# Social Trauma: Psychophysiological correlates and time course of social threat processing in social anxiety disorder

Dissertation

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Hiermit versichere ich, dass ich die vorliegende Synopse, sowie die für den Kumulus vorliegenden Schriften als Erstautor verfasst habe. Damit trage ich die inhaltliche und methodische Verantwortung für die aufgeführten Schriften. Die Arbeit hat in der gegenwärtigen, oder in einer anderen Fassung keiner anderen Fakultät oder Universität vorgelegen.

Bielefeld, den 28.05.2013 _____

(Pascal Wabnitz)

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# 1 Overview

## 1.1 Submitted articles and research contributions

The articles included in this thesis and my independent research contributions are listed in the following.

**Article #1: Cortical reactions to verbal abuse: event-related brain potentials reflecting the processing of socially threatening words**
Pascal Wabnitz[1], Ulla Martens[2], & Frank Neuner[1]; *June 2012 in Neuroreport*

*I carried out the EEG recordings and performed the data pre-processing and the source estimation. I performed the statistical analyses and drafted the manuscript.*

**Article #2: Written threat: Electrophysiological evidence for an attention bias to affective words in social anxiety disorder**
Pascal Wabnitz[1], Ulla Martens[2], & Frank Neuner[1]; *submitted*

*I carried out all clinical interviews and a large number of EEG recordings. I performed the data pre-processing and supported the development of procedures and routines for EEG data analyses. I performed the statistical analyses and drafted the manuscript.*

**Article #3: Time course of emotional face processing in social anxiety disorder**
Pascal Wabnitz[1], Frank Neuner[1], Fabian Klein[1], & Ulla Martens[2]; *submitted*

*I carried out all clinical interviews and a large number of EEG recordings. I contributed to data pre-processing and supported the development of procedures and routines for EEG data analyses. I performed the statistical analyses and drafted the manuscript.*

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# 2 Introduction

## 2.1 Introduction to the context of this research

Imagine yourself roaming through a forest. The beauty of nature and the smell of fresh grass and wood fill your senses. Meanwhile, your thoughts are floating between the present and past events of your life. Suddenly you hear a hissing sound. You turn around and catch sight of a snake nearby. Immediately your musculature is activated. Your heart is pounding, your body is shaking and your pupils are dilated. The thought, "*Snakes are fast and dangerous animals*" intrudes your mind. The sound of the forest and the smell of grass suddenly disappear and the feelings of fear and anxiety dominate the moment. Your entire attention is dedicated to the hissing snake, leaving you to decide between fight or flight.

This cascade of bodily activations represents the function of a normal fear structure (Foa & Kozak, 1986; Lang, 1979) that serves as an evolutionary written scheme for responding to impending danger (LeDoux, 2000; Öhman & Mineka, 2001). Being confronted with threats like a dangerous animal or a suddenly approaching car demands the fast recognition and knowledge of the nature and meaning of possible threats (Huppert & Foa, 2004). Luckily our perception is not only sensitive to the stimulus itself but also to pictorial representation of the feared stimulus. Hence, emotionally arousing stimuli that are either highly aversive, such as pictures of spiders or guns, or highly attractive, such as erotic pictures (Junghöfer, Bradley, Elbert & Lang, 2001) attract our attention. The common denominator of such arousing stimuli is that they indicate relevance for basic motivational goals, in particular survival or reproduction. Within a two-factorial model of emotions (Bradley & Lang, 1994) these stimuli can be arranged according to the dimensions of valence (pleasant vs. unpleasant) and arousal (arousing vs. calm). The outlined rapid allocation of attention resources to such stimuli is typically referred to as "bias" or "attention bias". These biases are embedded within a neural pathway that encompasses several brain structures located in various regions of the human brain (Lang & Bradley, 2009; LeDoux, 2000). If a potential threat is detected, the activation of a fear network typically entails the mobilization of all bodily systems leading to an affective (fear of the snake), cognitive ("it will bite me"), motivational (survive!) and physical (pounding heart, sweating) reaction. While escaping from

snakes might not be part of our daily routine, everyone can probably think of somewhat similar situations: Even if not faced with imminent danger of death, we are used to the reactions described above as part of the body's natural response to stress.

While nature equipped us with an adaptive system that works very efficiently when faced with a physical threat, this system sometimes works against us. Under certain conditions, people may misjudge a situation´s importance to their physical or social wellbeing, leading to a fear response even when this is not the appropriate reaction in the given situation. Evolutionarily speaking our body and brain seem to prefer a "false positive" (false alarm) over a "false negative" (missed danger) when confronted with an ambiguous situation (Beck, Emery, & Greenberg, 2005).

Let us now turn from the (fortunately) rare occasion of being confronted with a snake or spider to an everyday situation. Imagine yourself in front of an audience just before giving a speech or in a group facing the task of introducing yourself. What precisely would be the focus of your attention? Which aspects of the environment would be crucial for the way you feel and behave? Would your physical reactions resemble the situation in the forest when being confronted with the snake? What will be crucial for the way you feel and interact in a situation such as this one? What are aspects and occasions you might fear? Being accompanied and appreciated by others is a basic human need (Baumeister & Leary, 1995) and part of our everyday social life. If you were suffering from social anxiety, your main concern might be a negative evaluation by others. Consequently, you would fear that your behavior will result in other people thinking you were weak, stupid or somehow less approachable. Ultimately, this might result in social exclusion and social isolation. The emerging "social pain" would lead to similar psychological and physiological reactions tendencies as physical pain (e.g. being bitten by a snake; Corr, 2005; MacDonald & Leary, 2010, 2005). One way of monitoring any indication of such a potential outcome could be the quick detection of possibly threatening cues in oneself or others, respectively. These cues could represent a threat for your social integrity (social rank or group affiliation). Thus, to catch a glimpse of a facial expression or another cue indicating a negative evaluation might result in an immediate fear response that will capture your attention as quickly and efficiently as being confronted with a physical threat.

Aside from rather normal fear reactions, much research has been dedicated to fear-related attention processes in the pathological form of social anxiety, namely social anxiety disorder (or *social phobia*, in the following the abbreviation SAD will be used). During the past three decades studies have reported evidence for deviant internal and external attention foci in SAD (e.g. Heinrichs & Hofmann, 2001; Schultz & Heimberg, 2008). While prominent models highlight a biased internal self-focus in social anxiety (Clark & Wells, 1995), others promote the simultaneous functioning of internal and external processing bias to potentially threatening cues (Rapee & Heimberg, 1997). Evidence for the latter account comes in the form of sensitivity to negative evaluations, difficulties in ignoring threats, allocating attention to possible threats and a subsequent processing including hyperarousal and later avoidance of threat cues (Schultz & Heimberg, 2008). The extent to which these biases might be attributable to effects of task load (e.g. attention capture within an emotion discrimination task) or divergence in stimulus characteristics (usage of faces, pictures or written words as stimulus material) needs further clarification. Angry faces or negative words as *stutter* or *audience* (both frequently used in research) do not solely affect attention allocation in SAD but also in other anxiety disorders or healthy subjects. Moreover, the matching of the threatening stimulus to the disorder at hand is crucial for the understanding of attention processes underlying SAD (Heinrichs & Hofmann, 2001).

