it seems difficult to verbalize mental processes without the risk of demands, distortions, attributional biases (Nisbett & Wilson, 1977).

A second argument concerns the difference between automatic and strategic/controlled activation of information in anxiety. Talking about fear (e.g., in interviews or questionnaires) assesses immediate consciousness experience in explicit memory. However, researchers from several fields of psychology points out the importance of automatic and unconscious activation of fear concepts. Anxiety contains acute and intense emotional reactions with a strong automatic component, but also long termed cognitive elaboration around themes of risk and danger. As Williams et al. (1997) suggest in their theory, information and its retrieval involves automatic as well as strategic components. On one hand, this could explain why cognitive research in anxiety found such a complex pattern of biased processing in attention, learning, and memory. On the other hand this makes clear that self-reports will not be able to access all cognitive components of anxiety. There is a partial dissociation between rational and automatic cognitive processes in people suffering from simple phobias (Williams et al., 1997). They often believe that there is no reason to be frightened of their phobic object like spiders and consequently feel that their phobia is stupid and irrational. Nevertheless, in the presence of phobic objects they automatically become frightened and experience little intentional control over the reaction to spiders (Mayer, Merckelbach, and Muris, 2000). It appears as if automatic and uncontrollable expressions of fear associations represent important additional information about cognitive characteristics of phobia, and might complement explicit reports when trying to predict fear-related behavior. From a biological and neurophysiological perspective, there is evidence that the amygdala plays an important role in processing and reacting to fearful stimuli (LeDoux, 1998; LeDoux & Phelps, 2000). Because of a quick subcortical (automatic) pathway, sensory information about fearful stimuli activates the human fear system rapidly, and leads to fast activation of bodily responses. Stored cognitive representations of feared stimuli in explicit memory also send information to the amygdala on a much slower cortical pathway from the prefrontal cortex. In return, the immediate conscious experience of a specific stimulus (e.g., a spider) in working memory integrates information from sensory processing systems, hippocampus-dependent explicit memory representations, and from the amygdala-dependent emotional system (LeDoux & Phelps, 2000). These various influences and interactions highlight the above assumptions that automatic and unconscious, as well as explicit and accessible components are involved in cognitive fear processing.

The above arguments display clearly, that self-reports and other introspective methods are very limited alternatives to measure cognitive representations, because relevant cognitions might be unavailable to introspection and verbal descriptions (e.g., de Jong, Pasman, Kindt, & van den Hout, 2001; Dovidio and Fazio, 1992), and are influenced by deception and self-presentation strategies. An alternative approach would be the assessment of cognitive structures and states of specific fear associations through indirect, performance based, and seemingly unrelated tasks.

1.2.3 Indirect measures of associations: New tools in cognitive research

In recent years, a large number of indirect or *implicit* measures have been proposed. In the following chapter I give a short introduction to several methods which try to estimate evaluative responses and cognitive representations of emotionally valenced stimuli. Subsequently, the focus will be on one of these measures, the 'Implicit Association Test' (IAT), which was used in most of the experiments reported in this dissertation.

In cognitive research a variety of different indirect measurement techniques have been employed. All these approaches have in common that they want to provide an estimate of the construct of interest without having to directly ask the participant for a verbal report. Therefore, these indirect tasks seem to be free of social desirability concerns (Fazio & Olson, 2003). More differentiated is the discussion of whether the paradigms assess attitudes, stereotypes, or schemata without participants' being aware that these constructs are actually assessed. Another important issue concerns the extent to which these methods measure automatically and not strategically activated responses to a person or object. These and other theoretical aspects will be discussed separately for the IAT used in this dissertation.

One of the first tasks that was developed to provide an indirect measure of attitudes was the affective priming task by Fazio, Sanbonmatsu, Powell, and Kardes (1986). In an affective priming study, two stimuli are presented in succession and participants are asked to evaluate the second stimulus, that is, to determine whether the second stimulus refers to something good or to something bad (e.g., by saying 'good' or 'bad' or pressing a certain key). When the second stimulus (also called target) has the same valence as the first stimulus (called prime), less time is needed to express this evaluation (pressing a key or saying 'good' or 'bad'). This task also allows one to assess associations and attitudes. If the presentation of a prime leads to faster processing of the positive than negative targets, this indicates, then the participant has a positive attitude or association toward the prime. If a prime facilitates the processing of a negative target, one can assume that the prime is rather negative for the participant. For example, Fazio, Jackson, Dunton, and Williams (1995) used a priming experiment to measure racial associations or attitudes, by priming participants with photos of black versus white undergraduates. The black and white faces had different consequences for the latency with which participants responded to the subsequently presented target adjective. Black faces facilitated responding to negative adjectives and interfered with responding to positive adjectives; the opposite pattern was shown for white faces. The pattern suggests that, on average, negativity was automatically activated by the black primes. Priming techniques are employed to measure constructs like self-esteem, racial prejudice, or stereotypes. (For an overview see: Fazio & Olson, 2003).

De Houwer and Eelen (1998) introduced an affective variant of the spatial Simon task as an indirect measure of attitudes. Participants have to discriminate targets regarding a certain grammatical feature of this stimulus (e.g., noun/adjective). The task is to respond by saying 'positive' or 'negative' depending on the grammatical feature (e.g., participants have to say 'positive' when it is a noun, and 'negative' when it is a adjective). Because the target stimuli vary in their valence, this leads to congruent trials, in which the valence of the target and the correct response have the same valence (e.g., saying 'positive' to 'flower' because it is a noun), and incongruent trials in which there is response competition (e.g., saying 'negative' to 'happy' because it is an adjective). Despite the fact that participants were explicitly instructed to ignore the affective meaning of the presented words, reaction times were faster when the affective connotation of the presented word and the correct response was the same (congruent trial) than when it differed (incongruent trial). The results further supported to the hypothesis that stimulus valence can be processed automatically.

A rather new and most prominent indirect technique is the Implicit Association Test (IAT), developed by Greenwald, McGhee, and Schwartz (1998). The IAT assesses the strength of associations between a target concept and an attribute dimension by measuring the latency with which participants can respond on two response keys, when each has been assigned a dual meaning. Greenwald et al. (1998, Experiment 1) asked participants to categorize stimuli as they appear on the screen. The stimuli were targets representing names of flowers and names of insects, and attributes, representing positive adjectives, and negative adjectives. In a first practice trial participants categorized the targets (target discrimination task) by pressing one key for flower names and the second key for insect names. Here, the response keys were labeled 'flower' and 'insect'. In the second practice trial (attribute discrimination task) participants categorized a variety of clearly valenced attribute words (e.g., 'poison' or 'gift') as pleasant or unpleasant. In the critical phase of the experiment (combined tasks), these two categorization tasks were combined. Participants performed this combined task twice - once with one response key signifying flower/pleasant and the other labeled insect/unpleasant, and once with one key meaning flower/unpleasant and the other insect/pleasant - in counterbalanced order. The question is which response mapping participants find easier to use. Greenwald et al. (1998) demonstrated that participants are faster to press one key for flower names and positive adjectives and another key for insect names and negative adjectives (compatible task) than to press one key for flower names and negative adjectives and the other key for insect names and positive adjectives (incompatible task). These results indicated that the attribute concept of positive is more closely associated in memory with the target concept of flower than with the target concept of insect and that the attribute concept of negative is more closely associated with insect than with flower.

Because of the assumption that attitudes, stereotypes and other psychological constructs are stored in memory as an association between the representation of the specific object or subject and the representation of positive and negative valence (e.g., Fazio, 1986), one can argue that the IAT provides an indirect way to measure such constructs.

Since its first publication in 1998, the Implicit Association Test (IAT) has been used repeatedly to measure implicit attitudes and other automatic associations. Its applications are primarily in social cognition research but also in psychology of personality, and health psychology.

Several studies are on social attitudes towards groups and minorities (e.g., Banse, Seise, Zerbes, 2001; Dasgupta & Greenwald, 2001; Mitchell, Nosek, & Banaji, 2003), or towards behavior (e.g., Maison, Greenwald, & Bruin, 2001; Plessner & Banse, 2001; Marsh, Johnson, & Scott-Sheldon, 2001; Swanson, Rudman, & Greenwald, 2001; Steffens & Buchner, 2003). Automatic or implicit stereotypes and prejudice was conducted in many studies (e.g., Greenwald, et al., 1998; Rudman, Greenwald, Mellott, & Schwartz, 1999; Phelps, O'Connor, Cunningham, Funayama, Gatenby, & Gore, 2000; Ashburn-Nardo, Voils, & Monteith, 2001; Monteith, Voils, & Ashburn-Nardo, 2001; Kuehnen, Schiessl, Bauer, Paulig, Poehlmann, & Schmidthals, 2001; McConnell & Leibold, 2001; Wittenbrink, Judd, & Park, 2001; Nosek, Banaji, & Greenwald, 2002; Ashburn-Nardo, Knowles, & Monteith, 2003; Richeson, & Shelton, in press; Richeson, & Ambady, 2003). Another field of great interest concerns implicit self-esteem and self-concept (e.g., Greenwald & Farnham, 2000; Bosson, Swann, & Pennebaker, 2000, Asendorpf, Banse, & Muecke, 2002; de Jong, 2002; Hummert, Garstka, O'Brien, Greenwald, & Mellott, 2002; McFarland & Crouch, 2002; Asendorpf, Banse, & Schnabel, 2003). The IAT was also used in a differential psychological perspective to measure constructs of personality (e.g., general anxiety: Egloff, Wilhelm, Neubauer, Mauss, & Gross, 2002; Egloff & Schmukle, 2002; Schmukle & Egloff, 2003). Recently there are several interesting studies on implicit attitudes and health behavior, such as alcohol consumption (e.g., Wiers, van Woerden, Smulders, & de Jong, 2002; Jajodia, & Earleywine, 2003; Palfai & Ostafin, 2003) and relations to high fat foods (e.g., Roefs, & Jansen, 2002, Teachman, Gapinski, Brownell, Rawlins, & Jeyaram, 2003).

Most of the research on indirect measures that has been conducted in social psychology has concerned either various forms of priming or the IAT. Affective priming tasks, however, seem to be unfavorable to assess the activation of fear relevant structures in anxiety. Searching through clinical literature there are barely any examples about the use of subliminal priming experiments to detect group differences between high and low anxious participants. Meyer and Merckelbach (1999) examined 31 undergraduate students reporting a high or low fear of spiders, who viewed images of spiders and snakes, preceded by 8-msec subliminal primes of either smiling faces, scowling faces, or neutral configurations. Subsequently, participants evaluated the negativity and fearfulness of each image and completed questionnaires concerning snakes and spiders. Results show that individuals who were not spider phobic reported more fear following negative priming. No effects of primes were observed for individuals with spider phobia. Mayer and Merckelbach (1999), nevertheless, suggest that subliminal affective priming has little or no clinical potential.

Moreover, priming methods and the IAT do not seem to measure the same cognitive structure or processes. Priming measures are based on the spontaneous activation of a single evaluation in response to the subliminally presented primed stimulus. The IAT has little to do with what is unconsciously activated in response to a given stimulus (see chapter 1.3.3-1). It rather represents an indirect method to assess a specific association of interest between a target category and an attribute dimension. Because of the indirect approach, the IAT seems to be useful to tap into the cognitive fear structures uninfluenced by intentional processes or conscious search. Furthermore, numerous promising IAT applications in social and health psychology further support applying the IAT to assess memory-based cognitive structures referred to in schema theories of anxiety.

1.3 IAT measures in psychopathology: Advantages, limitations, and open questions

Following the above assumption that the associations assessed by the IAT share many of the qualities ascribed to schemata, the IAT seems to be quite promising for clinical orientated research. The experiments of this dissertation focused on one specific type of anxiety, namely fear of spiders. The following chapter gives an introduction to spider phobia and explains why it could be fruitful to assess fear associations in spider phobia using indirect measures. Then this paper will focus on previous research, its limitations and still open questions, which lead to the experiments of this dissertation.

1.3.1 Spider Phobia

What are the characteristics of spider phobia and why could it be a worthwhile approach to use indirect measures of associations in this domain? According to the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994), spider phobia belongs to specific phobias, previously known as simple phobia in DSM-III. Specific phobias display a marked and persistent fear of clearly discernible, circumscribed objects or situations (Criterion A). Exposure to the phobic stimulus would invariably provoke an immediate anxiety response (Criterion B) which may take the form of a situationally bound panic attack. Adults describe their fear as excessive or unreasonable (Criterion C). In most cases the phobic stimulus is avoided, although it is sometimes endured with worry and dread (Criterion D). The diagnosis is appropriate only if the avoidance, fear or anxious anticipation of encountering the phobic stimulus interferes significantly with the person's daily routine, occupational functioning, social life or if the person is markedly distressed about having the phobia (Criterion E). Upon exposure to the feared stimulus, a severe anxiety response occurs, and individuals with specific phobia realize that their fear is irrational or excessive; but this does not help alleviate the fear. Individuals with phobias focus on anticipated harm from some aspects of the feared object. They may also show phobic concerns about losing control and panicking that might occur on exposed to the feared object. There are several subtypes of specific phobia, like blood-injection-injury, natural environment, or situational type. Spider phobia belongs to the animal type.

Specific phobias are one of the most common anxiety disorders. Estimations of the life prevalence vary between 7-8% (Bland, Newman, & Orn, 1988; Wittchen, 1986), 15% (Robins, Helzer, Weissman, Orvaschel, Gruenerg, Burke, & Regier, 1984) und 20% (Fredrikson, Annas, Fischer & Wik, 1996). Specific phobias have the lowest comorbidity rates of all anxiety disorders (ca. 27%). In most cases they are combined with other anxiety disorders (23%), but seldom with affective disorders (2.2%; Becker, Tuerke, Neumer, Soeder & Margraf, 2000). Furthermore, animal phobias are among the most prevalent of specific phobias (Bourdon, Boyd, Rae, Burns, Thompson, & Locke, 1988; Curtis, Magee, Eaton, Wittchen, & Kessler, 1998), with an estimated life time prevalence of 5% in young women (Becker et al., 2000.). Females account for up to 70-90% of situational, animal or natural environmental type phobias. Blood-injection-injury type phobias are seen almost as frequently in males as females. Moreover, 80% of those who have animal phobias report that their age of onset was before they were ten (Öst, 1987). Because there is no specific diagnosis of spider phobia, its prevalence is difficult to estimate. Spider fear is, however, considered to be one of the most common animal fears. Not all spider-fearing individuals fulfill all criteria for diagnosis. Spiders can be easily avoided in normal life, which leads to less distress or impairment in a person’s social or occupational functioning. One can estimate that the prevalence of spider fear (without Criterion E) and spider phobia is about 7-9 %.

Although fear of spiders is reported to be one of the most common animal fears, particularly in Western culture, its etiology remains unclear (e.g., Davey, 1992; Merkelbach, Arntz, Arrindell, & de Jong, 1992). One can assume that there are various factors that influence the development of a phobia. In a very general way, genetic factors might determine a predisposition or vulnerability for the acquisition of a phobia. It seems unlikely, however, that a specific phobia is genetically transmitted (Barlow, 1988). More predictive importance for the etiology of phobias comes from behavioral approaches, which propose that symptoms of these anxiety disorders are reinforced or conditioned (e.g., Mowrer 1947; Miller, 1948). According to these models all stimuli could become phobic objects by being paired with a frightening experience. Nevertheless, traditional models of conditioning are not able to explain the specificity of phobic objects, for instance that humans develop phobias towards spiders, snakes, elevators, but not flowers, or dangerous electric cables or guns. Without doubt, conditioning processes play an important aspect in phobia acquisition, but not all stimuli have the same potential to become relevant. With Seligman's preparedness hypothesis (Seligman, 1971) an influential and important explanation was offered. According to Seligman, certain situations and objects (e.g., animals including spiders) at one time posed a threat to our species. As a consequence, we are born with a predisposition to fear whatever is related to sources of serious danger in the evolutionary past. Such a prepared stimulus has a high potential to become a phobic threat, when conditioned in an aversive context. Important for the etiology of specific phobias is the fact that phobias can be learned without a self experience of the threatening stimulus, but just by observation. Cook and Mineka (1990) were able to show that lab-reared monkeys acquired fear of snakes vicariously by observing other monkeys expressing fear of snakes. When non-fearful lab-reared monkeys were given the opportunity to observe a wild-reared model monkey displaying fear of live and toy snakes, they were rapidly conditioned to fear snakes. This fear was even learned when the fearful model was shown on videotape. In another experiment, lab-reared monkeys were shown a video with a monkey model that displayed fear in response to toy snakes and flowers, or to toy crocodiles and rabbits. The monkeys showed substantial conditioning to toy snakes and crocodiles, but not to flowers and rabbits. Because the monkeys had never seen any of these stimuli prior to this experience, the results provide a strong support for an evolutionary basis to the selective learning (Öhman & Mineka, 2003).

However, it also seems that the nature of preparedness goes beyond the stimulus itself. For example, we may be predisposed to fear some animals, including spiders, because of their sudden and speedy movement (Bennett-Levy & Marteau, 1984), or their particular visual characteristics (Merkelbach, Van Den Hout, & Van Der Molen, 1987).

Because conditioning and preparedness does not adequately explain the development and especially the persistence of phobias, recently attention has been focused on the influence of cognitions (Beck et al., 1985, Chapter 1.1.2). Cognitive processes seem to play an important role as mediators between experience and response. It is believed that distorted processes in attention, memory, or interpretation are basic mechanisms involved in the etiology and maintenance of phobias. For example, individuals with phobias attend vigilantly to even fleeting signs of danger, especially when they are under stress (e.g., Williams, Mathews, & MacLeod, 1996). At such times, the recognition of danger cues triggers a maladaptive, self-perpetuating cycle of cognitive processes than can quickly spin out of control.

Tomarken, Mineka, and Cook (1989) demonstrated cognitive misinterpretations in simple phobia in the following experiment. Participants with animal phobias were presented fear-relevant pictures (e.g., spider) or irrelevant pictures (e.g., flowers). After each picture, an aversive electrical shock, a neutral tone or no stimulus followed. Participants were instructed to estimate the frequencies of the pairing between each picture category and the subsequent stimulus. The frequencies were equal for each stimulus i.e., shock, tone and no subsequent stimulus, were uniformly distributed for each picture. Nevertheless, highly fearful participants overestimated the appearance of an aversive shock after the fear-relevant stimuli compared to non-fearful participants. Tomarken et al. (1989) concluded that there information processing is biased toward the fear relevant information.

The assumption that humans have a natural predisposition to fear or averse spiders is one reason to choose individuals with spider phobia as an experimental group in this dissertation. It would be of great etiological interest, whether individuals without phobia show the same aversive and fear-related cognitive pattern when assessed with an indirect test such as the IAT, which promises to assess automatic associations uninfluenced by explicit intentions and control.

Moreover, because spider phobia fits into the etiological concept of preparedness, the results of this study could be generalized over similar evolutionary-prepared phobias (e.g., social phobia). Since these phobias represent some of the most common and prevalent types of anxiety disorders and mental illnesses in general, the application of an experimental paradigm like the IAT in spider phobia is a useful and adequate approach for the understanding of cognitive characteristics and processes that underlie this type of disorder.

In addition, indirect measures in spider phobia also refer to automatic and uncontrollable aspects of fear associations and concepts. Self reports, such as questionnaires or interviews, refer to immediate conscious experience in explicit memory. Individuals with spider phobia are able to express their fear of spiders, but most of them find it difficult to explain the special characteristics that make these animals become phobic objects, compared to more rational evolutionary threats like heights or water (Davey, 1992). Although these individuals explicitly view their attitude to spiders as irrational (Mayer, Merckelbach, and Muris, 2000), people do feel threatened by the harmless and defenseless spiders, which seem to 'trigger an evolved predator defense system in human beings (McNally, 2002, p.562). The crucial point is that people with spider phobia and those without significantly differ with respect to their experienced intentional control over the reaction to spiders (Mayer et al., 2000). This little intentional control could relate to the connections between explicit - declarative memory structures (where people store information that spiders are harmless and can be found in the basement) and brain's primary motivational system (see chapter 1.1.2), which leads to a fast fear activation without necessarily including the information of the declarative memory. Therefore, it appears that automatic and uncontrollable expressions of fear associations (assessed by indirect measures like the IAT) represent important additional information about cognitive characteristics of spider phobia that might complement explicit reports when trying to predict fear-related behavior.

1.3.2 Psychological disorders and IAT measures - Previous studies

Although the IAT lead to numerous applications in social psychology, its applications in clinically oriented research is rather limited. There are a few very promising applications of the IAT, investigating implicit associations in patients recovered from depression (Gemar, Segal, Sagrati, & Kennedy, 2001) and anxiety disorders (de Jong et a., 2001; Teachman, Gregg, & Woody, 2001; de Jong, 2002; Teachman & Woody, 2003; de Jong, van den Hout, Rietbroek, & Huijding, 2003).

Gemar et al.(2001) used a mood induction paradigm to examine dysphoria-related changes of cognitive processing in individuals who had previously experienced depression. The patients who had been depressed (n = 23) and never-depressed controls (n = 27) performed the Implicit Association Test to measures a self-evaluative bias before and after a negative-mood induction. In the first combined task, negative words and self-items were assigned to one key and positive words and non-self-items were assigned to a second key. The assignment of the valence keys was changed in the second combined task. Results obtained by Gemar et al. suggested that after inducing a negative mood participants who had experienced depression had less positive attitudes about themselves (faster reactions when negative words and self-items share one key) than participants who were never diagnosed as having a depression. These findings suggest that even a mild negative mood in individuals who had been depressed can reinstate some of the cognitive features observed in depression itself.

De Jong et al (2001) investigated whether an IAT can be used to assess dysfunctional beliefs in social phobia. Their IAT was designed to differentiate between individuals with high and low social anxiety. Social situations and neutral words were the targets (e.g., date vs. hall), and positive and negative outcomes (e.g., compliment vs. rejection) the associated attributes. Women with high social anxiety (N=32) showed the predicted deterioration of task performance if the required responses switched from compatible to incompatible with the idea that social situations are related to negative outcomes and vice versa; whereas the opposite was true for women with low anxiety (N=32). In a later study, de Jong (2002) investigated the role of negative self-image in social phobia. Participants were 19 women with high and 19 with low social anxiety . The IAT was used to assess participants' self-esteem as well as their general evaluation of others ('other-esteem'). Women with social anxiety displayed relatively low levels of self-esteem on self-report measures. At the implicit level, however, women with low and high anxiety did not differ from each other and were characterized by a similar, highly positive self-image, but both groups displayed a relatively low 'other-esteem'. Furthermore, this self-favoring effect was considerably weaker with high than in low anxiety . The results provided equivocal support for the idea that low self-esteem plays an important role in social anxiety. On the other hand, de Jong et al. (2001) argue that rather than by low self-esteem per se, socially anxious people are characterized by a small discrepancy between esteem of self and others, and it may be this reduced tendency to self-favoring that is pivotal to social anxiety.

Most of the clinical studies using an IAT have focused on spider phobia. Similar to studies in social psychology, the IAT can be designed to measure the strength of associations between an *attribute* dimension (e.g., pleasant vs. unpleasant) and clinically relevant *targets* (e.g., spiders vs. butterflies) by comparing the reaction times of two successive categorization tasks. In the critical categorization tasks, participants would classify both target stimuli and attribute stimuli into two categories each. For instance, they might press a certain key on the computer keyboard in response to pictures of spiders and in response to pleasant words, and they press another key whenever a butterfly or an unpleasant word is shown. The key assignment of one concept (e.g., target pictures) changes between the two critical tasks, leading to the crucial question whether one response mapping is easier for the participants than the other. If strongly associated concepts share the same response in one task (e.g., spiders and unpleasant words on one key, butterflies and pleasant words on the other key) responses in this *compatible task* should be faster than in the *incompatible task* with the opposite assignment (e.g., spiders and pleasant words on one key, butterflies and unpleasant words on the other key). The differences in average response time between the compatible and the incompatible task indicates the strength of the associations between the paired categories.

In the first published study about IAT and spider phobia, Teachman et al. (2001) investigated fear-related automatic associations among individuals with snake (n = 30) and spider fear (n = 37), and found the IAT to discriminate between the two groups. Teachman et al. used spiders and snakes as targets pictures of and paired them in four separate IATs with attribute concepts of 'bad vs. good', 'afraid vs. unafraid', 'danger vs. safety', and 'disgusting vs. appealing'. Different to the design introduced by Greenwald et al. (1998) their IAT consisted of two critical blocks with only 48 classification trials. Of these, the first 12 were practice trials, and the remaining 36 constituted the experimental data. Results indicated that individuals with spider and snake fear show automatic associations with pictorial stimuli of the feared animal. These implicit associations were robust across multiple semantic categorizations (valence evaluation, fear, danger, and disgust).

Using the same paradigm, Teachman & Woody (2003) examined 31 individuals with spider phobia and 30 without before and after a group-based exposure treatment. Again participants categorized pictures of spiders and snakes along with semantic categorization (valence, fear, danger, and disgust). Spider phobic and non-phobic groups showed different fear-related implicit associations toward spiders. Over the course of treatment, these associations changed mostly in participants with high anxiety. Results supported the clinical applications for implicit fear associations, including prediction of phobic avoidance, and treatment sensitivity of fear- and disgust-specific automatic associations.

De Jong et al. (2003) also explored the presence of implicit fear-related associations in participants who did and did not fear spiders . In contrast to the picture stimuli (spiders vs. snakes) used by Teachman et al. (2001, 2003), de Jong et al. (2003) used verbal spider cues versus neutral words as target stimuli, and negative fear-related versus positive words as attributes. As expected, both groups differed on the explicit level, with more negative attitudes towards spider cues in participants with high fear. Surprisingly, those with high and low fear both showed similar negative associations to spiders at the implicit level. De Jong et al. (2003) assumed that individuals may be similar with respect to a general implicit affective evaluation of spiders whether they have high fear or not.

Previous studies using the IAT in the field of psychopathology showed very promising results. Based on the hypothesis about the meaning of the IAT, associatively matched pairings (e.g., spider pictures and fear words) are more quickly categorized because they involve concepts that are strongly elaborated or accessible within the same schema. Because these concepts are linked in memory and associations between them have been reinforced, it is easy for individuals to access this connected information and process stimuli in a compatible task. On the other hand, mismatched pairings take longer for categorization, because individuals need to override these highly connected associations when performing the incompatible task. It seems that mismatched pairings are difficult to access because they contradict the established automatic association. Following the assumption that reaction time can be used to assess the ease of cognitive processing, the IAT reflects the extent that a concept or association is accessible in memory. Taking into the clinical domain, this approach offers a useful method to reflect accessibility of schematic fear associations.

1.3.3 Limitations and open questions in the use of the IAT

In research in clinical psychology, reporters often mention *implicit* fear associations or schemata, which are assessed by the IAT (e.g., de Jong et al., 2001; de Jong et al., 2003; Teachman & Woody, 2001; Teachman et al., 2003). Undoubtedly, many researchers transfer the concepts of implicit attitudes or stereotypes to clinical psychology. Where, however, is a theory of implicit associations found in clinical psychology? Does the IAT measure implicit associations or does it measure associations implicitly?

In recent years, there was intense criticism of the IAT, coming from cognitive psychology. For example, Fiedler (2003) pointed out unresolved problems with the 'I', the 'A' and the 'T' of the IAT, critisizing logical and psychometric properties of the Implicit Association Test. The following chapter will focus on these limitations, critiques and open questions which are the source of the experimental approaches in this dissertation.

1. Implicit associations or implicit measurement?

The main goal of this dissertation is to apply indirect measures like the IAT in a psychopathological context and to investigate implicit dysfunctional associations and cognitive fear-related structures in spider phobia. Although the constructs of implicit attitudes, stereotypes, and self-esteem are commonly used in cognitive social psychology (e.g., Greenwald & Banaji, 1995),it is necessary to define the meaning of the term 'implicit' in relation to cognitive fear-related structures in memory (i.e., schemata). Talking about 'implicit fear associations towards spiders' could confusingly imply the existence of two separate structures (explicit and implicit), with a lack of awareness and no introspective access into the implicit one. Many individuals with phobias are, however, surely able to express their associations towards spiders accurately, and they are more than aware of their negative fear associations. It is rather uncertain which structures are assessed by the IAT. Because the task uses stimuli that need to be categorized regarding a given dimension, explicit and declarative knowledge is necessary. Nevertheless, in an investigation concerning fMRI-assessed activation of the amygdala, Phelps et al. (2000) found that the strength of amygdala activation to unfamiliar Black-versus-White faces was correlated with IAT measures of race evaluation, but not with the direct (conscious) expression of race attitudes. According to LeDoux and Phelps (2000) amygdala activation relates to the implicit emotional memory system. On the other hand, the IAT requires an evaluation of stimuli that are stored in memory. Literature on acquisition and activation of evaluative information in memory propose that evaluative information is stored in semantic memory (e.g., Hermans, Baeyens, & Eelen, 2003). To prevent speculations about activated structures it seems more helpful to focus on cognitive processes and responses activated by the IAT and clarify, whether the measure is implicit or explicit.

