Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

Fakultät für
Psychologie und
Bewegungswissenschaft

DISSERTATION

Aufmerksamkeit für soziale Reize bei sozialer Angststörung

zur Erlangung des Doktorgrades der Naturwissenschaften

(Dr. rer. nat.)

dem Institut für Psychologie der Universität Hamburg
vorgelegt von

Richard Wermes

Hamburg, Juni 2018

Fakultät für Psychologie und Bewegungswissenschaft

Institut für Psychologie

Arbeitsbereich Klinische Psychologie und Psychotherapie

Vorsitzende des Promotionsprüfungsausschusses: Prof. Dr. Yvonne Nestoriuc

Erstes Dissertationsgutachten: Prof. Dr. Tania Lincoln

Zweites Dissertationsgutachten: Dr. Sylvia Helbig-Lang

Erstes Disputationsgutachten: Prof. Dr. Ulf Liszkowski

Zweites Disputationsgutachten: Prof. Dr. Lars Schwabe

Tag der Disputation: 30.10.2018

Danksagung

Zuallererst möchte ich mich bei Sylvia Helbig-Lang bedanken. Du hast mir viel Freiraum für Selbstständigkeit gegeben und du warst gleichzeitig immer da, wenn ich nicht weiterwusste oder aufbauende Worte brauchte. Ich bedanke mich herzlich für eine spannende Zeit, eine angenehme, produktive und immer wohlwollende Zusammenarbeit, bei der ich mich auf dich verlassen konnte und viel lernen durfte.

Ebenfalls möchte ich mich herzlich bei Tania Lincoln bedanken. Ich habe mich unter deiner Leitung an unserem Arbeitsbereich gut aufgehoben gefühlt. Auch auf deine Unterstützung konnte ich zählen und du warst mit deiner Erfahrung eine wichtige Richtungsgeberin für unsere gemeinsame Forschung.

Ich hatte das große Glück, in einem Team von Doktoranden zu arbeiten. Auf das was wir zusammen erlebt haben, auf euren Rat und eure Freundschaft hätte ich nicht verzichten wollen. Ich bedanke mich sehr für die großartige Zeit, für Kongressreisen, Feiern und Wegbegleitung insgesamt. Unbedingt hervorheben will ich dabei die statistische und emotionale Unterstützung von Katarina Krkovic sowie den technischen und evolutionstheoretischen Rat von Jürgen Kempkensteffen.

Ich danke ganz besonders meiner Familie und den Freunden, die mich durch das Auf und Ab meiner Promotion begleitet haben.

Schließlich wäre meine Promotion ohne die Unterstützung der vielen studentischen Mitarbeiterinnen nicht möglich gewesen, die sich engagiert an unserem Forschungsprojekt beteiligten. Ich bedanke mich herzlich bei Jana Mestmäcker, Celina von Eiff, Pelin Cekel, Freba Hamid, Justine Spieß, Lea Fischer und Anna Liedtke. Ebenfalls danke ich allen Probanden für ihre Teilnahme und damit für ihre Unterstützung der Forschung zu sozialer Angst.

Nicht zu vergessen ist Nader Amir, der mich offenherzig in seine Forschungsklinik aufnahm und mir damit prägende wissenschaftliche Eindrücke und aufregende Monate im kalifornischen San Diego bescherte.

Inhaltsverzeichnis

1. Zusammenfassung und Abstract

1.1. Zusammenfassung

Die soziale Angststörung zählt zu den häufigsten psychischen Störungen und bedeutet für Betroffene erhebliches Leiden und weitreichende Einschränkungen in vielen Lebens- und Funktionsbereichen. Kognitiv-behaviorale Störungsmodelle beziehen sich zur Erklärung der Aufrechterhaltung sozialer Angst explizit auf verzerrte Aufmerksamkeitsprozesse in Bezug auf bedrohliche soziale Reize, aber gleichzeitig bleibt deren genauere Beschaffenheit unklar. Die gegenwärtige Arbeit untersucht Aufmerksamkeit für soziale Reize bei sozialer Angststörung und setzt dabei auf ein kombiniertes Visual Search- und Eye-tracking-Paradigma. Im Unterschied zur Mehrheit bisheriger Studien konnten dadurch die psychometrische Güte verwendeter Verfahren sowie die Vermeidung visueller Reize bestimmt werden. Eine erste methodische Studie zeigte, dass Erstfixationslatenzen weniger intern konsistent sind als manuelle Reaktionszeiten im Hinblick auf die Messung erleichterter Hinwendung zu dargestellten Zielreizen. Dennoch waren beide Parameter durchgehend hoch korreliert, was für ihre konvergente Validität spricht. Eine zweite und zentrale Studie offenbarte einen Zusammenhang zwischen sozialer Angststörung und der Vermeidung bedrohlicher sozialer Reize sowie zwischen Angstaktivierung und Störbarkeit durch bedrohliche soziale Reize. Anders als zahlreiche bisherige Befunde fanden sich keine Hinweise auf eine schnellere Hinwendung oder verzögerte Abwendung in Bezug auf bedrohliche soziale Reize bei sozialer Angst. Eine dritte Studie zeigte, dass Probanden mit sozialer Angststörung sich in ihrer Wachsamkeit (Hypervigilanz) bei der Betrachtung sozialer Reize von gesunden Probanden unterscheiden. Ein spezifischer Zusammenhang zur Suche nach bedrohlichen sozialen Reizen konnte dabei nicht gefunden werden. In Anbetracht inkonsistenter bisheriger Befunde sprechen unsere Ergebnisse dafür verwendete methodische Paradigmen genauer zu untersuchen. Zukünftige Studien sollten zudem visuelle Vermeidung und Hypervigilanz stärker berücksichtigen. Vor jeglicher Ableitung therapeutischer Interventionen bedarf es zunächst weiterer Grundlagenforschung, um die genauere Beschaffenheit von Aufmerksamkeitsverzerrungen bei sozialer Angststörung aufzuklären.

1.2. Abstract

Social anxiety disorder is one of the most frequent mental disorders and involves considerable suffering as well as extensive limitations to many areas of life and activity. Cognitive-behavioral models explain the maintenance of social anxiety while explicitly referring to biased attentional processes with regard to threatening social stimuli. However, the specific characteristics of these biases remain unclear. The current work investigates attention for social stimuli in social anxiety disorder and relies on a combined visual search and eye tracking paradigm. In contrast to the majority of previous studies, our design allowed to measure the psychometric properties of applied methods as well as avoidance of visual stimuli. A first methodological study revealed that first fixation latencies were less internally consistent than manual response times in measuring facilitated attention towards presented target stimuli. Nevertheless, both measures were highly correlated throughout, indicating convergent validity. A second and most important study revealed a relation between social anxiety disorder and avoidance of threatening social stimuli as well as between anxiety induction and distraction by threatening social stimuli. Unlike numerous previous results, no indicators of facilitated attention or delayed disengagement considering threatening social stimuli were found according to social anxiety. A third study showed that participants with social anxiety disorder differed in their alertness (hypervigilance) while regarding social stimuli from healthy participants. A specific relation to the search for threatening social stimuli could not be found. With regard to the inconsistency of previous results, our findings suggest to further examine applied methodological paradigms. Moreover, future studies should further consider attentional avoidance and hypervigilance. Prior to any deduction of therapeutic interventions, additional fundamental research is required to clarify the specific characteristics of attentional biases in social anxiety disorder.

2. Soziale Angststörung

Das Leben von Menschen ist elementar durch soziale Situationen, also durch Begegnung mit anderen geprägt. Unser Erleben und Verhalten in solchen Situationen ist entscheidend dafür, wie sich zwischenmenschliche Beziehungen gestalten, wie sich berufliche Karrieren entwickeln und wie die Unterhaltung mit dem Busfahrer auf dem Weg zur Arbeit verläuft. Dementsprechend schwerwiegend kann es sein, wenn in sozialen Situationen Angst ein prägender Bestandteil des Erlebens ist. Soziale Angst bezieht sich auf die Befürchtung von anderen negativ bewertet zu werden (Wittchen & Hoyer, 2011). Dabei erstreckt sie sich von der subklinischen Dimension sozialer Ängstlichkeit bis hin zum pathologischen Zustand einer sozialen Angststörung (englisch: Social Anxiety Disorder; SAD). Einerseits kennt so gut wie jeder von uns Angst vor negativer Bewertung. In geringerer Ausprägung kann sie durchaus adaptiv sein und dabei helfen unser Verhalten so zu gestalten, dass andere uns die gewünschte Wertschätzung entgegenbringen. Andererseits bedeuten höhere, pathologische Ausprägungen sozialer Angst für Betroffene erhebliches Leiden und weitreichende Einschränkungen in vielen Lebens- und Funktionsbereichen (Fehm, Pelissolo, Furmark, & Wittchen, 2005; Stein & Kean, 2000).

SAD ist mit einer Lebenszeitprävalenz von 7 – 13% in westlichen Industrienationen eine der häufigsten psychischen Störungen (Furmark, 2002). Gefürchtete Situationen können sich auf Interaktionen im Allgemeinen beziehen, also zum Beispiel auf alltägliche Unterhaltungen. Andererseits können auch ausschließlich spezifische Leistungssituationen betroffen sein, bei denen man im Zentrum der Aufmerksamkeit steht, wie zum Beispiel bei Vorträgen. Dabei befürchten Betroffene sich in beschämender oder peinlicher Art und Weise zu verhalten (z.B. etwas Unangemessenes zu sagen) oder Angstsymptome zu haben, die andere sehen können (z.B. Erröten oder Zittern). Die Konfrontation mit angstauslösenden sozialen Situationen führt immer zu einer sofortigen Angstreaktion, wobei Betroffene ihre Ängste gleichzeitig als unverhältnismäßig und als stärker als bei anderen betrachten. Dementsprechend werden gefürchtete soziale Situationen vermieden oder nur unter intensiver Angst ertragen, was für Betroffene erhebliches Leiden bedeutet (Diagnostisches und Statistisches Manual Psychischer Störungen: DSM-5; American Psychiatric Association, 2013).

Es erscheint dabei bedeutend schwieriger gefürchtete soziale Situationen im Alltag zu vermeiden, als beispielsweise enge oder abgeschlossene Räume bei einer Klaustrophobie. Für das

Krankheitsbild der SAD ist im Unterschied zu anderen Angststörungen bemerkenswert, dass hier auch bei häufiger Konfrontation mit angstauslösenden Situationen kaum spontane Besserung zu beobachten ist (Clark & Ehlers, 2002). Als Ursachen dafür werden neben verschiedenen Formen von Sicherheitsverhalten (z.B. das Zurechtlegen von Sätzen um nichts Falsches zu sagen) auch Aufmerksamkeitsverzerrungen diskutiert.