In the present research I focused on the processing of threat cues in SAD. There is no doubt that people suffering from SAD engage in a somewhat hampered (or biased) processing of threat cues. Yet the question remains whether this bias appears solely in response to specific threat cues, or also in response to unspecific ones with respect to stimulus characteristics or disorder relevance. In contrast to the large body of literature documenting attention processes in SAD using behavioral paradigms, research using electroencephalographic (EEG) measures is scarce. The excellent temporal resolution of EEG measures allows us to precisely determine changes within the processing stream, tracking changes within milliseconds. The present thesis applies this advantage to study disorder specific threat processing in SAD using socially threatening words and faces to contribute to existing cognitive models (Amir, Elias, Klumpp, & Przeworski, 2003, Clark & Wells, 1995; Rapee & Heimberg, 1997). Social anxiety deters individuals from enjoying and satisfying one of our most natural and human needs (i.e. the need for affiliation, the company of others or the need to be loved by others). While

being aware of its limits, research on basic mechanisms underlying the oppressive symptoms of SAD can contribute to a better understanding of the key symptoms and might help us develop possible ways of change through psychotherapy.

## 2.2 Definition of social anxiety disorder

A rapid fear response to an imminent physical threat is an adaptive mechanism ensuring the survival of the individual. However, the fear in subjects with SAD is not about physical, but interpersonal threats such as social isolation, negative evaluation, exclusion and/or rejection (Stein & Stein, 2008). Consequently, the hallmark of SAD is a clinically significant fear of exposure to unfamiliar people or embarrassment in social or performance situations. This fear manifests itself in behavioral, cognitive, affective and physiological dysfunctions (APA, 2000). Phenomenologically, SAD either appears in the presence of a specific social situation (e.g. public speaking, fear of blushing) or as a more general fear across various social situations including interpersonal and performance situations (Kessler, Chiu, Demler, & Walters, 2005). While avoidance of a feared situation or object is a necessary feature for the diagnosis of most anxiety disorders (APA, 2000), the feared situation in SAD must either be "avoided *or* endured with intense distress" (APA, 2000, p. 417). Within a feared situation patients generally experience physiological symptoms such as blushing, palpitations, trembling and sweating. Some experience extensive fear due to the assumed visibility of these symptoms (Stein & Bouwer, 1997). Under intense fear, panic attacks can also occur (Rapee, Sanderson, McCauley, & DiNardo, 1992). Despite being aware that their fear might be exaggerated and/or unrealistic, patients remain concerned that they might be observed and evaluated negatively which leads to anticipatory anxiety (Schultz & Heimberg, 2008). Symptoms typically cause significant distress and impaired functioning in daily life including social, occupational and academic activities (APA, 2000). It has been suggested, that a fear structure underlying some anxiety disorders (Foa & Kozak, 1986; Lang, 1977) and serving as a "blueprint for responding to danger" (Huppert & Foa, 2004, p. 213) is also evident in SAD (Huppert & Foa, 2004). The critical aspect distinguishing the fear network in SAD from other anxiety disorders is that the feared stimulus is a social, rather than a physical threat (Huppert & Foa, 2004). Consequently, current etiological models of SAD (Ollendick & Hirschfeld-Becker, 2002; Rapee &

Spence, 2004) propose traumatic or conditioning events preceding the onset of the disorder in a majority of patients. In sum, the marked psychological and social effects of SAD combined with a high prevalence (Kessler et al., 2005) underline the need for further research on possible etiological and maintaining factors. In recent years these factors have already been addressed in cognitive models of SAD that will be reviewed in the following section.

## 2.3 Cognitive models of social anxiety disorder

**Beck & Emery, 1985**

One of the first to propose a cognitive model of anxiety based on his earlier contributions to the study of affective disorders was Aeron T. Beck (Beck, 1976; Beck, Emery, & Greenberg, 1985). In Beck, Emery and Greenberg´s cognitive model the authors emphasize the presence of distinct *cognitive schemata* as one key element leading to anxiety. Schemata are developed through childhood experiences via different forms of learning. A schema contains emotions, behaviors and cognitions that are interconnected and influence how we perceive, process and interpret information, situations and other people (Beck et al., 1985). The information about the threat value of a stimulus (e.g. expression of others) and the resulting need for early detection is stored in such a schema. Additionally, Beck and Emery argue that social anxiety is the product of faulty thinking. In this light, SAD subjects are not only on the lookout for potential socially threatening cues, but they also persistently estimate the current threat value and their own ability to cope with it. This idea is also supported by Leary and Kowalski´s (1995) theory. In their self-presentation model of social phobia the authors state that social anxiety occurs when the individual is motivated to make a particular impression on others but has doubts that he/she has the ability to make the desired impression (Leary & Kowalski, 1995). According to the schema congruency hypothesis, the resulting biases in threat processing should be connected with the degree to which cues are systematically related to the personal schema (Beck et al, 1985). As cognitive biases hamper the realistic processing of a person´s ability and self-efficiency (Beck et al., 1985), the anticipated fear of negative experiences prevents the person to engage in social interactions and maintains the anxiety. In sum then, pathological schema activation triggers symptoms of anxiety and biased processing of social information. These schemata in turn are triggered by events or stimuli that

match or support the schema and can distort different aspects of thinking, feeling and behavior (Anderson, 2010; Beck et al., 1985).

In the 1990´s a fruitful body of research inspired by Beck and colleagues´ theoretical work led to the formulation of two cognitive behavioral theories of social anxiety (Clark & Wells, 1995; Rapee & Heimberg, 1997). While both models underline the central role of attention processes in the maintenance of SAD, they disagree with regard to the focus of attention. Central aspects and differences between both models are outlined in the following section.

**Clark & Wells (1995)**

According to Clark and Wells (1995), SAD subjects become anxious as soon as they detect an audience. In line with Beck and colleagues (1985), socially anxious individuals possess negative beliefs and assumptions about social interactions and the self. Additionally, they anticipate that others have high standards for the performance of their counterpart (Clark & Wells, 1995). Consequently, these assumptions trigger negative cognitions, leading the individual to believe that his/her behavior will result in rejection or exclusion. The mere presence of others activates an *"anxiety program"* that is followed by an automatic shift of attention (Clark & Wells, 1995). From now on, the socially anxious individual will tend to use interoceptive information (e.g. warm skin as sign of blushing) to build up an impression of themselves (e.g. the "*social self")*. Because it is most likely that physiological arousal is already elevated by the mere presence of others, physical signs of arousal (e.g. trembling, sweating, palpitation) become reinforced and, therefore, the focus of attention. Thus, while the anxiety program continues, socially anxious individuals do not focus on others but monitor their bodily signs of anxiety. This process creates a vivid but exacerbated image of the individual themselves (e.g. *my entire body is shaking*) via cognitive and somatic feedback and is the key process in Clark and Wells´ (1995) theory. Moreover, the internal attention focus prevents the individual from noticing signs of approval or acceptance and leaves fewer resources for the actual task effectively leading to poor performance. To cope with their arousal and anxiety, social phobics engage in various compensatory behaviors ("*safety behavior*"; Clark & Wells, 1995). Although these behaviors are intended to reduce the possibility of embarrassment and rejection (e.g. holding a glass so tightly that shaking of the hand is impossible), in

many instances they make the feared outcome even more likely (e.g. holding a glass very tightly increases muscle tension). However, the absence of the feared outcome is usually attributed to their success in "surviving the catastrophe" by the use of safety behaviors (Clark & Wells, 1995; Schultz & Heimberg, 2008). Another factor leading to exacerbated anxiety involves the post event processing: social phobics` ruminating about their own performance. This process is distorted by the internal attention biases and the activation of dysfunctional schemata. A critical issue in Clark and Wells' theory is that it does not specify how the first initially threatening cue (i.e. the audience) is recognized and perceived and which process or mechanism predicts an attention bias for threat cues over other cues (Schultz & Heimberg, 2008).