There are serious reasons, however, to not consider the IAT an implicit measure (e.g., De Houwer, 2002; Fazio & Olson, 2003). Using the term 'implicit' as applied in cognitive psychology leads to some theoretical problems and major misunderstandings of the IAT.

Firstly, one rather strict definition would state that the IAT is implicit if participants are not aware of what the test is measuring (similar to the definition of an implicit memory test, see: Graf & Schacter, 1985; Roediger, 1990). In the IAT, just because an individual has more difficulty associating a given target object with the category pleasant than with the category unpleasant does not mean that the individual is unaware that he or she views the object negatively. As long as the term implicit is to reflect unawareness, there is no justification for labeling this task as implicit. Moreover, the requirements for an implicit task are certainly not met because participants usually notice the purpose of the IAT they are performing (Motheith, Voils, & Ashburn-Nardo, 2001).

Secondly, some researchers have argued that the IAT may be considered implicit because it is nearly impossible to fake its results. Although some evidence in favor of the IAT's resistance against faking attempts has been presented (Banse et al., 2001; Kim & Greenwald, 1998), it is by no means indisputable (e.g., Fiedler, 2003). It remains, however, unclear whether this criterion is sufficient to define implicitness.

A third aspect is that the method provides estimates of individuals’ attitudes without our having to directly ask them for such information. Participants are not required to consciously think about what is being measured, they may be unaware that their attitudes are being assessed, but that does not mean that they are unaware that they possess those attitudes.

Consequently, because the IAT is a performance-related task that does not ask directly for a verbal report about the construct of interest, it seems reasonable to call the IAT an 'indirect' measure (Fazio & Olson, 2003) based on automatic expressions of the constructs being tested (e.g., Dasgupta, McGhee, Greenwald, & Banaji, 2000). As in earlier research on automaticity, it will become necessary to determine possible automatic features of the IAT (e.g., control, intention, efficiency, awareness) to find out whether they satisfy the definition of automaticity (see Bargh, 1994; Bargh & Chartrand, 2000). For the IAT the emphasis is on controllability, compared to priming measures where the term automatic appears to have a different meaning (Fazio & Olson, 2003). As Dasgupta et al. (2001, p. 317) stated: "IAT responses are considered automatic because they are expressed without intention or control, although perceivers may become aware of the attitude under scrutiny during the task".

In this paper I use the term 'implicit associations' with respect to cognitive structures tested through the performance-based indirect approach. Then, the IAT provides a measure of associations between the representations of a target stimulus (e.g., spider) and more or less related representations of evaluation (affect, attitudes). The human cognitive system is endowed with a mechanism that automatically evaluates all incoming stimulus information as pleasant/unpleasant, fearful/nonfearful, etc.(LeDoux, 1993, 1995), and automatically leads to the activation of representations associated with it (e.g., Bower, 1981; Fazio et al., 1986). This activation depends on the strength of the associations between the memory representations of the object (e.g., spider) and the evaluative tag. In return, the IAT measures the ease of performance on a given target-attribute association and reflects the extent that this association is accessible in the activated memory system.

2. What does the IAT measure?

To use the IAT in clinical research it needs to be certain that valid IAT measures are only influenced by the strength of the interested associations and not by other factors. There are some alternative explanations, however, which argue that IAT effects might reflect salience (Rothermund & Wentura, 2001) or that they can be attributed to differential costs for switching between task sets (Mierke & Klauer, 2001).

According to the figure –ground- asymmetry model by Rothermund and Wentura (2001) participants do not classify the presented stimuli regarding the given dimensions (e.g., spider vs. butterfly / unpleasant vs. pleasant), but select one YES category (i.e., figure category) and one NO category (i.e., background) for the given target and attribute concepts. The YES category tends to be the salient category, usually the more unfamiliar (e.g., nonwords) or negative category. Performing an IAT, participants only respond to a presented stimulus whether it does belong to the YES category. As a result IAT performance depends on whether target and attribute YES category are assigned to the same key, which would lead to a faster classification because the YES classification (due to its salience) leads to the same response for targets and attributes. Performance will be slowed down, when target and attribute YES categories are assigned to different keys. On the other hand, numerous experiments by Rothermund and Wentura only demonstrated that IAT effects can be produced by figure-ground processes, but do not proof that IAT effects are always due to such processes. Moreover, when IAT effects are based on figure-ground asymmetries that are mediated by salience, why do different groups of participants (e.g., those with and without spider phobia) show different IAT effects with regard to the measured target – attribute relation? In terms of the figure-ground model, the explanation would be that salience of certain concepts differs between the groups, but what are the underlying mechanisms that influence salience?

Here, the figure-ground model offers no explanations and one can assume that this group's effects relate to different associations tested by the IAT. Studies that demonstrate group differences in IAT performance (known group approach) support the validity of the IAT as a measure of associative strength. Nevertheless, figure-ground processes can influence IAT effects and therefore one should try to avoid highly salient concepts in IAT studies (like very unfamiliar concepts such as the concept 'nonword ') (De Houwer, 2002).

Mierke and Klauer (2001) argue that IAT effects could also be due to the fact that participants use different strategies in the compatible and incompatible task. In the compatible task it is irrelevant whether target stimuli are classified according the target categories (e.g., flower vs. insect) or according the attribute dimension (e.g., positive vs. negative), because one target concept (flower) consists of positive exemplars (and thus can be categorized as positive) and the other (insects) consists of negative exemplars that can be categorized as negative.

In the compatible task participants do not need to switch between the categorizing of targets and attributes, because classifying a flower name as flower will lead to the same response as classifying it as a positive word. Mierke and Klauer (2001) argue that responding on the basis of the attribute-related information is sufficient to lead to faster performance in the compatible phase of the IAT. On the other hand, switching to the incompatible task makes this strategy impossible and leads to longer reaction times. It remains unclear, however, whether participants use these strategies during an IAT task or whether they categorize the presented stimuli according the given instruction. Moreover, the approach by Mierke and Klauer should refer to all participating individuals and would not be able to explain differences between groups, as observed in 'known group approaches'.

Especially important is De Houwer's (2001) consideration of 'relevant' and 'irrelevant' feature accounts and the question, whether IAT performance is sensitive to the valence of the category (e.g., flower) or to the valence of the single stimulus (e.g., tulip). This approach is related to the assumption that reaction time performance depends on the compatibility between presented stimuli and the required responses and/or the relation between features of the stimuli that are presented. Based on a classification by Kornblum (e.g., Kornblum & Lee, 1995) de Houwer's (2001) structural and process analysis discusses two possible response selection accounts of IAT effects (for a detailed overview, see: De Houwer, 2003a). The structurally relevant feature of any given target stimulus (e.g., tulip) in the IAT is its membership in one of the given categories (e.g., tulip is a flower – flower has positive valence). On the other hand, it is of great interest whether the IAT is sensitive to the irrelevant feature of the stimulus, the valence of the individual target stimuli (e.g., tulip itself is positive). Stimulus valence is an irrelevant feature of target stimuli because participants are instructed to respond on the basis of the semantic category and do not need to process the valence of the individual stimuli. De Houwer (2001) points out that in a typical IAT, there is a perfect confounding between the relevant and irrelevant feature of target concept stimuli. De Houwer (2001) empirically tested the two accounts conducting an experiment with British participants that involved the target categories 'British' and 'foreign'. Importantly, half of the British and foreign names referred to positively valued names (e.g., Princess Diana, or Albert Einstein) and half of the names referred to negatively valenced names (e.g., Margaret Thatcher or Adolf Hitler). Results indicated that valence of individual names had no impact on the magnitude of the IAT effect and participants responded faster, when British names and positive attributes had the same key assignment. This leads to the conclusion that IAT effects reflect the associations involving target concepts rather than involving the exemplars that describe those concepts. Nevertheless, Steffens and Plewe (2001) suggested that valence of single exemplars has profound influence on IAT performance. In their IAT experiment female and male target words (typical female and male names) were combined with positive and negative attributes. As predicted, female participants exhibited significantly faster responses, when female names and positive words had the same key assignment (and male names referred to the same key as negative words) as when the assignment was reversed. This effect, however, depended on the single attributes used in the study. It was twice as large when the individual words were positive stereotypical female adjectives (e.g., intuitive) and negative individual male-related stereotypes (e.g., brutal). The IAT effect decreased when the negative attributes displayed strongly negative female-related stereotypes (e.g., bitchy) compared to positive male-related stereotypes (e.g., independent). Contrary to De Houwer (2001) results by Steffens and Plewe (2001) indicate a strong influence of exemplar valence on IAT performance. For application in research it seems to be important to pay close attention to the selection of attribute stimuli, because particular selection of exemplars can have impact on IAT scores.

3. IAT and relative strength of associations

In the IAT four stimulus categories are needed. Two categories refer to the target concept (e.g., flower vs. insect), while the other two are attribute concepts (e.g., positive vs. negative). Because of their being always two target concepts in the same task, the IAT can only provide a measure of the relative strength of associations. Faster responses in the compatible task (flowers and positive words are assigned on one key vs. insects and negative words on the other key) compared to the incompatible task (flowers and negative words are assigned to one key vs. insects and positive words on the other key) informs about the evaluation of flowers relative to insects. Here, flowers show stronger associations with positive attributes than negative attributes in relation to the associations of the concept insect to positive and negative words. Hence, one cannot argue that insects are associated with negativity in absolute terms; one can only conclude that insects hold rather negative associations compared to flowers. For application of the IAT in clinical research this implies that one cannot measure one specific dysfunctional association in one specific disorder. Results will only provide information about the relative strength of associations.

4. Malleability and the influence of context

Talking about indirect measures for testing dysfunctional associations in clinically oriented research, aspects of validity (as pointed out under point 2 of this chapter) are most important to understand what the paradigms are measuring. For interpretation and diagnostic use, however, it should be clear whether the effects measured by these new instruments are malleable and what might influence the test outcome. Recent evidence shows IAT effects have a good test-retest reliability. Across several studies, test-retest reliabilities of IAT measures have averaged above $r = .60$ (e.g., Bosson, Swann, & Pennebaker, 2000; Dasgupta & Greenwald, 2001; Greenwald & Farnham, 2000). Banse et al. reported quite satisfactory internal consistencies of IAT measures (average $r > .80$), although they also mentioned that test-retest reliabilities were lower than anticipated. Nevertheless, there is also growing evidence that IAT effects are malleable (e.g., Lowery et al., 2001; Richeson & Ambdy, 2003; Blair, Ma, & Lenton, 2001; Dasgupta & Greenwald, 2001; Rudman, Ashmore, & Gary, 2001; Wittenbrink, Judd, & Park, 2001, Rudman & Lee, 2002; Mitchell, Nosek, & Banaji, 2003; for an overview, see: Blair, 2002).

Many studies examined the influence of additional context information on IAT performance. Wittenbrink et al. (2001, Study 1) conducted an IAT measuring racial stereotypes towards white and black people. Similar to the IAT used by Greenwald et al. (1998) participants categorized target words that consisted of first names stereotypic of Blacks and Whites (e.g., Rasaan, Andrew) as well as nouns (attribute dimension) with either strong positive or strong negative connotation. In two critical tasks both category judgments (Black vs. White for names and good vs. bad for nouns) had to be classified by using just two response keys (e.g., task one: Black/good vs. White/bad; task two: White/good vs. Black/bad). Faster responses should be observed for the combination that are compatible with the participants associations, whereas response times should slow down if the category combinations are incompatible with the participants associations. After the participants performed this IAT in the beginning of the experiment (baseline), half of the participants were shown a movie clip that depicted Black targets in a positive stereotypic situation (harmonious family barbecue), whereas the remaining participants saw a movie clip with negative stereotypic context (an argumentative gang-related incident). The question was how this manipulation would affect IAT effects in the second IAT following the video. Results indicated that stereotype exposure moderated IAT effects differently. Comparing the different context information, (white) participants who were exposed to the positive stereotype showed a significantly larger decrease in their spontaneous prejudice bias than did participants in the negative exposure condition. One can conclude that just by placing either positive or negative context information reliably changes participants' response on the IAT.

Similar to the results by Wittenbrink et al. (2001), other studies clearly indicate the malleability of IAT effects. IAT measures of racial prejudice were not only influenced by movie clips or exposure to violent rap music (Rudman & Lee, 2002), but also through social interactions during the experiment. Negativity towards Blacks was decreased in the presence of a Black experimenter, compared to the presence of a White experimenter (Lowery et al., 2001). Dasgupta and Greenwald (2001) found less negativity toward elderly (measured by an IAT) after exposure of admired vs. disliked older individuals. Mitchell et al. (2003) reported an influence on IAT effects depending on the focus of attention. There was more positivism towards Blacks, when participants categorized pictures of Black athletes and White politicians according their occupation. The reversed pattern was observed, when participants had to focus on the race of the targets. Moreover, even mental imagery of a counter stereotypical concept influenced IAT effects (Blair et al., 2001). In one of their IAT experiments (Blair et al., 2001, study 1 & 2) the strength of a stereotypic gender association was reduced following counter stereotypic mental imagery (e.g., imagine a strong woman), compared to a control condition. Overall it seems that salient positive information about a given category produces IAT scores indicating a more positive evaluation of the category.

These findings have several implications for using the IAT and other indirect measures in clinically oriented research and raise important questions about the nature of the evaluative, fear-related representation. The degree of contextual dependence of an evaluation will determine the stability and retest-reliability of measurements across context. Just as there is sometimes low reliability in explicit measures of associations across time due to the underlying constructive nature, an automatic evaluation will be similarly bound by contextual factors (see: Ferguson & Bargh, 2003). It seems fruitful to explore the extent to which automatically activated fear-related associations are contextually dependent, and therefore to be considered as the result of a constructive process in a certain situation. Imagine a person with spider phobia who associates specific situations or objects with spiders and therefore with fear. If such fear-associated objects (e.g., the corner of a window) are stored in memory as one solitary (single tag) evaluative representation, this object should always activate fear-related responses and would not relate to neutral or more positive contents; however, this concept of one single affective tag seems very unlikely. The second possibility relates to the assumption that valence is based on various representations, including multiple categories that relate to the object in various ways (Ferguson & Bargh, 2003). With respect to phobias, these assumptions imply that automatically activated dysfunctional associations vary across time and context, depending on the way the object is perceived and what has been recently activated with regard to this object. This would influence subsequent judgments, feelings, and behavior according to the activated context. Moreover, the assessment of automatic fear-related associations in different contextual situations would help to shed the light on the debate about the nature of dysfunctional beliefs and associations that underlie psychopathology (De Houer, 2002). Originally, these associations were believed to be context-independent and relatively stable over time (e.g., Beck, 1976). This would suggest that an automatic evaluation is based on a stable, preexisting representation of the phobic object. Nevertheless, traditional self- report measures of dysfunctional beliefs indicated to be rather context-dependent (e.g., Teasdale, 1993). In this case, (automatic) associations measured by indirect tasks rather reflect a composite of multiple representations and in thus be flexible and sensitive to current contextual conditions and object relevant activations.

1.4 The approaches of this dissertation

The main goal of this dissertation is to apply indirect measures of associations like the Implicit Association Test and related paradigms in spider phobia. Based on the promising applications, as well on unsolved problems and open questions of previous IAT studies this dissertation will now focus on three major issues.

On one hand the focus will be on clinically oriented questions about the usefulness of IAT measures to assess fear-relevant associations and schemata and to predict anxious behavior. It could be of great interest for clinically oriented research, when techniques like the IAT offer information about maladaptive schemata that relate to automatic evaluations of the feared stimuli, in addition to controlled cognitive and behavioral aspects measured through interviews and questionnaires. In this respect Study 1 applies a modified IAT to investigate cognitive structures in spider phobia. As a special methodological feature, the influence of different IAT designs (two vs. five tasks) on performance will be examined. Fear associations towards spiders are measured among participants with and without spider phobia. Moreover, in advantage to previous studies spider enthusiasts will be introduced as an experimental group. Study 1 will address the question, if individuals with and without phobia differ in fear-related 'implicit' associations as proposed by Teachman et al. (2003), or if the two groups do just differ on an explicit and behavioral level (e.g., de Jong et al., 2003). Previous IAT research on spider phobia as well as this study suffers the limitations that the results can only be interpreted in terms of group comparisons and not in absolute terms. Introducing spider enthusiasts as a third experimental group offers the innovative possibility to compare IAT effects of fearful and non-fearful participants in relation to a surely absolute no-fear baseline.

The second part of IAT studies in this dissertation will focus on a methodological question regarding the IAT. As chapter 1.3.3 explains in point 2 it is of great interest whether the IAT is sensitive to the valence of the individual target/attribute stimuli, or if IAT effects are just driven by the valence of the concept category. In recent IAT experiments the relevant category dimensions are labeled explicitly. The special approach of Study 2, however, is to test the ability of the IAT to measure fear associations when the attribute dimension (pleasant vs. unpleasant) is masked by a neutral category dimension (e.g., capitalized letters vs. small letters). Through this masking process participants are forced to classify attribute words according a neutral (surface) dimension (no valence) and not according the irrelevant feature of stimulus valence. On the other hand, if IAT effects remain significant in such a masking condition, this would support the assumption that irrelevant stimulus features (valence) still influence IAT performance. Moreover, besides these theoretical implications, the results of Study 2 could provide new applications with practical relevance for the use of IAT experiments in clinical psychology.

Study 3 examines the question of how different context conditions lead to differential activation of cognitive schemata in anxiety. In previous research specific fear-related associations with spiders are tested and compared between individuals with high and low fear, whereas the context was disregarded. There is, however, much evidence from social psychology that indirect associations are context dependent. As a first approach to this matter, Study 3 will investigate whether fear associations involving possible specific spider-related features and situations (e.g., to crawl, legs, basement, attic) depend on different context conditions. The IAT used in previous clinical experiments only measured the relative strength of associations in respect to two target concepts. The innovation of Study 3 is the application of an absolute indirect measure called Extrinsic Affective Simon Task (EAST; De Houwer, 2003b) that is based on features of the IAT and the affective variant of the Simon Task (De Houwer & Eelen, 1998). This EAST will measure the extent in which the target words (i.e., features and situations) are associated with pleasant words and unpleasant, fear-related words. The question is whether these implicit associations depend on the activation of a 'spider' concept or a 'human' concept (concepts will be activated through the presentation of relating pictures before the experiment) and how this activation depends on the individual score of spider fear.

2. Study 1: Explicit and Implicit Associations in Spider Phobia

The goal of Study 1 was to apply the IAT in a psychopathological context and to investigate 'implicit' dysfunctional associations and cognitive fear-related structures in a specific type of anxiety, namely fear of spiders. As discussed in chapter 1.3.3-1 I use the term 'implicit associations' with respect to the performance-based indirect approach of the IAT to fear associations.

Study 1 examined implicit fear-related associations towards spiders, using modified versions of the Implicit Association Test in three experiments. I sought to find out how automatic expressions of fear associations (implicit fear associations) relate to explicit direct measures of fear (e.g., questionnaires, interviews) and how both relate to actual behavior. To justify the use of indirect methods in clinical psychology, it is important to know whether indirect measures improve the prediction of fear-related behavior, over and above explicit measures such as questionnaires. Furthermore, this study focused on some methodological problems and open questions of prior research in this field.

The aim of the first experiment was to apply a version of the Implicit Association Test which would be able to detect individual differences in implicit spider associations. If negative implicit associations towards spiders play a critical role in spider phobia they should correlate with inter-individual differences in avoidance behavior and explicitly expressed fear, leading to differences in IAT performance between highly fearful and non-fearful individuals. Comparing the conflicting IAT results of Teachman et al. (2003) and de Jong et al. (2003), it remains unclear, whether differences between high and low fearful individuals do not exist or whether differences in the IAT designs and target materials led to inconsistent findings (see, chapter 1.3.2).

Given the promising results presented by Greenwald et al. (1998), the IAT design of Experiment 1 followed the original IAT, consisting of a complete sequence of five tasks (1. target discrimination, 2. attribute discrimination, 3. first combined task, 4. reversed target discrimination, and 5. reversed combined task), with an adequate number of practice trials and experimental trials presented during the combined tasks. This approach constitutes a major difference compared to the IAT designs used by Teachman et al. (2001, 2003), who employed only 36 data trials in their versions of the IAT [1].

[1] Teachman et al. (2001, 2003) used only two combined tasks with 12 practice trials and 36 experimental data trials each. De Jong et al. (2003) used four tasks (target and attribute discrimination, two combined tasks, no reversed target discrimination). Each combined task included 48 experimental trials and no practice trials.

I chose the original long version of the IAT because it is important to ensure that IAT performance is based on reaction times in a highly automatic task which is not influenced by insufficient practice or unaccustomed task features. As critical targets, ecologically relevant stimuli (pictures of spiders) were used. Visual confrontation with phobia-related pictures should lead to differential activation of spider-fear associations, differently from verbal cue words (cf. de Jong et al., 2003).

The second target category was butterflies. Several pre-tests had demonstrated that butterfly pictures are not associated with fear or negative valence. In order to estimate and classify indirect fear associations towards spiders, butterflies are a useful second target category because they also represent a class of 'insect-related' small animals, but without an automatic negative schema. Teachman et al. (2003) used snakes as the second target class, which makes drawing conclusions about the direction of automatic fear associations towards spiders more difficult. Snakes generally seem to be strongly and automatically associated with fear in humans (Öhman & Mineka, 2003). Using two fear-related animal classes to investigate automatic associations toward one class – that is, spiders - might distort the results on such indirect tasks. On the other hand, neutral stimuli as the second IAT target class (i.e., de Jong et al., 2003) are indeed completely unrelated to spiders, but it remains unclear whether neutral stimuli offer a true 'neutral' baseline (De Houwer, 2002). Moreover, there is converging evidence suggesting that affectively valenced stimuli (positive and negative) are generally processed more easily and more quickly than neutral stimuli (see Ferre, 2003). To avoid unpredictable effects of neutral stimuli on IAT performance, it seems reasonable to use two affectively valenced target classes. In pretests, butterflies were indeed evaluated as clearly positive, accompanied by very little variance between individuals. Therefore, butterfly pictures make it easier to attribute significantly different IAT effects between phobic individuals and controls to different attitudes towards spiders [2]. As in all IAT applications, mean reaction times in the two combined tasks are compared to each other. If a target concept such as spiders is highly associated with a specific attribute such as fear-related words, the categorization task of the IAT should be easier when the associated concepts share the same response (the compatible task) as when they require different responses (the incompatible task).

[2] To assure that group differences in IAT performance have its origin in different attitudes towards spiders, evaluation of the second target category (butterfly) must not vary between participants. In this study, the material was rated by all participants after the experiment. As pre-tests had already indicated, butterflies were generally evaluated as pleasant, with no threatening or disgusting potential.

The second experiment investigated how a reduction of the IAT from five tasks to only two critical tasks affects IAT performance. As mentioned before, some studies applied short versions of the IAT, reducing the procedure to the two combined tasks (e.g., Dasgupta & Greenwald, 2001; Teachman et al., 2001, 2003). A successfully reduced IAT would be a much more practical tool for applied research in psychopathology because it would be shorter and less exhausting for the participants; however, it has not been shown yet whether a reduced IAT yields results comparable to the original long version. Therefore, in order to allow a direct comparison, Experiment 1 and 2 only differed in the number of IAT tasks and not in any other methodological feature. The main question in Experiment 2 was whether spider fearful participants' IAT performance differs from that of explicitly non-fearful controls, and how implicit associations correlate with behavior and questionnaire scores.

The third experiment focused on the results of de Jong et al. (2003). In this study, both spider fearful and non-fearful participants exhibited significant IAT effects, interpreted as negative implicit spider stereotypes. Consequently, de Jong et al. (2003) assumed that their findings reflect a disassociation in non-phobic individuals between explicit associations (no fear in questionnaires) and implicit associations (better performance when spiders and anxiety related words share the same response). Significantly different IAT effects between phobic individuals and controls may certainly be due to different attitudes towards spiders if evaluations of the second target are comparable in both groups. Beyond this group comparison, however, interpretation of IAT effects is more problematic because the IAT only measures the *relative* strength of associations (see De Houwer, 2002). There are always two target concepts (e.g., spiders cues vs. neutral words) which are related to the two types of attribute concepts (see chapter 1.3.3-3). Studies like the one by de Jong et al. (2003) only show that (1) fear associations are stronger with spider words than with neutral words, or (2) pleasant associations are stronger with neutral words than with spider words, or (3) both of the above. There is no information, however, to tell whether non-phobic controls show implicit fear associations with spiders on an absolute level. Indeed, in order to characterize implicit associations towards spiders, it is important to know if implicit fear associations towards spiders are a general phenomenon, only varying in degree between phobics and non-phobics. If so, non-fearful individuals would show simultaneous possession of contradictory implicit and explicit associations towards spiders (known as 'dual attitudes'; see Wilson, Lindslay, & Schooler, 2000). To examine the assumption of an implicit-explicit dissociation in non-phobic individuals, a third experimental group becomes necessary: spider enthusiasts or spider lovers. Spider enthusiasts should *not* differ from extremely non-fearful controls in scores of fear questionnaires or in clinical diagnostics. They do differ in their habit to keep spiders as a domestic animal with surely no negative stereotypes or fear associations towards (harmless) spiders. Therefore, in Experiment 3 spider enthusiasts served as the critical experimental population, providing the control condition for a more satisfactory classification and interpretation of IAT effects in the non-fearful groups. Assuming that neither spiders nor butterflies are associated with fear in spider enthusiasm, there should not be any advantage for one of the combined tasks (compatible or incompatible). If spider lovers do not show IAT effects, or even negative effects, the hypothesis of a dissociation between implicit and explicit measures in non-phobic controls would be supported.

Besides the above stated there is a second advantage of using spider enthusiasts in this study. According to the figure-ground model by Rothermund and Wentura (2001), participants may not classify the presented stimuli regarding the given dimensions (e.g., spider vs. butterfly / unpleasant vs. pleasant), but select one figure category and one background category for the given target and attribute concepts (see chapter 1.3.3-2). According to this model salience and familiarity drive the IAT effect, and one could argue that figure-ground selection varies between phobics and nonphobics, because spiders are more salient or familiar to phobics. Now, spider lovers serve as a useful control for this explanation because spiders should be as salient for them as they are for spider phobics.

2.1 Experiment 1: IAT performance and spider fear

Method

Participants and Questionnaires. About 750 undergraduate students of Dresden University of Technology were pre-screened using a short screening questionnaire (Spider Anxiety Screening - SAS, Rinck, Bundschuh, Engler, Müller, Wissmann, Ellwart, & Becker, 2002), estimating fear and avoidance of spiders as well as possible distress (See Appendix G for details). Two groups of students were selected, namely 24 individuals with high fear of spiders and 24 individuals with no fear at all, who were invited and participated in Experiment 1. Spider anxious participants fulfilled DSM-IV criteria (American Psychiatric Association, 1994) for specific phobia (animal type/spiders). The only exception from DSM-IV diagnostic criteria concerned criterion E (spider interferes significantly with person's daily routine, occupational functioning, or social life, or the person is markedly distressed about having the phobia). Because spiders can be easily avoided in Western life, relevant restrictions and strain are very rare in fear of spiders. For this reason, criterion E did not have to be fulfilled. The terms 'spider anxiety' and 'spider phobia' are used synonymously in this paper. To diagnose spider phobia, a trained clinical psychologist interviewed participants using the 'Mini-Dips' (Margraf, 1994). To assess the degree of spider fear, all participants completed the Spider Fear Questionnaire (FAS, Rinck et al., 2002; see Appendix H for details), a German version of the 'Fear of Spiders Questionnaire' (Szymanski & O'Donohue, 1995), and once more the SAS (Rinck et al., 2002). Furthermore, a similar screening questionnaire scored possible fear of butterflies (BAS). All participants were free of any major mental or medical illness or any associated disorder (drug abuse, alcoholism, personality disorder, mental deterioration). All participants were paid a modest fee for their participation.