3. Aufmerksamkeitsverzerrungen

Kognitiv-behaviorale Störungsmodelle beziehen sich zur Erklärung der Aufrechterhaltung sozialer Angst explizit auf verzerrte Aufmerksamkeitsprozesse in Bezug auf bedrohliche soziale Reize, sogenannte Attentional Biases to Threat (ABT; z.B. Heinrichs & Hofmann, 2001). Derartige Aufmerksamkeitsverzerrungen können zum Beispiel sichtbare Anzeichen von Missfallen betreffen, wie etwa ein Stirnrunzeln oder Gähnen beim Gegenüber. Die große Mehrzahl bisheriger Studien zu ABT thematisieren eine selektive, also besondere Aufmerksamkeit für bedrohliche Reize (Cisler & Koster, 2010). Verschiedene klinische Modelle beziehen sich außerdem auf Hypervigilanz, als weitere Manifestation von ABT und Ausdruck erhöhter Wachsamkeit für bedrohliche Reize, die im Unterschied zu selektiver Aufmerksamkeit auch unabhängig von sichtbarer Bedrohung relevant sein kann (Richards, Benson, Donnelly, & Hadwin, 2014). Neben ABT, also Aufmerksamkeitsverzerrungen in Bezug auf externe Reize, berücksichtigen klinische Modelle außerdem Aufmerksamkeitsverzerrungen in Bezug auf interne Reize, sogenannte Selbstaufmerksamkeit (Clark & Wells, 1995; Rapee & Heimberg, 1997). Während die Bedeutung von Selbstaufmerksamkeit bei SAD relativ gut verstanden ist und hier ein kausaler Zusammenhang zum Erleben sozialer Angst nachgewiesen werden konnte (Woody, 1996), bleiben Theorien und Befunde zu ABT bisher heterogen. Trotz der Bedeutung, die klinische Modelle ABT zuweisen, bleibt deren genauere Beschaffenheit bisher unklar und bedarf weiterer grundlegender Forschungsarbeit. In ihrer Übersichtsarbeit integrieren Cisler und Koster (2010) Befunde zu ABT bei Angst zu einem übergreifenden Modell. Dabei gehen sie, ähnlich wie auch andere Modelle zur Informationsverarbeitung bei Angst (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Eysenck, Derakshan, Santos, & Calvo, 2007) von einem gestuften Prozess aus. Demnach sind in frühen Phasen der Informationsverarbeitung automatische Prozesse zur Entdeckung von bedrohlichen Reizen relevant, die im Zusammenhang mit der Aktivität der Amygdala stehen. Die darauffolgende zielgerichtete Verarbeitung wird mit

willentlichen Prozessen und der exekutiven Funktion des präfrontalen Kortex in Verbindung gebracht, wobei hier Emotionsregulationsstrategien als Mediatoren angenommen werden. Konkrete Formen von ABT kommen demnach durch die Interaktion beider Systeme zustande, mediiert durch Strategien und Fähigkeiten zur Emotionsregulation und Aufmerksamkeitskontrolle sowie durch neuronale Mechanismen.

In Bezug auf die Behandlung von SAD kann die weitere Erforschung von ABT kann nützlich sein, um aufrechterhaltende Faktoren der Störung zu verstehen und dadurch therapeutische Interventionen zu verbessern. Obwohl vor allem kognitive Verhaltenstherapie bereits wirksame Verfahren zur Behandlung von SAD bereitstellt, bleibt weitere Grundlagenforschung hier wichtig. Zwar konnten vor allem für Expositionsverfahren mittlere Effektstärken nachgewiesen werden (Gould, Buckminster, Pollack, Otto, & Yap, 1997; Ruhmland & Margraf, 2001), dennoch können nicht alle Patienten davon profitieren. So fanden zum Beispiel Harb und Heimberg (2002), dass mehr als 40% der Teilnehmer eine kognitiv-behavioralen Gruppentherapie nicht erfolgreich abschließen.

3.1. Methodische Grundlagen

Die umfangreiche, aber inkonsistente Befundlage zu ABT bedarf der besonderen Betrachtung dabei zugrundeliegender Methoden. Hier finden sich verschiedene experimentelle Paradigmen bei denen direkt oder indirekt die Aufmerksamkeit von Probanden in Bezug auf visuelle Reize gemessen wird (vgl. Cisler & Koster, 2010). Dabei basiert der Großteil empirischer Befunde auf manuellen Reaktionszeitparadigmen, die manuelle Reaktionen messen und sie als indirekte Indikatoren für visuelle Aufmerksamkeit in Bezug auf präsentierte Reize interpretieren. Unter Anderem werden dabei Visual Probe (z.B. Bradley, Mogg, White, Groom, & de Bono, 1999), Emotional Cueing (z.B. Fox, Russo, Bowles, & Dutton, 2001), Emotional Stroop (z.B. Williams, Mathews, & MacLeod, 1996), und Visual Search Paradigmen (z.B. Juth et al., 2005) verwendet. Visual Probe Paradigmen wurden dabei am häufigsten benutzt, aber auch gleichzeitig wiederholt für eine unzureichende psychometrische Güte kritisiert (z.B. Schmukle, 2005; Staugaard, 2009). Darüber hinaus ist mit manuellen Reaktionszeitparadigmen im Allgemeinen keine genauere Unterscheidung zwischen Aufmerksamkeitslenkung, Verarbeitung wahrgenommener Reize und manueller Reaktion möglich (vgl. Mogg, Holmes, Garner, & Bradley, 2008).

Im Gegensatz zu den häufiger verwendeten Visual Probe- und Emotional Cueing-Paradigmen könnten Visual Search-Paradigmen (e.g., Juth, Lundqvist, Karlsson, & Öhman, 2005; Rinck, Becker, Kellermann, & Roth, 2003) ökologisch valider sein, insofern hier mehrere Reize gleichzeitig und anhand von verschiedenen Aufgabentypen präsentiert werden. Damit könnten natürliche Situationen, in denen typischerweise mehrere visuelle Reize um Aufmerksamkeit konkurrieren, besser abgebildet werden. Genauer sehen Visual Search-Paradigmen vor, dass Anordnungen mehrerer visueller Reize (z.B. eine Menge von Fotografien von Gesichtern) präsentiert werden, wobei Probanden durch Tastendruck so schnell wie möglich auf definierte Zielreize reagieren sollen. Unterschiede anhand von manuellen Reaktionszeiten in Bezug auf bedrohliche und nicht bedrohliche Reize werden dementsprechend als Hinweise auf ABT interpretiert. Genauer sprechen schnellere Reaktionen auf bedrohliche Reize für eine erleichterte Hinwendung, während langsamere Reaktionen auf neutrale Reize vor einem Hintergrund von bedrohlichen Reizen als verzögerte Abwendung interpretiert werden können. Trotz ihrer bisher nur seltenen Verwendung konnten Visual Search-Paradigmen Hinweise auf verschiedene Komponenten von ABT bei sozialer Angst zeigen (Eastwood et al., 2005; Gilboa-Schechtman, Foa, & Amir, 1999; Juth et al., 2005).

Während manuelle Reaktionszeitparadigmen indirekt auf visuelle Aufmerksamkeitsprozesse schließen lassen, bedeuten Eye-tracking-Paradigmen eine direktere Erfassung. Hier werden Augenbewegungen durch Infrarotkameras gemessen und damit ein direkterer Zugang zur raumzeitlichen Verteilung von offener Aufmerksamkeit ermöglicht (z.B. Kowler, Anderson, Dosher, & Blaser, 1995; Mogg, Millar, & Bradley, 2000). Offene Aufmerksamkeit für visuelle Reize umfasst im Gegensatz zu verdeckter Aufmerksamkeit die Ausrichtung der Fovea, den zentralen Punkt der Retina (Hoffman, 1998). Demnach kann angenommen werden, dass Augenbewegungen eng mit visueller Aufmerksamkeit verbunden sind, wobei verdeckte Aufmerksamkeitsprozesse hier nicht abgebildet werden können (Kowler et al., 1995). Eye-tracking-Parameter umfassen die Zeit bis zur ersten Fixation einer Zielregion (Erstfixationslatenz), die Fixationsdauer, die Fixationshäufigkeit und den Blickbewegungspfad. Dabei werden häufig Free Viewing-Aufgaben verwendet, bei denen präsentierte Reize frei von genaueren Handlungsanweisungen betrachtet werden sollen. Eye-tracking-Paradigmen erlauben im Gegensatz zu manuellen Reaktionszeitparadigmen eine genauere zeitliche und räumliche

Erfassung visueller Aufmerksamkeit, was die Bedeutung dieser experimentellen Methode zur Erfassung von ABT verdeutlicht. Dennoch gibt es nur wenige bisherige Studien zu ABT bei sozialer Angst anhand von Eye-tracking-Paradigmen allein oder in Kombination mit manuellen Reaktionszeitparadigmen (Buckner et al., 2010; Gamble & Rapee, 2010; Garner et al., 2006; Schofield et al., 2012; Singh et al., 2015). Weitere Forschung, die auf einer solchen Kombination aufbaut, könnte vielversprechend sein, insofern Aufmerksamkeitsprozesse damit umfassender, aus direkter und indirekter Perspektive abgebildet werden können. Darüber hinaus ergibt sich damit die Möglichkeit die psychometrische Güte beider Verfahren parallel zu untersuchen.

Insgesamt ist in Anbetracht inkonsistenter Befunde eine grundlegende Erforschung der psychometrischen Güte verwendeter Methoden naheliegend, wobei es dazu bisher überraschenderweise nur wenige Studien gibt. Erste Ergebnisse zeigen für Rohwerte manueller Reaktionszeiten in Bezug auf einzelne Reiztypen weitgehend akzeptable bis exzellente Reliabilität (Brown et al., 2014; Eide, Kemp, Silberstein, Nathan, & Stough, 2002; Waechter, Nelson, Wright, Hyatt, & Oakman, 2014). Im Gegensatz dazu waren Differenzwerte, die zum Vergleich von Rohwerten zu verschiedene Reiztypen und als Indikation von ABT dienen, in den meisten Fällen nicht reliabel (Brown et al., 2014; Eide et al., 2002; Schmukle, 2005; Staugaard, 2009; Waechter et al., 2014; Waechter & Stolz, 2015). Bisherige Studien fanden nur geringe (Brosschot, De Ruiter, & Kindt, 1999; Brown et al., 2014; Egloff & Hock, 2003; Waechter & Stolz, 2015) oder keine (Dalgleish et al., 2003; Gotlib et al., 2004; Mogg, Bradley, et al., 2000) Korrelationen zwischen Differenzwerten verschiedener manueller Reaktionszeitparadigmen und geben damit kaum Hinweise auf konvergente Validität. Bisher existiert nur eine Studie zur Reliabilität und Validität eines Eye-Tracking-Paradigmas zur Erfassung von ABT (Waechter et al., 2014). Dabei waren Differenzwerte teilweise reliabel, aber weitgehend nicht korreliert mit Differenzwerten einer Visual Probe-Aufgabe, zeigten also keine Hinweise auf konvergente Validität. Insgesamt bleibt demnach unklar, inwiefern direkte und indirekte Maße zur Erfassung visueller Aufmerksamkeit geeignet, also reliabel und valide sind. Darin könnte ein wichtiger Grund für die Inkonsistenz empirischer Befunde zu ABT liegen (Cooper et al., 2011; Waechter & Stolz, 2015).