**Rapee & Heimberg, 1997**

Extending the idea that SAD is predominantly associated with self-focused attention, Rapee and Heimberg emphasize that social phobics scan their environment for signs of impending social disapproval or rejection (e.g. *yawning*) (Rapee & Heimberg, 1997; Schultz & Heimberg, 2008). Sustained monitoring of the environment results in an unbalanced and faulty appraisal of social situations. At the same time individuals attend to the mental representation of themselves consistent with Clark and Wells (1995). Thus, when a socially anxious individual enters a social situation, he/she will divide his/her attention resources to the environment and the self. Together, both attention biases are crucial for the maintenance of SAD (Rapee & Heimberg, 1997; Schultz & Heimberg, 2008). Moreover, the interaction of monitoring the environment for potential social threats and self-focused attention is not included in Clark and Wells' theory (1995). The individual will experience fear because he/she is convinced that others are naturally critical and likely to engage in negative evaluations. Immediately he/she will show vigilance for cues, which might predict this feared outcome (Schultz & Heimberg, 2008). Besides the mental image and external cues, several other sources for the evaluation of outcomes are used. Consequently, past experiences, cognitions about social interactions, internal and external information create an image of the self ("baseline *image*"). Subsequently, social phobics scan the environment to gain evidence for this mental image (e.g. "this guy is yawning so I must be boring"). As both attention foci constantly interact with each other, the detection of external signs of

social threat results in a greater internal focus and vice versa. Conclusively, while Clark and Wells (1995) suggest that a focus on the mental representation of the self should solely exacerbate anxiety, Rapee and Heimberg assume that an increased internal focus should also affect the external focus (Rapee & Heimberg, 1997; Schultz & Heimberg, 2008).

Conclusively, virtually all cognitive models converge on the aspects that social anxious individuals are overly concerned of how they might be perceived and that they show a self-focused attention bias (Beck et al., 1985; Clark & Wells, 1995; Rapee & Heimberg, 1997). However, whether attention biases occur exclusively with regard to internal or simultaneously with regard to internal and external sources of social threats remains a controversial conceptual question. Most importantly, as differential biases are thought to depend on the subject's personal schema and the systematics in diagnosis (Beck et al., 1985; Heinrichs & Hofmann, 2001), the specificity of attentional biases (unspecific hypervigilance to all threatening *versus* to disorder specific stimuli) need further scientific investigation. During the last decades considerable research effort has been devoted to clarify these issues. A picture of research on information processing biases will be drawn in the following chapter.

## 2.4 Cognitive and attention biases in social anxiety disorder

The cognitive models outlined above provide an excellent conceptual framework for studying different attention biases in SAD. Accordingly, social anxiety manifests in vigilance for negative evaluation, difficulties ignoring threats, altered allocation of attention in the environment as well as memory, interpretation and judgmental biases (e.g. Heinrichs & Hofmann, 2001). As theories do not converge on the nature and mechanism of these biases, substantial research has been devoted to these issues. Over the last decades, reviews on attention biases have documented evidence derived from different behavioral attention paradigms (e.g. emotional stroop, dot probe, visual search, memory tasks, face in the crowd paradigm) and stimulus categories (mainly words and faces) (for reviews see Amir & Foa, 2001; Heinrichs & Hofmann, 2001; Hirsch & Clark, 2004; Schultz & Heimberg, 2008). Biases have not only been reported for SAD, but also, more generally for anxious (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van Ijzendoorn, 2007; Yiend, 2010) or even healthy individuals

(Mathews & MacLeaod, 1994; Mathews & Mackintosh, 1998). This raises questions about the disorder-specificity of these biases (Bar-Haim et al., 2007; Yiend, 2010).

Most cognitive models of visual attention propose that selective attention to threat cues is the crucial process leading to exacerbating and maintenance of anxiety (MacLeod, Mathews, & Tata, 1986; Mogg & Bradley, 1998; Williams, Watts, MacLeod, & Matthew, 1997; Mathew & Mackintosh, 1998). In SAD these cues include negative facial expressions (anger or disgusted) or apparently disorder-specific words (e.g. stutter, embarrassment or shy; e.g. Becker, Rinck, Margraf, & Roth, 2001). However, it remains unclear if the increased attention to threat cues that is frequently absent in non-anxious controls (e.g. Mogg, Phlippot, & Bradley, 2004; Pishyar, Harris, & Menzies, 2004) arises because these cues rapidly capture attention, delay the disengagement or both (Cisler, Bacon, & Williams, 2009; Yiend, 2010). Another explanation for the occasional findings of attention biases occurring in healthy controls is that threat cues can capture attention in everyone when they exceed a critical threshold (Mathew & Mackintosch, 1998; Mogg & Bradley, 1998).

Another line of research suggests that another mechanism accounts for the observed pattern of attention biases. Recently, studies using the modified Posner spatial cuing task (Posner, 1980) showed that anxious individuals are not faster in responding to probes replacing threatening compared to neutral cues, but are somewhat slower in responding to cues that are opposite a threat cues, relative to non-anxious controls (Amir et al., 2003). Thus, once detected, the anxious individual fails to disengage attention from the threatening cues (Amir et al., 2003; Fox et al., 2001, 2002; Koster, Crombez, Verschueren, & De Houwer, 2004; Yiend & Mathews, 2001). As a consequence, the likelihood of the detection of threatening cues might be increased resulting in intensified anxiety (Mogg & Bradley, 2005). In this light the cost of attending to irrelevant social information might be the maintaining factor underlying numerous anxiety disorders (Amir et al., 2003).

The mixed pattern of findings has also been subsumed within a model of consecutive stages of threat processing. According to this model, the direction of attention biases changes as a function of time. While socially anxious individuals exhibit initial vigilance for threat cues, they immediately direct their attention away from these cues in order to avoid detailed processing and to minimize their anxiety (Amir, Foa, & Coles, 1998; Mogg & Bradley, 1998). This *hypervigilance-avoidance hypothesis*

has been widely studied (Amir et al., 1998; Heinrichs & Hofmann, 2001; Williams et al., 1997). While some findings support the assumption of consecutive and inverted attention biases, others are clearly inconsistent with the hypervigilance-avoidance hypotheses (for discussions see Bögels & Mansell, 2004 and Heinrichs & Hofmann, 2001).