IAT. Each IAT consisted of a complete sequence of five tasks: (a) target discrimination, (b) attribute discrimination, (c) first combined task, (d) reversed target discrimination and (e) reversed combined task. Each task started with instructions describing the *category discrimination* and the assignments of response keys (left vs. right). During each trial, reminder labels (appropriate category names positioned to the left or right) remained on the screen. The procedure started with (a) the target discrimination task, in which participants had to distinguish single pictures of spiders from pictures of butterflies by pressing one of two colored keys (the letter 'Y' on the keyboard) in response to one type of animal and the other key (the '-' key) in response to the other animal. The second task was (b) the *attribute dimension*. Participants had to categorize single words according to emotional valence (pleasant vs. unpleasant). The same two keys as in the preceding target discrimination task were used by assigning the left key to one word type and the right key to the other word type. Each task consisted of 80 trials (each of the 40 pictures appeared twice, each of the 20 words appeared 4 times), divided into a practice block of 40 trials followed by 40 experimental trials that were analyzed. The following critical *first combined task* (c) was a combination of target and attribute discrimination in which targets and attributes appeared on alternating trials. During the *reversed target discrimination task* (d) the participants learned a reversal of the response assignment for targets (spiders and butterflies), consisting of 120 trials (each of the pictures appeared 3 times), including 80 practice and 40 experimental trials. The final *reversed combined task* (e) combined the attribute discrimination (not changed in its assignment) with the reversed target discrimination. Analogous to the first combined task (c) 240 items were presented (each of the 40 pictures appeared 3 times, each of the 20 words appeared 6 times), divided into 80 practice trials and 160 critical trials which were analyzed. Performance in a combined task should be faster, if a target concept (e.g., spiders) is highly associated with an attribute concept (e.g., unpleasant), and both require responding with the same key (called the *compatible task*). Performance should slow down in the combined task (called *incompatible task*), when unassociated targets (e.g., spider) and attributes (e.g., pleasantness) require the same response.

All Stimuli (black lettered words and colored pictures) were presented vertically and horizontally centered against a light gray screen background. During each trial, reminder labels (appropriate category names positioned in the top left and top right corner of the screen) remained visible. Stimuli appeared in the same fixed random order for each participant. Each stimulus was preceded by a fixation cross presented for 500 ms. The stimulus was shown until a response was made. After an incorrect response, a black 'X' appeared in the center of the screen for one second. The experiment was programmed in RSVP (Williams & Tarr, no date) and implemented on a Macintosh Performa 5100.

Word materials. For the experiment, a list of unpleasant German words, which were also anxiety-related, and a list of positive words were created. First, a large pool of words specifically related to anxiety was created by a literature search and by contributions of clinical experts. To the resulting words, relevant synonyms were added, taken from Mueller (1972). Valence of the words (from very unpleasant to very pleasant) and relation to anxiety were determined in pre-tests. In addition, lists of pleasant words were created. These words came from the categories 'vacation' and 'relaxation'. A total of 10 unpleasant/anxiety-related and 10 pleasant words were selected from these lists. The final 20 experimental words were unambiguously classifiable ('pleasant' vs. 'unpleasant') by members of the participant population. Words of the two categories did not differ with regard to word frequency or word length. English translations of the words are given in the Appendix.

Picture materials. 20 pictures of spiders and 20 pictures of butterflies were used in the IAT as target stimuli. As a pre-selection, a pool of 56 spider and 54 butterfly pictures were gathered from different media (books, Internet) and standardized as 16 bit color pictures in a 5 x 4 cm format. In pilot tests ease of identification and emotional valence of each single picture were assessed. Participants of the pilot tests did not participate in the main experiment and were free of spider phobia. From this pool, 10 spider pictures and 10 butterfly pictures were selected according to the results of the pilot tests (see Figure 2-1).

Each of the resulting pictures was duplicated by creating its mirror image, resulting in 20 experimental pictures in each category.

Figure 2-1. Pictures used for the IAT-Experiments of Study 1 and 2

Behavioral avoidance test (BAT). To measure fear and avoidance of spiders, participants were asked to take a behavioral test. In front of a closed, separate room, the participants were asked to open the door and approach a spider as quickly and closely as possible. The spider was a 7 cm long harmless tarantula (Aphonopelma Pallidum) positioned about 5 meters away from the door in a closed terrarium. When participants indicated that they wanted to stop the approach, distance between the participant and the spider as well as the duration of the approach attempt were registered. Because participants could avoid the spider either by a approaching slowly (affecting time) or by refraining from approaching (affecting distance), the *approach speed* was calculated, taking both time and distance into account. Directly after the BAT, participants gave four retrospective ratings of their emotional state during the test. The ratings included nervousness, tension, and anxiety while approaching the spider, and how much they would have liked to leave the situation (avoidance). Ratings were given on scales ranging from one (labeled 'not at all') to five (labeled 'extremely').

Procedure. Participants were tested individually and were informed that they would be completing a classification task including words and pictures. Before the experiment, participants completed the FAS (Spider Fear Questionnaire), SAS (Spider Anxiety

Screening), and BAS (Butterfly Anxiety Screening), followed by a diagnostic interview.). Afterwards, participants completed the IAT. To control for possible task order effects, the sequence of the combined discrimination tasks (c) and (e) was counterbalanced across participants, such that half of them started with the compatible task and the others started with the incompatible task ('task sequence'). Participants were instructed to respond as quickly and accurately as possible during the task. The experimental session closed with the behavioral avoidance test, a questionnaire concerning the emotional state during confrontation with the spider, and a valence rating of all presented word stimuli. Additionally, state anxiety and trait anxiety was assessed using the German version of the State-Trait-Anxiety-Inventory (STAI-T and STAI-S; Laux, Glanzmann, Schaffner, & Spielberger, 1981; Spielberger, Gorsuch, & Lusthene, 1970). State anxiety was measured at the beginning and at the end of the experimental session. Trait anxiety was assessed once at the beginning.

Design. The main dependent variable *(the IAT effect)* is calculated for each participant as the average latency of the incompatible task minus the average latency of the compatible task. Positive IAT effects occur when mean reaction times are larger in the incompatible condition (when spiders are paired with positive attributes) than in the compatible condition (spiders paired with anxiety-related attributes). IAT effects were analyzed with an ANOVA including the between-subjects factor *'group'* (spider anxious vs. non-anxious) and *'task sequence'* (compatible task before incompatible or vice versa). I hypothesize that pictures may be categorized on a perceptual level, whereas words have to be categorized on a semantic level, therefore I expected differences in the processing of targets and attributes. Thus, besides the general IAT effects averaged across all materials, separate IAT effects for targets (pictures) and attributes (words) were computed, yielding the within-subjects factor *'IAT Type'* (IAT targets, IAT attributes). Effect sizes were computed as eta squares, and are given below.

Results

Participants characteristics. As Table 2-1 indicates, spider phobic and non-phobic participants markedly differed on explicit measures of spider fear (FAS, SAS). The spider phobic group had a significantly higher fear score in the Spider Fear Questionnaire (FAS, Rinck et al., 2002) ($t(46) = 19.1$, $p < .001$) and in the Spider Anxiety Screening (SAS, Rinck et al., 2002) ($t(46) = 24.7$, $p < .001$). Among the spider phobic group, 6 out of 24 participants fulfilled all DSM-IV criteria (American Psychiatric Association, 1994) for specific phobia (animal type/spiders), the remaining 18 spider anxious participants did not meet the criteria concerning distress and interference with usual routines. The phobic group and controls reported no fear, avoidance or distress regarding butterflies and did not differ in their BAS (butterfly fear screening) scores from each other($t(46) = .61$, n.s.). Scores of state anxiety did not differ between both groups before the experiment ($t(46) = 1.92$, n.s.), but were different at the end of the experiment ($t(46) = 4.27$, $p < .001$). During the course of the experiment, state anxiety in the phobic group increased, in contrast to constant STAI-S scores of non-phobic controls. This pattern was substantiated by a significant group by measurement time interaction ($F(1,46) = 14.6$, $p < .001$, $eta^2 = .24$).

Table 2-1. Participants' characteristics and valance ratings of word material in Experiment 1 to 3

	Experiment 1		**Experiment 2**		**Experiment 3**	
	Sp. Phobic	*Control*	*Sp. Phobic*	*Control*	*Sp. Lover*	*Control*
Participants						
n	24	24	24	24	9	9
Sex ratio (F/M)	22/02	20/04	22/02	23/01	04/05	04/05
Age	23.4 (2.36)	23.2 (2.73)	22.17 (4.46)	22.42 (2.50)	25.78 (6.57)	27.11 (4.88)
FAS	62.4 (15.47)	1.4 (2.16)	65.88 (15.25)	1.71 (2.53)	.00 (.00)	.44 (.73)
SAS Spider	19.2 (2.87)	1.7 (1.94)	16.33 (1.90)	1.67 (1.58)	.00 (.00)	3.67 (2.06)
BAS Butterfly	.67 (1.31)	.46 (.1.06)	.46 (.93)	.13 (.34)	-	-
STAI-S (1)	34.8 (8.1)	31.1 (4.7)	39.1 (7.1)	32.1 (6.1)	-	-
STAI-S (2)	42.3 (11.1)	32.0 (4.0)	44.3 (12.1)	31.4 (3.94)	-	-
STAI-T	39.8 (8.5)	36.4 (9.7)	40.2 (9.7)	37.7 (25.5)	-	-
Ratings of word stimuli [a]						
pleasant words	1.61 (.24)	1.53 (.28)	1.46 (.28)	1.48 (.28)	1.52 (.36)	1.58 (.41)
unpleasant words	-1.67 (.24)	-1.65 (.26)	-1.66 (.24)	-1.61 (.21)	-1.52 (.12)	-1.40 (.01)

FAS: (Spider Fear Questionnaire); SAS Spider: (Spider Fear Screening); BAS Butterfly: (Butterfly Fear Screening)
STAI-Stait (1): (Stait Anxiety Inventory / pre test); STAI-Stait (2): (Stait Anxiety Inventory / post test);
STAI-Trait: (Trait Anxiety Inventory)
[a] Range of scale: -2 = 'very unpleasant', -1='unpleasant', 0=neutral, 1= 'pleasant', 2= 'very pleasant'

Thus, confrontation with phobia-related materials (spider pictures) increased state anxiety in phobic participants, even before encountering a real spider in the BAT. Phobic and non-phobic participants did not differ regarding trait anxiety (STAI-T) (t(46) = 1.27, n.s.), age (t(46) = .23, n.s.) or sex ratio (Chi^2 = .19, n.s.). All participant characteristics are displayed in Table 2-1.

IAT effects. Data for each task included response latencies (in milliseconds) and error rates. Prior to the planned analyses, distributions of error rates were examined. Error rates were uniformly low, averaging just under 5% on critical IAT blocks. Therefore, latencies data of correctly answered trials were averaged for each critical task, yielding median latencies for each participant. IAT effects were computed by subtracting the median latency of the compatible task from that of the incompatible task [3].

Table 2-2 displays IAT effects for both groups (phobic and controls), separately for attributes and targets. Generally, a significant IAT effect indicates faster processing of the compatible task (reflecting associations between spiders and anxiety-related words vs. butterflies and positive words) compared to the incompatible task (reflecting associations between butterflies and anxiety-related words vs. spiders and positive words). An overall analysis of variance (ANOVA), with the between-subjects factors Group and Task Sequence, and the within-subjects factor IAT type (IAT pictures vs. IAT words) indicated no influence of task sequence on IAT performance (F(1,44) = .35, n.s.).

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[3] The analysis strategy I use for IAT experiments differs from the strategy introduced by Greenwald et al. (1998). Greenwald et al. eliminated outliers by counting response latencies less than 300 ms or greater than 3,000 ms as errors and recoded these responses as 300 or 3,000 ms. This seems an unusual outlier elimination, because it leads to increasing frequencies at both ends of the distribution. Aggregating response latencies via median score represents a useful strategy to eliminate the influence of extreme outliers, a typical phenomenon of the IAT.
There is a confusingly large number of techniques used in IAT data reduction so far. As reported, Greenwald et al. (1998) recoded outliers below 300 ms and above 3000 ms and log transforms the response times. Teachman et al. (2001) used the same outlier elimination, but reciprocally transforms trial latency data (1,000/latency), whereas Teachman & Woody (2003) used no further transformation. De Jong et al. (2003) computed IAT indices just for one target category (i.e., spiders) by subtracting mean RTs on trials during which the target words shared the response with negative adjectives from the mean RTs on trials during which the target shared the response key of positive adjectives. Grennwald, Nosek, and Banaji (2003) report in their paper various possible scoring algorithms of IAT measures: (1) median aggregation of each combined block, (2) mean aggregation of each combined block, (3) log transformation and mean aggregation, (4) reciprocal of latencies are mean aggregated, (5) D measure *D* (divides the difference between combined block means by the standard deviation of all the latencies in the two test blocks). Performances of the five IAT measures (*D*, mean, median, log, and reciprocal) was examined and evaluated under numerous conditions of data reduction in terms of each measure's correlation (a) with its parallel explicit measure for the entire sample (high values are desired) and (b) with average latency for the subsample of self-characterized strong supporters for each target (Bush or Gore -values near zero are desired, indicating lack of contamination of the measure by slowness of responding). Results indicated that correlations between the IAT and the two criteria depend on differential effects of latency exclusions based on the rates of excluded and included percent of fast responses, error rates, or practice trials. Grennwald et al. (2003) now recommend the D measure as favorite IAT score computed out of all combined response latencies (including practice trial latencies and replaced error latencies (replaced with block mean + 600ms)).
I will refer to the median score because of its proven ability to eliminate outliers without having chosen an elimination and transformation strategy which suits my predicted results best.

A significant main effect of Group ($F(1,44) = 6.79$, $p < .01$, $eta^2 = .13$), however, indicated different IAT effects in phobics and controls. Both spider phobic participants and non-phobic controls showed significant IAT effects (phobic: mean 90.3 , SD 72.; $t(23) = 6.07$, $p < .001$; control: mean 47.4 , SD 50.1; $t(23) = 4.50$, $p < .001$), but the effect was significantly larger in the phobic group. A significant main effect of IAT type ($F(1,44) = 14.9$, $p < .001$, $eta^2 = .25$) indicated different IAT effects for target pictures and attribute words; although all effects were significantly larger than zero, IAT effects were much larger for words than for pictures. A significant interaction between Group and IAT type ($F(1,44) = 4.67$, $p < .05$, $eta^2 = .10$) revealed that IAT effects for both groups differed for attribute words ($t(46) = 2.49$, $p < .05$), but not for target pictures ($t(46) = 1.08$, n.s.). No other effects approached significance.

Table 2-2. Mean reaction times in ms for compatible and incompatible task and IAT Effects in ms (with Standard Deviations) for all stimuli (pictures and words), and separately for words (attributes) and pictures (targets) in Experiment 1 to 3

	Experiment 1		**Experiment 2**		**Experiment 3**	
	Sp. Phobic	*Control*	*Sp. Phobic*	*Control*	*Sp. Lover*	*Control*
Compatible	571 (50)	557 (41)	614 (73)	609 (70)	772 (192)	619 (68)
Incompatible	661 (93)	604 (48)	761 (164)	731 (117)	752 (147)	753 (109)
IAT Effect	90** (73)	47** (50)	147** (121)	123** (98)	-20.0 (75)	134** (86)
IAT attributes	130** (122)	59** (66)	203** (174)	162** (134)	-25 (69)	152** (110)
IAT targets	51** (51)	36** (45)	91** (91)	83** (81)	-16 (92)	116** (79)

IAT effects are computed as the mean latency difference between the compatible and the incompatible task. IAT Effects marked with '*' are significantly different from zero with $p < .05$, marked with '**' with $p< .01$.

Behavioral avoidance test (BAT). As expected, the two groups' behavior differed significantly in the behavioral assessment task (BAT) for mean approximation time, distance, and speed (see Table 2-3). Compared to non-phobic controls, spider fearful participants were significantly slower in approaching the spider (Speed ($t(46) = 10.3$, $p < .001$); Time ($t(46) = 6.57$, $p < .001$)), and they avoided standing close to the animal ($t(46) = 3.1$, $p < .01$). Emotional state during the test (measured by four retrospective ratings) showed high levels of nervousness ($t(46) = 8.43$, $p < .001$), tension ($t(46) = 8.15$, $p < .001$), anxiety (t(46) = 15.3, $p < .001$), and wish to avoid in the phobic group (t(46) = 8.27, $p < .001$), but not the control group.

Table 2-3. Results of Behavior Assessment Test (BAT) in Experiment 1 and 2

	Experiment 1		**Experiment 2**	
	Sp. Phobic	*Control*	*Sp. Phobic*	*Control*
Behavior Assessment Test (BAT)				
Distance (cm)	104.8** (148.0)	11.3 (4.5)	171.5** (184.4)	10.8 (2.8)
Time (sec)	23.6** (11.1)	8.3 (2.4)	17.9** (8.3)	7.6 (2.5)
Speed (cm/sec)	29.7** (14.1)	88.9 (24.2)	36.0** (22.4)	101.0 (31.5)
Emotional Valence Rating [a]				
Nervousness	3.42** (.93)	1.46 (.66)	3.17** (.94)	1.54 (.78)
Tension	3.13** (1.12)	1.13 (.45)	3.13** (1.01)	1.04 (.20)
Anxiety	4.04** (.69)	1.29 (.55)	4.04** (.82)	1.04 (.20)
Avoidance	3.00** (1.14)	1.04 (.20)	2.70** (1.02)	1.00 (.00)

[a] Range of emotional rating scale from: 1 ('not at all') to 5 ('extremely').
All scores marked with '*' are significantly different with $p < .05$ from control group score ('**' $p < .01$).

Relations among fear measures. Table 2-4 displays relations between IAT scores, behavioral fear measures, and self-reported fear scores. The overall pattern indicates moderate correlations of the IAT scores with behavioral measures of fear (e.g., speed) as well as correlations with self-reported fear scores (Spider Questionnaires, emotional ratings). As expected, participants with large IAT effects approached the spider more slowly. Most importantly, the correlation between the IAT effect and behavior (speed) remained significant ($r = -.29$; $p < .05$), even after the correlation between questionnaire scores (FAS) and behavior was partialed out.

Materials Ratings. Participants rated all word stimuli regarding their fit with the predefined categories used in the IAT. Appendix A shows that the attributes were evaluated consistently with the predefined categories (unpleasant anxiety-related words as rather unpleasant, positive words as rather pleasant). All pictures were rated in terms of emotional valence, magnitude of disgust, and threatening potential. Not surprisingly, spider phobic participants rated spider pictures as significantly more unpleasant than to non-phobic controls who evaluated spiders as rather neutral ($t(24) = 6.7$, $p < .001$). Both spider phobics and controls evaluated the butterfly pictures as pleasant. Similar results were obtained regarding disgust and threatening potential of the target pictures; the two groups showed different judgments regarding disgust and threat of spiders, but not for butterflies. Controls explicitly judged spiders as non-threatening nor disgusting, whereas phobics expressed the opposite pattern, labeling spiders as disgusting with a high threat potential. Mean ratings of both groups and levels of significance are displayed in Appendix B.

Table 2-4. Correlations between fear measures in Experiment 1

Fear Measure	IAT word	IAT picture	BAT time	BAT distance	BAT speed	Mean Rating	FAS	SAS	BAS
IAT	.94**	.70**	.39**	-.04	-.40**	.31*	.29*	.34*	.23
IAT word	-	.42**	.43**	-.02	-.40**	.31*	.31*	35*	.24
IAT picture		-	.12	-.09	-.21	.17	.13	.19	.11
BAT time			-	.07	-.78**	.62**	.66**	.65**	.09
BAT distance				-	-.43**	.58**	.54**	45**	-.07
BAT speed					-	-.79**	-.81**	-.82**	.03
Rating						-	.91**	.90**	.01
FAS							-	96**	.10
SAS								-	.08

IAT: (mean overall IAT effect); IAT word: (mean IAT effect for words); IAT picture: (mean IAT effect for pictures); BAT time: (time to approach the spider); BAT distance: (final distance from spider); BAT speed: (speed approaching the spider); Rating: (mean of 4 emotional ratings - nervousness - tension - anxiety - avoidance); FAS: (Spider Fear Questionnaire); SAS: (Spider Fear Screening); BAS: (Butterfly Fear Screening)
Correlations marked with '*' are significantl on a .05 level, marked '**' on a .01 level.

Discussion

The results of Experiment 1indicate that this modified version of the IAT is a useful method to assess automatic (implicit) expressions of fear associations, providing additional information to traditional explicit questionnaire measures. Participants with high scores of spider fear had significantly higher IAT effects compared to non-fearful participants indicating much stronger fear relevant, implicit associations to spiders. Moreover, IAT performance correlated with behavior during confrontation and questionnaire scores. The predictive potential of the IAT is underlined by significant correlations between this indirect measure and behavior, even when the influence of questionnaires was eliminated.

From a methodological viewpoint, the results show that it is useful to analyze and report IAT effects separately for pictures and word stimuli. IAT effects with verbal attribute stimuli differentiated between spider fearing and control participants, whereas target pictures did not. The reason for this lack of group differences in target pictures may be seen in a floor effect, caused by fast and privileged access of pictures to semantic memory for categories (Glaser, 1992; Seifert, 1997). All reported IAT effects yielded significance, however, implying that both groups were faster performing the compatible task (spider-unpleasant) than the incompatible task (spider-pleasant).

2.2 Experiment 2: An IAT short-version and spider fear

Experiment 2 investigated how a reduction of the IAT from five tasks to only two critical tasks affects IAT performance. As in Experiment 1, a group of highly spider-fearful participants and a group of control participants performed an IAT, which only differed in the number of IAT tasks and not in any other methodological feature. The main question was whether IAT effects of the short version and their correlations with questionnaire scores and behavior are comparable to those observed in Experiment 1.

Method

This experiment was very similar to the first one, therefore only the differences will be explained in detail.

Participants and questionnaires. About 750 undergraduate students of Dresden University of Technology were prescreened with the SAS (Rinck et al., 2002). Of these, 24 spider anxious students and 24 non-anxious students participated in Experiment 2. The diagnostic criteria for participation equaled those of Experiment 1. Spider anxious participants fulfilled DSM-IV criteria (American Psychiatric Association, 1994) for specific phobia (animal type/spiders), except criteria E (phobia interferes with daily routines). All participants were interviewed by a clinical psychologist for the diagnosis. Again, questionnaires addressed spider fear (FAS and SAS, Rinck et al., 2002), fear of butterflies (BAS), state anxiety (STAI-S), and trait anxiety (STAI-T). All participants were free of any major mental or medical illness or any associated disorder (drug abuse, alcoholism, personality disorder, mental deterioration). The participants did not report fear of butterflies, and they had not participated in Experiment 1.

Short IAT. The only difference to the IAT procedure of Experiment 1 was the reduction from five to two tasks: (a) first combined task and (b) reversed combined task (either 'compatible' or 'incompatible'). As before, in the compatible task, spiders and unpleasant words required the same response, as did butterflies and pleasant words. In the incompatible task, the allocation of pictures to response keys was switched, such that spiders and pleasant words now required the same response, as did butterflies and unpleasant words. Each task consisted of 80 practice trials followed by 160 experimental trials (each of the 40 pictures appeared 3 times, each of the 20 words appeared 6 times). The words and pictures were identical to those of Experiment 1.

Procedure and design. As before, participants completed the spider fear questionnaires FAS and SAS, the BAS, a diagnostic interview and the IAT, which consisted only of two combined tasks. The sequence of the combined discrimination tasks (a) and (b) was counterbalanced across participants. After the IAT, participants took the BAT, and gave the four retrospective ratings of their emotional state during the BAT. Again, state anxiety and trait anxiety was assessed using the German version of the State-Trait-Anxiety-Inventory (state anxiety was measured at the beginning and at the end of the experimental session, trait anxiety was assessed once at the beginning). The experimental design was identical to that of Experiment 1.

Results

Participants characteristics. As Table 2-1 indicates, spider phobics showed significantly higher fear scores in both the FAS ($t(46) = 20.34$, $p < .001$) and the SAS ($t(46) = 29.05$ $p < .001$) (Rinck et al., 2002). Of the 24 participants in the spider phobic group, 10 fulfilled all DSM-IV criteria for specific phobia (animal type/spiders). Importantly, spider phobic individuals and controls reported no fear, avoidance, or distress regarding butterflies and did not differ in their BAS scores. Scores of state anxiety differed between groups, with higher scores for fearful participants (main effect Group ($F(1,46) = 28.45$, $p < .001$, $eta^2 = .38$). As before, spider phobics' but not controls' state anxiety increased during the course of the experiment, yielding a significant interaction of group and measurement time ($F(1,46) = 5.07$, $p < .05$, $eta^2 = .01$). Trait anxiety (STAI-T) was comparable in both groups. Means and levels of significance are shown in Table 2-1.

IAT Effects. Response latencies, error rates, and IAT effects were computed and analyzed as in the first experiment. IAT effects observed in this experiment are displayed in Table 2-2. A 2x2 analysis of variance (ANOVA), with the between-subjects factors Group and Task Sequence and the within-subjects factor IAT Type revealed no influence of Task Sequence ($F(1,44) = .07$, n.s.). As in Experiment 1, there was a significant main effect of IAT type ($F(1,44) = 31.74$, $p < .001$, $eta^2 = .42$), indicating smaller IAT effects for pictures than for words across all participants. Both spider phobics and non-phobic controls showed significant IAT effects (phobics: mean 146.8, SD 121.2, $t(23) = 5.93$, $p < .001$; controls: mean 122.5, SD 98.3, $t(23) = 6.11$, $p < .001$), but these effects did not differ from each other in magnitude ($F(1,44) = .53$, n.s.). In addition, separate analyses of IAT effects for words and pictures did not differentiate between the experimental groups either (IAT words: $t(46) = .92$, n.s.; IAT targets: $t(46) = .31$, n.s.). No other effect approached significance.

Behavioral measures (BAT). Table 2-3 displays results of the behavioral avoidance test (approaching a real spider). The two groups significantly differed in their behavior, with spider fearful participants being significantly slower in approaching the spider (Speed ($t(42) = 7.69$, $p < .001$); Time ($t(42) = 5.76$, $p < .001$); Distance ($t(45) = 4.49$, $p < .001$)). In addition, the spider phobic group showed high levels of nervousness ($t(45) = 6.51$, $p < .001$), tension ($t(45) = 9.89$, $p < .001$), anxiety ($t(45) = 17.30$, $p < .001$), and wish for avoidance during the test ($t(45) = 8.15$, $p < .001$), compared to lower scores for controls (Table 2-3).

Relations among Fear Measures. Table 2-5 displays relations between IAT scores, behavioral fear measures and self-reported fear scores. The overall pattern indicates that IAT scores did not predict behavioral measures of fear (speed - approaching a spider) or self -reported fear scores (Spider Questionnaires, emotional ratings) very well. Only IAT scores for attributes correlated significantly with approach speed ($r = -.32$, $p < .05$), such that participants with large IAT effects approached the spider more slowly.

Material Ratings. As in Experiment 1, participants rated words and pictures after the experiment. As expected, valence of word stimuli matched the predefined categories of the IAT experiment very well. See Appendix C for detailed mean ratings. As before, spider phobic participants evaluated spider pictures as very unpleasant, highly disgusting, and threatening. They differed significantly from non-phobic controls, who found spiders more neutral in valence ($t(46) = -5.58$, $p < .001$), less disgusting ($t(46) = 18.54$, $p < .001$) and less threatening ($t(46) = 19.75$, $p < .001$). Both spider phobics and control participants evaluated butterflies in a comparable manner as pleasant (t(46) = -.83, n.s.) , with a very low level of disgust (t(46) = 1.72, n.s.) and threat (t(46) = 1.62, n.s.). Mean ratings of both groups are displayed in Appendix D.

Table 2-5. Correlations between fear measures in Experiment 2

Fear Measure	IAT word	IAT picture	BAT time	BAT distance	BAT speed	Mean Rating	FAS	SAS	BAS
IAT	.95**	.84**	.01	.21	-.23	.25	.13	.11	.08
IAT word	-	.64**	.13	.26	-.32*	.27	.17	.11	.04
IAT picture		-	-.20	.06	-.02	.14	.04	.10	.13
BAT time			-	46**	-.80**	.51**	.67**	.65**	.04
BAT distance				-	-.61**	.72**	.57**	.55**	.00
BAT speed					-	-.75**	-.77**	-.74**	-.13
Rating						-	.89**	.86**	.28
FAS							-	.93**	.31*
SAS								-	.30*

IAT: (mean overall IAT effect); IAT word: (mean IAT effect for words); IAT picture: (mean IAT effect for pictures); BAT time: (time to approach the spider); BAT distance: (final distance from spider); BAT speed: (speed approaching the spider); Rating: (mean of 4 emotional ratings - nervousness - tension - anxiety - avoidance); FAS: (Spider Fear Questionnaire); SAS: (Spider Fear Screening); BAS: (Butterfly Fear Screening)
Correlations marked with '*' are significantl on a .05 level, marked '**' on a .01 level.

Discussion

As in Experiment 1, highly spider fearful and non-fearful participants displayed significant IAT effects, due to faster responses in the compatible task. Nevertheless, dissonant to the results of Experiment 1, differences in IAT performance between the groups did not reach significance, probably because of the large variance in reaction times. Subsequently, correlations between IAT scores and questionnaires or behavior failed to appear. One has to conclude that practice tasks have a relevant influence on IAT performance, a feature which needs attention in further research.