3.2. Selektive Aufmerksamkeit

Trotz zahlreicher Befunde, die die Bedeutsamkeit von ABT in Form von selektiver Aufmerksamkeit für soziale Angst herausstellen, bleibt bisher ungeklärt, wie derartige

Verzerrungen genauer beschaffen sind. Als mögliche Komponenten werden dazu in der Forschung erleichterte Hinwendung (Vigilanz), verzögerte Abwendung und Vermeidung in Bezug auf bedrohliche soziale Reize diskutiert (Cisler & Koster, 2010). Eine konkrete, angstbesetze soziale Situation könnte zum Beispiel das Sprechen vor anderen bedeuten. Bedrohliche soziale Reize könnten dabei zum Beispiel kritische Blicke bedeuten, wobei eine selektive Aufmerksamkeit in Bezug darauf die Aufrechterhaltung sozialer Angst zur Folge hätte. Erleichterte Hinwendung bedeutet dabei, dass der Blick schneller auf bedrohliche Reize gerichtet wird, während verzögerte Abwendung eine verlängerte Betrachtung bedrohlicher Reize und deren Vermeidung eine Abwendung des Blickes davon bedeutet. Seltener wird hier auch eine Störbarkeit oder Ablenkbarkeit durch bedrohliche soziale Reize als weitere mögliche Komponente berücksichtigt (Rinck, Reinecke, Ellwart, Heuer, & Becker, 2005). Hinsichtlich einer genaueren Erklärung, welche dieser Bestandteile inwiefern für soziale Angst bedeutsam sind, weisen Befunde und Erklärungsmodelle zum Thema in verschiedene Richtungen. Während klinische Modelle einheitlich annehmen, dass soziale Angststörungen mit einer initial erleichterten Hinwendung zu bedrohlichen sozialen Reizen einhergehen, besteht Uneinigkeit in Bezug auf nachfolgende Aufmerksamkeitsprozesse. Clark und Wells (1995) nehmen an, dass sozial ängstliche Menschen bedrohliche soziale Reize vermeiden, insofern sie ihre Aufmerksamkeit verstärkt auf sich selbst richten und so Informationen ignorieren, die ihre Ängste widerlegen könnten. Damit wird ein Vigilanz-Vermeidungs-Muster impliziert, bei dem auf eine initial erleichterten Hinwendung zu bedrohlichen Reizen, eine Vermeidung bedrohlicher Reize folgt (Vigilanz-Vermeidungs-Hypothese; z.B. Mogg, Bradley, Miles, & Dixon, 2004). Im Unterschied dazu gehen Rapee und Heimberg (1997), wie auch Heimberg, Brozovich und Rapee (2010) davon aus, dass Aufmerksamkeit für bedrohliche soziale Reize bei sozial ängstlichen Personen generell verstärkt ist. Dementsprechend folgt auf eine erleichterte Hinwendung eine verzögerte Abwendung in Bezug auf bedrohliche soziale Reize.

Empirische Studien zu ABT bei sozialer Angst und SAD konnten Hinweise auf erleichterte Hinwendung (Eastwood et al., 2005; Gamble & Rapee, 2010; Gilboa-Schechtman, Foa, & Amir, 1999; Juth, Lundqvist, Karlsson, Ohman, & Öhman, 2005, Studie 5; Mogg & Bradley, 2002; Mogg, Philippot, & Bradley, 2004) und Vermeidung (Garner et al., 2006; Singh et al., 2015) finden. Allerdings gelang es den meisten Studien nicht, das zeitliche Muster nachzuweisen, welches die

Vigilanz-Vermeidungs-Hypothese postuliert, also eine erleichtere Hinwendung gefolgt von einer Vermeidung (Garner et al., 2006). Im Gegensatz dazu fanden andere Studien Hinweise auf verzögerte Abwendung von bedrohlichen sozialen Reizen (Amir, Elias, Klumpp, & Przeworski, 2003; Buckner et al., 2010; Schofield et al., 2012) oder keine Hinweise auf ABT bei sozialer Angst (Juth et al., 2005, studies 1 - 3; Rinck, Becker, Kellermann, & Roth, 2003). Als weitere mögliche Komponente von ABT, die bisher nur selten berücksichtigt wurde, untersuchten Rinck, Becker, Kellermann, & Roth (2003) eine erhöhte Störbarkeit durch bedrohliche soziale Reize. Insgesamt zeigt sich die Befundlage demnach als inkonsistent.

Neben dem Aspekt der psychometrischen Güte verwendeter Paradigmen könnten weitere Ansätze hilfreich sein, um diese Inkonsistenzen aufzuklären. Hier könnte die Unterscheidung zwischen Trait-Angst als übergreifendes Merkmal (indiziert durch die Diagnose einer sozialen Angststörung) und State-Angst als situatives Merkmal und momentane Reaktion auf eine akute Bedrohung wichtig sein. Es ist unklar, inwiefern ABT inhärente Eigenschaften hoher Trait-Angst sind oder ob sie erst durch State-Angst ausgelöst werden. Empirische Studien zum Thema beinhalten durchweg die Präsentation bedrohlicher sozialer Reize, also zum Beispiel ärgerliche Gesichter. Hier ist anzunehmen, dass Effekte von Trait- und State-Angst konfundiert sind, insofern Personen mit höheren Werten für Trait-Angst dazu tendieren Reize als bedrohlicher wahrzunehmen (z.B. Stopa & Clark, 2000). Nur wenige Studien haben die Effekte von Trait- und State-Angst durch eine Manipulation von State-Angst verglichen (z.B. Quigley, Nelson, Carriere, Smilek, & Purdon, 2012). Einzelne Ergebnisse deuten dabei darauf hin, dass eine erleichterte Hinwendung für bedrohliche soziale Reize eher mit State- als Trait-Angst zusammenhängt.

Aus theoretischer Perspektive passt die Unterscheidung von Trait- und State-Angst gut in den Rahmen der Attentional Control Theory (Eysenck, Derakshan, Santos, & Calvo, 2007), als übergeordnetes Modell angstspezifischer Informationsverarbeitung. Der Attentional Control Theory zufolge funktioniert Informationsverarbeitung als gestufter Prozess durch die Interaktion von zwei Systemen. Dabei reagiert ein "stimulus-driven attentional system" automatisch auf relevante Reize (bottom-up), während ein "goal-directed attentional system" als exekutive Steuerung der Informationsverarbeitung (top-down) agiert. Es folgt also auf eine schnelle und automatische Verarbeitung potenziell relevanter Reize eine schemabezogene Verarbeitung in späteren Phasen der Informationsverarbeitung, die von individuellen Strategien und Fähigkeiten

zur Aufmerksamkeitsregulation abhängt. Eine Aktivierung des Furchtnetzwerkes, also erhöhte State-Angst, führt gemäß der Attentional Control Theory zu einer Verschiebung des Gleichgewichts zwischen beiden Systemen der Informationsverarbeitung, hin zu einer verstärkten automatischen Verarbeitung möglicher Bedrohungsreize. Dieses grundsätzliche Verständnis vom Zusammenhang von Angstaktivierung und Informationsverarbeitung lässt sich auch auf den spezifischen Zusammenhang von explizit sozialer Angst und visueller Aufmerksamkeit für soziale Reize übertragen. Angstaktivierung könnte demnach zu gesteigerter Ausrichtung von Aufmerksamkeit auf bedrohliche Reize und dementsprechend zu erleichterter Hinwendung und verzögerter Abwendung führen. Darüber hinaus könnte man annehmen, dass State-Angst auch mit einer erhöhten Störbarkeit durch bedrohliche Reize einhergeht, insofern man hier davon ausgehen kann, dass Aufmerksamkeitsressourcen vermehrt in Anspruch genommen werden. Demgegenüber wird die Trait-Komponente von Angst generell eher mit einer Vermeidung negativer Emotionen und damit dem „goal-directed system“ assoziiert (Clark, 2001). Dieses vermeidungsorientierte Schema könnte sich bei sozialer Angst auch in Aufmerksamkeitsverzerrungen niederschlagen und nach einer initial erleichterten Hinwendung zu bedrohlichen sozialen Reizen zu deren Vermeidung führen (Wadlinger & Isaacowitz, 2011). Die Unterscheidung unterschiedlicher Effekte von Trait- und State-Merkmalen sozialer Angst könnte ein wichtiger Aspekt sein, dessen Vernachlässigung zur aktuellen heterogenen Befundlage beigetragen haben könnte.

Es bleibt festzuhalten, dass zahlreiche Studien Aufmerksamkeitsverzerrung in Form von selektiver Aufmerksamkeit für bedrohliche soziale Reize bei Personen mit SAD zeigen konnten (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). Dennoch ist die genauere Beschaffenheit solcher ABT sowie die psychometrische Güte verwendeter Paradigmen weiterhin unklar. Es bleibt offen, inwiefern ABT von potentiellen Einflussfaktoren wie State-Angst und verwendeten Paradigmen abhängen. Darüber hinaus weisen klinische Modelle vor allem im Hinblick auf Aufmerksamkeitsprozesse nach einer initialen Orientierung in verschiedene Richtungen und nehmen entweder Vermeidung oder verzögerte Abwendung in Bezug auf bedrohliche soziale Reize an.