Different aspects may account for the mixed results regarding the direction (i.e. hypervigilance, avoidance, difficulties in disengagement) of attention biases. First, studies vary with respect to the population (clinical, sub-clinical, healthy populations), making it difficult to disentangle pathological from normal attention processes (Amir et al., 2003). In clinical sample, this issue can be further exacerbated by the fact that comorbid disorders, particularly depressive disorders (Grant & Beck, 2006; Musa, Lépine, Clark, Mansell, & Ehlers, 2003) have shown to influence and even eliminate attention biases in anxiety. Second, given the fact that the presented findings are based on a variety of different paradigms, it is likely that each paradigm taps into different stages of attention processes (Bar-Haim et al., 2007). Finally, most studies differ with regard to stimulus material and duration of presentation, further complicating the integration of their findings. Main achievements from research using behavioral paradigms will be briefly outlined in the following section.

### 2.4.1 Evidence from behavioral paradigms

As noted earlier, most studies of attention biases in social anxiety have utilized either a modified version of the emotional stroop (Stroop, 1935), or the modified dot probe task (MacLeod et al., 1986). In the emotional stroop task, words of varying emotional connotation (neutral, positive, negative) are written in different colors. Subjects are asked to name the color of the word while ignoring the meaning of the word. Longer color naming latencies are assumed to arise from interferences that occur when attention is allocated to the meaning instead to the color of the word. Research utilizing the task generally shows that socially anxious subjects take longer to name the color of a socially threatening word (e.g. stupid) than non-anxious subjects (Amir et al., 1998; Hope, Rapee, Heimberg, & Dombeck, 1990; Mattia, Heimberg, & Hope, 1993; Van Niekerk, Moller, & Nortje, 1999). Findings are typically assumed to reflect attention allocation towards social threat cues. However, the emotional stroop task has been heavily criticized as being an incorrect measure of attention. Acording

to this critique, delayed response times may only be due to actual emotional arousal arising from reading an emotional word. This in turn may hamper the actual performance, leading to slower responses. Consequently, it has been speculated that it is the emotional arousal instead of attention allocation that modulates the emotional stroop effect (Mogg & Bradley, 1998).

In reaction to the criticisms regarding the validity of the social stroop task it has been argued that the dot probe task represents a more direct measure of visual attention (Mogg & Bradley, 1998; MacLeod et al., 1986). In the dot probe task subject are initially presented with a fixation marker (× or •) in the middle of the screen. Markers are then followed by a pair of either words or faces that appear either horizontally or vertically to each other. Typically one word or face is neutral and the other has a negative or positive valence. Usually, both stimuli remain on the screen for usually 500 to 1500 milliseconds. Subsequently, the stimuli disappear and a probe appears on one of the locations previously occupied by the stimuli. Subjects are briefed to respond to the appearance of the probe as quick as possible by indicating its position (right/ left, up/down). Quicker responses to probes replacing an emotionally negative cue are thought to indicate a bias towards threat. The dot probe is thought to offer several advantages over the emotional stroop task (for a detailed description see Mogg & Bradley, 1998; MacLeod et al., 1986). These advantages spawned numerous studies measuring attention processes in samples of clinical and non-clinical social anxiety (for reviews see Mogg & Bradley, 1998, 1999). While some studies utilized threatening words (Asmundson & Stein, 1994) others used threatening faces (Mansell, Clark, Ehlers, & Chen, 1999; Chen, Ehlers, Clark, & Mansell, 2002; Mogg & Bradley, 2002; Pishyar et al., 2004), yielding mixed results. In non-clinical samples of social anxiety, evidence has been reported for an avoidance (e.g. Mansell et al., 1999), vigilance (e.g. Mogg & Bradley, 2002; Mogg et al., 2004; Pishyar et al., 2004) or none of both attention biases (e.g. Bradley, Mogg, Millar, & Bonham-Carter, 1997; Pineles & Mineka, 2005). In clinical samples, most evidence has been reported for the avoidance (Chen et al., 2002), the vigilance (Sposari & Rapee, 2007) or the hypervigilance-avoidance hypothesis (Mogg et al., 2004). Unfortunately, the majority of research lacks the possibility of direct comparisons due to methodological issues as time of stimulus presentation, type of stimulus or facial expression. By now, the dot probe task widely accepted as the most methodological sound measure of visual attention biases (Mogg & Bradley, 1998). However, due

to the nature of attention biases in anxiety, one issue should be emphasized. In light of an evolutionary advantage, the processing of threatening cues, regardless of their origin or valence (physical *versus* social threat), would only be adaptive if the detection and further processing occur very quickly and thus protects the individual from impending harm (LeDoux, 2000). Unfortunately, a critical limitation of most behavioral paradigms is that they only provide an indirect measure of attention processing (Horley, Williams, Gonsalvez, & Gordon, 2004) and thus, are incapable of mapping fine temporal dynamics. Moreover, behavioral measures can be confounded with post-perceptual processes (e.g. decision making, motor response) (Bar-Haim et al., 2007; Handy, Green, Klein, & Mangun, 2001). Consequently, a fruitful body of research using different measures of brain activity mainly through event-related potentials (ERPs) has focused on attention processes in anxiety. ERPs offer the advantage of studying fine temporal dynamics in stimulus processing (Mueller, Hofmann, Santesso, Meuret, Bitran, & Pizzagalli, 2009). Thereby, attention processes can be traced more directly, allowing circumventing some of the limitations attached to behavioral paradigms.

### 2.4.2 Evidence from electrophysiological research

By now, it is widely accepted that attention biases manifest themselves in different ERPs of the human EEG. These components differ in amplitude, frequency, polarity and onset. In general, they provide a measure of cortical activity provoked by passive and active forms of attentional control and processing (Hopfinger, Luck, & Hillyard, 2004). Different ERPs are known to covary with the amount of processing resources (Hopfinger et al., 2004). The larger their amplitude, the more processing resources are engaged. Different ERP components are modulated by selective attention (Eimer & Driver, 2001; Luck, Woodman, & Vogel, 2000), conveniently qualifying them for the study of anxiety. For a detailed overview of ERP components, their functional associations and specific neurocognitive aspects, see Luck and Kappenman (2011).

To date no EEG study has addressed the influence of social anxiety on the cortical processing of emotional words. However, research focusing on the processing of emotional faces in SAD is fairly comprehensive. An impact of emotion expression on early perceptual (P100), face specific (N170,

N205r) as well as early (EPN) and late emotion related (N400 and LPP) components is evident, while not always concordant.