2.3 Experiment 3: IAT performance and spider enthusiasm

Experiment 3 was conducted to classify and interpret IAT results of non-phobic controls in more absolute terms. Therefore, spider enthusiasts served as another control group that associates neither spiders nor butterflies with fear. The idea of dissociation between implicit and explicit measures in non-phobic controls would be supported, if spider lovers do not show IAT effects, or even negative effects.

Method

Participants and Questionnaires. Spider enthusiasts were recruited through newspaper and radio advertisements. Interested individuals were invited to participate if they owned at least one spider as a domestic animal at home. Finally, 9 spider enthusiasts participated in Experiment 3. Matched in age, sex, and educational level, 9 yoked control participants were also recruited and invited to the study. Controls reported no fear of spiders. All participants were free of any major mental or medical illness or any associated disorder. None of them reported increased fear of butterflies, and no one had participated in the previous experiments.

Short IAT, words, pictures, and design. The short IAT of Experiment 2 was used, consisting of two critical combined tasks. In the compatible task, spiders and unpleasant words required the same response (as did butterflies and pleasant words), whereas the allocation of pictures to response keys was switched in the incompatible task (spiders and pleasant words vs. butterflies and unpleasant words). For ease of comprehension, the labels 'compatible task' and 'incompatible task' are used in the same way as in Experiments 1 and 2. One should keep in mind, however, that these compatibility labels may correspond only to the associations of spider phobics and non-phobic controls, but not to the associations of spider lovers. The experimental design mirrored that of Experiment 2.

Procedure. All Participants were tested individually. Before application of the IAT, a 'warm-up' interview addressed the topic of spider enthusiasm as well as possible mental and medical illnesses. Then participants completed the FAS, the SAS, and the IAT. Again, the sequence of the combined discrimination tasks was counterbalanced across participants. After completing the IAT, word stimuli were rated regarding emotional valence, and pictures were rated regarding emotional valence, magnitude of disgust and threatening potential.

Results

Participants' characteristics. The two groups did not differ from each other in regard to education, gender distribution (4 females and 5 males in each group), or age (spider lovers: mean 25.78, SD 6.57; controls: mean 27.11, SD 4.88; $t(16) = .49$, n.s.). In the FAS and the SAS, enthusiasts scored uniformly zero. Non-fearful controls did not differ from spider enthusiasts in the FAS (mean .44, SD .73; $t(16) = 1.84$, n.s.). In the SAS, their scores were significantly higher (mean 3.67, SD 2.06, $t(16) = 5.34$, $p < .001$), although this difference is without practical relevance; the mean score of 3.67 indicates no fear of spiders, and it is very similar to the scores of non-fearful participants in Experiments 1 and 2. (see Table 2-1).

IAT Effects. Response latencies, error rates, and IAT effects were computed and analyzed as before. The IAT effects observed in this experiment are displayed in Table 2-2. The 2x2x2 ANOVA with the between-subjects variables Group and Task Sequence, and the within-subjects variable IAT Type did not yield a significant main effect of Task Sequence ($F(1,14) = .09$, n.s.). Again, it did not matter whether participants performed the compatible task before the incompatible one or vice versa. Importantly, there was a significant main effect of Group ($F(1,14) = 17.66$, $p<.001$, $eta^2 = .40$). As expected, non-phobic controls showed significant IAT effects (mean 134.1, SD 86.1, $t(8) = 4.67$, $p < .01$), comparable to the effects observed in Experiment 2. These significant positive IAT effects reflect stronger associations between spiders and anxiety-related words compared to spiders and positive words. In contrast, spider lovers did not show positive IAT effects (mean: -20.0, SD 74.8). Negative IAT effects display faster performance in the incompatible task, which indicates stronger associations between spiders and positive words. IAT effects of spider lovers were not significantly different from zero, however, ($t(8) = .80$, n.s.), yielding no advantages for the compatible or the incompatible task. Spider lovers and non-phobic controls significantly differed in IAT performance regarding both attributes ($t(16) = 4.08$, $p < .001$) and targets ($t(16) = 3.26$, $p<.01$).

Relations between IAT and Questionnaires. Because there was only minimal variance in explicit measures of fear, high correlations of the questionnaires with the IAT effects may not be expected. Nevertheless, the correlation between IAT effects and SAS scores was significant ($r = .50$, $p < .05$).

Materials Ratings. The ratings of attributes and targets given by the participants are listed in Appendix E. In contrast to all the other participants tested so far, spider lovers evaluated spider pictures as rather pleasant, with low disgust and low threatening potential.

For all of the three ratings, they differed significantly from non-anxious controls, who evaluated spiders as rather neutral in valence, with low magnitudes of disgust and threatening potential. The two groups rated butterflies in similar ways: pleasant, with very low potential of disgust and threat. Mean ratings and levels of significance are displayed in Appendix F.

Discussion

IAT effects of spider enthusiasts indicated similar reaction times for the compatible (spider-fear) and the incompatible (spider-pleasure) IAT task. With butterflies as the second target, there was no advantage for one of the combined tasks, suggesting that spiders and butterflies share similarly positive associations in the spider lover group. The results of Experiment 3 support the hypothesis that even non-fearful controls associate spiders with negative, fear relevant attributes in a performance based automatic task. This clearly stands in contrast to their explicitly expressed attitudes and their behavior towards spiders. Moreover, although all participants of Experiment 3 were explicitly non-fearful, the difference between controls and spider lovers indicates that spiders are not generally and automatically linked to negative fear relevant schemata.

2.4. General Discussion Study 1

Experiment 1 and 2 were designed to investigate the relations between explicit and implicit associations towards phobic stimuli (spiders) in fearful and non-fearful participants. As expected, spider anxious individuals explicitly expressed their fear and negative evaluation of spiders in interviews and questionnaires. Non-fearful individuals expressed rather neutral evaluations of spiders. Regarding implicit associations, however, both spider phobic participants and non-phobic controls displayed negative implicit attitudes towards spiders. Both groups associated spiders with negative, anxiety-related attributes, leading to faster responses in compatible tasks, when spiders and negative adjectives shared the same response key. In contrast to the study by de Jong et al. (2003), the experimental paradigm used in Experiment 1 was sensitive to inter-individual differences in the strength of the affective associations. Non-fearful and fearful participants differed significantly in their strength of negative implicit associations towards spiders, with more negative associations for spider fearful individuals. Moreover, correlations between IAT effects, questionnaire scores, and behavioral tests in Experiment 1 point to the usefulness of IAT data. Significant partial correlations between the IAT scores and relevant behavior - controlling for the influence of questionnaire scores - support the claim that indirect measures such as the IAT are able to predict behavior beyond the predictions of direct measures such as questionnaires.

The results of Experiment 1 yield evidence that phobic and non-phobic individuals exhibit different implicit fear associations, as assessed by the performance based approach of the IAT. These results are compatible with Teachman et al. (2001) who detected group differences as well. The experimental paradigm used by de Jong et al. (2003) was not able to assess group differences in IAT performance. It was more sensitive to categorical differences (e.g., spiders are negative), than to individual variations. One reason could be that the target stimuli used by de Jong et al. (2003) consisted of verbal spider cues like 'web' and 'hairy' vs. neutral cues such as 'door' and 'key'. In contrast, the present study as well as the ones by Teachman and her colleagues (2001, 2003) used ecologically more valid stimuli (pictures of spiders) to assess implicit associations between spiders and negative, anxiety-related attributes. Visual confrontation with phobia-related picture stimuli might indeed lead to differential activation of spider-fear associations, other than words would do.

In Experiment 2 a short version of the IAT was applied to find out whether comparable IAT performance may be observed when separate practice tasks for targets and attributes are deleted. Although the IAT effects were again larger in the spider phobic group, statistical analyses did not yield a significant difference in IAT performance, dissonant to the group differences found by Teachman et al. (2003), who also employed a short version of the IAT. One obvious reason for this discrepancy may be the large variance in reaction times, due to the lack of practice trials. With this discrepancy it becomes more difficult to find significant group differences, especially when IAT effects in different groups do not differ in absolute direction (both groups exhibited negative, anxiety-related implicit associations towards spiders), but only slightly in their degree.

Concluding from the differences between Experiments 1 and 2, further research needs to clarify the methodological properties of the IAT. Special attention should be paid to the influences of practice tasks (five tasks IAT vs. two tasks IAT), to the number of data trials during each critical combined task and to the impact of the stimulus materials (words vs. picture stimuli) on IAT processing.

Despite these differences, both Experiments 1 and 2 yielded significant IAT effects in spider phobic and explicitly non-phobic participants, indicating that the IAT categorization task was easier when spiders and unpleasant words required the same response versus when spiders were combined with pleasant words. Interpreting the IAT performance of non-phobic controls as evidence for implicit fear-related associations (e.g., de Jong et al., 2003) seems problematic, however, because the IAT only reflects associations towards spiders *relative* to butterflies. Therefore, Experiment 3 attempted to provide an interpretation of IAT effects in the non-fearful group beyond the relative estimation by introducing a third experimental group, namely spider enthusiasts. These participants served as an experimental baseline group, assuming that they lack all negative fear-related associations towards spiders. Indeed, the results of Experiment 3 replicated the significant IAT effect in non-fearful controls, while spider enthusiasts displayed a balanced performance in the compatible and incompatible tasks (no IAT effect), expressing comparable implicit associations towards spiders and butterflies. These results indicate that non-fearful controls, who explicitly negate fear associations towards spiders, seem to possess implicit negative associations toward spiders. Without doubt, non-fearful controls did not dissimulate a negative attitude towards spiders. Moreover, spiders are associated with aversion on a more automatic, performance-based manner. De Jong et al. (2003) suggested that non-fearful controls can override or control an automatic negative stereotype, compared to highly fearful individuals who do not have this ability. This suggestion is consistent with results by Mayer et al. (2000), who assessed the extent to which spider phobic and non-phobic participants experience fear reactions to spiders as automatic. Compared to controls, phobic participants perceived their responses to spiders more often as automatic, and not under intentional control.

Given that the possible range of implicit spider associations varies from fear to pleasure, it is worthwhile to think about the possible implications for therapy of spider phobia. Teachman et al. (2003) were able to demonstrate changes of implicit fear associations in spider phobia with successful exposure therapy, down to the baseline level of control participants. Nevertheless, the results observed with spider enthusiasts suggest that it might even be possible to eliminate fear-related implicit associations altogether. If therapeutic techniques were able to change automatic spider associations in such fundamental ways, consequential risk of relapse after successful CBT might be greatly reduced.

Despite the promising results of IAT applications in psychopathological research, some problems and open questions require attention in future research. First, the relative nature of the IAT is also one of its major limits. In the study reported here, it was overcome by using a between-groups design (e.g., spider fearfuls and non-fearfuls) together with one target that was evaluated comparably by both groups (e.g., butterflies). Consequently, group differences in IAT performance may be attributed to different attitudes towards the second target (e.g., spiders), when equality of attitudes towards the first target is guaranteed. Moreover, the relative approach of the IAT is not obstructive when changes of implicit associations over the course of therapy are measured, as long as the results are compared to a baseline sample (see Teachman et al., 2003). In studies examining cognitive structures and schemata on anxiety disorders, however, the absolute degree of fear associations is certainly more important than the relative strength of alternative associations. Therefore, 'new' methods, which are able to assess the strength of associations in more absolute terms, represent promising alternatives, such as the 'Extrinsic Affective Simon Task' (EAST) by De Houwer (2003), the Single Target IAT (STIAT) by Wigboldus, van Knippenberg, & Holland (2001), or the 'Go/No-Go Association Task' by Nosek and Banaji (2001). For further explanations see chapter 5.2.

Second, before indirect measures such as the IAT may be used as reliable instruments for individual diagnostics in psychopathology, more needs to be known about the nature of implicit associations assessed by these tasks. Therefore, it will be important to investigate whether dysfunctional implicit associations are relatively stable, or whether they are malleable, and what their malleability depends on. As reported in chapter 1.3.3-4, there is evidence from social psychology research that spontaneous evaluations tested through performance-based indirect measures are influenced by context (e.g., Dasgupta et al., 2001; Wittenbrink et al., 2001; Mitchell; Nosek, & Banaji, 2003). If implicit associations and their activation are easily affected by external context situations, retest reliability will suffer. Therefore, further research should determine whether the associations of interest represent a state or trait construct, and how qualities of these associations such as activation level could change during tests.

Third, referring to the debate about the influence of stimulus vs. category valence (e.g., De Houwer, 2001; Steffens & Plewe, 2001; see chapter 1.3.3-2) it remains unclear whether IAT effects found in this study are driven by valence and content of each attribute word (e.g., panic, fear vs. easygoing, happy) or the general valence of the category to which each word refers (pleasant vs. unpleasant). In Study 1 this question relates only to attribute words, because each single spider and butterfly (pictures) is perfectly confounded with the category concept (i.e., spiders vs. butterflies). Regarding attribute classification, participants categorize these words according to valence (pleasant vs. unpleasant). Material ratings in study 1 clearly indicate that all attribute words were categorized according to the given dimension indicating a perfect fitting of attributes in its category. However, because all negative attributes are related to fear as well as to unpleasantness, one can not assume that IAT effects are solely driven by the fear-related valence of each unpleasant attribute, but also by the valence of the category (for a detailed discussion, see Study 2). On the other hand, results by Steffens and Plewe (2001) clearly demonstrate that IAT effects depend heavily on the attribute exemplar that one selects, which supports the suggestion that fear-related contents of the attribute words influenced the above results. To prevent these problems in future studies it would be helpful to develop indirect measure that are based on the impact of each attribute's valence and less on the category name.

3. Study 2: Category valence or stimulus valence: What drives the IAT effect?

The Implicit Association Test promises to be an indirect measure of the strength of associations between concepts stored in memory. Recently, however, several aspects of the IAT have been doubted and criticized (see chapter 1.3.3). It is claimed that an IAT account based on the compatibility and incompatibility between response assignments and existing associations alone is not sufficient to explain the effect (e.g., Mierke & Klauer, 2001; Rothermund & Wentura, 2001). Therefore, the following chapter will focus on three critical aspects about the IAT. First, De Houwer (2001) claimed that IAT effects reflect attitudes toward the given target concept rather than attitudes toward the individual exemplar. Second, Mierke and Klauer (2001) propose an alternative IAT explanation, which attributes IAT effects to differential costs for switching between the two combined tasks. Third, I argue that explicitly labeled category dimensions used in most IAT experiments (e.g., flower vs. insect; positive vs. negative) represent one reason for the two problems mentioned above. This could be prevented by masking the relevant dimensions.

Although most IAT researchers focus on questions about the predictive potential of IAT responses, it is also necessary to address methodological concerns along the way. In the following part I will introduce the three critical aspects in a greater detail, which will lead to the experiments of Study 2. It will become apparent that this methodological focus is helpful in a theoretical as well in a practical respect.

1. Category Concepts vs. Individual Stimuli

In a typical IAT task, participants classify target stimuli into two categories (e.g., substantives into the category of *flowers* vs. *insects*). Simultaneously, they also classify attribute stimuli into two categories (e.g., words into *pleasant* vs. *unpleasant* ones). If a target concept such as insect is highly associated with a specific attribute such as unpleasantness, the categorization task of the IAT should be easier when the associated concepts share the same response (compatible task) than when they require different responses (incompatible task; e.g., flowers and unpleasant words require the same response). But what are the features that drive the IAT when stimuli are categorized during IAT performance? De Houwer (2001) introduced a useful analysis of IAT performance focusing on relevant and irrelevant features of the stimuli. When classifying targets and attributes by pressing a right or a left key, the semantic category of the stimulus (flower vs. insect, or pleasant vs. unpleasant) is the relevant stimulus feature (see De Houwer, 2001; 2003a; chapter 1.3.3-2). In the compatible task, positive valence becomes associated with one response (e.g., press left key), because the concepts of *flowers* and *pleasant* have a positive valence. The same could be assumed for the concepts *insect* and *unpleasant*, which are of negative valence, becoming associated with the right key. When the word 'Tulip' is presented in the IAT, participants have to focus on the relevant feature (i.e., flower) to give the correct response. At this point the concept *flower* has positive valence that is associated with the left response key and positive valence. Response selection and performance will be facilitated in the compatible task because pleasant attribute words and flowers require the same response associated with positive valence. It seems rather irrelevant, however, whether the tulip itself is considered to have a positive valence. The crucial question remains: Does the individual valence of a target stimuli (e.g., tulip) also mediate IAT performance, or do the effects solely depend on the valence of the concept category? This question is less important, as long the valence of target stimuli and its category are perfectly confounded (the concept flower and all presented stimuli (tulip, roses, etc.) have a positive valence). But what happens when target stimuli of the same category vary in their valence? De Houwer (2001) investigated this question in an experiment (see chapter 1.3.3-2) and found that valence of individual target stimuli (irrelevant feature) had little or no impact on performance. Only valence of the relevant target categories (e.g., 'British' vs. 'Foreign') mattered. Therefore, De Houwer (2001) suggested that IAT effects are not located at the level of individual exemplars, but rather at the level of the global target categories. But is this also true for attribute words? Steffens and Plewe (2001) found that IAT effects depend on single attribute words indicating a strong influence of exemplar valence on IAT performance (see chapter 1.3.3-2). This influence could be due to the fact that during attribute concept trials, participants need to process the valence of the individual stimuli (relevant feature) in order to select the correct response. During target trials valence is not a relevant feature. It seems that more weight will automatically be given to the dimension that is linked with the correct response and its valence, compared to the individual stimulus valence (irrelevant feature), which is assumed to be activated during performance.

Either the influence of individual stimulus valence or the concept valence should lead to comparable IAT effects because in most IATs there is a perfect confound between the relevant and the irrelevant feature of target and attribute stimuli (individual stimuli of one category should have the same valence as the analogical concept category). On the other hand, it would be of great theoretical and practical interest, whether single stimuli or categories mediate IAT effects. The IAT in Study 1 of this dissertation used negative attributes that are related to fear as well as to the category dimension of unpleasantness. As a consequence the effects could solely be driven by the fear-related valence of each unpleasant attribute, or by the valence of the category. Moreover, to prevent these problems in the future, it would be helpful to apply indirect measures that are based on the impact of each attribute's valence and less on the category name. Such tasks could be used in situations when it is difficult to label the attribute dimension of interest, because participants vary in their evaluative judgments.

2. The Task-Switch-Neglect Model

Mierke and Klauer (2001) argue that IAT effects do not solely relate to the associative strength between target and attribute concepts, but depend 'on executive control processes responsible for task-set organization or the passive dissipation of residual task-set activation during the incompatible task' (Mierke & Klauer, 2001, p. 117). In an IAT participants have to switch between two tasks. If a target stimuli appears, they have to decide according to the target categories (e.g., flower vs. insect); if an attribute stimuli appears, participants have to switch to the valence-related classification (e.g., pleasant vs. unpleasant). Mierke and Klauer (2001) suggested that in the compatible task of the IAT fast and accurate responses are possible, because participants neglect the instruction to switch between task sets (targets vs. attribute). They argue that just the attribute-related information becomes available upon processing a stimulus from the attribute as well from the target category, because only one dimension, namely emotional valence, is necessary for correct categorization [e.g., everything pleasant (positive attributes and flowers) requires one response, everything unpleasant (negative attributes and insects) requires the other response]. Therefore, it is not necessary to switch between the tasks, avoiding switching costs. In contrast, this is not possible in the incompatible task. Here, two alternative dimensions must be used: attributes may still be categorized according to emotional valence, but targets have to be categorized according its type. Emotional valence cannot be used easily for classification of the targets because the pleasant targets (flowers) require the same response as the unpleasant attributes, and vice versa, creating strong interference. Therefore, during the incompatible task, participants have to monitor two different dimensions and switch back and forth between them, making the incompatible task more difficult than the compatible one.

Mierke and Klauer (2001) showed that task-switching [i.e., performance in task-switch trials, where an evaluative decision (attribute classification) is followed by a flower-insect discrimination or vice versa] leads to longer reaction times (higher costs) in the incompatible than in the compatible IAT condition. The authors propose that these results are based on the assumption of participants neglecting the IAT instruction (this does not need to be intentional) by using attribute-related information while processing a stimulus from the target category; however, it must be stated that there is no evidence to the extent to which participants actually use such strategies. Even when the task-switch costs are responsible for some of the differences between incompatible and compatible tasks, this factor should affect all participants in a similar way and would not explain the group differences as in Study 1. Moreover, differential use of the task-switch strategy in high and low fearful participants is very unlikely, because IAT differences between the two groups comes from different performance in the incompatible task, in which the task-switching strategy has no beneficial effect.

3. Explicit Category Labels

In the standard IAT task, target categories and attribute categories are explicitly labeled with names of the dimensions of interest (e.g., spiders vs. butterflies and pleasant words vs. unpleasant words). Thus, the associations meant to be measured are completely explicit to the participants. They are made even more obvious by the way the category labels are shown on the screen to remind participants of the current assignment of categories to keys. In a compatible task, for instance, the word 'spider' would be located on one side of the screen, together with the word 'unpleasant', while the words 'butterfly and 'pleasant' would be located on the other side.

These explicit category labels are one argument against the implicitness of the IAT in the way that participants are not aware of what is being measured (see also chapter 1.3.3-1). Moreover, presenting explicit labels on the upper screen (e.g., 'spider-pleasant' vs. 'butterfly-unpleasant') participants easily recognize the intents of the experiment.

The influence of category labels becomes apparent in an IAT experiment by Mitchell et al. (2003). Participants had to categorize pictures of Black athletes and White politicians. In two experimental conditions the same pictures were used, but with different category labels for the target concepts. In one condition targets had to be classified according race

(Black vs. White), in the second condition according their occupation (Athlete vs. Politician). The IAT effects depended on the labels of the target categories. There was more positivism towards Blacks, when participants categorized pictures of Black athletes and White politicians according their occupation. The reversed pattern was observed, when participants had to focus on the race of the targets. This is in line with De Houwer (2001) claiming that the IAT measures associations between concept categories rather than associations between individual stimuli. When labels explicitly relate and activate the relevant categories (e.g., Athlete vs. Politicians) responses will be mainly guided by this feature because it is most relevant to the participants within context. While focusing on the category features, irrelevant individual stimulus features will be ignored. This seems to be the case for target stimuli, but is it also true for the attribute dimension? Steffens and Plewe (2001) were able to show the influence of individual attribute stimuli on IAT performance, a result that can be due to the fact that valence is the relevant feature during attribute discrimination.

But what would happen if valence would be an irrelevant feature in the attribute discrimination trials? One could mask the IAT attribute dimension (e.g., pleasant vs. unpleasant) with a rather neutral unrelated feature (CAPITALIZED LETTERS vs. small letters), presenting all negative attributes in capitalized letters and all positive attributes in small letters (or vice versa)? The aim of the present study was to investigate the influence of masked category labels on IAT effects because of three important theoretical points. 1. Masked category labels would not make the association intended to be measured visual. 2. When masking the attribute dimension with an unrelated feature (e.g., letter type), the relevant feature would be the size of the letters and the irrelevant feature would be the valence of the individual stimuli. Assuming that the size of letters is unrelated with the target categories (e.g., spider vs. butterfly), possible IAT effects would relate to the emotional valence of the individual attribute words. 3. In a masked IAT, the influences of task-switching should be comparable in the two combined tasks. Because the valence information of attribute words is masked participants would be unable to ignore the instruction in the 'compatible task' using just one valence-related dimension to categorize targets and attributes.

Because of these objections, Experiment 4 tested the ability of the IAT to measure associations between targets and attributes without referring explicitly to the attribute dimension of interest. In Experiment 4, participants received an IAT that was identical to the IAT used in Experiment 2 and 3 of this dissertation using pictures of spiders and butterflies as target stimuli. In the compatible task, spiders and unpleasant words required the same response, as did butterflies and pleasant words. In the incompatible task, the allocation of pictures to response keys was switched, such that spiders and pleasant words now required the same response, as did butterflies and unpleasant words One group of participants, however, categorized pleasant and unpleasant words explicitly according to their valence (exactly like in Experiment 2 and 3). For the other participants, the attribute categories were masked instead of being explicitly mentioned. As a result, the pleasant and unpleasant words were categorized according to a surface feature (words in upper case letters vs. words in lower case letters) by one group of participants. Another group categorized the same words according to language (German words vs. English words). This language condition was introduced because classifying stimuli according this feature requires more semantic processing then in the surface condition. The critical question was whether valence of individual attribute words (irrelevant feature) would affect IAT performance even when participants are not instructed to pay attention to valence (they could safely ignore valence while categorizing the words according to language and surface). If this were the case, it would support the assumption that the emotional valence of individual stimuli is indeed processed automatically. Nevertheless, I also have the hypothesis that IAT effects will decrease in the masked conditions, because explicit valence labels lead to a stronger activation of the relevant concepts in memory. On the other hand, if participants process the material solely in terms of the explicitly instructed category (letter size and language) without an automatically activation the individual stimulus valence, mean reaction times of the compatible task and the incompatible task should not differ in the new masked IAT versions.

3.1 Experiment 4: Masked category labels and IAT performance

Method

Participants. Sixty undergraduate psychology students of Dresden University of Technology participated. Equal numbers of participants were randomly allocated to the three tasks described below. None of the participants showed increased spider fear in a screening questionnaire (SAS, Rinck, Bundschuh, Engler, Müller, Wissmann, Ellwart, & Becker, 2002).

Implicit Association Tests. Three IATs where designed similar to the IATs used in Experiment 2 and 3. They differed only with regard to the categorization task for the attribute materials. In the *Original IAT*, 20 participants categorized target pictures into spiders and butterflies (20 individual spider pictures and 20 individual butterfly pictures were used). Simultaneously, they categorized 10 fear-related, unpleasant words (e.g., fear, panic) and 10 relaxation-related, pleasant words (e.g., holiday, paradise) into the categories 'pleasant' vs. 'unpleasant'. This original task served as a control condition because it has shown reliable IAT effects within non-fearful control groups of Study 1. In the *Language IAT*, another 20 participants categorized the same pictures in the same way. The words were categorized according to language, however all pleasant words were translated into well known, positive English synonyms (e.g., fun, happy). Sufficient familiarity with the English words was confirmed by pre-tests. The unpleasant German words remained unchanged. No reference was made to the fact that there was a 'confound' of language and valence. The 20 participants of the *Surface IAT* categorized the same pictures in the same way as well. They categorized the words according to letter type, however the pleasant German words were presented completely in upper case letters, and the unpleasant German words completely in lower case letters. Again, no reference was made to the emotional valence of the words.

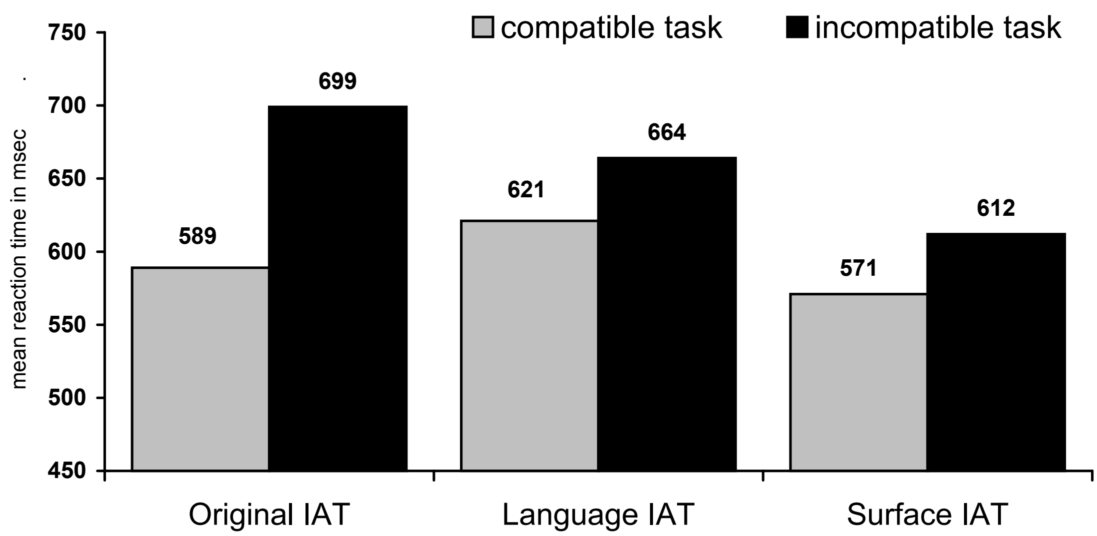
Procedure. Each IAT consisted of a 'compatible task' and an 'incompatible task'. In the compatible one, spiders and unpleasant words required the same response, as did butterflies and pleasant words. In the incompatible task, the allocation of pictures to response keys was switched, such that spiders and pleasant words now required the same response, as did butterflies and unpleasant words. Each task consisted of 80 practice trials followed by 240 experimental trials. Of the latter, 60 trials each consisted of spider pictures, butterfly pictures, pleasant words, and unpleasant words in random order. All participants received the compatible task before the incompatible one.