3.3. Hypervigilanz

Hypervigilanz bedeutet eine weitere Manifestation von ABT und wird als erhöhte Wachsamkeit für Bedrohung definiert (Richards et al., 2014). Dazu wird die visuelle Umgebung durch vermehrte Augenbewegungen oder anhand eines breiten Aufmerksamkeitsfokus intensiv nach bedrohlichen Reizen abgesucht. Im Gegensatz zu selektiver Aufmerksamkeit für bedrohliche soziale Reize gibt es dazu bisher nur wenige Studien, obwohl verschiedene kognitive Modelle Hypervigilanz ebenfalls Bedeutung für die Aufrechterhaltung von SAD zuschreiben (Beck, Emery, & Greenberg, 2005; Eysenck, 1992; Rapee & Heimberg, 1997). Aus evolutionärer Perspektive kann Hypervigilanz einen Überlebensvorteil bedeuten: Laut Richards et al. (2014) fördert sie das Entdecken von Gefahren in Form von bedrohlichen Reizen bei ängstlichen Personen. Hypervigilanz könnte darüber hinaus vor allem bei Angststörungen ausgeprägt sein, die durch umfassende Erwartungsangst geprägt sind. Die dabei zentrale, ständige Antizipation potenzieller Bedrohung (Barlow, 2002) findet sich bei Personen mit SAD (Rapee & Heimberg, 1997; Tancer, 1997). Ebenfalls nimmt die Attentional Control Theory an, dass Aufmerksamkeitsprozesse bei ängstlichen Personen durch exzessives Absuchen der visuellen Umgebung (Hypervigilanz) geprägt sind. Darauf folge wiederum die Einengung von Aufmerksamkeit, sobald ein potenziell bedrohlicher Reiz entdeckt wurde (selektive Aufmerksamkeit). Dementsprechend sollte Hypervigilanz als übergeordnetes Aufmerksamkeitsmuster gerade ohne sichtbare bedrohliche Reize beobachtbar sein.

In experimentellen Studien wird Hypervigilanz in Form vermehrter Blickbewegungen anhand von Eye-tracking-Verfahren untersucht (Richards et al., 2014). Genauer werden dazu Blickbewegungspfadlängen (die Strecke, die eine Person mit ihrer Blickbewegung zurücklegt) und Fixationshäufigkeiten (Häufigkeiten gezielter Betrachtungen einzelner Bereiche) bestimmt. Horley, Williams, Gonsalvez und Gordon (2003, 2004) untersuchten Hypervigilanz bei Betrachtung von einzeln gezeigten Fotografien emotionaler Gesichtsausdrücke in einem Free Viewing-Paradigma. Bei diesem Paradigma werden im Allgemeinen visuelle Reize präsentiert und Blickbewegungen in Bezug darauf gemessen, wobei Probanden ohne weitere Anweisungen die präsentierten Reize betrachten sollen. Dabei zeigten Probanden mit SAD im Vergleich zu gesunden Probanden erhöhte Blickbewegungspfadlängen, besonders bei Betrachtung bedrohlicher sozialer Reize in Form von ärgerlichen Gesichtern. Demgegenüber waren Ergebnisse

in Bezug auf Fixationshäufigkeiten weniger konsistent. Horley et al. (2003) fanden Hinweise auf verringerte Fixationshäufigkeiten bei SAD während Horley et al. (2004) hier keine Unterschiede zu gesunden Probanden finden konnten. Chen et al. (2015) verwendeten ebenfalls ein Free Viewing-Paradigma und darüber hinaus eine State-Angst Induktion. Dazu mussten alle Probanden eine Präsentation vor einem voraufgezeichneten Videopublikum halten. Auch hier zeigten Probanden mit SAD erhöhte Blickbewegungspfadlängen, jedoch keine Unterschiede anhand von Fixationszahlen, die als zusätzlicher Indikator für Hypervigilanz diskutiert werden. Effekte von Trait- und State-Komponenten sozialer Angst wurden hier nicht unterschieden, da alle Probanden die State-Angst-Induktion durchliefen. Insgesamt legen die wenigen bisherigen Studien nahe, dass SAD tatsächlich mit hypervigilanten Aufmerksamkeitsmustern einhergehen könnte. Für Behandlungsoptionen könnte Hypervigilanz demnach eine wichtige Rolle spielen, insofern bisherige Interventionen zu SAD, die auf die Modifikation selektiver Aufmerksamkeit abzielen keine Langzeiteffekte zeigen konnten (Cristea, Kok & Cuijpers, 2015; Heeren, Mogoase, Philippot & McNally, 2015).

In Anbetracht der geringen Zahl bisheriger Studien bedarf es weiterer Forschung, um aufzuklären, inwiefern Hypervigilanz mit SAD zusammenhängt. Vor allem Variationen experimenteller Paradigmen sowie der Einfluss von State-Angst-Aktivierung sollten dazu genauer untersucht werden.

4. Relevanz und Ziel

Die Relevanz dieser Arbeit ergibt sich zunächst aus dem Stand der Forschung zum Thema Aufmerksamkeit für soziale Reize bei sozialer Angst. Obwohl kognitiv-behaviorale Störungsmodelle durchweg die Bedeutsamkeit von ABT bei SAD betonen, bleiben empirische Befunde inkonsistent (vgl. Cisler & Koster, 2010). Hier bleibt die genauere Beschaffenheit von ABT bei SAD sowohl im Hinblick auf selektive Aufmerksamkeit als auch anhand von Hypervigilanz unklar. Ebenfalls unklar bleibt die psychometrische Güte der dabei verwendeten experimentellen Paradigmen. Schließlich ist hier auch ein Anwendungsbezug wichtig: Durch ein besseres Verständnis von SAD kann man auch auf eine Verbesserung darauf aufbauender klinischer Interventionen hoffen. Im Besonderen werden gegenwärtig computerbasierte Aufmerksamkeitsmodifikationstrainings diskutiert, die darauf ausgelegt sind Aufmerksamkeitsverzerrungen und dadurch auch gegebene Symptome zu verringern. Hier zeigt

sich das bestehende Verständnis von Aufmerksamkeitsverzerrungen als unzureichend, um aufzuklären inwiefern derartige Ansätze hilfreich sein können.

Ziel dieser Arbeit war die Erforschung von Aufmerksamkeit für soziale Reize bei sozialer Angststörung im Hinblick auf ABT. Grundlegend wurde dazu zunächst die psychometrische Güte verwendeter Methoden zur Aufmerksamkeitsmessung erforscht. Hier sollte unsere Untersuchung zur Klärung der Frage beitragen, inwiefern verwendete experimentelle Paradigmen geeignet sind, um visuelle Aufmerksamkeit zu abzubilden. Darauf aufbauend war unser zentrales Ziel die Messung verschiedener Ausprägungen von ABT (erleichterte Hinwendung, verzögerte Abwendung, Vermeidung, Störbarkeit und Hypervigilanz) in Abhängigkeit von Trait- und State-Merkmalen sozialer Angst. Dazu wurden Probanden mit SAD und gesunde Probanden sowie eine State-Angst-Induktion und eine Kontrollbedingung eingeschlossen. Die Kombination von direkten und indirekten Maßen sollte als umfassender und neuartiger methodischer Ansatz dienen. Dabei wurde Aufmerksamkeit für soziale Reize durch ein kombiniertes Visual Search und Eye-Tracking-Paradigma erfasst.

5. Forschungsdesign

Um unser Vorhaben systematisch umzusetzen, wurden drei Studien durchgeführt, die sich auf eine umfassende Datenerhebung stützen. Alle verwendeten Methoden wurden durch die Ethikkommission der Deutschen Forschungsgemeinschaft befürwortet (DFG-Nr.: SHL012014).

Probanden

Eingeschlossen wurden Probanden mit SAD sowie eine gesunde Kontrollgruppe. Die Rekrutierung wurde mit gedruckten Aushängen auf lokalen Anschlagtafeln und auf einer lokalen Website für Stellengesuche durchgeführt. Dabei fragte der Aushang für die SAD-Gruppe nach Probanden mit Angst in sozialen Situationen, während der Aushang für die Kontrollgruppe schlicht nach Probanden fragte, die interessiert sind an einer Studie zu Aufmerksamkeitsprozessen teilzunehmen. Beide Aushänge enthielten darüber hinaus wesentliche Einschlusskriterien sowie Informationen zum Studienablauf. Eine Gesamtzahl von 445 Probanden zeigte Interesse an einer Studienteilnahme und 315 davon nahmen an einem Telefon-Screening zu generellen Einschlusskriterien teil. Daraufhin durchliefen 187 Probanden ein diagnostisches Interview und 140 Probanden die vollständige Studie. Entsprechend

unterschiedlicher Anforderungen an die Vollständigkeit der erhobenen Daten, variieren die genaueren Probandenzahlen der nachfolgend dargestellten Studien.

Generelle Einschlusskriterien umfassen a) Alter zwischen 18 und 65 Jahren, b) Informed Consent, c) ausreichende Deutschkenntnisse, d) Rechtshändigkeit, e) keine unkorrigierten Sehstörungen oder harte Kontaktlinsen und f) keine Medikation die Aufmerksamkeit oder Reaktionszeit beeinträchtigen könnte (einschließlich Benzodiazepine, Antihistaminika, Schmerzmittel und Augentropfen). Für die gesunde Kontrollgruppe durften Probanden keine Lebenszeitdiagnose einer affektiven, psychotischen oder Substanzstörung aufweisen. Andere psychische Störungen mussten hier mehr als fünf Jahre zurückliegen (ausgenommen Nikotinabhängigkeit). Für die klinische Gruppe mussten Probanden die DSM-IV Kriterien einer SAD erfüllen. Darüber hinaus durften sie keine Lebenszeitdiagnose einer bipolaren, psychotischen oder Substanzstörung haben und keine kürzliche (weniger als sechs Wochen vor Einschluss) Aufnahme oder Änderung psychopharmakologischer Medikation.

Messinstrumente

Die Diagnose einer SAD wurde anhand des *Strukturierten Klinischen Interviews für DSM-IV* (Wittchen, Zaudig, & Fydrich, 1997) von entsprechend geschulten Studenten oder ausgebildeten Psychologen durchgeführt. Trait-Komponenten sozialer Angst wurden neben der diagnostischen Einteilung auch anhand von Selbstberichtfragebogen erfasst, vor allem anhand des *Liebowitz Soziale Angst-Skala* (Liebowitz, 1987; German: Stangier & Heidenreich, 2005). Das *State-Trait-Angstinventar* (Laux, Glanzmann, Schaffner, & Spielberger, 1981) diente zur Erfassung von State-Komponenten sozialer Angst und der Manipulationskontrolle zur durchgeführten State-Angst-Induktion. Darüber hinaus kontrollierten wir unter anderem für Depressivität, anhand des *Beck Depressionsinventars* (Beck, Steer, & Brown, 1996; German: Hautzinger, Keller, & Kühner, 2006).