In a series of studies Kolassa and colleagues investigated cortical characteristics of attention biases to angry, sad, happy and neutral faces. Using a modified emotional stroop task, subjects in one study had to identify either the gender or the expression of the face (Kolassa & Miltner, 2006). Unlike controls subjects with SAD, they showed enhanced right temporo-parietal N170 amplitudes in response to angry faces. However, phobics showed no deviations to controls in early P100 and P200 amplitudes to angry faces albeit P100 amplitude was enhanced in SAD to all facial expressions. Comparing social phobics with healthy controls and spider phobics, these results were partly replicated. In reaction to schematic faces presenting different emotional expressions (angry, happy, neutral) generally enhanced P100 amplitudes to all faces were exclusively found in SAD patients. At the same time, an enhanced right-hemispheric N170 only to emotional faces was evident in all subjects (Kolassa, Kolassa, Musial, & Miltner, 2007). In a third study, patients (SAD and spider phobics) showed enhanced P100 amplitudes to all faces, probably indicating a state of general hypersensitivity, while a modulation of the N170 by facial expression did not discriminate between patients and controls (Kolassa et al., 2009). The finding of enhanced right temporo-parietal N170 in SAD has also been reported in subclinical social anxiety within a passive viewing task (Mühlberger et al., 2009). Mühlberger and colleagues also reported that in highly socially anxious subjects, the P100 was enhanced in response to all faces, while emotional modulation of the early posterior negativity (EPN) was specific to emotional faces (Mühlberger et al., 2009. Moreover, it seems that the modulation of early perceptual and face specific components is not limited to trait social anxiety. When state social anxiety is induced by a fear of public speaking, N170 amplitudes are observed for angry faces compared to other facial expressions (Wieser, Pauli, Reicherts, & Mühlberger, 2010).

Looking at later stages within the processing stream, enhanced later ERP responses (e.g. P300, LPP) to threatening faces in general have been reported in other studies (Moser, Huppert, Duval, & Simons, 2008; Sewell, Palermo, Atkinson, & McArthur, 2008). For instance, Moser and colleagues reported enhanced late LPP responses to threatening faces (anger, disgusted) in a modified Erickson flanker task. The authors speculate that this finding might indicate that SAD is associated with the

absence of a positive processing bias in favor of a negative processing bias (Moser et al., 2008). Evidence for a directional change of attention biases comes from a study by Mueller et al. The authors presented subjects suffering from SAD and healthy control subjects with angry-neutral and happy-neutral pairs of faces within a dot probe task. Unlike controls, social phobics showed enhanced P100 potentials to angry-neutral compared to happy-neutral face pairs. More importantly, compared to controls' reactions to probes replacing angry-neutral *versus* happy-neutral face pairs yielded in decreased P100 amplitudes. The authors interpret their findings as evidence for the hypervigilance-avoidance hypothesis, stating that the direction of attention biases changes as a function of time.

Another method of analyzing electrophysiological activity in response to threat cues is the stimulus-dependent modulation of oscillatory brain activity. In particular, α frequency activations have been shown to be directly associated with distinct cognitive processes (i.e. inhibition). Cognitive inhibition can be mapped on to distinct regions of the prefrontal cortex (PFC; Aron, Robbins, & Poldrack, 2004) The PFC exerts its inhibitory control on subcortical regions to implement executive control (Aron et al., 2004). This functional role has been shown to be associated with frontal α oscillations in the human EEG (Davidson, Marshall, Tomarken, & Henriques, 2000) with different anxiety related correlates (i.e. approach and withdrawal related behavior) for right and left frontal α activity (Davidson et al., 2000; Heller, Nitschke, Etienne, & Miller, 1997). In fact, it has been shown that right-sided brain activity (reduced α activity) increases in anxious subjects while listening to fearful and sad narratives compared to nonanxious subjects (Heller et al., 1997). Furthermore, greater right-sided activity (reduced α activity) in the PFC has been shown to correlate positively with anxiety (Coan & Allen, 2004; Heller & Nietschke, 1998; Davidson et al., 2000; Heller et al., 1997). So far, patterns of event-related cortical activity in social anxiety are mixed and more research is needed, especially with clinical forms of social anxiety. Indeed, current research assessing oscillations in frontal regions of the brain typically measures α desynchronization while subjects anticipated a public speech (Davidson et al., 2000), reading anxious and sad narratives (Heller et al., 1997) or during resting periods (Heller et al., 1997; Shackerman, McMenamin, Maxwell, Greischar, & Davidson, 2009). In sum, support for the activation of fear relevant structures by emotional faces in SAD via various measures of cortical activity derives from hemodynamic imaging studies that parallel the electrophysiological evidence. By

measuring the cerebral blood flow, studies applying functional magnetic resonance imaging (fMRI) suggest activation of the brain's fear circuitry when socially anxious participants view social stimuli. This has been shown for angry (Evans et al., 2008; Phan et al., 2006; Straube et al., 2005; Stein et al., 2002), but also to neutral (Veit et al., 2002; Birbaumer et al., 1998) and even happy faces (Straube et al., 2005). Taken together the evidence is inconclusive and may points to a more *general* fear system activation bias in response to – as opposed to a *specific* fear system activation bias in response to certain types of faces (e.g. angry faces) – in social anxiety. However, the time course and schema and/or disorder specificity remain unclear.

## 2.5 Integrating the present research

The present dissertation rests on three manuscripts. The first manuscript aimed at investigating to which extent previous evidence for attention biases can be transferred to stimuli that are associated with a social rather than a physical threat. This study measured ERPs in response to socially threatening words in a sample of healthy subjects. In Study #2 we extended findings from Study #1 and investigated whether attention biases in SAD can be transferred to a general hypersensitivity or are specific to disorder-relevant socially threatening words. In addition, we assessed how these biases can be traced with analyses of oscillatory brain activity Finally, in Study #3 we examined if attention biases in SAD are also evident in response to socially threatening faces. Furthermore, Study #2 and #3 also sought to assess the time course of attention biases in SAD.

As outlined above, previous research examining attention biases in healthy or anxious subjects has predominantly used facial expressions or emotional pictures as stimuli (e.g. Eimer & Holmes, 2002, 2007; Junghöfer et al., 2001; Schupp et al., 2004; Schupp, Flaisch, Stockburger, & Junghöfer, 2006). However, there are a number of reasons to assume that words should equally serve as motivationally relevant stimuli. Most humans are socialized via verbal learning processes. Consequently then, the affective value of a stimulus does not need to be transported by the stimuli itself (e.g. a snake) but can be triggered by the word. Indeed, if someone tells us about the dangerous nature of a stimulus, we usually adopt a similar fear reaction as when being confronted with the stimulus itself (Phelps et al., 2001). On a neural level, words are even associated with a similar

activation in brain structures that are usually activated when confronted with the stimulus itself (e.g. Herbert, 2007). Additionally, it is generally accepted that emotional stimuli become reinforced by means of different types of learning such as associative learning, priming, or by the significance an individual ascribes to the stimuli (e.g. Adolphs, 2003; Öhman, Flykt, & Esteves, 2001; LeDoux, 2000). Consequently, research using emotional words in behavioral and ERP studies has yielded similar results as research using affective pictures, faces and sounds. Databases comprising emotional words became more prominent during the last decades (e.g. Bradley & Lang, 1999; Herbert, Junghöfer, & Kissler, 2008). However, while electroencephalographic research assessing the impact of emotional faces in SAD is frequent (e.g. Kissler, Assadollahi, & Herbert, 2006), comparably little is known about emotional word processing in SAD. Recent studies reporting biased word processing in SAD only applied behavioral measures that did not allow for analyzing fine temporal dynamics.