Results

Data for each IAT included response latencies for the compatible and incompatible task (in milliseconds) and error rates. Prior to the planned analyses, distributions of error rates were examined. Error rates were uniformly low, averaging just under 5% on critical IAT blocks. Therefore, latencies data of correctly answered trials were averaged for each critical task, yielding median latencies for each participant. IAT effects were computed by subtracting the median latency of the compatible task from that of the incompatible task.

Mean reaction times (RTs) in the compatible and incompatible tasks of the three different IATs are shown in Figure 3-1. The ANOVA of these RTs yielded a significant interaction of IAT version and compatibility ($F(2,57) = 4.38$, $p < .05$, $eta^2 = .13$). Separate analyses of the three IAT versions indicated that the incompatible task yielded significantly longer RTs than the compatible task in the original IAT ($t(19) = 5.67$, $p < .0001$) and in the Surface IAT ($t(19) = 4.22$, $p < .0001$), whereas the difference was only marginally significant in the Language IAT ($t(19) = 1.78$, $p = .09$). These results suggest that - at least in the Original IAT and the Surface IAT - the emotional valence of the attribute words was activated, causing longer RTs in the incompatible task. Further analyses, however, indicated that it is important to treat the IAT effects separately for pictures and words.

Figure 3-1. Mean reaction times in ms in the compatible and incompatible tasks of the Original IAT, the Language IAT, and the Surface IAT in Experiment 4

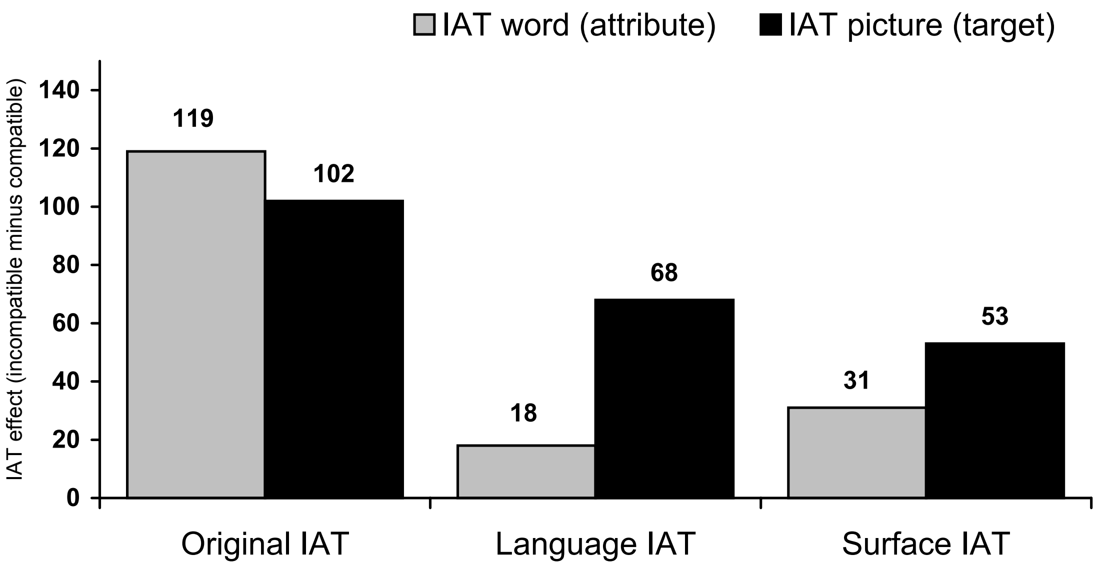


By definition, IAT effects are computed by subtracting the mean RT of the compatible task from that of the incompatible task. For further analyses, these IAT effects were used, yielding a significant interaction of IAT version and material type (words, pictures) in a two-way ANOVA ($F(2, 57) = 3.98$, $p < .05$, $eta^2 = .12$). In the Original IAT, the IAT effects were large both for words (mean 119 ms, s.d.116) and pictures (mean 102 ms, SD 83); they were significantly different from zero (both $t(19) > 4.58$, $p < .0001$), but they did not differ from each other ($t(19) < 1$). In the Language IAT, however, the IAT effect was significantly larger for pictures than for words ($t(19) = 2.99$, $p < .01$); there was no IAT effect for words (mean 18 ms, SD 93), $t(19) < 1$), but a significant effect for pictures (mean 68 ms, SD 131), $t(19) = 2.30$, $p < .05$). In the Surface IAT, the IAT effects were significant both for words (mean 31 ms, SD 44), $t(19) = 3.09$, $p < .01$) and pictures (mean 53 ms, SD 50), $t(19) = 4.74$, $p < .001$), and the effect for pictures was significantly larger ($t(19) = 3.05$, $p < .01$). IAT Effects for attributes and targets for all three IATs are displayed in Figure 3-2.

Discussion

These results suggest that masking the attribute dimension leads to significant IAT effects, but only for the Surface condition. For the Language IAT there is a strong reason to suspect that there are serious problems matching word familiarity or processing speed, which led to the extremely large differences within the group.

Figure 3-2. Mean IAT Effects in ms for attributes (words) and targets (pictures) in the Original IAT, the Language IAT, and the Surface IAT in Experiment 4



Even though the English words used in the experiment are often used in conversation, television and advertisements, one has to assume that they are rather unfamiliar in German and not useful for masking the IAT attribute dimension. IAT effects of the Original IAT revealed similar results as shown by control participants in Experiment 2 and 3 of Study 1. As expected, non-fearful participants associate spiders with negative, fear relevant contents, compared to butterflies. Moreover, IAT effects in the Surface condition remained significant indicating a faster performance in the compatible than in the incompatible condition. As hypothesized, compared to the Original IAT the effects decreased in the surface condition. Smaller IAT effects in this condition indicate a strong influence of explicit category labels on IAT performance (e.g., De Houwer, 2001). The relevant attribute feature (letter type) is easy to categorize, which leads to quick responses that do not interfere with the activated target concepts of spiders and butterflies. Because the masked attribute dimension does not refer to valence at all, individual stimulus valance drives the IAT effects in the surface condition. On the other hand, the impact of this actually irrelevant stimulus feature is less influential, compared to the condition, when it is explicitly activated.

Unfortunately, Experiment 4 had several methodological artifacts questioning its empirical and theoretical relevance. In Experiment 4 valence is perfectly confounded with the other dimensions (language, letter type), not only in the way that was necessary to mask the attribute dimension, but also in a more mundane way. In the language condition, pleasant words were always in English and of positive valence? Unpleasant words were always in German. Counterbalancing which language was associated with positive words (as a between-subjects manipulation) was not done, mainly because it was not possible to find unpleasant English words that are familiar and well known for Germans. For the Surface condition it seems unlikely that people differ in the favorability of their response to upper case versus lower case words. Therefore, confounds with valence across participants condition seems much less worrisome. Nevertheless, a serious problem remains in the fixed order of the combined tasks, presenting the compatible task before the incompatible one. Even though previous studies (Experiments 1 - 3) showed no influence of task order, it is important to counterbalance the order in which participants complete the combined tasks of the IAT. In the absence of such counterbalancing it is impossible to tell whether the results are simply due to practice or some pre-existing mental associations.

Participants of the Surface IAT and the Language IAT were explicitly instructed to categorize the words according to some dimension other than emotional valence, and they could ignore valence while categorizing the words according to language or letter type. This leads to the assumption that the amount of task-switching costs was equal in the compatible and incompatible IAT task because in the compatible task participants are not able to classify target and attribute stimuli just regarding one emotional dimension. I cannot exclude the possibility, however, that at least some participants of these IAT versions did not ignore the words' valence, and categorized the words according to valence instead of language or letter type, which makes a task-switching explanation again possible. Experiment 5 was designed to address this problem, focusing on the Surface IAT.

3.2 Experiment 5: The Surface IAT

Method

Participants. Thirty undergraduate psychology students of Dresden University of Technology participated. None of them had participated in the previous experiment.

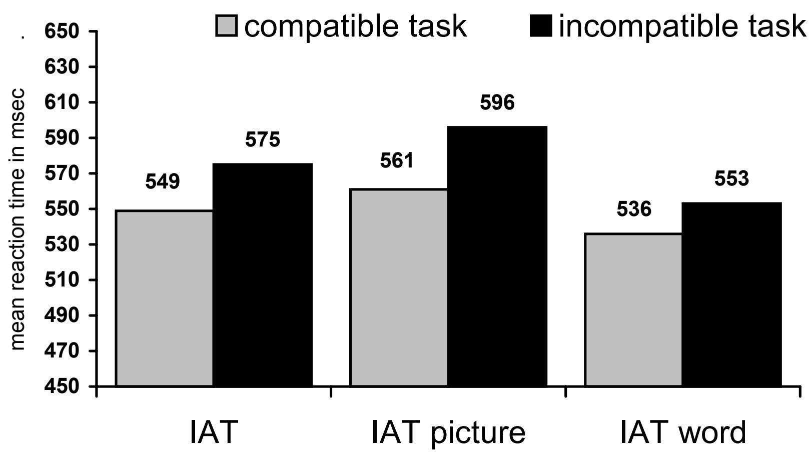
Implicit Association Test. All participants received the Surface IAT described above. However, in addition to the words used before, they also categorized meaningless letter strings of similar length (e.g., erdranda , KREMSOLLE) presented at random serial positions. Each of the 8 strings was presented three times in upper case letters and three times in lower case. Obviously, these strings may not be categorized according to emotional valence. They should also discourage the participants from categorizing the words according to emotional valence because of the costs caused by switching back and forth between two different categorization dimensions. Moreover, these letter strings make it even more difficult to detect the aim of the IAT to investigate the associations between the target stimuli and a valence. As before, no reference was made to the emotional valence of the words. After the experiment, however, participants were questioned whether they had noticed an attribute dimension in addition to letter type, and whether they had used any other dimension to categorize the words instead of the categorization by letter type.

The procedure was identical to Experiment 4, except that for each task (compatible and incompatible), the practice phase consisted of 60 trials (20 pictures, 20 words, 20 letter strings), and the experimental trials comprised 120 pictures (60 spiders and 60 butterflies), 120 words (60 pleasant words in upper case letters and 60 unpleasant words in lower case letters), and 48 letter strings (24 in upper case letters and 24 in lower case letters). Moreover, the order of the compatible and incompatible task was counterbalanced across participants.

Results and Discussion

The overall analysis of RTs of the compatible and the incompatible task yielded results similar to the first experiment (see Figure 3-3). The IAT effects were significant overall (mean 26 ms, SD 42), t(29) = 3.3, p < .01), for pictures (mean 35 ms, SD 53), t(29) = 3.6, p < .001), and marginally significant for words (mean 17 ms (46), t(29) = 2.0, p < .06). Furthermore, there was no interaction of task order (compatible - incompatible vs. incompatible - compatible) and IAT effects (F(1,28) = .57, n.s.).

Figure 3-3. Mean reaction times in ms for the compatible and incompatible IAT-tasks, and separately for pictures (targets) and words (attributes) in Experiment 5



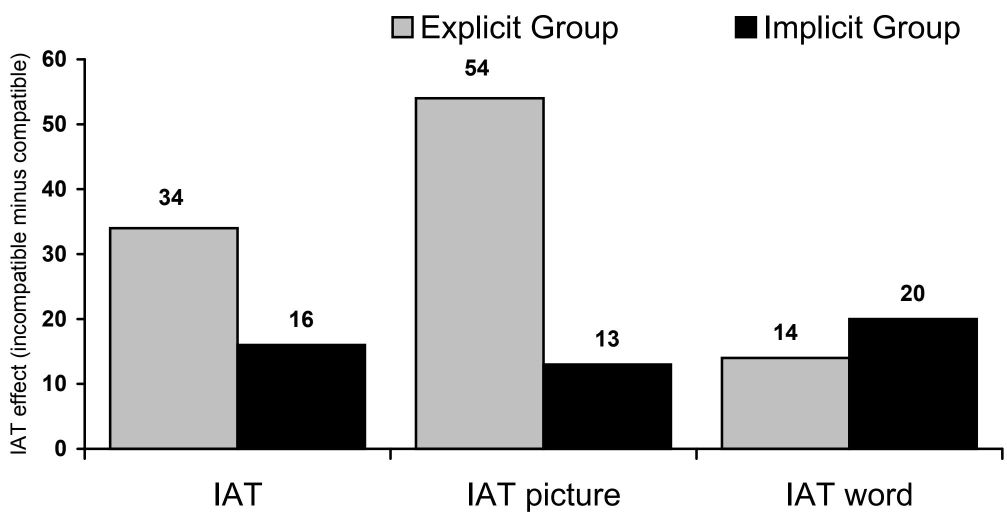
Upon being questioned after the experiment, none of the participants indicated that they had used emotional valence to categorize the words. Further analyses were carried out to substantiate these subjective responses. First, if participants had used emotional valence to categorize the words, error rates for the non-words should correlate positively with the IAT effects. This should be the case because emotional valence cannot be used to categorize the non-words, creating confusion and errors when they are presented. On the other hand, this was not the case; error rates for non-words did not correlate positively with the IAT effects (r = -.37, p < .05). Second, there should be an effect of compatibility on reaction times of the non-words. Instead, practice effects revealed: RTs of nonwords decreased from the first to the second task, no matter whether this was a compatible or an incompatible one (F(1,28) = 17.1, p < .001). Results are shown in Table 3-1.

Table 3-1. Mean reaction times in ms and error rates of non-words (with Standard Deviations) broken down by compatibility and task position in Experiment 5

	Position 1		Position 2		Significance
RTs	Incompatible	607 (102)	Compatible	537 (71)	p<.01
	Compatible	609 (76)	Incompatible	579 (54)	p<.05
	Significance	n.s.		n.s.	
Error Rates	Incompatible	2.4 (1.8)	Compatible	2.5 (2.3)	n.s.
	Compatible	1.3 (1.4)	Incompatible	1.9 (1.7)	n.s.
	Significance	n.s.		n.s.	

After the experiment participants were asked what attribute dimension they had recognized additionally (other than the given one). Sixteen participants correctly indicated pleasant and unpleasant words. This group will be called 'explicit group' group, because they showed correct explicit knowledge about the categorization dimensions. The remaining 14 participants did not recognize the valence dimension ('implicit group'). Comparing IAT performance of the two groups (between factor) a major difference occurred (Figure 3-4).

Figure 3-4. Mean IAT Effects in ms for pictures (targets) and words (attributes) broken down by Group (explicit knowledge, no explicit knowledge) in Experiment 5



A two way ANOVA yielded a significant interaction of Group (explicit, implicit) and material type (words, pictures) ($F(1, 28) = 6.79$, $p < .01$, $eta^2 = .20$). The IAT effects for words did not differ between the groups and were not different from zero in both groups (explicit group: mean 14 ms, SD 49), $t(15) = 1.17$, n.s.; implicit group: mean 20 ms, SD 44), $t(13) = 1.65$, n.s.)., The IAT effects for pictures, however were significantly larger for the explicit group than for the implicit group ($t(28) = 2.24$, $p < .05$); there was a significant IAT effect for the explicit group (mean 54 ms, SD 55), $t(15) = 3.86$, $p < .01$), but no IAT effect for the implicit group (mean 13 ms, SD 42), $t(13) = 1.13$, n.s.). The overall IAT effect for the explicit group was significantly different from zero (mean 34 ms, SD 47), $t(15) = 2.90$, $p <.01$), but not for the implicit group (mean 16 ms, SD 36), $t(13) = 1.68$, n.s.). These results indicate that significant IAT effects depend on the fact that participants somehow recognize and activate the valence dimension introduced by the attribute words. Although all attributes were categorized according to the surface feature, performance in target trials slowed down when spiders and pleasant upper case letters were assigned onto one key, compared to the opposite key assignment. This result supports the hypothesis that the valence of individual attribute stimuli is activated and interferes with the valence of target stimuli; however, the effects disappears when the valence of the attributes remains undiscovered.

3.3 General Discussion

As expected, participants of the Original IAT associated 'spiders' more strongly with 'unpleasant', fear-related words, and 'butterflies' more strongly with 'pleasant', relaxation-related words than vice versa. This pattern of associations yielded fairly large IAT effects both for the targets (pictures) and the explicit attributes (words). For the new masked versions of the IAT in Experiment 4, a more complex pattern of results was found: For words, there was only a weak IAT effect (Surface IAT) or no effect at all (Language IAT), but a significant IAT effect for pictures. Nevertheless, emotional valence of the words did affect task performance, interfering with picture categorization in the incompatible task. This interference effect is reminiscent of the classical Stroop effect (Stroop, 1935). The fact that the IAT effect for words was reduced almost to zero indicates that participants of the Language IAT and the Surface IAT did indeed categorize the words according to language and letter type, respectively. Interestingly, emotional valence of the words was activated nevertheless, creating significant IAT effects for pictures in both the Language

IAT and the Surface IAT. In hindsight, one might have expected this for the Language IAT. For the Surface IAT, however, it is most notable because the simple categorization according to letter type does not require semantic processing at all. Experiment 5 demonstrated that emotional valence of single exemplars (the attribute words) is activated in a task in which participants are effectively discouraged from using valence as a criterion for their decisions. Instead, the results indicate that they used the neutral and perceptual categorization dimension for categorizing attribute words.

What are the conclusions for the initial questions and problems raised?

Category Concepts vs. Individual Stimuli. Study 2 investigated the question whether the IAT is driven by valence of the given concept category or by the presented stimulus. De Houwer (2001) found that valence of individual target stimuli had little or no impact on performance; rather, only valence of the target categories (e.g., 'British' vs. 'Foreign') mattered. Therefore, de Houwer (2001) suggested that IAT effects are not located at the level of individual target exemplars, but rather at the level of the global target categories. For attribute stimuli Steffens and Plewe (2001) report a strong influence of exemplar valence on IAT performance. The results of Experiment 4 and 5 support both predictions. In the masked IAT conditions of Experiment 4 and 5 the 'confound' of attribute categorization task and emotional valence was introduced on purpose, revealing that the associations of spiders with fear and of butterflies with pleasure affected decisions even when the attributes were categorized according to completely different dimensions. At first glance this stands in contrast to results reported by de Houwer (2001). Experiment 4 and 5 found that emotional valence of individual stimuli affected performance of target stimuli, congruent to the results by Steffens and Plewe (2001). The size of the IAT effects, however, depended on the explicitness of the valence dimension. Although the effects remained significant when valence was masked, IAT effects were significantly smaller in the masked conditions. One can assume that explicit valence labels additionally activate the relevant valence concepts in memory leading to a stronger interference with incompatible target concepts. Moreover, when the valence dimensions remain undiscovered by the participants, IAT effects will disappear. The data of Study 2 suggests that to a large extent IAT effects are induced by the valence of the relevant feature of the presented stimuli (De Houwer, 2001). On the other hand, irrelevant features of attribute stimuli affect IAT performance (Steffens and Plewe, 2001), even when the attribute dimensions are masked by neutral, non-relevant concepts.

Task-Switch-Neglect Model. Secondly, Mierke and Klauer (2001) discuss an alternative IAT explanation and propose a model that attributes IAT effects to different costs related to task-set switching. According to this model reaction times in the compatible IAT task decrease, because participants may categorize all items according to only one dimension or task set, namely emotional valence. In compatible tasks, neglecting the instruction to focus on the two given concept dimensions is possible because participants can use knowledge about these concepts, especially when target and attribute categories are explicitly labeled with names of the dimensions of interest (e.g., spider vs. butterfly; pleasant words vs. unpleasant words). For the Original IAT used in Experiment 4 the compatible IAT task is easy because participants may categorize all items according to only one dimension, namely emotional valence: everything pleasant (words and butterflies) requires one response, everything unpleasant (words and spiders) requires the other. In contrast, in the incompatible task, two alternative dimensions must be used; words may still be categorized according to emotional valence, but pictures have to be categorized according to type of animal. Emotional valence cannot be used easily for classification of the pictures because the pleasant pictures require the same response as the unpleasant words, and vice versa, creating strong interference. Therefore, during the incompatible task, participants have to monitor two different dimensions and switch back and forth between them, making the incompatible task more difficult than the compatible one. Nevertheless, the present IAT results and statements of the participants speak against this alternative explanation of IAT effects. Results of Experiment 5 suggest that this explanation is at least incomplete as an explanation of IAT effects because Experiment 5 revealed IAT effects, even though the participants used two different dimensions in both the compatible and the incompatible task; however, the observed effect was considerably smaller than the one observed in the Original IAT of Experiment 4. I would suggest that this is more due to the lack of explicitly valenced category labels than to neglecting of the task-switch instruction. On the other hand, one can not exclude that the task-switching explanation may indeed explain part of the effects found in the Original IAT.

Explicit Category Labels. In the original IAT the associations meant to be measured are completely explicit to the participants. They are made even more obvious by the way the category labels are shown on the screen to remind participants of the current category-key assignments. As reported above, explicit labels of valence lead to a stronger activation of the relevant associations and larger IAT effects, but results also indicate that the effects do not solely depend on the category concept. Nevertheless, in a typical IAT there is a perfect confound between the relevant and the irrelevant feature of target and attribute stimuli (e.g., individual spider and the spider concept should not vary in their valence). On the other hand, when stimulus and target concept valence are confounded as in the Original IAT, participants may adopt a different strategy in the compatible task than that which is adopted in the incompatible response assignment [c.f. Task-Switch-Neglect Model, Mierke & Klauer (2001)]. The masking of concept categories represents an alternative to prevent strategic factors that might underlie IAT effects and introduces a possibility to assess associations induced by the individual stimuli.

In addition to these theoretical conclusions, the present results also suggest some useful practical implications. First, I suggest that researchers routinely analyze and report IAT effects separately for targets and attributes. Otherwise, important differences might be obscured by reporting only IAT effects averaged across all materials. Second, masked IAT versions like the ones presented here may be very helpful when it is difficult to use the attribute dimension of interest. To give just one example, one might be interested in measuring how strongly socially phobic patients associate angry versus smiling faces with social threat versus social acceptance. In this case, the attribute materials might consist of threat-related words versus positive words. It would be difficult to ask participants to categorize the words according to the threat-acceptance dimension because they might lack the necessary knowledge, and words like 'audience', 'speech', or 'heartbeat' might not be threatening to healthy control participants. For the same reason, the standard classification into pleasant versus unpleasant words might not work well with these words and control participants. With a masked IAT version, however, it is possible to use just about any group of words for any participant because the categorization dimension may be perfectly unequivocal. For this purpose, I suggest using a task similar to the letter type categorization presented here. It uses a surface dimension completely unrelated to the dimension of interest, and it may be applied to any type of verbal material, with any group of participants. Moreover, a similar approach might be taken with pictorial stimuli. Instead of judging their emotional valence, participants might categorize them according to another feature such as grayscale vs. color, animate vs. inanimate, animal vs. human, or male vs. female. A categorization according to the color of the presented stimuli was already successfully applied in another indirect paradigm, the 'Extrinsic Affective Simon Task' (EAST) introduced by Jan De Houwer (2003). Nevertheless, it has to be tested in future experiments if the masking of both target and attribute dimensions will yield sufficient IAT effects, since an absolute masking of all relevant dimensions could extinguish the influence of the single stimulus valence.

4. Study 3: Malleability of fear associations: The influence of context

As pointed out in the introduction of this dissertation, an increasingly large number of empirical studies investigated the relationship between cognitive processes and anxiety disorders (see chapter 1.1 and 1.2). Most psychological models of anxiety disorders (Barlow, 1988; Beck, et al., 1985; Eysenck, 1992; Foa & Kozak, 1985) postulate that cognitive processes are important for the etiology and maintenance of anxiety. General predictions about cognitive processing in emotional disorders may be derived from theories such as the ones proposed by Bower (1981, 1987), and Beck (Beck, 1976; Beck et al., 1985). According to these theories, cognitive processing is guided by schemata, an underlying cognitive structure which selectively influences perceptions, interpretations, and memories. In anxiety, the important schemata are distorted towards danger and vulnerability. The schema models proposed by Beck, Bower and others led to a tremendous amount of research designed to find out how emotions interact with cognitive processes (see chapter 1.2.1; Williams, et al., 1997). Integrating psychophysiological aspects and response behavior into the cognitive fear network, Lang's bio-informational theory (Lang, 1977, 1978; Lang et al.,1998) offers another useful and far more specific model to describe cognitive representations in anxiety. To test the elements of a fear network, traditional cognitive paradigms are circumspect because they investigate how cognitive structures affect information processing (e.g., memory and attention). Self-reports and other introspective methods are also very limited alternatives to measure cognitive representations because relevant cognitions might be unavailable to introspection and verbal descriptions (e.g., de Jong, et al., 2001; Dovidio and Fazio, 1992), and are influenced by deception and self-presentation strategies. An alternative approach would be the assessment of cognitive structures and states of specific fear associations through indirect, performance- based tasks.

Indirect experimental paradigms, like the Implicit Association Test (Greenwald et al., 1998) may be a helpful additional tool in the research of anxiety disorders, because they promise to assess the structure and state of specific fear associations. Results of Study 1 in this dissertation clearly indicate the usefulness of this tool for examining associative structures in spider phobia. In Experiment 1 and 2, both spider phobic participants and non-phobic controls displayed negative implicit attitudes towards spiders. Both groups associated spiders with negative, anxiety-related attributes, leading to faster responses in compatible tasks of the IAT, when spiders and negative adjectives shared the same response key. Moreover, correlations between IAT effects, questionnaire scores, and behavioral tests in Experiment 1 are further positive arguments for IAT use. Significant partial correlations between the IAT scores and relevant behavior - controlling for the influence of questionnaire scores - support the claim that indirect measures such as the IAT are able to predict behavior beyond the predictions of direct measures such as questionnaires. There are further promising applications of the IAT, investigating implicit associations in recovered depressed patients (Gemar, et al., 2001) and anxiety disorders (de Jong et a., 2001; Teachman, et al., 2001; de Jong, 2002; Teachman & Woody, 2003; de Jong, et al., 2003).

Little is known, however, about the nature of implicit associations in clinical research and their degree of contextual dependence. Looking at studies in social psychology it becomes obvious that the associations measured by the IAT can be influenced by context information (e.g., Lowery et al., 2001; Blair, et al., 2001; Dasgupta & Greenwald, 2001; Wittenbrink, et al., 2001, Rudman & Lee, 2002; Mitchell, et al., 2003; for an overview, see chapter 1.3.3-4; Blair, 2002).

For the clinical application of indirect measures these findings raise the important question: Will fear-related representation will be similarly bound by contextual factors due to its underlying constructive nature? It seems fruitful to explore the extent to which automatically activated fear-related associations are contextually dependent, and therefore to be considered as the result of a constructive process in a certain situation. When objects or situation are associated with fear (e.g., basement rooms in spider phobia) are stored in memory as one solitary evaluative representation, this situation should always activate fear-related responses and would not relate to neutral or more positive contents. On the other hand, this concept of one single affective tag seems very unlikely because different contextual conditions should lead to different evaluations (e.g., a basement room could be associated with more positive valence when it solves a storage problem). One can rather assume that associations toward an object depend on various representations, including multiple categories that relate to the object in various ways (see Ferguson & Bargh, 2003). These assumptions imply that automatically activated dysfunctional associations vary across time and context, depending on the just activated representations, which then would influence subsequent judgments, feelings, and behavior. The assessment of automatic fear-related associations in different contextual situations would help to shed the light on the debate about the nature of dysfunctional beliefs and associations that underlie psychopathology (De Houwer, 2002). Originally, these associations were believed to be contextually independent and relatively stable over time (e.g., Beck, 1976). However, traditional self- report measures of dysfunctional beliefs indicated to be rather contextually dependent (e.g., Teasdale, 1993). The aim of the present study is to investigate the influences of context on dysfunctional fear-related association using an indirect measure of associations. Before explaining the questions and goals of Study 3 I want to explain the reasons for not using an IAT as in the previous experiments.

In Study 1 and 2 the Implicit Association Test was successfully applied to measure fear relevant association; however, despite the advantages and positive results of the IAT, several aspects have been criticized (see chapter 1.3.3; Fazio & Olson 2003). The following two aspects led to the decision not to use an IAT in Study 3. First, the relative nature of the IAT drastically limits the use of this method. The goal of this study is to investigate associations between certain objects/ situations and an evaluative dimension in absolute terms. With the IAT this is not possible, because always two target concepts are related to two attribute concepts providing an estimate of the relative strength of associations. Secondly, testing how specific targets (i.e., situations or objects) are associated with fear-related attributes, it is difficult to find precisely definable category labels for the target categories. Therefore, it would be useful to apply a method where target stimuli are classified according a neutral and unrelated feature (relevant feature), but that which is driven by the impact of each individual target valence (irrelevant feature).