Aufmerksamkeitsmessung

Als Stimuli wurden Fotografien von fröhlichen, neutralen und ärgerlichen Gesichtsausdrücken aus der Radboud Faces Database (Langner et al., 2010) verwendet. Genauer wurden dazu drei männliche und drei weibliche Darsteller ausgewählt, deren Emotionsausdruck in einer Validierungsstudie am höchsten bewertet wurde (Langner et al., 2010). Einzelne Stimuli wurden dabei als Stimulus Sets präsentiert, bestehend aus kreisförmigen Anordnungen von jeweils acht Gesichtern (Juth et al., 2005, siehe Abbildung 1). Hier lassen sich verschiedene Set

Typen unterscheiden: a) Non-Target-Trials mit nur einem Gesichtsausdruck (ärgerlich, fröhlich oder neutral), b) Non-Target- bzw. Target-Trials mit einem abweichenden Gesichtsausdruck vor neutralem Hintergrund c) Trials mit zwei abweichenden Gesichtsausdrücken, einem Target und einem Distraktor. Die Positionen von Target- und Distraktor-Stimuli wurden über alle Trials hinweg ausbalanciert. Um Aufmerksamkeitslenkung auch nach initialer Orientierung zu messen, wurden alle Stimulus Sets für 4000 ms präsentiert, wobei vor jedem Stimulus für 500 ms ein Fixationskreuz gezeigt wurde.

Zur Aufmerksamkeitsmessung verwendeten wir zwei Visual Search Aufgaben. Eine Detektionsaufgabe („odd-one-out“) sah vor, dass Probanden den Knopf auf linken Seite einer Reaktionsbox drücken sollten, wenn ein Stimulus Set einen abweichenden Gesichtsausdruck (Target-Trial) zeigt. Der Knopf auf der rechten Seite der Reaktionsbox sollte in dieser Aufgabe gedrückt werden, wenn alle gezeigten Gesichtsausdrücke gleich waren (Non-Target-Trial). Die Aufgabe umfasste 36 Non-Target und 64 Target-Trials, die in randomisierter Reihenfolge präsentiert wurden. Darüber hinaus verwendeten wir eine Suchaufgabe, die vorsah, dass Probanden den linken Knopf einer Reaktionsbox drücken sollten, wenn ein vorher definierter Gesichtsausdruck (Target-Trial) zu sehen war und war dies nicht der Fall (Non-Target-Trials), sollten die Probanden die rechte Taste der Reaktionsbox drücken. Probanden mussten entweder nach ärgerlichen oder fröhlichen Gesichtsausdrücken suchen. Beide dieser Teilaufgaben beinhalteten jeweils 16 Target-Trials ohne Distraktoren, 32 Target-Trials mit Disktraktoren und 16 Non-Target-Trials. Alle Teilaufgaben wurden in randomisierter Reihenfolge dargeboten und beinhalteten jeweils 12 Übungs-Trials.

Alle Computeraufgaben wurden anhand von E-Prime 2.0, auf einem Dell OptiPlex 790 Computer zusammen mit einem 22-Zoll Dell P2210 Monitor, in einer Auflösung von 1680x1050 durchgeführt. Stimulus Sets hatten dabei einen Durchmesser von 20,1 cm (16.3 °), der Durchmesser von einzelnen Stimuli lag bei 5,3 cm (4.3 °) auf dem verwendeten Monitor, von dem Probanden in etwa 70 cm entfernt saßen. Manuelle Reaktionen wurden mithilfe einer Serial Response Box 200A (Psychology Software Tools), kombiniert mit E-Prime 2.0 erfasst. Augenbewegungen wurden anhand eines SensoMotoric Instruments RED500 Desktop Eye-tracking-Systems und der Hersteller-Software iViewX 2.8 mit einer Datenrate von 60 Hz gemessen. Die Kalibrierung erfolgte über ein 9-Punkt-Verfahren, wobei nur Kalibrierungswerte

von weniger als einem visuellen Grad akzeptiert wurden, was eine maximale Differenz zwischen gemessener und tatsächlicher Fixation von 12 mm bedeutet.

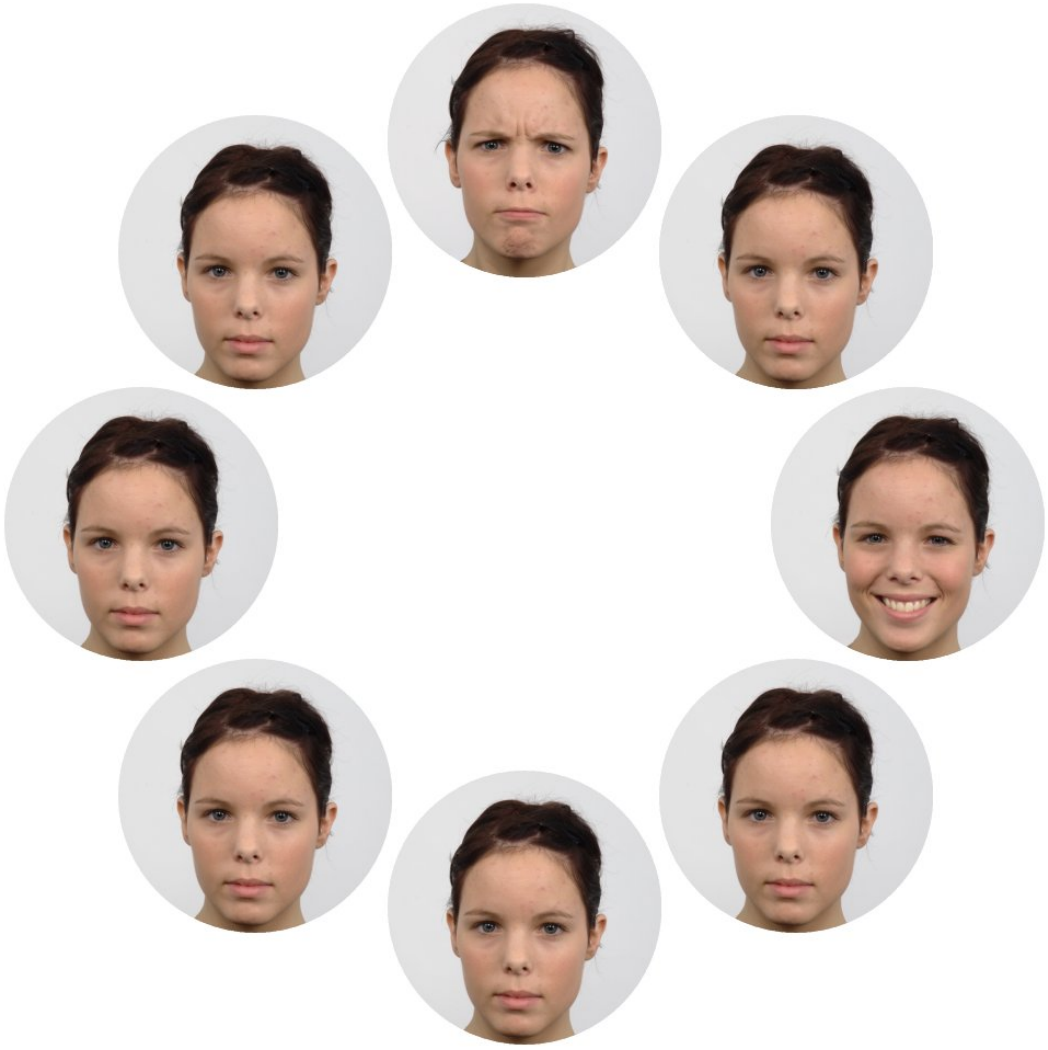

Abbildung 1. Beispielhaftes Reizmaterial: Ärgerliches Target vor neutralem Hintergrund mit fröhlichem Distraktor / fröhliches Target vor neutralem Hintergrund mit ärgerlichem Distraktor

Studienablauf

Durch das Telefon-Screening wurden geeignete Personen zu einem ersten Termin eingeladen, der in unserem Labor stattfand. Hier erhielten die Probanden Informationen über Ziele und Prozeduren der Studie und wurden gebeten eine schriftliche Einverständniserklärung dazu abzugeben. Die darauffolgende Eingangsuntersuchung umfasste das diagnostische Interview SCID-I und mehrere Selbstberichtfragebogen. Probanden, die unsere

Einschlusskriterien erfüllten wurden zu einem zweiten Termin eingeladen, der eine experimentelle Testung umfasste und in etwa zehn Tage nach dem ersten Termin stattfand (*M* = 11, *SD* = 7). Die experimentelle Testung beinhaltete eine angepasste Version des Continuous Performance Test (Knye, Roth, Westhus, & Heine, 2003), den wir als übergreifenden Test für visuelle Aufmerksamkeit und Ausschlusskriterium einsetzten. Anschließend wurden die Probanden randomisiert entweder einer Angstinduktion oder einer Wartekontrollbedingung zugeordnet. Im Rahmen der Angstinduktion wurden die Probanden vom Versuchsleiter informiert, dass sie am Ende des Experiments einen kurzen Vortrag vor einem kleinen Publikum zu einem kontroversen Thema zu halten hätten, den sie in den nächsten fünf Minuten vorbereiten sollen. Dabei musste der angekündigte Vortrag tatsächlich nicht gehalten werden und ausschließlich dessen Ankündigung diente als Angstinduktion. Die experimentelle Manipulation folgt damit einem Verfahren, das von Mansell und Clark (1999) vorgeschlagen wurde und in vorherigen Studien erfolgreich zur Induktion von State-Angst eingesetzt wurde (z.B. Leber, Heidenreich, Stangier, & Hofmann, 2009; Mansell, Clark, Ehlers, & Chen, 1999). Probanden in der Kontrollbedingung bekamen stattdessen eine fünfminütige Pause ohne weitere Instruktionen. Vor und nach der experimentellen Manipulation füllten alle Probanden den STAI-S als Manipulationskontrolle aus und begannen danach mit der Visual Search-Aufgabe. Am Ende des Experiments wurden Probanden in der Angstinduktionsbedingung darüber aufgeklärt und sie erhielten einen kurzen Fragebogen zur Glaubwürdigkeit der fälschlichen Ankündigung des Vortrags. Alle Probanden erhielten eine Aufwandsentschädigung von 10 € pro Stunde. Abbildung 2 zeigt einen Überblick über die Prozedur des Experiments.