Furthermore, the specificity of these effects is still unclear. Among those who applied emotional words, no study distinguished between their physical and social connotations. One goal of the first study was to fill this gap and examine whether reported effects of emotional word processing (e.g. Kissler et al., 2006; Scott, O`Donnell, Leuthold, & Sereno, 2009) can be found using socially threatening words, i.e. abusive swear words (or *insults*: see appendix A). A strong self-reference combined with a negative social connotation indicate their usefulness for the study of social threat processing. Swear words serve as a cue for an endangered social integrity (i.e. rank or group affiliation), possibly leading to social exclusion (Leary, 1990; Williams, 2001). As humans share a basic need for affiliation and social inclusion (Baumeister & Leary, 1995) socially threatening situations have shown to elicit intense emotional, behavioral and physiological stress responses (for a discussion see Corr, 2005; MacDonald & Leary, 2010, 2005). The purpose of Study #1 was to identify cortical responses to abusive swear words in a sample of healthy subjects. The main findings indicate that socially threatening words provoke a unique pattern of cortical response. While semantic processing resembles the level of other affective words (e.g. Kissler et al., 2006; Scott et al., 2009), facilitated processing at early stages was limited to positive and physically threatening words. Moreover, memory retrieval accuracy for socially threatening words was similar to that for physically threatening words.

Whereas the first study addressed social threat processing in healthy subjects, Study #2 investigated attention biases in SAD. The aim of the Study was to determine the specificity (e.g. Heinrichs & Hofmann, 2001) and temporal dynamics of attention biases using the same experimental paradigm as Study #1. Importantly, it included analyses of oscillatory activity during passive viewing of emotional words. As outlined above, recent research on the impact of social anxiety on emotional word processing suffers from two methodological limitations. First, the specificity hypothesis predicts differential biases in subjects with anxiety disorder depending on the individual and disorder-relevant schema (e.g. Heinrichs & Hofmann, 2001; Mathews & MacLeod, 1994). Tests of this assumption yielded mixed results (Asmundson & Stein, 1994; Becker et al., 2001; Hope et al., 1990; Mattia et al., 1993; Wilson & MacLeod, 2003), probably due to methodological limitations (Heinrichs & Hofmann, 2001). Moreover, the relevance of abusive swear words for the social self should be particularly evident in socially anxious subjects. Second, no study to date has applied electroencephalographic measures to investigate emotional word processing in SAD. Given the idea that threat processing can occur pre-attentively and without conscious processing (Yiend, 2010), behavioral paradigms may not be capable of mapping these fast temporal processes. Measuring ERPs however allows for excellent temporal resolutions.

The time course of threat processing is another critical aspect of current research. As mentioned above, attention biases differ in their direction (avoidance, hypervigilance) and temporal dynamics (e.g. sustained/ early hypervigilance or hypervigilance-avoidance). Research on this topic is fairly inconclusive and reveals a mixed pattern of results. Therefore, the second aim of Study #2 was to disentangle the time course of attention biases in SAD. Based on the body of ERP literature on SAD, we expected to find a hypervigilance among subjects with SAD, with an increased specificity in consecutive ERP components. As evidence for later avoidance is rare, the analyses of correlates of avoidance was rather explorative. In sum, subjects with SAD showed blunted sensory processing (P100) followed by a rapid processing of emotional words during early stages (EPN). At later stages, all subjects showed enhanced processing of negative (physically and socially threatening) compared to neutral and positive words (N400). Most importantly, frontal α activity (as inverse measure of cortical activation) was increased for negative words in SAD compared to controls. These findings are

consistent with a general avoidance and more specifically with the deactivation of a threat detection system at late stages of stimulus processing that is limited to SAD. Taken together, these results suggest that under certain conditions swear words are processed similarly to physically threatening words. Overall, our study lends support for an increase of specificity in the time course of emotional word processing in SAD that finally leads to cognitive avoidance.

Research presented in Study #3 applied the same experimental paradigms introduced in Study #1 and #2. By presenting facial expressions we extended our findings reported in Study #2. This helps answering the question whether facial expressions displaying a physical (i.e. anger) or social (i.e. disgusted) threat provoke similar or unique patterns of cortical activity. Specifically, we thought to answer two questions. First, most commonly EEG research using facial expressions compares responses between neutral and angry or fearful expressions (e.g. Eimer & Holmes, 2007; Mühlberger et al., 2009; Holmes, Vuilleumier, & Eimer, 2003). These investigations do not allow answering the question whether reactions to these faces reflect a perceived threat to physical or to social integrity. However, the discrimination of effects of socially or physically threatening faces might be important in the study of social anxiety. Human facial expressions serve as signal of social exclusion by connoting approval or disapproval (Amir, Klumpp, Elias, Bedwell, Yanasak, & Miller, 2005; Gilboa-Schechtman, Foa, & Amir, 1999). They represent useful cues for the detection of social threats (Amir et al., 2005; Schultz & Heimberg, 2008; Heinrichs & Hofmann, 2001). Contrary to the widespread utilization of angry facial expressions, disgust has been mostly neglected (Rossignol, Anserlerne, Vermeulen, Philippot, & Campanella, 2007). Since the facial expression of disgust is usually perceived as self-directed and induces the fear of being publicly humiliated or rejected (Amir et al., 2005; Phillips, Fahy, David, & Senior, 1998), it may represent a more disorder-specific cue than angry face (Adolphs, 2002; Amir et al., 2005). Therefore, we aimed at differentiating cortical responses to disgusted and angry faces. Moreover, emotional face processing in general can be divided into early and late stages (e.g. Frenkel & Bar-Haim, 2011). Nevertheless, theories on face processing are inconclusive with regard to the question whether expression is processed in a parallel or in a consecutive fashion with facial identity (Bruce & Young, 1986; Palermo & Rhodes, 2007; Haxby, Hoffman, & Gobbini, 2000). If an evolutionary and disorder-specific advantage lies in the early detection of threat cues, facial

expression should be processed before identity, especially in anxious individuals. Thus, Study #3 was conducted to analyze whether the impact of displayed emotion on face processing occurs at early or late stages of face processing. Behavioral and ERP data of Study #3 support the assumption of a very early hypervigilance to emotional relative to neutral faces, with the strongest bias to disgusted faces. At subsequent stages the differentiation between SAD and healthy subjects diminished and resulted in higher activity in response to a broader range of threatening cues.

In conclusion, all studies provide evidence for a distinct pattern of threat processing in SAD. Depending on stimulus characteristics this pattern reflects the fast hypervigilance to disorder-specific threatening cues. In emotional word processing this early hypervigilance seems to be followed by avoidance of negative words in SAD. Together the results highlight the importance of considering attention processes in the etiology and maintenance of social anxiety.

# 3 General discussion and outlook

In this section, I will first outline the main findings of this dissertation and then offer a broader theoretical framework in which these findings may be incorporated. In doing so I will abstain from repeating the main discussions of the three manuscripts. Finally, I will discuss the clinical implications and directions for further research.