One method that would fulfill the above criteria is a modified version of the IAT, called the 'Extrinsic Affective Simon Task' (EAST), which was developed by Jan De Houwer (2003). This paradigm provides solutions for several problems associated with the classical IAT. Most importantly, the EAST measures associations in a single task. De Houwer (2003) successfully applied the EAST as an absolute measure of attitudes toward various target stimuli (flower vs. insects) and as a measure to assess self- and other esteem. In the EAST, responses are extrinsically related to a valence dimension (e.g., 'pleasant' vs. 'unpleasant') as a result of task instructions. First, participants are instructed to press a left versus a right key in response to pleasant and unpleasant words, respectively. These attribute words are presented in black color (called 'uncolored' words). The words appear separately on the computer screen until the response is made. By means of many practice trials, responses become extrinsically associated with positive or negative valence, creating what might be called a 'pleasant key' and an 'unpleasant key'. In the critical EAST phase, participants also categorize colored target words (e.g., red and blue words) according to their color by pressing the 'pleasant' or 'unpleasant' key (e.g., red color - pleasant key vs. blue color - unpleasant key). The colored words are those target stimuli, whose association with the extrinsic valence dimension are to be measured. As an example, one could introduce as targets words of flowers (e.g., tulip, rose, etc.) and insects (e.g., mosquito, cockroach, etc.). Each of the words is presented both in red and blue color several times. The participants are instructed to press the left or right key in response to the emotional valence of black (uncolored) words, and in response to the print color of colored words. In effect, performance should be superior (i.e., reactions should be faster) on trials in which participants need to press the extrinsically pleasant key in response to a positively associated word (i.e., flower words), and the extrinsically unpleasant key in response to a negatively associated word (i.e., insect words). There should not be any difference in performance if target words are associated neither with pleasantness nor with unpleasantness. One advantage of color as a relevant feature is that it may be used with any kind of verbal stimulus, and that every target word may be presented both in red and blue color, thereby serving as its own control item.

The study reported here used the EAST paradigm to investigate cognitive structures or schemata in spider fear. The aim of the experiment was to measure how ambiguous, neutral stimuli may or may not be associated with threat when different emotional concepts (humans vs. spiders) are activated. If anxiety is related to distortions of important schemata towards danger and vulnerability, spider fearful participants should associate the ambiguous stimuli with threat when the spider concept is activated, compared to non-fearful participants without such an elaborated fear schemata. Furthermore, the results of this experiment should provide useful empirical evidence regarding the question whether dysfunctional threat associations in memory are context-independent, or whether they depend on the specific context activated in the situation. Third, as a tool to investigate the structure of fear networks, the EAST might be a useful research tool in clinical psychology.

The study focused on particular target words (e.g., 'to crawl', 'hair'), which may be related to a 'human' concept (mainly activated by pictures of babies and adults), but might also be related to a 'spider' concept (activated by spider pictures). There were two categories of ambiguous target stimuli. One set described features (e.g., legs, hair, to crawl); the other set described different situations where spiders may occur (e.g., corner, walls, cellar). The critical quality of these target words is their ambiguity; they may be related to humans (e.g., human legs, a fishnet) or to spiders (e.g., legs of spiders, a cobweb). The distinction between features and situations seems useful accordingly to Lang et al. (1998). He claims that fear is represented as a network in memory that includes three kinds of information: a) information about the feared stimulus situation, b) information about verbal, physiological, and overt behavioral responses c) interpretive information about the meaning of the stimulus.

Based on these aspects of Lang's bio-informational theory of fear, Foa and Kozak (1986) outlined an emotional processing account of fear reduction as a part of treatment. Besides the assumption about different kinds of information within the cognitive fear structure (e.g., stimulus, response, meaning) they also claim that the fear structure must be activated by providing information that matches part of the network. In order to disintegrate various conceptual relations between fear-related elements in memory, incompatible information with elements of the fear structure must be made available and cognitively processed (e.g., the experience of physiological habituation as a result of exposure will lower the perception and association of harm from the stimulus). Moreover, there is empirical evidence for different types of fear representations from memory experiments on panic disorder. For instance, Becker, Roth, Andrich and Margraf (1999) found that information about the feared situations is processed differently in memory from stimuli referring to physiological arousal.

4.1 Experiment 6: Context activation and EAST performance

To study the associations between ambiguous, 'neutral' stimuli and pleasant vs. unpleasant threatening words, a modified version of the 'Extrinsic Affective Simon Task' (EAST) was employed in this experiment. To assess the effect of context information on associations, the EAST was conducted twice. In the first EAST, a rather pleasant 'human' concept was activated directly before performing the EAST, whereas a 'spider' concept was activated directly before the second EAST. The first critical question addressed here is whether it is possible to selectively activate these different concepts, such that neutral ambiguous stimuli (words) are associated with fear when related to spiders, but not when related to humans. The second question is whether these differential association strengths may be measured by an implicit test of associations.

Method

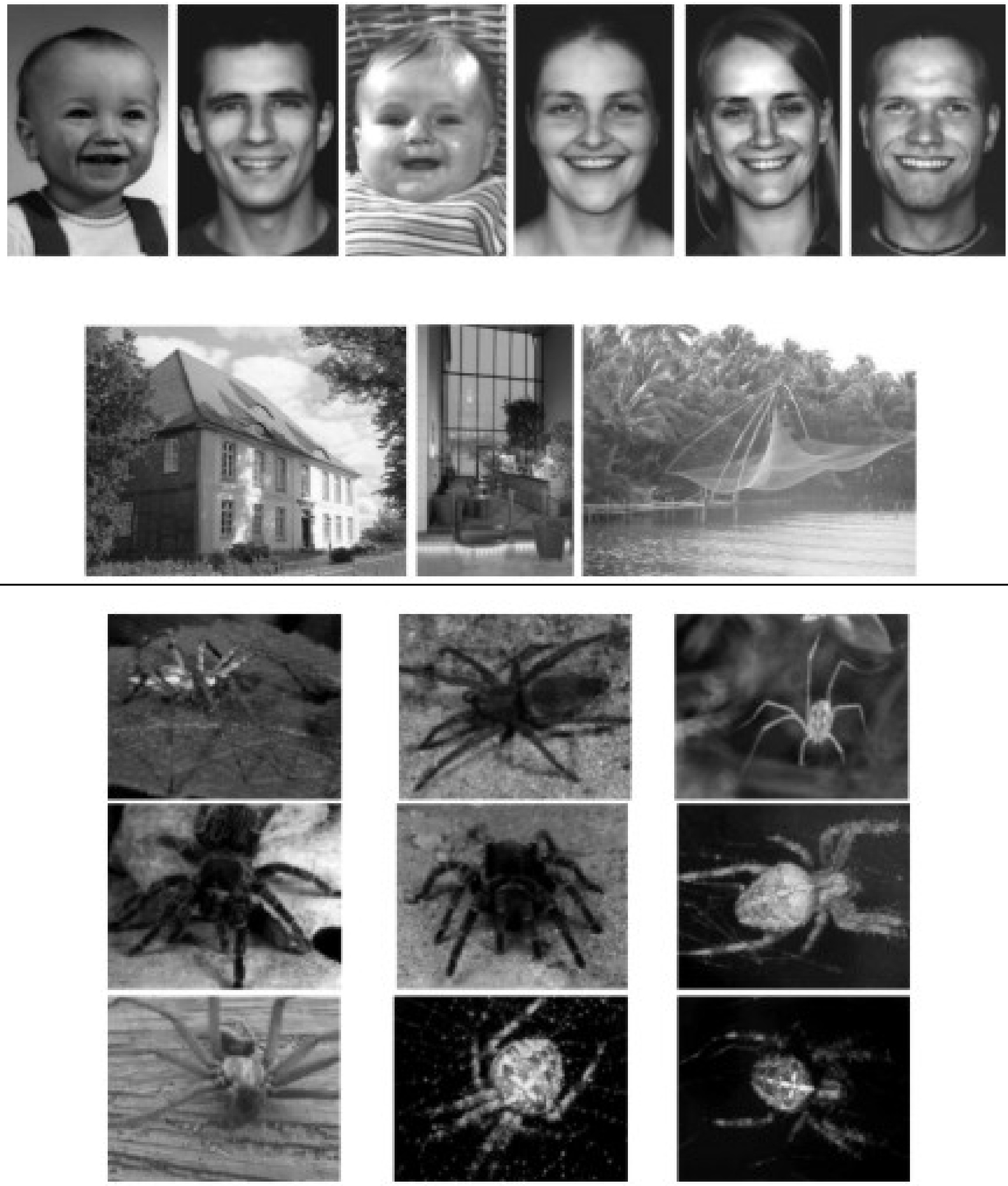
Participants and Questionnaires. Fifty-two undergraduate psychology students of Dresden University of Technology participated in this study in exchange for course credit.

Materials. For selective activation of 'human' concepts and 'spider' concepts, pictures of both categories were collected and evaluated. The pictures needed to fit to the ambiguous feature words and situation words used in the experiment. For example, in the 'human' priming condition, pictures of adults and babies were shown, relating to feature words like 'legs' or 'to crawl'. In contrast, in the 'spider' priming condition, spider pictures were shown, relating to the very same words in a different sense (spider legs or crawling spider). After pre-testing the pictures regarding their fit and ease of identification, nine pictures were selected for the human concept (four adult pictures, two baby pictures, one indoor house scene, one outdoor house scene, one fishing net) and nine pictures were selected for the spider concept (nine pictures of various spiders and their surroundings). The pictures size was 9,5 x 15 cm (3,74 x 5,91 inch). Figure 4-1 displays the pictures that were used for activating the 'human' and the 'spider' concepts.

For the valence categorization trials, eight positive and eight negative, fear-related words (see Appendix J) were presented in black color. In the color practice phase, red and blue 'XXXX'-strings were presented. The ambiguous words of the color categorization trials consisted of six words characterizing features or qualities (legs, to crawl, net, to weave, filament, hair) and six words characterizing situations (attic, walls, cellar, foliage, window, corner). In pre-tests, the emotional valence of these words was rated as neutral by random student participants. All pictures and words were presented on a white background. A letter was 8 mm high and 6 mm wide. The experiment was programmed in RSVP (Williams & Tarr, no date) and implemented on an Apple Power Macintosh 7600/132.

Procedure. The experiment consisted of two EAST experiments, the first one preceded by a human priming phase and the second one by a spider priming phase. All participants started with priming of the 'human' concept presented to the participants as an independent picture rating task (the relation between the pictures and the following EAST was not mentioned). Each of the nine pictures from this category were presented in the middle of the screen below a five point scale reaching from 'very unpleasant' (-2) to 'very pleasant' (+2). Participants were asked to rate the emotional valence of each picture by responding according to this rating scale.

Figure 4-1. Pictures used for priming the 'human' and the 'spider' concept in Experiment 6



The following 'human' EAST experiment started with the valence categorization task. Participants were informed that words would be presented in the middle of the screen. Their task was to classify these words according to their emotional valence by pressing a key of the computer keyboard denoted 'pleasant' or a key denoted 'unpleasant' (extrinsic valence). Each of the eight pleasant and eight unpleasant words was presented twice in a fixed random order; afterwards, the color categorization task was introduced. Equal numbers of participants were randomly allocated to the following sets: half of the participants were instructed to press the 'pleasant key' in response to blue words and the 'unpleasant key' in response to red words (Set 1). The other participants received the opposite assignment (Set 2). For practicing of the color categorization task, ten blue 'XXXX'-strings and ten red 'XXXX'-strings were presented in a fixed random order.

In the final critical phase, all ambiguous words (features and situations) were presented in red or blue color, and the pleasant and unpleasant words were presented in black ('not colored'). Participants were instructed to press the 'pleasant' or 'unpleasant' key depending on the emotional valence or the color of the word. If the word was not colored (black), valence was critical, as practiced before. If the word was colored, they had to respond on the basis of color, as practiced before. The critical phase consisted of two identical test blocks, each of which started with four practice trials (two pleasant and two unpleasant black words). Following, each of the 12 ambiguous words (six features, six situations) were presented once in red color and once in blue color, and each of the 16 valence words were presented once in black color (eight pleasant and eight unpleasant words), resulting in 40 trials per block. There was a short break between the two test blocks. During this break, the nine human pictures appeared on the screen for two seconds each, with the objective of further concept priming. Again, the relation between the pictures and the EAST was not mentioned. Afterwards, the task continued with the second test block. All stimuli appeared in the same fixed random order for each participant. Each stimulus was signalized by a fixation cross for 500 ms; then the stimulus was shown until a response was made. If the participants made an incorrect response, the message 'WRONG KEY' appeared for one second. The inter-trial interval was 1500 ms. The participants needed approximately 10 minutes to complete the first EAST experiment.

After the EAST, all participants conducted on an unrelated text reading experiment for about 50 minutes. After this experiment, the 'spider' EAST was introduced [4]. This second EAST experiment was perfectly identical to the first, except for the picture materials used in the priming task. Instead of the human pictures, nine pictures of spiders were presented to the participants who rated them according to their emotional valence before the first phase of the EAST.

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[4] One critical point of this design could arise from the lack of counterbalancing the 'human' concept and the 'spider' concept condition; however, activating fear associations in the spider priming condition before the human priming condition, one has to assume that this would influence later performance in the latter condition.

Again, there was a break between the two critical blocks, and the nine spider pictures were presented to reactivate priming of the spider concept. In all other respects, the 'spider' EAST was identical to the 'human' EAST. After the experiment, the participants completed a spider fear screening questionnaire (SAS, Rinck, Bundschuh, Engler, Müller, Wissmann, Ellwart, & Becker, 2002) to assess their degree of spider fear (see Appendix G). In a final task all participants rated the words presented in the experiment regarding their emotional valence on a five point scale reaching from 'very unpleasant' (-2) to 'very pleasant' (+2).

Results

Human Priming EAST. For further analyses, error rates of the colored test trials were evaluated. The error rates were uniformly low (mean 3.1%), so no further analyses were calculated for errors.

From the reaction times (RTs) for all ambiguous (colored) words, median RTs were computed, separately for trials on which an extrinsically positive response was required (pleasant key for positive black words) and for trials on which an extrinsically negative response was required (unpleasant key for negative black words). Analysis was computed to compare the reaction times of ambiguous words in relation to extrinsic positive and negative valence and to control for a possible effect of the counterbalanced assignment of the extrinsic valence keys to the colored keys (positive and blue key vs. negative and red key for Set 1; positive and red key versus negative and blue key for Set2). A 2x2 ANOVA with the between-subjects variable Key Assignment (Set 1 vs. Set 2) and the within-subjects variable Extrinsic Response Valence (positive vs. negative) did not yield a significant interaction between key assignments and valence ($F(1,50) = 2.75$, n.s.). More importantly, there was no main effect of extrinsic response valence ($F(1,50) = 1.05$, n.s.), showing that participants were not generally faster to give responses that were associated with either negative or positive valence. Separate analyses for reaction times of ambiguous situation words and feature words showed similar results (situations: $t(51) < 1$; features: $t(51) = 1.28$, n.s.). Table 4-1 shows reaction times of the ambiguous words regarding their assignment to extrinsically positive and negative keys.

Table 4-1. Human Priming: Mean reaction times in ms of ambiguous words regarding their assignment to extrinsically positive and negative keys (and Standard Deviations) in Experiment 6

words	**negative key**	**positive key**	**significance of negative-positive difference**
all words	648 (83)	658 (104)	n.s.
feature words	638 (94)	656 (112)	n.s.
situation words	658 (97)	660 (115)	n.s.

For further analyses, a performance index was generated for each participant by subtracting the mean reaction time of the extrinsically positive key from the mean reaction time of the extrinsically negative key. Thus, index scores below zero indicate faster responses associated with negative valence, and scores above zero indicate faster responses associated with positive valence. To examine the influence of spider fear on task performance in the human EAST, individual spider questionnaire scores were correlated with the performance index of all colored words (RT of extrinsically negative key minus RT of extrinsically positive key). However, there was no significant correlation between all colored words (features and situations) and fear scores ($r = .03$, n.s.), between feature words and fear scores ($r = -,006$, n.s.), or situation words and fear scores ($r = ,05$, n.s.). This indicates that participants with high spider-fear scores did not associate ambiguous target words with negative valence (negative index) in the human priming condition. Moreover, for further examinations two groups were created according to the participants' spider fear questionnaire scores (SAS, Rinck et al., 2002). Scores ranged from 0 (absolute no spider fear) to 24 (high spider phobic) with a mean of 9.44 (SD 7.27). Participants were divided into high versus low spider fear groups according to whether their scores were above or below the median of 9.0, leaving 26 participants in each group. A 2x2 ANOVA with the between-subjects variable Group (low fear vs. high fear) and the within-subjects variable Target Type (features vs. situations) did not yield a significant main effect Group ($F(1,50) = .10$, n.s.) indicating that high and low fearful participants did not differ in their EAST performance. Comparing the indices for feature and situation words there was no significant main effect Target Type ($F(1,50) = .70$, n.s.) and no significant interaction ($F(1,50) = .50$, n.s.). Separate analysis indicated no differences between the two groups regarding their associations between ambiguous feature or situation (situations: $t(50) < 1$, n.s.); features: t(50) < 1, n.s.). Mean reaction times of the two groups are displayed in Table 4-2. None of the indices was different from zero, indicating equally fast responses associated with negative and positive valence.

Table 4-2. Human Priming: Mean reaction time indices in ms (and Standard Deviations) of ambiguous words broken down by high vs. low spider fear in Experiment 6

index	**low spider fear**	**high spider fear**	**significance of low-high difference**
all words	-12.8 (76)	-6.7 (64)	n.s.
feature words	-27.5 (87)	-8.0 (112)	n.s.
situation words	1.81 (94)	-5.4 (97)	n.s.

Negative indices indicate stronger association with the negative key; positive indices indicate stronger association with the positive key. Indices marked with '*' are significantly different from zero with p < .05.

Spider Priming EAST. As in the first EAST experiment, RTs of the colored test trials were analyzed. Again, the error rates were uniformly low (mean 3.2%), and no further analyses were calculated for errors. As before, RTs for all ambiguous (colored) words were aggregated separately for trials in which an extrinsically positive response was required and for trials on which an extrinsically negative response was required.

Again, the 2x2 ANOVA with the between-subjects variable Key Assignment (Set 1 vs. Set 2) and the within-subjects variable Extrinsic Response Valence (positive vs. negative) did not yield a significant interaction between key assignment and valence (F(1,50) = 2.02, n.s.). For the colored words in general, there was no main effect of extrinsic response valence (F(1,50) < 1, n.s.), indicating that participants were not faster to give responses associated with negative or positive valence. A separate analysis of RTs for ambiguous situation words showed similar results (t(51) = 1.24, n.s.); however, there was a marginally significant difference for the feature words (t(51) = 1.72, p < .09), indicating marginally faster responses to feature words when they were associated with negative valence (see Table 4-3).

Table 4-3. Spider Priming: Mean reaction times in ms of ambiguous words regarding their assignment to extrinsically positive and negative keys (and Standard Deviations) in Experiment 6

words	**negative key**	**positive key**	**significance of negative-positive difference**
all words	621 (139)	627 (167)	n.s.
feature words	609 (153)	635 (219)	$p < .09$
situation words	633 (135)	620 (126)	n.s.

To examine the influence of spider fear on task performance in the spider EAST, individual spider questionnaire scores were correlated with the performance index of all colored words (RT of extrinsically negative key minus RT of extrinsically positive key). The result was a significant correlation of $r = -35$ ($p < .01$), indicating that participants with high spider fear associated the ambiguous target words with negative valence. Separate correlations between fear scores and performance scores for feature words versus situation words yielded a significant correlation for feature words ($r = - .31$, $p < .05$), but not for situation words ($r = - 21$, n.s.). Comparing the mean indices of the high and low spider fearful group (questionnaire scores above or below the median of 9.0), a 2x2 ANOVA with the between-subjects variable Group (low fear vs. high fear) and the within-subjects variable Target Type (features vs. situations) yielded a significant main effect Group ($F(1,50) = 7.29$, $p<.01$, $eta^2 = .13$) indicating that highly fearful participants responded faster with the negative key on ambiguous words (compared to low fearful participants). Generally, there was a more negative association for feature words displayed by a significant main effect Target Type ($F(1,50) = 5.29$, $p<.05$, $eta^2 = .10$). No interaction approached significance. Analyzing feature and situation words separately, there was a significant difference between high and low fearful participants for the feature words ($t(50) = 2.23$, $p < .05$), and a marginal difference for situation words ($t(50) = 1.73$, $p < .09$) . Moreover, the indices of highly fearful participants were significantly different from zero, indicating faster extrinsically negative responses, especially to feature words. Indices and significance levels are displayed in Table 4-4.

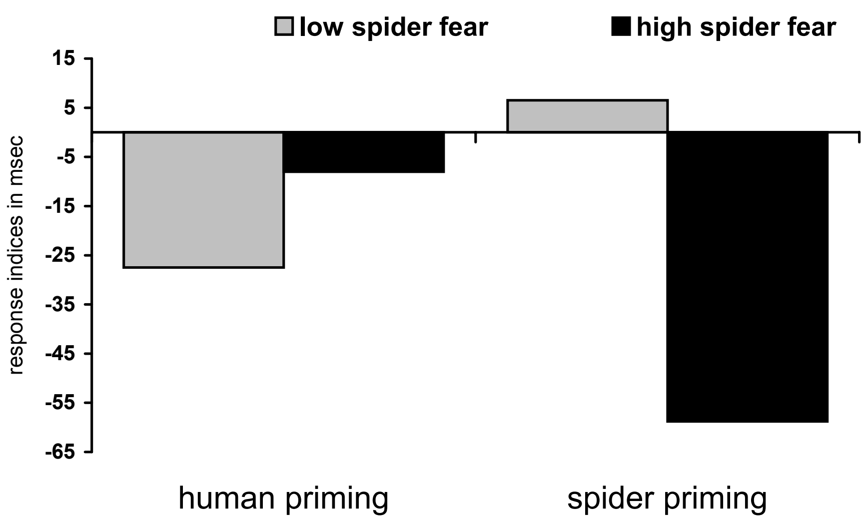
Table 4-4. Spider Priming: Mean reaction time indices in ms (and Standard Deviations) of ambiguous words broken down by high vs. low Spider Fear in Experiment 6

index	low spider fear	high spider fear	significance of low-high difference
all words	18.9 (57)	-31.8 * (77)	p < .01
feature words	6.5 (70)	-58.8 * (132)	p < .05
situation words	31.3 * (77)	-4.9 (73)	p < .09

Negative indices indicate stronger association with the negative key; positive indices indicate stronger association with the positive key. Indices marked with '*' are significantly different from zero with p < .05.

To analyze the differential influence of the two priming conditions on task performance of high vs. low spider fear groups, a 2x2 ANOVA was calculated with the between-subjects factor group (high vs. low spider fear), the within-subjects factor priming condition (human vs. spider priming), and performance indices as the dependent variable. This ANOVA yielded a significant interaction of priming condition and group ($F(1,50) = 6.31$, $p < .015$, $eta^2 = .11$), indicating that participants with high fear scores associated ambiguous target words with fear-related, negative valence if the spider concept was activated. Participants without fear of spiders showed no association of the ambiguous words with either positive or fear-related words.

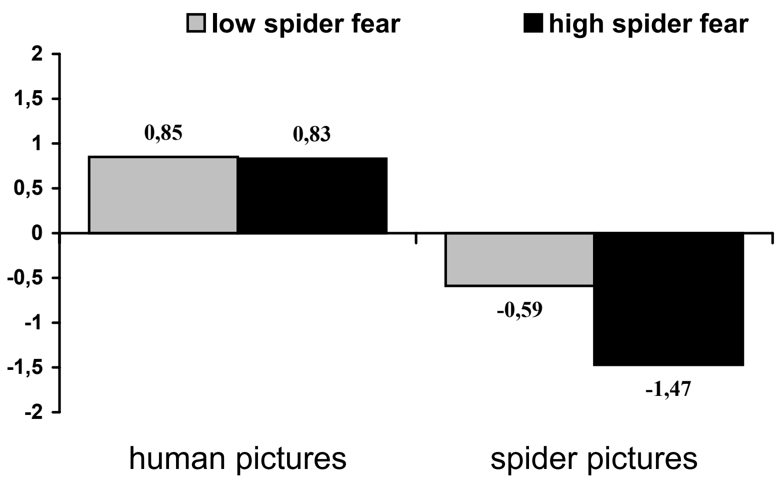
Figure 4-2. Interaction between priming condition and fear of spiders for feature words in Experiment 6



This interaction was also significant for feature words alone ($F(1,50) = 7.01$, $p < .011$, $eta^2 = .12$), but not for situation words ($F(1,50) = 1.15$, n.s.). The interaction between group and priming condition for feature words is displayed in Figure 4-2.

Concept Priming: Picture Ratings. For priming of the human concept, 9 pictures of the human category were rated by the participants before the EAST experiment. The mean ratings of high vs. low spider fearful participants indicated that these pictures were perceived as rather pleasant (mean: 0.84, SD: .44). For priming of the spider concept, nine spider pictures were rated by the participants. The mean ratings of both groups shown in Figure 4-3 indicated that these pictures were indeed perceived as rather unpleasant (mean: -1.03, SD: .68). Comparing high vs. low spider fearful participants, both groups evaluated spiders as rather unpleasant, but with a significant difference between the groups ($t(50) = 5.99$, $p < .001$). For participants with high fear scores, spider pictures were more unpleasant (mean: -1.5, SD: .40) than for participants with low fear scores (mean: -0.59, SD: .63)

Figure 4-3. Mean Ratings of human vs. spider pictures broken down by high vs. low spider fear in Experiment 6



Valence Ratings: -2 = 'very unpleasant', -1='unpleasant', 0=neutral, 1= 'pleasant', 2= 'very pleasant'

Word Ratings. All participants rated the presented word materials regarding their emotional valence. High and low spider fearful participants did not differ regarding their ratings of pleasant and unpleasant words. Surprisingly, the valence of situation and feature words was rated as rather 'neutral' by both groups after the experiment (see Table 4-5).

Table 4-5. Word Ratings: Mean valence ratings of word materials (and Standard Deviations) by high vs. low spider fearful participants in Experiment 6

	low spider fear	**high spider fear**	**significance of low-high difference**
pleasant words	1.71 (.39)	1.75 (.73)	n.s.
unpleasant words	- 1.61 (.40)	- 1.58 (.73)	n.s.
situation words	0.17 * (.37)	- 0.08 (.50)	p < .05
feature words	0.07 (.27)	- 0.17 (61)	n.s.

Ratings were given on a 5-point scale reaching from 'very unpleasant' (-2) to 'very pleasant' (+2). Indices marked with '*' are significantly different from zero with p < .05.

Discussion

The activation of different concepts (human vs. spider) before each EAST led to different associations between ambiguous stimuli and threat. Before the first EAST, a 'human' concept was activated, and results of the EAST indicated comparable performance for the extrinsically pleasant and unpleasant keys. Additionally, there were no differences between high spider fearful participants and low spider fearful participants. In this situation, the ambiguous target stimuli seemed to be rather neutral to all participants, and not associated with threat or fear. Before the second EAST, a 'spider' concept was activated, causing differences in the performance of high vs. low fearful participants. Participants with high scores in a spider fear questionnaire showed faster responses when the ambiguous stimuli were associated with the extrinsically unpleasant key, particularly when feature words were used. In contrast, no such difference was found for participants who did not fear spiders. Interestingly, all ambiguous words were evaluated as rather 'neutral' by both groups immediately after the experiment (word ratings, following the spider priming EAST). These results indicate that different context conditions may lead to differential activation of cognitive schemata in anxiety. In light of these findings, implicit threat associations towards special features of the feared object seem to be available only in a certain activated context. With regard to the 'neutral' explicit valence rating at the end of the experiments, one can assume that there is difference between automatic and indirect processes of evaluation tested through the EAST, and rather explicit and direct evaluations. This would relate to results by Mayer et al. (2000), who assessed the extent to which spider phobic and non-phobic participants experience fear reactions to spiders as automatic.

Compared to controls, phobic participants perceived their responses to spiders more often as automatic, and not under intentional control.

Employing the EAST, it was possible to assess associations between ambiguous target words and valence. Especially for cognitive structures that are not entirely available to consciousness and self-report, the indirect procedure of the EAST offers an alternative way of measurement. Like the IAT introduced by Greenwald et al. (1998), the EAST measures the strength of associations between a valence dimension (e.g., threatening vs. positive) and particular targets (e.g., feared stimuli, situations, physiological responses). Moreover, the EAST offers some important practical and methodological advantages. One limitation of the classical IAT is that it only offers measures of relative strength. The EAST, however, allows an absolute estimate of the association between a particular class of target stimuli and the valence dimension.