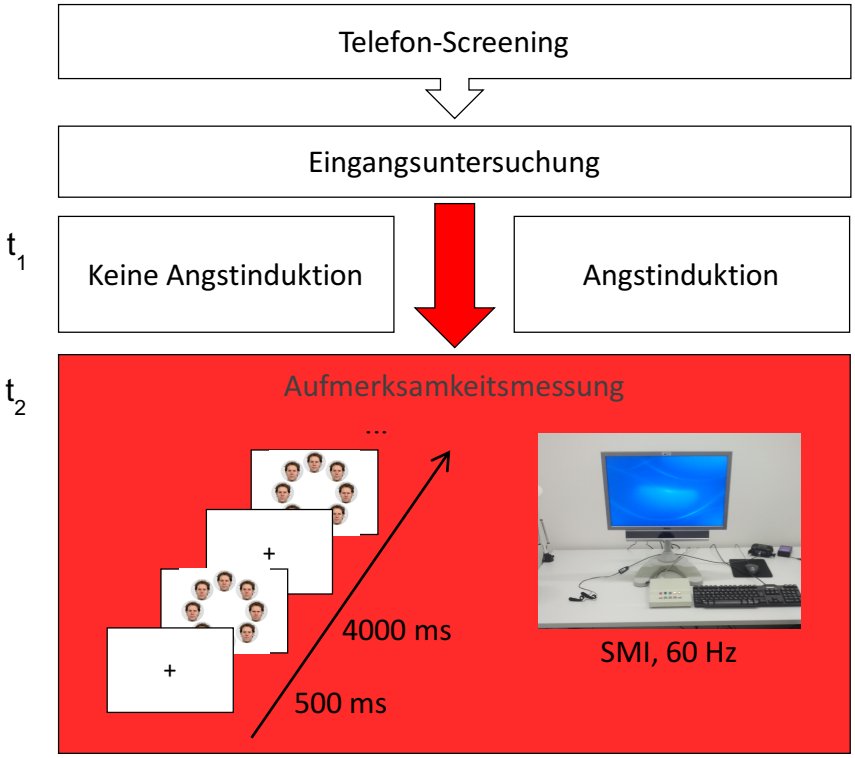

Abbildung 2. Darstellung des Studienablaufs

Datenaufbereitung

Eye-tracking-Daten wurden anhand von BeGaze 3.5 (SensoMotoric Instruments 2015) aufbereitet, das dazu diente Target-Stimuli als Areas of Interest und Fixationen als stabiles Blickverhalten von mindestens 100 ms zu definieren. Alle weiteren Datenaufbereitungen wurden mit R 3.1.2 (R Development Core Team 2009) durchgeführt. Berücksichtigte Eye-tracking-Parameter umfassten a) Erstfixationslatenz (Zeit bis zur ersten Fixation eines Target-Stimulus), b) Fixationsdauer (Dauer der Fixation eines Target-Stimulus) und c) Blickbewegungspfadlänge (zurückgelegte Strecke von Blickbewegungen). Entsprechend unterschiedlicher Anforderungen an die untersuchten Daten und den sich damit ergebenden Ausreißeranalysen variiert die Gesamtzahl berücksichtigter Probanden über die einzelnen Studien hinweg.

6. Studien

6.1. Studie 1: Methodische Grundlagen

Wermes, R., Lincoln, T. M., & Helbig-Lang, S. (2017). How well can we measure visual attention? Psychometric properties of manual response times and first fixation latencies in a visual search paradigm. *Cognitive Therapy and Research*, *41*(4), 588–599.

https://doi.org/10.1007/s10608-016-9830-9

Einleitung

Obwohl es viel Forschung zu Aufmerksamkeitsverzerrungen bei Angststörungen gibt, wurde die psychometrische Güte verwendeter Methoden nur selten erforscht. Die Frage, wie reliabel und valide Aufmerksamkeitsverzerrungen überhaupt gemessen werden können bleibt damit unklar. Dabei liegt es nahe, dass inkonsistente empirische Befunde zu ABT auch durch dabei verwendete experimentelle Paradigmen zur Aufmerksamkeitsmessung bedingt sind (Cooper et al., 2011; Waechter & Stolz, 2015).

Die gegenwärtige Studie untersuchte manuelle Reaktionszeiten und Erstfixationslatenzen im Rahmen des übergeordneten Forschungsdesigns. Dabei wurde angenommen, dass Eye-tracking das direktere und damit geeignetere Maß für visuelle Aufmerksamkeit ist. Demnach sollten Erstfixationslatenzen reliabler als manuelle Reaktionszeiten sein. Im Sinne konvergenter Validität wurde eine Korrelation beider Maße erwartet.

Methoden

Diese Hypothesen wurde auf Grundlage der Daten von N = 122 Probanden (n = 62 Probanden mit SAD) untersucht. Zentral für die Aufbereitung der Daten war an dieser Stelle, dass nur Probanden berücksichtigt wurden, für die sowohl manuelle Reaktionszeiten als auch Erstfixationslatenzen gemessen wurden.

Genauer wurden Reliabilität und konvergente Validität von manuellen Reaktionszeiten und Erstfixationslatenzen analysiert. Die Reliabilität von Rohwerten wurde dabei anhand von interner Konsistenz (Cronbachs Alpha) bestimmt, während die Reliabilität berechneter Differenzwerte mit einem Permutationsverfahren untersucht wurden. Die konvergente Validität von Rohwerten und Differenzwerten wurde über die Korrelation der Mittelwerte von manuellen Reaktionszeiten und Erstfixationslatenzen gemessen.

Ergebnisse

Rohwerte manueller Reaktionszeiten zeigten sich hypothesenkonform als hoch reliabel, Cronbachs Alpha lag dabei konstant über .82, mit einem Mittelwert von α = .87. Entgegen unserer Erwartungen waren Erstfixationslatenzen bei sieben von zehn Set Typen nicht reliabel. Auch Differenzwerte waren sowohl für manuelle Reaktionszeiten als auch für Erstfixationslatenzen

nicht reliabel. Spearman-Brown-korrigierte Werte für Permutationsreliabilität lagen hier konstant unterhalb von .28.

Mittelwerte von manuellen Reaktionszeiten und Erstfixationslatenzen zeigten sich entsprechend unserer Hypothesen und als Indikatoren für konvergente Validität als durchgängig korreliert. Korrelationskoeffizienten waren dabei durchgängig hoch und lagen für Rohwerte im Mittel bei r = .74 und für Differenzwerte im Mittel bei r = .66.

Diskussion

In dieser Studie wurden die methodischen Grundlagen von bestimmten direkten und indirekten Maßen zur visuellen Aufmerksamkeitslenkung evaluiert. Entgegen unserer Erwartungen zeigte sich Eye-tracking dabei nicht als reliableres Maß zur Erfassung visueller Aufmerksamkeit. Dennoch deuten die gefundenen Korrelationen zwischen Mittelwerten von manuellen Reaktionszeiten und Erstfixationslatenzen auf deren konvergente Validität hin, was für ihre Verwendung spricht.

Die Frage, wie gut visuelle Aufmerksamkeit gemessen werden kann, bedarf weiterer Forschungsarbeit. Zukünftige Studien sollten weitere Parameter zur Berechnung von Reliabilität und Validität sowie Variationen experimenteller Paradigmen untersuchen. Unsere Ergebnisse verdeutlichen die Notwendigkeit die psychometrische Güte experimenteller Paradigmen zu Erforschung von ABT zu hinterfragen. Bisherige Befunde zu ABT sollten in Anbetracht der aufgezeigten methodischen Unklarheiten mit Vorsicht betrachtet werden.

6.2. Studie 2: Selektive Aufmerksamkeit

Wermes, R., Lincoln, T. M., & Helbig-Lang, S. (2018). Attentional biases to threat in social anxiety disorder: Time to focus our attention elsewhere? *Anxiety, Stress, & Coping*. https://doi.org/10.1080/10615806.2018.1483497

Einleitung

Selektive Aufmerksamkeit für bedrohliche soziale Reize ist laut kognitiv-behavioralen Störungsmodellen wichtig für die Entstehung und Aufrechterhaltung von SAD. Gleichzeitig weisen empirische Befunde hier in verschiedene Richtungen und so bleibt die genauere Beschaffenheit selektiver Aufmerksamkeit bisher ungeklärt. Während verschiedene klinische Modelle konsistent von einer zunächst erleichterten Hinwendung zu bedrohlichen sozialen Reizen ausgehen,

erwarten Clark und Wells (1995) eine darauffolgende Vermeidung, während Rapee und Heimberg (1997) eine verzögerte Abwendung annehmen.

Die gegenwärtige Studie war darauf ausgelegt die genauere Beschaffenheit selektiver Aufmerksamkeit bei SAD aufzuklären. Entsprechend kognitiv-behavioraler Störungsmodelle haben wir dabei eine erleichterte Hinwendung zu bedrohlichen sozialen Reizen bei SAD und bei State-Angst-Induktion erwartet. Ausgehend von der Attentional Control Theory nahmen wir außerdem an, dass Probanden mit SAD eine Vermeidung in Bezug auf bedrohliche soziale Reize zeigen, während die State-Angst-Induktion zu verzögerter Abwendung und erhöhter Störbarkeit führt.

Methoden

Für die Studie wurden Daten von N = 129 Probanden (n = 67 Probanden mit SAD) untersucht. Zentral für die Aufbereitung der Daten war an dieser Stelle, dass auch Probanden berücksichtigt wurden, für die entweder keine manuellen Reaktionszeit- oder keine Eye-tracking-Daten erhoben werden konnten.

Für die Analysen wurden Differenzwerte berechnet, die dazu dienten die verschiedenen Komponenten selektiver Aufmerksamkeit für bedrohliche soziale Reize (erleichtere Hinwendung, verzögerte Abwendung und Vermeidung) über manuelle Reaktionen und Eye-tracking-Parameter abzubilden. Dabei wurden jeweils bedrohliche mit nicht bedrohlichen Reizen verglichen. Schließlich haben wir die damit berechneten Differenzwerte in Abhängigkeit von Trait- und State-Komponenten sozialer Angst und anhand des allgemeinen linearen Modells untersucht.

Ergebnisse

Fragebogenwerte zu Trait- und State-Komponenten sozialer Angst bestätigten sowohl unsere diagnostische Einteilung der Probandengruppen, als auch die Effektivität unserer State-Angst-Induktion.

Entgegen unserer Hypothesen fanden wir weder für Trait- noch für State-Komponenten sozialer Angst Hinweise auf erleichterte Hinwendung oder verzögerte Abwendung in Bezug auf bedrohliche sozialen Reize. Entsprechend unserer Erwartungen zeigten aber Probanden mit SAD eine erhöhte Vermeidung ärgerlicher Gesichter, F (1,116) = 4.43, p = .037, $\eta^2_{partial}$ = .04. Außerdem führte unsere State-Angst-Induktion zu einer erhöhten Störbarkeit durch Distraktoren in Form von ärgerlichen Gesichtern, Λ = .91, F (2,109) = 5.34, p = .006, $\eta^2_{partial}$ = .09.