In addressing different types of threat processing, the present research sheds light on two fundamental aspects of attention biases in SAD, i.e. the specificity and time course of threat processing. The present dissertation rests in parts on the development and evaluation of a stimulus set that allows us to differentiate between the impact of social and physical threat on word processing (Study #1). By using this novel approach, the current work provides the first electroencephalographic confirmation that social anxiety is associated with specific processing of threatening words. Considering a rather symbolic representation of anxious schemata in SAD, the emotional content of a written word appeared to have an impact on early and late stages of processing (Study #1 and #2). Early hypervigilance to emotional words was followed by more specific vigilance to negative words in particular. Finally, the direction of the attention bias shifted, leading to cognitive avoidance of negative words in SAD. More ecologically valid stimuli such as faces led to accelerated processing in SAD compared to healthy controls (Study #3), which was followed by anxiety-unspecific attention capture. However, a specific effect to disorder-relevant cues was only evident in response to emotional faces but not words. By testing theoretical aspects of information processing theories via measures that allow an high temporal resolution, different conclusions can be drawn from the present set of studies.

In general, this dissertation offers support for current cognitive theories on social anxiety. More importantly, it adds to recent research showing that socially threatening faces and threatening words in general direct attention in SAD. This adds to findings from behavioral paradigms and the limited research on emotion ERP effects in SAD. The observed attention biases suggest strongly that a pathological mechanism leading to early threat detection is triggered in SAD. Despite the fact that an impact of emotion on word processing does not seem to occur before lexical processing (see Kissler et al., 2006; Scott et al., 2009 for discussions on this topic), social anxiety seems to precede the sequence of stimulus processing, allowing for a faster detection of threat cues. As words tend to be evaluated as

weaker emotional stimuli than pictures (Kindt & Brosschot, 1997), emotion may not modulate word processing so easily. However, in SAD it seems that even symbolic representation of individual concerns or individual schemata are sufficient to activate an "anxiety program" (Schultz & Heimberg, 2008). This program in turn leads to attention capture that is followed by avoidance (see Study #2). Moreover, the functional aspect of this early emotion tagging becomes even more efficient when we turn to more ecologically valid stimuli such as facial expressions (see Study #3). Relying on a passive viewing task allowed us to analyze the pure assumptions derived from cognitive theories on social anxiety. However, as the specificity of the attention biases observed in our study is far from understood, questions about the interplay of schemata, anxiety networks and attention allocation in SAD remain.

From a theoretical viewpoint, the present findings indicate that social anxiety may accelerate the normal threat detection system found in healthy individuals. To date, there is a theoretical agreement that attention biases occur on a preconscious or automatic level (for a review see Cisler, Bacon, & Williams, 2009). Most theories assume that these biases, as well as threat processing in general, follow at least two consecutive steps. After an initial "quick and dirty" exploration of the threat value of a stimulus that follows almost dichotomous rules (threat: yes/no), a somewhat more elaborate analysis begins (Mogg & Bradley, 1998; Mathews & Mackintosh, 1998; Williams et al., 1988). Theories do not agree on the precise number of stages and the impact of consciousness on each stage. However, all models do converge on the fact that at least the initial registration of the threat value of a given stimulus should be automatic and outside of conscious awareness (Cisler et al., 2009). In this regard, our results add to a growing body of research showing a dissociation of the impact of social anxiety on early and late stages of stimulus processing (e.g. Gamble & Rapee, 2010; Staugaard, 2010). While the interference generated by social anxiety influences a broader spectrum of stimuli at early stages, it seems to be less interfering at later stages or even work in the opposite direction probably due to stimulus specific interference. If a stimulus is initially tagged as "possibly threatening", disorder-specific cognition and schemata might guide its further elaboration. Moreover, recent research has shown that if the experimental setup requires more elaborated tasks such as judgment or interpretation, differences in attention biases between socially anxious and non-anxious individuals

would practically vanish (e.g. Staugaard, 2010). Hence, it seems that in SAD biases are also apparent when no task is at hand. In this case it might only be the activated anxiety program demanding the quick detection of threats. It will be interesting to further elucidate whether this mechanism is due to passive (stimulus-driven) or active (goal-directed) attention control (Öhman et al., 2001).

The present insights into the temporal dynamics of threat detection in SAD contribute to our clinical understanding of social anxiety. Attention biases are now known to be important contributing factors that most likely precede cognitive disturbances in SAD (e.g. misinterpretation, judgment, negative self-perception). This underlines the need for the development of specific treatments that target attention biases. A first step towards such treatment has been made in recent years (Amir et al., 2008, 2009; Bögels et al., 2006; Heeren, Peschard, & Philippot, 2012b; Li, Tan, Qian, & Liu, 2008). According to this line of research, attention biases for threat have devastating consequences for the individual. They predict the relapse in patients treated for generalized anxiety (Bradley, Mogg, Millar, & White, 1995) and SAD (Lundh & Öst, 2001). Furthermore, they not only represent a risk factor for the relapse of anxiety but also play a causal role in increasing state anxiety (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002; Heeren et al., 2012b). At a clinical level, these biases can be addressed through attention training, in order to minimize the cognitive vulnerability to stress (Heeren et al., 2012b). Typically, these interventions comprise techniques aiming at improving the ability to disengage attention from threat cues. However, whether this effect can be purely attributed to an improvement in the ability to disengage attention from threat (disengagement hypothesis; e.g. Amir et al., 2003; Fox et al., 2001) or to an improvement in the flexibility of attention allocation (flexibility hypothesis; Wells, 2002) requires further research. More importantly, as both cognitive behavioral therapy (CBT) and attention training have proven effective (e.g. Heeren et al., 2012a; Gould, Buckminster, Pollack, & Otto, 1997), the conditions under which one might be superior over the other need to be understood. This question becomes even more important considering data indicating that instructions to maintain the focus of attention on the feared situation increase the efficacy of CBT (Wells & Papageorgiou, 1998).

Of further significance, our findings of accelerated threat processing might indicate an alteration of a basic fear processing mechanism in SAD. There is now ample evidence that threat