An additional benefit of the EAST is in the number of target concepts assessable in a single experiment. IATs compare two target concepts with regard to certain attributes. In contrast, the EAST allows an absolute assessment of associations with a single target concept, but also with two or even more concepts simultaneously (De Houwer, 2003). This feature offers promising applications for research on cognitive structures in emotional disorders. Since fear seems to be represented in memory in a multidimensional way, containing information diverse concepts such as situations, responses, and meaning (Lang, 1977, 1979; Lang et al., 1998), activation of these concepts may be tested in a single task. The present experiment differentiated between two target concepts (features vs. situations) and found strong fear--related associations for feature words in high spider fearfuls, but only when a spider concept was active.

Another useful application of the EAST is related to the categorization dimensions of target stimuli. For an IAT it is necessary that the classified stimuli accurately fit into one of the predetermined dimensions (e.g., pleasant vs. unpleasant). For the EAST, this is unnecessary because the relevant feature of the categorization task is color instead of valence. Thus, it is possible to use just about any group of target words for any participant, because the categorization dimension 'color' is unequivocal. This would be very useful for experiments in which it is otherwise impossible to create accurate classification dimensions for all participants. For instance, suppose that one wants to examine associations between angry versus smiling faces and threat versus acceptance in social phobia. In this case, the target materials might consist of social threat-related words versus positive words. It would be difficult to categorize the words according to the threat-acceptance dimension or the pleasant-unpleasant dimension because some words related to social phobia (e.g., heartbeat, audience, speech, observed) might be threatening to social phobics, but not to non-anxious controls. Using the EAST, however, it is possible to use about any disorder-related word because valence is not the relevant classification dimension in the task.

As mentioned above, results of the present experiment indicate that high anxious participants performed differently under activation of the 'human' concept compared to the 'spider' concept, although all participants conducted exactly the same EAST twice within one hour. With regard to the goals of this experiment, the results are very encouraging, indicating the crucial influence of context information as well as high sensibility of the EAST to measure changes in the activation of associative structures. These results also raise critical questions regarding the retest reliability of implicit measures and the debate whether they assess state or trait characteristics. If the measured implicit associations and their activation are easily affected by external information, retest reliability will suffer. Therefore, in each case, it should be made clear whether the interesting associations represent a state or trait construct, and how qualities of these associations such as activation level could change during tests. Association tests meant to tap traits must show stability over time, assuming that the associations to be measured are fairly constant.

The results of this experiment also have implications regarding clinical-therapeutic questions. Various clinical studies of treatment outcome have found that phobic patients profited most from exposure therapy (systematic desensitization, flooding) when physiological responses and reports of fear occur, indicating activation of a relevant cognitive structure (e.g., Borkovec & Sides, 1979; Watson & Marks, 1971). Foa and Kozak (1986) conclude that activated fear structures and incorporated incompatible information (incompatible with the pathological elements) are the two conditions required to reduce pathological fear. The context-dependent EAST performance of high and low fearful participants observed in this study provides empirical evidence for the assumption that fear relevant associations are not always activated, but that its activation depends on context information. Therefore, fear-relevant activation of cognitive structures seems to be necessary to access significant pathological elements in cognition. Moreover, differences in the fear network structures of high and low anxious participants emphasize the importance of cognitive changes in therapy. One goal of therapy is the disintegration of various conceptual relations between fear-related elements in memory (Foa & Kozak, 1986). As an example, response elements (e.g., 'to strike dead' or 'shock') and meaning elements (e.g., 'threatening', 'dangerous') should become disassociated from stimulus elements (e.g., 'to crawl' or 'cellar'). Changes in cognitive structures should lead to representations of lower harm and decreased negative valence towards the feared object in memory. Indeed, in this experiment low fearful participants did not show the threat associations, in contrast to participants with high fear scores. The present results indicate that the EAST introduced by De Houwer (2003) can be used as an experimental paradigm, suitable for the assessment of fear associations and their current activation level. Additional research will have to address the psychometric properties and fundamental processes of the EAST, showing if the EAST is a reliable and valid instrument. If future research validates the EAST, it could provide a useful method to investigate changes of the cognitive fear structure induced by therapy.

5. Conclusions

The aim of this dissertation was the adoption and application of an indirect measure of associations in clinical psychology, particular in spider phobia. The main focus was on the Implicit Association Test introduced by Greenwald et al. (1998) a paradigm that originates from social psychology and promises to tap into cognitive structures by measuring the strength of associations between certain concepts, without having to ask for a verbal report. With regard to this indirect performance-based approach I used the term of 'implicit associations' (which does not necessarily mean unconscious or unaware associations), clarifying the difference to traditional explicit measures like questionnaires or interviews.

In the following chapter I want to briefly summarize the results of the three studies reported in this dissertation, first Study 1 and 3 with a rather clinical perspective, secondly Study 2 that focused on methodological properties of the IAT. I want to complete this dissertation with conclusions that focus on theoretical and methodological aspects of the introduced measures, as well on advantages and limitations for clinical applications.

Investigating the usefulness and predictive potential of the IAT in spider phobia, Study 1 applied an IAT to assess implicit fear relevant associations and schemata and to predict anxious behavior. The question was, does the IAT offer information about maladaptive schemata that relate to automatic evaluations of the feared stimuli, in addition to controlled cognitive and behavioral aspects measured through interviews and questionnaires. Study 1 used a modified version of the IAT, which tested the strength of associations between spider targets and an attribute dimension consisting of fear-related and positive attributes. The IAT procedure assesses the strength of the association between the target concepts (spider vs. butterfly) and the attribute dimension by considering the latency with which participants can employ two response keys, when each has been assigned a dual meaning. If spiders and aversive words are highly associated, the IAT's sorting tasks will be easier when the two concepts share the same response than when they require different responses. Besides the spider targets the IAT needs a second target dimension, testing spider associations relative to the evaluations of butterflies. However, because attitudes toward butterflies did not vary between participants with high and low scores of spider fear, differences in IAT performance have its origin in different attitudes towards spiders. In Study 1, participants with high scores of spider fear had significantly higher IAT effects compared to non-fearful participants indicating much stronger fear relevant, implicit associations to spiders. Above these group differences, the IAT correlated with behavior during confrontation or questionnaire scores, and predicted avoidance behavior beyond the predictions of explicit direct measures. Interestingly, despite these group differences, non-fearful controls, who explicitly negate fear associations towards spiders, seem to possess implicit negative associations toward spiders. This was examined, comparing nonfearful participants with spider enthusiasts. Because spider enthusiasts assumingly lack all negative fear-related associations towards spiders, these participants served as an experimental baseline group and displayed a balanced performance in the compatible and incompatible IAT tasks (no IAT effect), expressing comparable implicit associations towards spiders and butterflies. This leads to the assumption that even non-fearful participants aversively associate spiders on an automatic, performance-based manner, as conceptual approaches of independent and automatic fear reaction would predict (LeDoux & Phelps, 2000; Mayer et al., 2000).

A further clinical perspective was examined in Study 3. Here the question was, how do different context conditions lead to differential activation of cognitive schemata in anxiety? Because the IAT measures the relative strength of associations in respect to two target concepts (e.g., spiders vs. butterflies), Study 3 applied the Extrinsic Affective Simon Task (EAST) a method that measures the strength of associations between a valence dimension (e.g., threatening vs. positive) and particular targets (e.g., feared stimuli, situations, physiological responses) in absolute terms (compared to the relative nature of the IAT). Different from Study 1, the question of interest did not concern spider - fear associations, but whether it is possible to selectively activate different context conditions, such that ambiguous stimuli are associated with fear when related to spiders, but not when related to humans. The ambiguous stimuli represented features and situations that would fit into a hypothetical fear network, as well into a network representing concepts of humans. To assess the effect of context information on associations, the EAST was conducted twice. In the first EAST, a rather pleasant 'human' concept was activated directly before performing the EAST, whereas a 'spider' concept was activated directly before the second EAST. Assessing these associations with an EAST paradigm, results indicated that activation of different concepts (human vs. spider) before each EAST lead to different associations between ambiguous stimuli and threat. In an activated 'human' concept EAST performance of all participants displayed no associations of threat or fear in relation to the ambiguous target stimuli (feature and situation words). However, an activated 'spider' concept caused differences in the performance of high vs. low fearful participants. Participants with high scores in a spider fear questionnaire showed stronger associations between the feature and situational stimuli and unpleasant, fear-related words. In contrast, this was not found for participants who did not fear spiders. The context-dependent EAST performance of high and low fearful participants observed in this Study 3 provides empirical evidence for the assumption that fear relevant associations are not always activated, but that implicit threat associations towards special features of the feared object seem to be available only in a certain activated context. Therefore, fear-relevant activation of cognitive structures seems to be necessary to access significant pathological elements in cognition.

The methodological focus in this dissertation concerned some of the mechanisms that underlie and drive the IAT. In this respect the influence of explicit category labels on IAT performance was investigated. In the original IAT, the associations to be measured are completely explicit to the participants, because they are presented as category labels as a part of the instruction. Therefore, the explicit attribute dimension of the IAT (e.g., pleasant vs. unpleasant) was masked by a rather neutral, non-related dimension of language (English words vs. German words) and letter type (lower case words vs. upper case words). Nevertheless, emotional valence of the words did affect task performance, interfering with picture categorization in the incompatible task. Emotional valence of the words was activated, creating significant IAT effects for pictures in both the Language IAT and the Surface IAT. For the Surface IAT, however, it is most notable because the simple categorization according to letter type does not require semantic processing at all. Experiment 5 demonstrated that emotional valence of single exemplars (the attributes words) is activated in a task in which participants are effectively discouraged from using valence as a criterion for their decisions. Instead, the results indicate that they used the neutral and perceptual categorization dimension for categorizing attribute words.

5.1 Clinical Conclusions

Looking at the wide range of results introduced in this dissertation one can ask the question about benefits, advantages and conclusions arising for the use of IAT and EAST measures in the field of clinical psychology.

Indirect measures and the prediction of behavior

I want to start with an frequent question regarding the usefulness of IAT and EAST measures: 'What can these paradigms detect that we can't measure with traditional instruments like questionnaires and interviews?' It was often stated that the results of the IAT in Study 1 just mirror the pattern one could find using a questionnaire. Moreover, in the prediction of behavior (e.g., avoidance, etc.) questionnaires do a much better job than the IAT would do This is indicated, for example, by the high correlations between questionnaire fear scores and behavior in Experiment 1 (r = .82) compared to the much smaller correlation between IAT scores and behavior (r = .40). So why should one use indirect measures in psychopathology or other fields and what are the criterions to mark tasks like the IAT as useful for clinical applications? I have selected a tough criterion: Indirect measures have to predict behavior that cannot be predicted by other measures. Is this true for the IAT and EAST in clinical psychology?

Research using indirect measures in clinical psychology stems from its beginning, That is clearly shown by less than ten studies using IAT and IAT-related measures in a clinical context (e.g., Gemar, et al., 2001; de Jong et a., 2001; Teachman, et al., 2001; de Jong, 2002; Teachman & Woody, 2003; de Jong, et al., 2003; Ellwart, Becker, & Rinck, 2003; Ellwart, Rinck, & Becker, 2003). Thus it is premature to pass final judgement about the benefits and advantages of these measures. However, one has to ask the question about the behavior IAT researchers want to predict? Looking at Study 1 the critical behavior was avoidance of spiders assessed by the time and spatial distance when approaching a spider. But this is exactly the behavior questionnaires ask about (e.g., 'When I would see a spider in this room, I would leave the place immediately.'). It is no surprise that questionnaires are highly correlated with behavior they explicitly ask for, compared to the moderate correlations with indirect IAT scores. However, the attempt of Study 1 to validate IAT measures with real observable behavior is a reasonable path, which is not often used in IAT studies so far. Most studies validate their scores on questionnaires or just take them as granted. Nevertheless, these quite promising correlations with clinically relevant behavior should lead the focus to different aspects of fear-related behavior that are hardly predictable by questionnaires and interviews.

First, as pointed out in chapter 1.2.2 it appears as if automatic and uncontrollable expressions of fear associations represent important additional information about cognitive characteristics of phobia. For example, there seems to be a partial dissociation between rational and automatic cognitive processes in people suffering simple phobias (Williams et al., 1997). People with phobias often believe that there is no reason to be frightened of their phobic object like spiders and consequently feel that their phobia is stupid and irrational. Nevertheless, in the presence of phobic objects they automatically become frightened and experience little intentional control over the reaction to spiders. This makes clear that behavioral self -reports will not be able to evaluate all cognitive components of anxiety.

Second, from social psychology comes theoretical and empirical evidence that the discrimination between spontaneous/automatic aspects and controlled aspects of behavior is useful. As an example, the MODE model of attitude-behavior relations (Fazio, 1990, Fazio & Towles-Swenn, 1999) postulates that implicitly measured attitudes predict spontaneous or highly automatized behavior better than controlled behavior, whereas explicitly measured attitudes predict controlled better than spontaneous or automatized behavior. Empirical evidence comes from a study by Asendorpf, et al. (2002). They applied an IAT to predict shy behavior using explicit self-ratings and implicit IAT scores. Results indicate that the IAT correlated moderately with the explicit self-ratings and uniquely predicted spontaneous (but not controlled) shy behavior, whereas the explicit ratings uniquely predicted controlled (but not spontaneous) shy behavior (double dissociation). Following these indications, future clinical research should also focus on those kinds of spontaneous or automatic behavior (e.g., physiological arousal, uncontrollable stressful behavior) that is not predictable by self reports, because relevant cognitions might be unavailable to introspection and verbal descriptions (e.g., de Jong, et al., 2001; Dovidio & Fazio, 1992).

Besides the prediction of automatic and uncontrollable behavior, indirect measures could represent additional information about cognitive characteristics in anxiety that might complement explicit reports when trying to predict fear-related behavior. In this respect, research on indirect measures in clinical psychology should not exclude traditional tasks such as questionnaires or interviews from the diagnostic process. The attempt should rather be to investigate whether implicit and explicit measures each explain unique variance in phobic behavior, or if implicit fear associations uniquely predict relevant behavior beyond standard questionnaires and diagnosis. Moreover, implicit associations could be of great interest when the clinical question involves aspects that are susceptible to deception and self-presentation strategies, or if it is difficult to verbalize mental processes without the risk of demands, distortions, and attributional biases.

Implicit association and cognitive representations in anxiety

Using IATs and EAST paradigms that reflected simple associations in spider phobia, this study represents one potential strategy for assessing fear schemata or cognitive structures. In chapter 1.1 of the introduction I described important influences of cognitive representations for the etiology and maintenance of anxiety disorders (e.g., Beck et al., 1985; Lang et al., 1998). Using implicit association measures like IAT and EAST I argued that these measures help to analyze and evaluate maladaptive schemata with regard to automatic and uncontrollable expressions of fear associations. I recognize, however, that it is not possible to conclude with certainty that IAT and EAST capture those cognitive structures or schematic functioning. Nevertheless, I feel confident that the paradigms reflect basic fear associations in memory and thus correspond to many of the critical features ascribed to schemata. Although it is claimed that indirect measures like IAT and EAST directly tap into cognitive structures by measuring the strength of associations between certain concepts, it remains unclear whether these implicit associations should be labeled schemata or whether they simply refer to an automatic processing bias. This issue might be of theoretically interest, but it should be of minor importance, because the results support the value of cognitive processing in explaining clinical phenomena. Clinical research should focus on the usefulness of indirect measures to gain information about the cognitive characteristics in anxiety and other disorders, to apply these methods for diagnostics, or even for therapeutic questions.

Indirect measures in psychotherapy

Given that the possible range of implicit spider associations varies from fear to pleasure, it is worthwhile to think about the possible implications for therapy of spider phobia. Following the prediction of cognitive models of anxiety disorders that cognitive schemata should change over the course of treatment, indirect measures could offer one possibility to monitor such changes. Teachman and Woody (2003) were able to demonstrate changes of implicit fear associations in spider phobia with successful exposure therapy, down to the baseline level of control participants indicating that implicit associations are sensitive to treatment. One can hypothesize that individuals who do not show reduced implicit fear associations following treatment (but do show changes in other measures, such as self report) will be at risk for return or relapse Their automatic fear association could render them more vulnerable to anxiety and avoidance when unexpectedly faced with the stimulus (Teachman & Woody, 2003). However, the results indicate that it seems possible to change important aspects of schemata over the course therapy involving gradual *in vivo* exposure and elements of cognitive restructuring. Moreover, IAT results observed with spider enthusiasts in Study 1 suggest that it might even be possible to eliminate fear-related implicit associations altogether. If therapeutic techniques were able to change automatic spider associations in such fundamental ways, consequential risk of relapse after successful CBT might be greatly reduced.

Indirect measures and the influence of context

As indicated by the results of Study 3 and several IAT studies in social psychology, implicit associations are malleable through contextual variations (for an overview, see chapter 1.3.3-4; Blair, 2002). In Study 3 ambiguous verbal stimuli were associated with fear depending on participants fear scores and the information (fear-related pictures or positive pictures) presented before the indirect measurement. In light of these findings, implicit threat associations towards special features of the feared object seem to be available only in a certain activated context. These results have implications regarding clinical-therapeutic and methodological questions.

As studies of treatment outcome have found, phobic patients profited most from exposure therapy (systematic desensitization, flooding) when physiological responses and reports of fear occur, indicating activation of a relevant cognitive structure (e.g., Borkovec & Sides, 1979; Watson & Marks, 1971). In this respect Foa and Kozak (1986) conclude that activated fear structures and incorporated incompatible information (incompatible with the pathological elements) are the two conditions required to reduce pathological fear. The different performance of participants with high and low fear observed in Study 3 provides empirical evidence for the assumption that fear-relevant associations are not always activated, but that their activation depends on context information. One can conclude that the activation of fear-relevant structures may not only be important in the case of treatment and cognitive restructuring, but also for a successful assessment of significant pathological elements in cognition.

The activation of specific disorder-relevant context information may also be important for researchers wanting to investigate implicit associations or maladaptive schemata in various types of disorders like social phobia, generalized anxiety disorders, or depression. Depending on the experimental question, one has to decide which target and attributes are suitable for the investigation. In assessing fear associations in spider phobia, it was obvious to take spider pictures as target stimuli (Study 1). First, these pictures are ecologically relevant for those with spider phobia and second, pictures have privileged access to semantic memory for categories (Glaser, 1992; Seifert, 1997). Both aspects benefit a fast and easy activation of the specific fear concept. However, visual confrontation with disorder-related pictures may not always be possible. Additionally, the selection of targets depends on the questions asked. This could lead to an insufficient activation of the cognitive structures of interest with unintended effects on indirect measures and finally incorrect interpretations of the results. I want to point out that verbal target stimuli surely are eminently suitable for IAT and EAST research. Nonetheless, using verbal or picture stimuli, one has to be sure that the relevant concept is activated before conducting an IAT or EAST experiment.

Moreover, the degree of contextual dependence of an evaluation will determine the stability and retest-reliability of measurements across context. Just as there is sometimes low reliability in explicit measures of associations across time due to its underlying constructive nature, an automatic evaluation will be similarly bound by contextual factors. This could be important for successive measurements, for example to demonstrate changes of implicit fear associations in therapy. To compare indirect measurements before and after therapy one has to ensure that both tests are conducted under equal contextual conditions. Neglecting the influence of context information could lead to misinterpretations about treatment effects and the success of therapy.

5.2 Methodological Conclusions

In all experiments of this dissertation I have referred to methodological aspects that are of great interest for the use and understanding of IAT and EAST in psychological research. In the following chapter I want to point out several issues and problems to pay attention to when planning to use IAT and IAT-related instruments.

Explicit or masked category labels

Study 2 investigated the influence of explicit category labels on IAT performance. Results indicated that IAT effects will increase when the dimension of interest is explicitly labeled as a part of the instruction. In such a design, the categories relevant for categorization (e.g., left key = pleasant words and spider vs. right key = unpleasant words and butterflies) mirror the associations the IAT is interested in. Alternatively it is possible, to mask one of these dimension (e.g., attributes) by a neutral and not relevant category (e.g., letter type, color). IAT effects in such a design will decrease because the irrelevant feature of the individual stimuli (e.g., valence of the single word) has to influence task performance. In this dissertation Study 2 applied a masked IAT to investigate whether single stimulus valence still influences IAT effects. The EAST used in Study 3 based on a similar principle. Here, target stimuli are presented in two different colors, one color referring to a positive valence key, the second color to the negative key. In both experiments individual target valence was the irrelevant feature and lead to facilitated performance when the key assignment was congruent with individual associations. However, performance differences between incongruent and congruent conditions (IAT or EAST effects) are less stable and significant for the masked IAT and the EAST. This could be one of the reasons why there is almost no published literature about successful applications of these measures. Moreover, several experiments in our lab support the conclusion that masking of relevant IAT dimensions (target and attribute dimension) will lead to an insufficient activation and influence of individual stimulus valence and hence reduce the IAT effects. Finally, when both target and attribute dimensions are masked by a surface feature like letter type, no response time differences will occur between the compatible and incompatible task. It seems that activation of the irrelevant feature (valence) also depends on the degree of masking.

As pointed out in the discussion of Study 2 a perfect confounding between category concept and stimulus valence (as in all unmasked IATs) may lead to the adoption of a different strategy in the compatible task, then in the incompatible one (see Task-Switch-Neglect Model, Mierke & Klauer (2001)). Masking the concept categories represents an alternative to prevent strategic factors that might underlie IAT effects and introduces a possibility to assess associations induced by the individual stimuli.

Nonetheless, when researchers look for the effects of individual stimulus valence masked IAT versions may be very helpful. I would also recommend a masked IAT or an EAST when it is difficult to use the attribute dimension of interest.

At times, associations between stimuli can not be classified according to an unambiguous valence dimension (for example, for some participants the stimulus indicates something threatening, but this is not true for all participants) EAST and masked IAT, however, make it possible to use just about any group of words for any participant because the categorization dimension may be perfectly unequivocal.

Whenever it is desirable to label valence dimensions explicitly, researchers should focus on the relevant and wanted semantic category and use this category as label. Threat-relevant words of the attribute dimension in Study 1 were categorized according their pleasant and unpleasant valence. Although results by Steffens and Plewe (2001) clearly demonstrate that IAT effects depend heavily on the valence of the attribute exemplar, one can not assume that IAT effects are solely driven by the fear-related valence of each unpleasant attribute, but also by the valence of the category. To prevent these problems in future studies I recommend the use of explicit labels that clearly refer to the wanted semantic categories. For example, if the aim of the study is to measure target associations towards disgust and appeal, one should use 'disgust' and 'appeal' as semantic category label. Teachman et al. (2001) successfully applied four IAT assessing the associations between the targets 'spider vs. snake' and the attribute dimensions of 'bad vs. good', ‘afraid vs. unafraid', ‘danger vs. safety', and ‘disgusting vs. appealing'. Results demonstrated that associations tested by the two fear-related IAT tasks (afraid-unafraid, danger-safety) capture individual differences above and beyond the simple effects of the 'bad-good' IAT task.

Variants of IAT design and data analysis

Despite the promising results of IAT research in recent years it remains unresolved what IAT design one should choose. The original IAT introduced by Greenwald et al. (1998) involved 5 steps ((a) target discrimination, (b) attribute discrimination, (c) first combined task, (d) reversed target discrimination, and (e) reversed combined task). Each category consisted of 25 stimulus words. Each category in set (a), (b), and (d) consisted of 100 trials. Combined tasks consisted of a practice block (50 trials) and 150 trials for data collection, which represents a total of 700 trials in one IAT. Analyzing IAT literature published so far, there are numerous variants of different IAT designs reported. Although most researchers focus on the 5-step procedure introduced by Greenwald et al. (1998), there are several short versions with only two combined tasks (e.g., Teachman et al., 2001; Teachman & Woody, 2003; Experiment 2, 3, 4, & 5 in this dissertation). IATs consisting of 4 steps were used by de Jong et al(2003). Large variance is also found in the number of trials presented in the critical tasks of the IAT. Some featured large numbers of critical trials (about 150 combined data trials; Greenwald et al., 1998; Experiment 1 - 5 in this dissertation). Others had medium numbers of about 60 combined data trials (e.g., Eggloff & Schmukle, 2002), while some had very low numbers of about 36 data trials (e.g., Teachman et al., 2001; Teachman & Woody, 2003). Although all of these IATs are based on the same principal comparing response latencies of a compatible and an incompatible task, these different designs make it extremely difficult to compare the results of different studies. As results of Study 1 indicate, the short version of the IAT in Experiment 2 was not able to differentiate between individuals with high and low fear as in the long version of Experiment 1. However, the short version was sensitive to large differences between groups (e.g., between enthusiasts and nonfearful controls). At the present point there is no standard and recommended IAT design. Nosek, Greenwald, and Banaji (2003) discuss some methodological issues and properties of the IAT in a recent paper, including analytic methods, optimal number of stimulus items per category, influence of individual stimulus vs. category valence, task order effects. Unfortunately, these indications are based on studies that used large datasets from demonstration Web sites, making it difficult to generalize the reported results.

Similar to the various IAT designs there are numerous ways of analyzing the data of IAT experiments. Greenwald et al. (1998) eliminated outliers by counting response latencies less than 300 ms or greater than 3,000 ms as errors and recode these responses as 300 or 3,000 ms and log transforms the response times. Although this strategy is often used in IAT research it contains some methodological problems (e.g., increasing frequencies at both ends of the distribution). Greenwald et al. (2003) recommended a new appropriate strategy of data reduction and analysis depending on the correlation between the IAT effect with its parallel explicit measure for the entire sample, with average latency for the subsample of self-characterized strong supporters for each target. Besides that, there are several alternative methods to analyze IAT data (see Footnote 3 in Experiment 1 or Greenwald et al., 2003), but unfortunately, no strategy is generally recommended. From a methodological viewpoint, the results of this dissertation show that it is useful to analyze and report IAT effects separately for pictures and word stimuli. As results of Experiment 1 showed, IAT effects with verbal attribute stimuli differentiated between participants with spider fear and controls, whereas target pictures did not. On the other hand, in the masked versions of the IAT (Experiment 4 & 5) IAT effects for target pictures revealed larger effects. I suggest that researchers routinely analyze and report IAT effects separately for targets and attributes. Otherwise, important differences might be obscured by reporting only IAT effects, averaged across all materials.

Because of these different design and analysis strategies, I conclude that it is most important for future research to achieve comparable results within different experimental studies. This requires a standardized application and analysis strategy for the relevant studies. Using indirect measures as instruments for diagnostic purpose, researchers should focus on psychometric properties, such as different types of validity and reliability. Without these strict norms it is unlikely that indirect measures become reliable measures that are able to predict criterion variables such as fearful behavior.

From relative to absolute - new variants of indirect measures

One of the major disadvantages of the Implicit Association Test is the fact that results will only provide information about the relative strength of associations. Although some researchers have tried analyses of subsets of IAT trials to obtain separate evaluations of two target concepts in the IAT (e.g., de Jong et al., 2003), it is unclear whether the parameters of the IAT allow any meaningful breakdown of two concepts as if they represented independent concepts. Nosek et al. (2003) demonstrated that the relative nature of the IATs procedural format cannot be undone via analytic methods. Even when trials of only one concept are the focus of analysis, the IAT remains a relative measure of association strengths. This result supports the importance of selecting the appropriate comparison category in the IAT. In this dissertation I choose butterflies as a second target category, because different IAT effects between individuals with phobias and controls may certainly be due to different attitudes towards spiders if evaluations of the second target are comparable in both groups. Beyond this group comparison, however, interpretation of IAT effects is more problematic because of the relative nature of the IAT. Other alternatives for the second target category are the selection of a random, neutral, or irrelevant comparison, although this may not fulfill researchers' expectations for measuring an independent association for their target concept of interest. Researchers interested in assessing associations with a single target concept could use several new methods designed for that purpose.

Nosek and Banaji (2001) have introduced the Go/No-go Association Task (GNAT) as a variant of the IAT. Different to the two target categories of the IAT the GNAT does not require the use of a second category. In one condition, the GNAT requires the same response - "go" (press the space bar) - to items that belong to instances of a category (e.g., flower) and a particular evaluative attribute (e.g., good). No response "no-go" (do not press any key) is called for when items appear that do not belong to the target category and attribute. A second condition requires simultaneous identification of stimuli that represent the same target category and an alternative attribute (bad). The difference in accuracy and reaction times between these conditions is taken as a measure of automatic attitude or associations assuming that performance is facilitated when targets and attributes are highly associated.

Wigboldus et al. (2001) introduced an alternative to the original IAT that does allow for absolute judgments. In this Single Target IAT (STIAT), the associations between one single target category and the two poles of the evaluative dimension are measured independently. Similar to the relative IAT participants categorize presented attributes according to a given valence dimension (e.g., left key = positive words vs. right key = negative words). Different to the relative IAT is that there is only on target category introduced for the two combined tasks (e.g., spider), which would switch from the left response in the first combined task to the right response key in the second combined task. For the example above, in the compatible task spiders and positive words are assigned on the left key vs. negative words on the other key, compared to the incompatible task, when positive words are assigned to the left key vs. spiders and negative words on the left key. Comparing the target responses of the incompatible and compatible task, the STIAT measures the association between the concept spider and valence in an absolute way.