Diskussion

Die Ergebnisse dieser Studie legen nahe, dass SAD vor allem durch Vermeidung bedrohlicher sozialer Reize gekennzeichnet sein könnte. Damit ergibt sich ein Widerspruch zu bisherigen Befunden, die hier Hinweise auf erleichterte Hinwendung und verzögerte Abwendung fanden. Gleichzeitig bieten unsere Ergebnisse einen Erklärungsansatz für fehlende Langzeiteffekte existierender Aufmerksamkeitsmodifikationstrainings, die durchweg versuchen erleichterte Hinwendung und verzögerte Abwendung zu bedrohlichen sozialen Reizen zu reduzieren. Hier wird die Vermeidung bedrohlicher sozialer Reize verstärkt, was laut unseren Ergebnissen ein wichtiger aufrechterhaltender Faktor, im Sinne einer negativen Verstärkung sein könnte.

Es bedarf weiterer Forschungsarbeit unter Einbezug von Variationen experimenteller Paradigmen, vor allem auch unter Einsatz von Eye-tracking, um die genauere Beschaffenheit von selektiver Aufmerksamkeit bei SAD aufklären zu können.

6.3. Studie 3: Hypervigilanz

Wermes, R., Lincoln, T. M., & Helbig-Lang, S. (under review). Anxious and alert? Hypervigilance in social anxiety disorder. *Psychiatry Research*.

Einleitung

Kognitiv-behaviorale Störungsmodelle nehmen Hypervigilanz als bedeutsam für die Aufrechterhaltung von SAD an (Richards et al., 2014). Hypervigilanz bedeutet eine erhöhte Wachsamkeit für bedrohliche soziale Reize anhand von entweder exzessiven Augenbewegungen oder durch einen breiten Aufmerksamkeitsfokus (Richards et al., 2014). Die genauere Beschaffenheit von Hypervigilanz bei SAD ist bisher unklar, wobei hier nur vereinzelte empirische Ergebnisse vorliegen.

Die gegenwärtige Studie untersucht Hypervigilanz bei SAD in Bezug auf Trait- und State-Komponenten sozialer Angst. Erhöhte Blickbewegungspfadlängen und Fixationshäufigkeiten wurden als Indikator von Hypervigilanz interpretiert. Dabei nahmen wir an, dass sowohl die SAD Gruppe (Trait-Angst) als auch Probanden in der Angst-Induktionsbedingung (State-Angst) insgesamt hypervigilante Aufmerksamkeitsmuster bei der Betrachtung verschiedener sozialer Reize zeigen. Weiterhin haben wir erwartet, dass Probanden mit SAD vor allem bei der Suche nach bedrohlichen sozialen Reizen Hypervigilanz zeigen.

Methoden

Unsere Hypothesen wurden anhand der Daten von *N* = 121 Probanden (*n* = 61 Probanden mit SAD) untersucht. Dazu wurden Blickbewegungspfadlängen und Fixationshäufigkeiten in einem Visual Search-Paradigma anhand von Anordnungen emotionaler Gesichtsausdrücke erfasst. Für Hypothese eins wurden Effekte der diagnostischen Gruppen (Trait-Angst) und experimentellen Bedingungen (State-Angst) in Bezug auf übergreifende Blickbewegungspfadlängen und Fixationshäufigkeiten berechnet. Dabei wurden die Daten aller Visual-Search-Aufgaben und Arten von Stimuli zusammengefasst. Wir verwendeten vier One-Way-ANOVAs (Gruppe und Bedingung) mit entweder übergreifender Blickbewegungspfadlänge oder übergreifender Fixationshäufigkeit als abhängige Variable. In Bezug auf Hypothese zwei wurden Daten der Search-Angry-Aufgabe mit bedrohlichen (ärgerliches Target vor neutralem Hintergrund) und nicht bedrohlichen Stimuli (fröhliches Target vor neutralem Hintergrund) analysiert. Dazu wurden vier 2x2 ANOVAs (Gruppe x Set-Typ und Bedingung x Set-Typ) mit Blickbewegungspfadlängen und alternativ Fixationshäufigkeiten als abhängige Variable berechnet.

Ergebnisse

Entgegen unseren Erwartungen konnten wir keine Haupteffekte diagnostischer Gruppen oder experimenteller Bedingungen in Bezug auf übergreifende Blickbewegungspfadlängen oder Fixationshäufigkeiten finden.

Demgegenüber offenbarte eine explorative Analyse Interaktionseffekte zwischen diagnostischen Gruppen und experimentellen Bedingungen in Bezug auf übergreifende Blickbewegungspfadlängen (F (1,117) = 5.32, p = .023, $\eta^2_{partial}$ = .043) und Fixationshäufigkeiten (F (1,117) = 5.10, p = .026, $\eta^2_{partial}$ = .042). Damit zeigen sich Hinweise auf Hypervigilanz bei SAD erst bei State-Angst-Induktion und insgesamt ein Aufmerksamkeitsmuster, das dem von gesunden Probanden entgegengesetzt ist.

Entgegen unserer Hypothesen konnten wir keine Hinweise darauf finden, dass Probanden mit SAD erhöhte Blickbewegungspfadlängen oder Fixationshäufigkeiten bei der Suche nach bedrohlichen Reizen zeigen.

Diskussion

Unsere Analysen zeigen Hinweise auf Hypervigilanz bei Probanden mit SAD nur bei State-Angst-Induktion. Offenbar wechselten Probanden mit SAD den Fokus ihrer Aufmerksamkeit hin zu einem intensiven Absuchen der visuellen Umgebung, wenn sie in unserer Studie negative Evaluation antizipierten. Das könnte in alltäglichen Situationen zur Aufrechterhaltung der Störung beitragen, insofern durch den breiten Fokus derartiger Aufmerksamkeitsmuster wichtige soziale Informationen nicht hinreichend verarbeitet werden.

Zusammen mit bisherigen Befunden sprechen unsere Ergebnisse grundsätzlich für die Bedeutsamkeit von Hypervigilanz für das Störungsbild von SAD. In Anbetracht der inkonsistenten Befundlage zu selektiver Aufmerksamkeit (vgl. Cisler & Koster, 2010) und fehlenden Langzeiteffekten daraus abgeleiteter Interventionen (Cristea, Kok, & Cuijpers, 2015; Heeren et al., 2015) sollte zukünftige Forschung Hypervigilanz als potenziell aufrechterhaltenden Faktor von SAD stärker berücksichtigen. Grundsätzlich bedarf es einer Klärung der genaueren Beschaffenheit von Hypervigilanz im Zusammenhang mit SAD, bevor hier eine Ableitung therapeutischer Interventionen sinnvoll möglich ist. Dennoch könnten Trainings, die Hypervigilanz reduzieren langfristig einen vielversprechenden Ansatzpunkt bedeuten. Zukünftige Forschung könnte demnach versuchen therapeutische Elemente zu integrieren, die dem breiten Aufmerksamkeitsfokus von Hypervigilanz entgegenstehen, wie zum Beispiel Mindfulness-basierte Ansätze (z.B. Bögels, 2006).

7. Allgemeine Diskussion

Das Ziel der vorliegenden Arbeit war die Erforschung von Aufmerksamkeit für soziale Reize bei sozialer Angststörung im Hinblick auf ABT. Die Relevanz dieses Themas ergibt sich aus der Betonung von ABT bei SAD durch kognitiv-behaviorale Störungsmodelle und darüber hinaus durch eine inkonsistente Befundlage. Unsere übergeordnete Datenerhebung und deren Untersuchung anhand von drei Studien bieten hier neue Erkenntnisse. Studie 1 war darauf ausgelegt methodische Grundlagen visueller Aufmerksamkeitsmessung anhand des hier verwendeten kombinierten Visual Search- und Eye-Tracking-Paradigmas zu untersuchen. Dabei zeigte sich Eye-tracking entsprechend der untersuchten Parameter nicht als das bessere Maß zur Abbildung visueller Aufmerksamkeit im Vergleich zu manuellen Reaktionszeiten. Studie 2 diente als Kernstudie zum übergeordneten Thema zur Erforschung von Aufmerksamkeit für soziale Reize

bei sozialer Angst im Hinblick auf ABT. Hier zeigten Probanden mit SAD ausschließlich eine Vermeidung bedrohlicher sozialer Reize, während unsere State-Angst-Induktion zu erhöhter Störbarkeit durch bedrohliche Distraktoren führte. Demnach stellt unsere Studie verbreitete Annahmen über ABT bei sozialer Angst in Frage, die sich auf erleichterte Hinwendung und verzögerte Abwendung berufen. Gleichzeitig stützen unsere Ergebnisse die Annahme reduzierter Aufmerksamkeit für externe soziale Reize laut dem kognitiven Modell von Clark und Wells (1995). In Studie 3 ging es um Hypervigilanz als generelles Aufmerksamkeitsmuster bei SAD. Unsere Analysen offenbarten Interaktionseffekte von diagnostischen Gruppen und experimentellen Bedingungen anhand von Blickbewegungspfadlängen und Fixationshäufigkeiten, die für beide Maße das gleiche Muster abbildeten. Demnach zeigen Probanden mit SAD nur bei State-Angst-Induktion Hinweise auf Hypervigilanz, in direktem Gegensatz zum Aufmerksamkeitsmuster gesunder Probanden.

7.1. Limitationen

Forschung zu ABT im Allgemeinen und auch in Bezug auf SAD basiert auf verschiedensten experimentellen Paradigmen, wobei deren Reliabilität und Validität noch weitgehend unklar bleibt und sich bisher keine methodischen Standards etabliert haben. Dementsprechend sind auch die Ergebnisse dieser Arbeit grundsätzlich als bedingt durch das verwendete kombinierte Visual Search- und Eye-tracking-Paradigma zu betrachten.

Zwar entsprechen unsere Ergebnisse in vielen Aspekten bisherigen Studien (Brown et al., 2014; Waechter et al., 2014), dennoch ist nicht auszuschließen, dass eine zu geringe Zahl verwendeter Trials einschränkend auf die interne Konsistenz von manuellen Reaktionszeiten und Erstfixationslatenzen gewirkt hat. Andererseits könnte aber auch bei einer zu großen Zahl von Trials die Aufmerksamkeitsleistung mit der Zeit nachlassen und somit interne Konsistenz einschränken. Es gibt außerdem Hinweise auf Veränderungen von ABT über die Zeit hinweg (Heeren et al., 2015), weshalb es weiterer Forschungsarbeit auch zu Test-Retest-Reliabilität bedarf. Schließlich kann nicht ausgeschlossen werden, dass die fehlende interne Konsistenz von Differenzwerten unsere Erforschung von ABT limitiert. Demgegenüber ist hier jedoch auch die Messung interner Konsistenz durch geringe gruppenspezifische Unterschiede eingeschränkt. Zudem fanden wir Hinweise auf konvergente Validität, was insgesamt für die Verwendung unserer Differenzwerte zur Erfassung ABT bei SAD spricht.