processing in general is embedded in neural networks (fear structure) that enable a rapid detection of threat (e.g. Foa & Kozak, 1986; Lang, 1979; Lang & Bradley, 2009). These networks react to environmental cues of danger with various behavioral, cognitive and affective responses to ensure the survival of the individual. A normal, non-pathological fear structure contains associations that reflect an accurate image of the reality (e.g. approaching grizzly in the forest → grizzly bears are dangerous → fear) leading to an accurate response initiation (→ I should run away). On the other hand, a pathological fear structure includes associations that do not reflect the reality leading to exacerbated fear response. This maladaptive response is well known in posttraumatic stress disorder (PTSD). In PTSD, activation of the fear network has been linked to an early attention bias towards threatening cues (e.g. Adenauer et al., 2010). However, it has been stated that fear networks might also be evident in other anxiety disorders, including SAD, with varying disorder-specific association. In fact, several authors reported distinct levels of specificity and coherence of fear structures in SAD among other anxiety disorders (Cutchbert, Lang, Strauss, Drobes, Patrick, & Bradley, 2003; Huppert & Foa, 2004). It seems that at least in some cases social anxiety might be viewed as activation of such an emotional network structure in memory (Huppert & Foa, 2004; Roelofs, Hagenaars, & Stins, 2010). This view extends current cognitive theories on social anxiety. Moreover, it suggests the presence of a network that is created by aversive and potentially socially traumatizing childhood experiences (Huppert & Foa, 2004). In fact, an association between a history of childhood maltreatment and social phobia has been documented (e.g. Gibb, Chelminski, & Zimmerman, 2007; Simon et al., 2009) and might be even stronger for emotional rather than physical or sexual types of maltreatment (e.g. Iffland, Sansen, Catani, & Neuner, 2012). Our findings of enhanced attention (EEG data, Study #2 and #3) and accelerated responses to threat cues in SAD (e.g. behavioral data, Study #2 and #3) corroborates this idea. Hence, early hypervigilance followed by avoidance in SAD might also be due to the activation of a fear network leading to accelerated responses to threat cues. This has important clinical implications as will be outlined in the following section.

As already stated, CBT has long been the state-of-the-art therapy for SAD. However, progress in interventions focusing on attention biases and the idea of widespread fear networks in SAD might suggest need for a reconsideration of current interventions. The mere presence of an anxiety network

in patients calls for emotion processing that is traditionally embedded in exposure therapy (Huppert & Foa, 2004; Foa & Kozak, 1986). The activation of the anxiety network accompanied with the incorporation of information that is incompatible with the fear structure via exposure therapy has proven effective in anxiety disorders (e.g. Hofmann & Smith, 2008). In fact, similarly to CBT, exposure therapy has also proven effectiveness in the treatment of SAD (Feske & Chambless, 1995). Therefore, I propose that specific treatments (CBT, attention training, exposure therapy) might be more suited for certain subgroups of patients suffering from SAD. For instance, it would be plausible to assume that social phobics who experienced extensive social traumata or bullying would show more specific attention biases than those who did not. It is known that a subgroup of SAD report traumatic social experiences (Erwin, Heimberg, Marx, & Franklin, 2006; Öst & Hugdahl, 1981; Stemberger, Turner, Beidel, & Calhoun, 1995). Therefore, I assume that these individuals might be particularly prone to signals of social traumata due to an elaborated and sensitized fear network. In fact, some subjects with SAD responded to stressful social memories with PTSD-type symptoms (Erwin et al., 2006). They also reported negative, spontaneous, recurrent images of socially stressful events that occurred around the time of the onset of their anxiety (e.g. Hackmann, Clark, & McManus, 2000). Thus, the likelihood of accessing an emotion not only increases by presenting a disorder-specific cue (e.g. Beck et al., 1985), but also by presenting a cue that matches the propositions within a broader fear network (Lang, 1987; Lang, Bradley, & Cutchbert, 1998). In turn, this would only be the case if such a network really exists. If the crucial mechanism of social anxiety in this specific subgroup of patients was the presence and activation of a fear structure, this would have important implications for the treatment of SAD. Consequently, treatment should include a modification of the fear structure by means of emotional processing via exposure therapy (see Huppert & Foa, 2004 for a discussion). Our findings are consistent with the proposition of a fear network as they illustrate early attention biases to threat cues. The absence of a specific effect of swear words might be due to the failure to disentangle patients with and without an active fear network. However, as faces are more general and ecological valid stimuli they might be more frequently embedded in fear structures, thus leading to more specific attention effects as reported in the present dissertation. Within a socially traumatizing event it seems comprehensible that the likelihood of being confronted with an angry or disgusted face is much higher

than the likelihood of being called *asshole*, *cunt* or *motherfucker*. In summary then, considering the existence of a fear network in some cases of SAD might help to understand the mixed pattern of results found in the attention bias literature.

All in all, ample evidence suggests that vigilance to threat cues along with other cognitive and behavioral factors comprise important building blocks in our understanding of SAD. Nevertheless, the specific role and interplay of these factors still requires further research. The absence of a specific effect of socially threatening words may be due to experimental conditions. Perhaps the necessary conditions for a specific effect to manifest requires a specific task that focuses on the processing of emotion rather than passive viewing. Most importantly, our results add to the existing literature suggesting that specific subgroups of individuals suffering from social anxiety are associated with different cognitive, attention and memory disturbances. The development of specific treatments targeting these subgroups demands further empirical support.

Future perspectives for research are derived when we consider a number of limitations of the present research. Apart from the inclusion of a task that allows us to differentiate between attention biases, different measures of attention and anxiety (electrophysiological, behavioral, psychophysiological and self-report) should be combined. To study the underlying mechanism a task comprising two competing stimuli and the combination of behavioral and electrophysiological measures is fairly essential, as biases are known to emerge when two stimuli are simultaneously presented (Wieser, Pauli, Reicherts, & Mühlberger, 2010; Gamble & Rapee, 2010). Under these conditions anxious participants seem to avoid threatening cues when there is an unthreatening alternative (Chen et al., 2002; Mansell et al., 1999). However, if the observed biases are truly due to difficulties in disengagement from threat, the hampered disengagement still has to be preceded by the detection of the threat cue. Without a competition for attention a final conclusion about the mechanism underlying these biases cannot be drawn. As the functional aspects of ERPs are known to be limited (Gordon, 2000), a combination of measures might help to further understand attention processes in social anxiety.

As social anxiety is associated with a strong self-focused bias, future studies might want to address the issue of self-relevance in more detail. As it has been recognized that manipulation of the

self-relevance influences face and word processing (Herbert et al., 2011; Schwarz, Wieser, Gerdes, Mühlberger, & Pauli, 2012) it would be interesting to observe, how the manipulation of self-relevance influences attention biases in SAD.

In order to disentangle the effect of different types and levels of anxiety future research should try to include anxiety control groups showing either nonclinical social anxiety or other forms of clinically significant anxiety. By doing so the specificity of attention biases and the impact on various types and levels of anxiety can be distinguished, leading to a better understanding of processes that maintain anxiety.

Moreover, the idea of a fear network that modulates the allocation of attention in SAD has important implications. Most prominent models of attention biases provide accounts of findings of general negative biases in anxious individual. These models do not account for specific biases (e.g. Huppert & Foa, 2004). A fear structure with individual associations based in idiosyncratic experiences may in turn account for specific attention biases. Moreover, if attention biases to threatening cues and the resulting emotional response are indeed due to the activation of such fear networks, current treatment approaches might be ineffective for these patients since the fear structure remains unchanged. Thus, future research might want to aim at differentiating between those patients with and without a disorder-specific fear network. If fear networks modulate attention biases in some patients with SAD, these patients need to be identified and given specific treatments. To optimize current CBT approaches, the implementation of emotion processing techniques could be helpful in addressing subgroups of SAD. While this line of research would naturally result in larger sample sizes, it would also offer the opportunity to develop specialized treatments.

Finally, as attention biases seem to contribute to the maintaining of social anxiety, more research on the possibly mediating role of attention biases in the effectiveness of current treatments is needed.

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