The third IAT-related paradigm is the Extrinsic Affective Simon Task (EAST, De Houwer, 2003) that I already introduced in Study 3 of this dissertation. The EAST is based on a comparison of performance on trials within a single critical task rather than on a comparison of performance on different tasks. In an EAST, participants classify uncolored attribute words on the basis of stimulus valence (positive vs. negative) and colored target words on the basis of color (e.g., green vs. blue). In the critical task targets are presented either in the color that is assigned to the positive key, or in the color that is assigned to the negative key. Performance for targets is superior on those trials where the color of the target is compatible with the extrinsic valence of the response key.

Because the three variants have been developed only recently, little is known about their validity. However, with the results of Study 3 there is positive evidence about a successful application of the EAST. Additional research will have to address the psychometric properties and fundamental processes of the EAST, GNAT, and STIAT, showing that these measures are reliable and valid instruments. Nevertheless, because IAT effects reflect the relative strength of associations, I recommend paradigms such as the GNAT, STIAT, or EAST for researchers that want to assess the strength of single associations.

5.3 Final Conclusions

The intent of this dissertation was the adoption and application of indirect measures of associations in spider phobia. The advantage of indirect measures, like IAT and EAST, is the performance based approach on specific associative structures without having to ask the participant for a verbal report. Because of the assumption that these paradigms also refer to automatic and uncontrollable aspects of fear associations, this research might represent important additional information about cognitive characteristics of spider phobia, and related disorders that fit into the etiological concept of preparedness.

With the introduction of spider enthusiasts as a third experimental group, a new methodological feature of masked category labels, and a first clinically-related application of the EAST the studies presented here aimed for an innovative contribution to the current state of knowledge in this field of research. The results of this paper lead to the conclusion that the performance-based methodology of the IAT and EAST is sensitive to the strength of fear relevant implicit associations and able to predict anxious behavior, partly beyond the predictions of direct measures such as questionnaires.

However, despite the copious activity, research concerning these measures has been methodological, empirically-driven, but surprisingly a-theoretical. Moreover, several methodological aspects of the IAT and the EAST remain unresolved and unexplained, as it concerns the underlying mechanisms, the effects of context, or the role of awareness.

Currently, the use of indirect measures in clinical psychology is still at its beginning, and it requires intensive methodological and theoretical efforts. In the long run, implicit aspects of fear associations may be useful for possible implications in psychopathology, such as the prediction of treatment outcome and the likelihood of relapse after therapy, or for the identification of cognitive factors of vulnerability. Moreover, indirect measures may provide important theoretical insights about the effects of schema and maladaptive cognitive structures in anxiety disorders.

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7. Appendix

Appendix A. Stimulus Words Used in Experiment 1, Evaluation by Spider Phobic and Control Participants

German words	English translation	Mean Valence Spider Phobics	Mean Valence Controls	
Genuss	pleasure	1.83 (.387)	1.63 (.50)	(t(46) = 1.64, n.s.)
Begeisterung	exaltation	1.75 (.44)	1.75 (.44)	(t(46) = .00, n.s.)
Vergnuegen	amusement	1.79 (.42)	1.67 (.48)	(t(46) = .96, n.s.)
glücklich	happy	1.88 (.34)	1.75 (.44)	(t(46) = 1.1, n.s.)
Zufriedenheit	contentment	1.50 (.59)	1.33 (.57)	(t(46) = 1.00, n.s.)
Froehlichkeit	happiness	1.64 (.49)	1.71 (.46)	(t(46) = .31, n.s.)
erholen	to recreate	1.54 (.59)	1.29 (.63)	(t(46) = 1.63, n.s.)
unbeschwert	easygoing	1.17 (.57)	1.25 (.74)	(t(46) = .44, n.s.)
Urlaub	vacation	1.42 (.65)	1.50 (.65)	(t(46) = .25, n.s.)
Jubel	exultation	1.54 (.59)	1.50 (.66)	(t(46) = .23, n.s.)
	mean - pleasant	**1.61 (.24)**	**1.53 (.28)**	**(t(46) = .91, n.s.)**
Panik	panic	-1.79 (.42)	-1.79 (.42)	(t(46) = .00, n.s.)
Furcht	fear	-1.58 (.50)	-1.50 (.51)	(t(46) = .57, n.s.)
quaelen	to torment	-1.83 (.38)	-1.92 (.28)	(t(46) = .86, n.s.)
Schock	shock	-1.58 (.58)	-1.67 (.48)	(t(46) = .54, n.s.)
Todesangst	mortal fear	-1.92 (.28)	-2.00 (.00)	(t(46) = 1.45, n.s.)
Entsetzen	horrify	-1.67 (.57)	-1.54 (.51)	(t(46) = .81, n.s.)
Angstanfall	panic attack	-1.92 (.28)	-1.79 (.42)	(t(46) = .01, n.s.)
bedrohlich	threateningly	-1.38 (.50)	-1.42 (.59)	(t(46) = .18, n.s.)
gefaehrlich	dangerously	-1.33 (.48)	-1.33 (.64)	(t(46) = .00, n.s.)
Angstschweiss	cold sweat	-1.67 (.57)	-1.50 (.66)	(t(46) = .89, n.s.)
	mean - unpleasant	**-1.67 (.24)**	**-1.65 (.26)**	**(t(46) = .55, n.s.)**

Ratings: -2 = "very unpleasant", -1="unpleasant", 0=neutral, 1= "pleasant", 2= "very pleasant"

Appendix B. Mean ratings of target stimuli regarding emotional valence, magnitude of disgust, and threatening potential (with Standard Deviations) in Experiment 1

	Spider Phobic	Control	
Spider Pictures			
Valence	-1.66 (68)	-.29 (.73)	($t(24) = 6.75$, $p < .001$)
Disgust	4.67 (.32)	2.02 (.90)	($t(46) = 13.6$, $p < .001$)
Threat	4.50 (.73)	1.78 (.80)	($t(46) = 12.4$, $p < .001$)
Butterfly Pictures			
Valence	1.29 (.79)	1.13 (.76)	($t(24) = .69$, n.s.)
Disgust	1.13 (.28)	1.05 (.14)	($t(24) = 1.22$, n.s.)
Threat	1.14 (.23)	1.05 (.14)	($t(24) = 1.58$, n.s.)

Valence Ratings: -2 = "very unpleasant", -1="unpleasant", 0=neutral, 1= "pleasant", 2= "very pleasant"
Disgust and Threat: 1 = "very low", 2 = "low", 3 = "medium", 4 = "high", 5 = "very high"

Appendix C. Stimulus Words Used in Experiment 2, Evaluation by Spider Phobic and Control Participants

German words	English translation	Mean Valuation spider phobics	Mean Valuation Controls	
Genuss	pleasure	1.70 (.47)	1.88 (.34)	(t(45) = 1.5, n.s.)
Begeisterung	exaltation	1.61 (.66)	1.63 (.58)	(t(45) = .09, n.s.)
Vergnuegen	amusement	1.61 (.50)	1.58 (.50)	(t(45) = .17, n.s.)
glücklich	happy	1.70 (.47)	1.79 (.42)	(t(45) = .74, n.s.)
Zufriedenheit	contentment	1.35 (.57)	1.38 (.58)	(t(45) = .16, n.s.)
Froehlichkeit	happiness	1.35 (.57)	1.42 (.50)	(t(45) = .43, n.s.)
erholen	to recreate	1.30 (.56)	1.17 (.56)	(t(45) = .84, n.s.)
unbeschwert	easygoing	1.09 (.67)	1.04 (.69)	(t(45) = .23, n.s.)
Urlaub	vacation	1.57 (.51)	1.42 (.65)	(t(45) = .87, n.s.)
Jubel	exultation	1.35 (.65)	1.54 (.51)	(t(45) = 1.14, n.s.)
	mean - pleasant	**1.46 (.28)**	**1.48 (.28)**	**(t(45) = .28, n.s.)**
Panik	panic	-1.91 (.28)	-1.79 (.42)	(t(45) = 1.16, n.s.)
Furcht	fear	-1.52 (.59)	-1.21 (.51)	(t(45) = 1.95, n.s.)
quaelen	to torment	-1.87 (.46)	-1.79 (.59)	(t(45) = .51, n.s.)
Schock	shock	-1.52 (.59)	-1.63 (.65)	(t(45) = .75, n.s.)
Todesangst	mortal fear	-1.91 (.29)	-2.00 (.00)	(t(45) = 1.48, n.s.)
Entsetzen	horrify	-1.39 (.66)	-1.46 (.51)	(t(45) = .39, n.s.)
Angstanfall	panic attack	-1.70 (.47)	-1.83 (.38)	(t(45) = 1.11, n.s.)
bedrohlich	threateningly	-1.57 (.51)	-1.46 (.51)	(t(45) = .72, n.s.)
gefaehrlich	dangerously	-1.43 (.59)	-1.25 (.53)	(t(45) = 1.13, n.s.)
Angstschweiss	cold sweat	-1.74 (.54)	-1.67 (.48)	(t(45) = .49, n.s.)
	mean - unpleasant	**-1.66 (.24)**	**-1.61 (.21)**	**(t(45) = .73, n.s.)**

Ratings: -2 = "very unpleasant", -1="unpleasant", 0=neutral, 1= "pleasant", 2= "very pleasant"

Appendix D. Mean ratings of target stimuli regarding emotional valence, magnitude of disgust, and threatening potential (with Standard Deviations) in Experiment 2

	Spider Phobic	**Control**	
Spider Pictures			
valence	-1.54 (1.03)	-.19 (.54)	(t(24) = 5.58, p < .001)
disgust	4.84 (.22)	2.08 (.71)	(t(46) = 18.54, p < .001)
threat	4.49 (.38)	1.55 (.61)	(t(46) = 19.75, p < .001)
Butterfly Pictures			
valence	1.33 (.91)	1.50 (.41)	(t(24) = .83, n.s.)
disgust	1.28 (.44)	1.10 (.25)	(t(24) = 1.72, n.s.)
threat	1.20 (.37)	1.05 (.25)	(t(24) = 1.62, n.s.)

Valence Ratings: -2 = "very unpleasant", -1="unpleasant", 0=neutral, 1= "pleasant", 2= "very pleasant"
Disgust and Threat: 1 = "very low", 2 = "low", 3 = "medium", 4 = "high", 5 = "very high"

Appendix E. Stimulus Words Used in Experiment 3, Evaluation by Spider Lovers and Control Participants

German words	English translation	Mean Valuation Spider Lovers	Mean Valuation Controls	
Genuss	pleasure	1.89 (.33)	1.78 (.44)	(t(16) = .60, n.s.)
Begeisterung	exaltation	1.56 (.73)	1.78 (.67)	(t(16) = .68, n.s.)
Vergnuegen	amusement	1.11 (1.30)	1.67 (.71)	(t(16) = 1.15, n.s.)
glücklich	happy	1.67 (.50)	1.78 (.44)	(t(16) = .50, n.s.)
Zufriedenheit	contentment	1.33 (.71)	1.67 (.50)	(t(16) = 1.15, n.s.)
Froehlichkeit	happiness	1.44 (.53)	1.56 (.73)	(t(16) = .37, n.s.)
erholen	to recreate	1.56 (.53)	1.56 (.53)	(t(16) = .00, n.s.)
unbeschwert	easygoing	1.33 (.71)	1.22 (.67)	(t(16) = .34, n.s.)
Urlaub	vacation	1.56 (.53)	1.44 (.53)	(t(16) = .45, n.s.)
Jubel	exultation	1.78 (.44)	1.33 (1.00)	(t(16) = 1.22, n.s.)
	mean - pleasant	**1.52 (.36)**	**1.58 (.41)**	**(t(16) = .30, n.s.)**
Panik	panic	-1.78 (.44)	-1.33 (.71)	(t(16) = 1.60, n.s.)
Furcht	fear	-1.22 (.44)	-1.22 (.67)	(t(16) = .00, n.s.)
quaelen	to torment	-2.00 (.00)	-1.67 (.50)	(t(16) = 2.00, n.s.)
Schock	shock	-1.67 (.50)	-1.44 (.53)	(t(16) = .92, n.s.)
Todesangst	mortal fear	-1.78 (.44)	-2.00 (.00)	(t(16) = 1.51, n.s.)
Entsetzen	horrify	-1.11 (.60)	-1.00 (.00)	(t(16) = .55, n.s.)
Angstanfall	panic attack	-1.56 (.53)	-1.89 (.33)	(t(16) = 1.60, n.s.)
bedrohlich	threateningly	-1.11 (.33)	-1.11 (.33)	(t(16) = .00, n.s.)
gefaehrlich	dangerously	-1.44 (.57)	-.78 (.83)	(t(16) = 2.03, n.s.)
Angstschweiss	cold sweat	-1.56 (.53)	-1.56 (.53)	(t(16) = .00, n.s.)
	mean - unpleasant	**-1.52 (.12)**	**-1.40 (.01)**	**(t(16) = 1.57, n.s.)**

Ratings: -2 = "very unpleasant", -1="unpleasant", 0=neutral, 1= "pleasant", 2= "very pleasant"

Appendix F. Mean ratings of target stimuli regarding emotional valence, magnitude of disgust, and threatening potential (with Standard Deviations) in Experiment 3.

	Spider Lovers	Controls	
Spider Pictures			
Valence	1.37 (.55)	.32 (.64)	(t(16) = 3.72, p < .01)
Disgust	1.24 (.35)	2.54 (.93)	(t(16) = 3.89, p < .01)
Threat	1.22 (.33)	2.09 (.78)	(t(16) = 3.08, p < .001)
Butterfly Pictures			
Valence	1.67 (.54)	1.61 (.44)	(t(16) = .26, n.s.)
Disgust	1.00 (.00)	1.15 (.30)	(t(16) = 1.51, n.s.)
Threat	1.01 (.30)	1.09 (.24)	(t(24) = 1.00, n.s.)

Valence Ratings: -2 = "very unpleasant", -1="unpleasant", 0=neutral, 1= "pleasant", 2= "very pleasant"
Disgust and Threat: 1 = "very low", 2 = "low", 3 = "medium", 4 = "high", 5 = "very high"

Appendix G. Spider Anxiety Screening (SAS)

The Spider Anxiety Screening (SAS, Spinnenangst Screening; Rinck, Bundschuh, Engler, Müller, Wissmann, Ellwart, & Becker, 2002) is a short and efficient questionnaire based on four DSM IV criteria for Specific Phobia (American Psychiatric Association, 1994). The four statements concern (1) subjective experience of spider fear, (2) physiological arousal, (3) avoidance of spiders, and (4) distress about the fear of spiders. Participants rate on a 7 point Likert-Scale (from "0 = absolutely not true" to "6 absolutely true") to what extent the statements correspond with their own evaluations.
Below are the 4 SAS statements in German and English.

01 Ich habe Angst vor Spinnen.
02 Beim Anblick von Spinnen bekomme ich Herzklopfen.
03 Ich vermeide Spinnen.
04 Meine Angst vor Spinnen belastet mich.

01 I'm afraid of spiders.
02 When I see a spider my heart starts to palpitate.
03 I avoid spiders.
04 I am distressed about my fear of spiders.

Appendix H. Spider Fear Questionnaire (FAS)

The Spider Fear Questionnaire (FAS, Fragebogen zur Angst vor Spinnen; Rinck, Bundschuh, Engler, Müller, Wissmann, Ellwart, & Becker, 2002) is the German version of the "Fear of Spiders Questionnaire" (Szymanski & O'Donohue, 1995). It consists of 18 statements regarding spiders or spider relevant situations. Participants rate on a 7 point Likert-Scale (from "0 = absolutely not true" to "6 absolutely true") to what extent the statements correspond with their own evaluations.
Below are the 18 FAS statements in German.

01 Wenn ich jetzt auf eine Spinne stoßen würde, würde ich jemanden zu Hilfe holen, um Sie zu beseitigen.
02 Zur Zeit halte ich manchmal Ausschau nach Spinnen.
03 Wenn ich jetzt eine Spinne sähe, würde ich denken, dass sie mir schaden wird.
04 Ich denke momentan häufig an Spinnen.
05 Ich würde mich etwas fürchten, jetzt einen Raum zu betreten, in dem ich schon einmal eine Spinne gesehen habe.
06 Ich würde momentan alles tun um zu versuchen, Spinnen zu vermeiden.
07 Zur Zeit denke ich manchmal daran, von einer Spinne gebissen zu werden.
08 Wenn ich jetzt auf eine Spinne treffen würde, wäre ich nicht in der Lage, damit angemessen umzugehen.
09 Wenn ich jetzt auf eine Spinne treffen würde, würde es lange dauern, sie wieder aus meinem Kopf zu verbannen.
10 Wenn ich jetzt auf eine Spinne stoßen würde, würde ich den Raum verlassen.
11 Wenn ich jetzt eine Spinne sehen würde, würde ich denken, sie könnte versuchen mich anzuspringen.
12 Wenn ich jetzt eine Spinne sähe, würde ich jemand anderes bitten, sie zu töten.
13 Würde ich jetzt einer Spinne begegnen, würde ich die Vorstellung haben, wie sie versucht, mich zu kriegen.
14 Wenn ich jetzt eine Spinne sähe, würde ich mich vor ihr fürchten.
15 Wenn ich jetzt eine Spinne sähe, würde ich in Panik geraten.
16 Spinnen gehören zu meinen schlimmsten Ängsten.
17 Ich würde mich sehr nervös fühlen, wenn ich jetzt eine Spinne sähe.
18 Wenn ich jetzt eine Spinne sähe, würde ich wahrscheinlich in Schweiß ausbrechen und mein Herz würde schneller schlagen.

Appendix J. Stimuli presented in the Human EAST and the Spider EAST (English translations)

positive words	negative words	feature words	situation words
pleasure	panic	legs	attic
exultation	to strike dead	to crawl	walls
to relax	anxiety	net	cellar
happy	shock	to weave	foliage
holidays	threateningly	filament	window
enjoyment	fear	hair	corner
enthusiasm	dangerous		
gladness	panic attack		

8. German Summary - Zusammenfassung

Einleitung. Mehr oder minder starke Angst vor Spinnen ist in der Bevölkerung weit verbreitet, und die krankhafte Angst vor Spinnen (Spinnenphobie, Arachnophobie) ist eine der häufigsten Angststörungen. Aus evolutionärer Sicht besteht die Aufgabe der Angst darin, vor Gefahren zu warnen und Reaktionen auf diese Gefahren - Flucht oder Kampf - vorzubereiten. Es wird davon ausgegangen, dass Gefahrenreize besonders schnell verarbeitet werden (Le Doux, 1996). So werden auch spezielle Gefahrenschemata und Angstassoziationen postuliert (Beck, 1976; Lang, 1979), die zum Teil genetisch vorprogrammiert sind ("preparedness", vgl. Seligman, 1971). Unter anderem scheinen Spinnen solche Gefahrenreize darzustellen, bei denen aufgrund der "preparedness" eine Angstreaktion besonders leicht erlernt wird, obwohl die in Mitteleuropa lebenden Spinnen völlig ungefährlich sind. Auffällig ist bei Spinnenängstlichen, dass ihnen die Irrationalität ihrer Angst in der Regel wohl bewusst ist, ohne dass dies zu einer Reduktion der Angst führt. Dies deutet darauf hin, dass neben den expliziten und bewussten Einstellungen gegenüber Spinnen auch andere, schlechter kontrollierbare Prozesse eine wichtige Rolle spielen. Diese assoziativen Prozesse sind bisher fast nie untersucht worden, obwohl die generelle Bedeutung kognitiver Prozesse für die Entstehung und Aufrechterhaltung von Angststörungen unstrittig ist. In der hier vorgestellten Dissertation wurden deshalb 'implizite', möglicherweise automatische und unkontrollierbare Prozesse bei Spinnenangst mit Hilfe sogenannter indirekter Verfahren der Assoziationsmessung untersucht. Bei den indirekten Maßen handelt es sich um den "Implicit Association Test" (IAT; Greenwald, McGhee, & Schwartz, 1998) und den Extrinsic Affective Simon Task (EAST; De Houwer, 2003). Diese indirekt erfassten Assoziationsmaße wurden mit direkten Maßen wie Fragebögen, Interviews und dem Verhalten bei Konfrontation mit Spinnen verglichen.

Die Dissertation konzentriert sich auf drei Fragestellungen. Studie 1 befasste sich mit der Frage, ob angstrelevante Assoziationen bei Spinnenangst mit Hilfe des IATs messbar sind und reales Verhalten vorhersagen. Weiterhin war von Interesse, ob das indirekte Maß neben direkten Fragebögen und Interviewdaten noch zusätzliche Informationen über angstrelevante Assoziationen liefert. Erstmalig wurde dafür neben spinnenängstlichen und nichtängstlichen Versuchspersonen eine Gruppe von Spinnenliebhabern (Züchter, Sammler) untersucht, wodurch es möglich wurde, die Ausprägung und Charakteristik von automatischen Angstassoziationen besser einzuordnen und zu interpretieren.

Eine zweite, methodisch orientierte Studie beschäftigte sich mit der Frage nach den Wirkmechanismen des IATs, speziell mit dem Einfluss der Valenz einzeln dargebotener Stimuli im Vergleich zur Valenz ihrer übergeordneten Kategorie. Dabei wurde eine modifizierte IAT-Variante mit maskierten Kategoriendimensionen entwickelt, die besonders für den klinischen Bereich nützliche Anwendungsmöglichkeiten bieten könnte.

Im dritten Teil der empirischen Studien stand die Frage im Mittelpunkt, inwieweit 'implizite' Angstassoziationen von jeweilig aktivierten Kontextbedingungen bei hoch und niedrig spinnenängstlichen Versuchpersonen abhängig sind. Um methodische Probleme des IAT zu vermeiden, wurde der EAST bei einer differentiell-klinischen Fragestellung angewandt.

Methoden. Der IAT und der EAST sind reaktionszeitbasierte Paradigmen, welche auf der Prämisse beruhen, dass man schneller und fehlerfreier reagieren kann, wenn hoch assoziierte Stimuli (z.B. Spinnenbilder und Angstwörter) die gleiche Antwortreaktion (Taste) erfordern. Dagegen sollten sich die Reaktionszeiten verlängern, wenn auf gegensätzliche oder nicht assoziierte Inhalte (z.B. Spinnenbilder und positive Wörter) mit der gleichen Antworttaste reagiert werden soll. Beim IAT wird aus der Differenz gemittelter Reaktionszeiten in zwei kritischen Testphasen (kompatible vs. inkompatible Phase) auf die Assoziation zwischen Zielreizen ("targets", z.B. Spinnenbilder) und Eigenschaftswörtern ("attributes", z.B. Angstwörter) geschlossen. Da im IAT nach Greenwald et al. (1998) zwei Zielreizkategorien und zwei Attributkategorien verwendet werden, erlaubt dieses Verfahren nur Aussagen über die *relativen* Assoziationsstärken zwischen Zielreizen und Attributen (siehe De Houwer, 2002). Der EAST (De Houwer, 2003) erlaubt dagegen, die absolute Assoziationsstärke zwischen einer Zielreizklasse und einer Attributdimension zu messen. Darüber hinaus ist es möglich, mehrere relevante Zielreize gleichzeitig in einer kritischen Phase zu testen.

Als direkte Maße der Spinnenangst dienten der 'Fragebogen zur Angst vor Spinnen' (FAS), sowie das 'Spinnenangst Screening' (SAS; Rinck et al., 2002), ein klinisch-diagnostisches Interview nach dem F-DIPS (Margraf et al., 1996), und Verhaltensmaße der Konfrontation mit einer lebenden Spinne. Insgesamt nahmen an den 6 Experimenten der drei Studien 256 Versuchspersonen teil.

Ergebnisse. Personen mit hoher versus keiner Spinnenangst unterschieden sich in Studie 1 signifikant hinsichtlich ihrer IAT Werte, was auf stärkere, angstrelevante implizite Assoziationen bei Spinnenängstlichen schließen lässt. Neben diesen Gruppenunterschieden deuten signifikante Korrelationen zwischen dem indirekten Maß und

Konfrontationsverhalten (selbst bei Herauspartialisierung der Fragebogenwerte) darauf hin, dass der IAT zusätzliche Informationen über angstrelevante Assoziationen liefern kann. Trotz der Gruppenunterschiede zwischen hoch- und nichtängstlichen Probanden erlauben die IAT Vergleiche mit Spinnenliebhabern die Vermutung, dass selbst explizit nichtängstliche Versuchspersonen Spinnen mit aversiven, angstrelevanten Inhalten verbinden, während Spinnenliebhaber dies nicht tun.

Die Ergebnisse von Studie 2 unterstützen die Annahme, dass sich die Valenz einzeln dargebotener Attributstimuli auf die IAT Effekte auswirkt, auch wenn die Stimuli nicht nach ihrer Valenz, sondern nach einer neutralen Dimension kategorisiert werden (z.B. Groß- vs. Kleinschreibung). Diese Maskierung der eigentlichen Valenzdimension im IAT bietet somit auch die Möglichkeit, den IAT bei Fragestellungen einzusetzen, die keine klare Valenzunterscheidung der interessierenden Attribute zulassen (z.B. bei störungsspezifischen Stimuli).

In der dritten Studie wurde untersucht, ob angstrelevante Assoziationen bei Spinnenangst ständig aktiviert sind, oder ob sie vom jeweiligen Kontext abhängen. Dazu wurde in einer Versuchsbedingung ein 'neutrales' und in einer zweiten Bedingung ein Spinnenschema aktiviert. In beiden Bedingungen wurde das Ausmaß der (Angst-)Assoziationen gegenüber den gleichen Zielwörtern (Situationen und Merkmale wie z.B. krabbeln, Netz, Keller etc.) untersucht und festgestellt, dass diese Assoziationen kontextabhängig sind und mit Hilfe des EAST erfasst werden können. Nur wenn ein Spinnenschema aktiviert war, assoziierten spinnenängstliche Versuchspersonen bestimmte Situations- und Merkmalswörter mit aversiven, angstrelevanten Inhalten, jedoch nicht in der neutralen Bedingung.

Diskussion und Schlussfolgerungen. Die Ergebnisse dieser Dissertation erlauben die Schlussfolgerung, dass performanzbasierte Verfahren wie IAT und EAST durchaus sensitiv gegenüber angstrelevanten impliziten Assoziationen sind und darüber hinaus auch ängstliches Verhalten vorhersagen können. Durch die Einführung einer dritten experimentellen Gruppe von Spinnenliebhabern, durch die Modifikation des klassischen IATs mittels Maskierung der Valenzdimension, sowie durch die erste experimentelle Anwendung des EAST zur Erfassung von Kontexteinflüssen konnten neue Erkenntnisse und Beiträge auf dem Gebiet der indirekten Assoziationsmessung erbracht werden.

Trotz erfolgversprechender Ergebnisse und zahlreicher experimenteller Arbeiten bleiben einige kritische Anmerkungen gegenüber indirekten Methoden bestehen. So fehlt den bisher eher empirisch geleiteten Anwendungen indirekter Verfahren eine ausreichend fundierte, theoretische Untermauerung. Darüber hinaus bleiben einige ungelöste methodische Aspekte und Probleme des IAT und EAST bestehen, wie die genaue Erklärung der Wirkmechanismen oder die psychometrischen Eigenschaften der Verfahren.

Zum gegenwärtigen Zeitpunkt befindet sich der Einsatz indirekter Paradigmen in der klinischen Psychologie noch am Anfang und es bedarf weiterer intensiver methodischer und theoretischer Anstrengungen, die praktische Anwendbarkeit dieser Methoden voranzutreiben. Auf lange Sicht könnte aber die Messung automatischer 'impliziter' Aspekte von Angstassoziationen einen wichtigen Beitrag in der klinisch-psychologischen Forschung leisten, wie bei der Vorhersage von Therapieerfolg oder Rückfallswahrscheinlichkeiten, sowie der Identifikation von kognitiven Vulnerabilitätsfaktoren bei psychischer Störungen.

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Erklärung

Hiermit versichere ich, dass ich die vorliegende Arbeit

'Indirect Measures of Associations and Psychopathology: Applications to Spider Phobia'

ohne unzulässige Hilfe Dritter und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sind als solche kenntlich gemacht. Die Arbeit wurde weder im In- oder Ausland in gleicher oder ähnlicher Form einer anderen Prüfungsbehörde vorgelegt.

Die Arbeit wurde am Institut für Allgemeine Psychologie, Biopsychologie und Methoden der Psychologie der Technischen Universität Dresden unter wissenschaftlicher Betreuung von Prof. Dr. phil. habil. Thomas Goschke angefertigt.

Die Promotionsordnung der Fakultät Mathematik und Naturwissenschaften vom 20. März 2000 erkenne ich an.

Dresden, den 22. Januar 2004

Thomas Ellwart