Im Gegensatz zur großen Mehrheit bisheriger Studien basiert das hier verwendete experimentelle Design auf einem Visual Search-Paradigma, das für Probanden vorsieht sich spezifisch zu verhalten, nämlich nach abweichenden oder bestimmten Reizen zu suchen. Der Einfluss im Rahmen einer experimentellen Studie auf Probanden, der die Variabilität ihres Verhaltens einschränken könnte, wird als situativer Druck bezeichnet (Stagner, 1977). Demzufolge könnte ein durch die Aufgabenanforderungen unseres Visual Search-Paradigmas erhöhter situativer Druck angstspezifisches Verhalten unserer Probanden eingeschränkt haben. Ebenso könnte das auch verwendete visuelle Reize betreffen. Sofern der situative Druck, also zum Beispiel die Bedrohlichkeit von Fotos von ärgerlichen Gesichtern nicht optimal ist, werden sie ähnlich bedrohlich oder nicht bedrohlich wahrgenommen, unabhängig von der sozialen Angst untersuchter Probanden.

Zu Hypervigilanz postulieren das klinische Modell von Rapee und Heimberg (1997) sowie die Attentional Control Theory, dass sie vor der Entdeckung bedrohlicher Reize passiert. Wir haben jedoch nicht zwischen Blickbewegungspfadlängen oder Fixationshäufigkeiten vor und nach der Entdeckung bedrohlicher Reize unterschieden. Demgegenüber wurden, wie auch in allen bisherigen Studien, ausschließlich bedrohliche mit nicht bedrohlichen Reizen verglichen. Aufgrund der damit gegebenen Vereinfachung ist nicht auszuschließen, dass Probanden auch ohne hypervigilante Aufmerksamkeitsmuster überblicken konnten, ob bedrohliche Reize vorhanden sind oder nicht.

In manchen bisherigen Studien zu ABT bei SAD wurden nur Probanden mit generalisierter SAD eingeschlossen (z.B. Gamble & Rapee, 2010), während nur 60% unserer klinischen Probandengruppe generalisierte SAD aufweisen. Im Sinne eines dimensionalen Ansatzes von Psychopathologie erscheint es dennoch unwahrscheinlich, dass unsere Ergebnisse dadurch kritisch beeinflusst wurden. Darüber hinaus ist unsere klinische Stichprobe durchaus mit anderen vergleichbar (z.B. Baker, Heinrichs, Kim, & Hofmann, 2002). Es finden sich außerdem Studien, die eine Untersuchung von isoliert auftretender SAD befürworten. Unser Einschluss komorbider Störungen könnte demnach einerseits eine Einschränkung, andererseits aber auch ein realistischeres Bild von SAD bedeuten, insofern Komorbiditäten hier häufig anzutreffen sind.

7.2. Implikationen

Trotz der genannten Limitationen konnte die gegenwärtige Arbeit einen wichtigen Beitrag zur Erforschung von Aufmerksamkeit für soziale Reize bei sozialer Angst im Hinblick auf ABT leisten.

Aus Studie 1 zur psychometrischen Güte von manuellen Reaktionszeiten und Erstfixationslatenzen ergibt sich ein besseres Verständnis methodischer Grundlagen zur Erfassung visueller Aufmerksamkeitslenkung. Unsere Ergebnisse machen deutlich, dass Eye-tracking hier nicht unbedingt reliabler ist, obwohl es den direkteren Ansatz zur Messung von Aufmerksamkeitslenkung bedeutet. Dennoch geben Korrelationen von manuellen Reaktionszeiten und Erstfixationslatenzen Hinweise auf Reliabilität und Validität beider Maße. Damit offenbart sich ein wichtiger Vorteil der gleichzeitigen Erfassung von manuellen Reaktionen und Blickbewegungen: So hatten wir die Möglichkeit beide Verfahren durch gegenseitige Vergleiche besser zu verstehen. Die gefundenen hohen Korrelationen geben Hinweise darauf, dass direkte und indirekte Maße visueller Aufmerksamkeitslenkung in unserem Fall ähnliche Prozesse abbilden. Dabei ist zu beachten, dass dies nur für die manuelle oder okulare Reaktion auf Target-Reize gilt. Fixationshäufigkeit und Fixationsdauer finden anhand unseres Paradigmas keine Entsprechung in manuellen Reaktionszeiten, während manuelle Reaktionen auf Non-Target-Reize nicht durch Eye-tracking abgebildet werden können. Es bedarf weiterer Forschungsarbeit, um umfassend aufzuklären inwiefern manuelle Reaktionszeiten und Eye-tracking-Parameter ähnliche Prozesse abbilden und ergänzend kombiniert werden können. Insgesamt bedarf es ebenfalls weiterer Forschungsarbeit, um die Frage wie gut wir visuelle Aufmerksamkeit messen können abschließend beantworten zu können. Grundlegend ist dabei auch die Erforschung psychometrischer Güte wichtig. Zukünftige Studien sollten demnach Variationen experimenteller Paradigmen verwenden und weitere Maße für Reliabilität und Validität einschließen. Der bisherige Stand der Forschung zu ABT sollte mit Vorsicht betrachtet werden, insofern die psychometrische Güte verwendeter Methoden weiterhin unklar bleibt.

Studie 2 ist die Kernstudie der gegenwärtigen Arbeit. Unter Berücksichtigung von Trait- und State-Merkmalen sozialer Angst sowie manueller Reaktionen und Eye-tracking-Parametern haben wir dazu einen umfassenden methodischen Ansatz gewählt, an dem sich zukünftige Forschung ausrichten könnte. Unsere Ergebnisse deuten vor allem darauf hin, dass Probanden

mit SAD bedrohliche soziale Reize vermeiden und keine erleichterte Hinwendung oder verzögerte Abwendung in Bezug darauf zeigen. Vermeidungsverhalten ist demnach auch in Bezug auf Aufmerksamkeitsprozesse zentral für das Störungsbild von SAD. Das impliziert einen Bedarf an weiterer Forschung, die Eye-tracking-Methoden integriert, um Aufmerksamkeitsprozesse genauer abbilden und damit die genauere Beschaffenheit von ABT besser verstehen zu können. Die Verbreitung therapeutischer Interventionen vor genauerer Klärung der grundlegenden Beschaffenheit von ABT bei sozialer Angst ist damit verfrüht. Interventionsstudien sollten im Gegensatz zu bisherigen Aufmerksamkeitsmodifikationstrainings aufklären, inwiefern die Regulation von Vermeidung bedrohlicher sozialer Reize zur Besserung von SAD hilfreich sein kann.

Schließlich brachte Studie 3 zur Erfassung von Hypervigilanz Einblicke in das bisher nur selten erforschte Thema genereller Aufmerksamkeitsmuster bei sozialer Angst. Hier zeigte sich ein Aufmerksamkeitsmuster von Probanden mit SAD, das dem von gesunden Probanden entgegengesetzt ist und Hinweise auf Hypervigilanz nur bei State-Angst Induktion beinhaltet. Hypervigilanz zeigt sich demnach als vielversprechendes Thema für zukünftige Forschung, auch im Hinblick auf bisher heterogene Befunde zu selektiver Aufmerksamkeit für bedrohliche soziale Reize und ineffektive klinische Interventionen, die sich daraus ableiten. Unter der Voraussetzung, dass zukünftige Forschung die genauere Beschaffenheit von Hypervigilanz bei SAD aufklärt, sind darauf aufbauend Interventionsstudien denkbar. Zum Beispiel Mindfulness-basierte Interventionen könnten hier vielversprechend sein, insofern sie an Stelle von hypervigilanten Aufmerksamkeitsmustern gleichmäßige Aufmerksamkeitsprozesse etablieren (Kabat-Zinn, 2003).

7.3. Ausblick

Insgesamt besteht weiterhin Bedarf an umfassender Grundlagenforschung zu Aufmerksamkeit für soziale Reize bei sozialer Angst im Hinblick auf ABT. Die heterogene Befundlage zu ABT sollte hier weiter aufgeklärt werden. Zukünftige Grundlagenforschung zu ABT sollte verwendete experimentelle Paradigmen im Hinblick auf ihre psychometrische Güte hinterfragen und Eye-tracking als direkteres Maß für visuelle Aufmerksamkeit einschließen. Darüber hinaus sollten auch State-Angst-Induktionen sowie generelle Aufmerksamkeitsmuster anstelle von selektiver Aufmerksamkeit berücksichtigt werden. Die gegenwärtige Arbeit bedeutet dazu einen ersten Schritt. Zukünftige Studien sollten die hier gefundenen Ergebnisse replizieren und verwendete methodische Ansätze erweitern.

Naheliegend wäre unter anderem eine Variation verwendeter sozialer Reize, die darauf abzielt ihren situativen Druck zu verringern, indem Emotionsausdrücke nur schematisch (z.B. Juth et al., 2005), in variierender Intensität (z.B. Gutiérrez-Garcia & Calvo, 2017) oder maskiert und damit weniger eindeutig dargestellt werden. In einer Folgestudie zur gegenwärtigen Arbeit wurde dieser Ansatz anhand von maskierten Gesichtern anhand einer subklinischen Stichprobe untersucht. Wir änderten dazu ausschließlich die dargestellten Reize des bestehenden Experiments, durch Überblendung von Mund- und Nasenbereichen. Entgegen unserer Erwartungen zeigten sich dabei keinerlei Hinweise auf ABT anhand von Trait- oder State-Merkmalen sozialer Angst. Demnach ist fraglich, inwiefern ABT auch bei subklinischer sozialer Ängstlichkeit als stabiles Phänomen auftreten. Außerdem stellen auch diese Ergebnisse das häufig berichtete Phänomen erleichterter Hinwendung zu bedrohlichen sozialen Reizen in Frage, für das wir auch bei verringertem situativen Druck keine Hinweise finden konnten.

Es gilt außerdem bei verwendeten experimentellen Paradigmen verschiedene Suchstrategien (serielle versus parallele Verarbeitung) zu berücksichtigen (vgl. Nothdurft, 1999). Vor allem für automatische Prozesse der Aufmerksamkeitslenkung könnte man hier unterschiedliche Effekte annehmen: Je nachdem ob eine visuelle Umgebung auf den ersten Blick als Ganzes oder anhand ihrer einzelnen Bestandteile nacheinander verarbeitet wird.

Weiterhin liegt es nahe, dass Fähigkeiten zur Aufmerksamkeitskontrolle und Strategien zur Emotionsregulation wichtige Moderatoren des Zusammenhangs zwischen sozialer Angst und ABT sein könnten (vgl. Cisler & Koster, 2010; Derryberry & Reed, 2002). Nach einer grundsätzlichen Erforschung der genaueren Beschaffenheit von ABT bei SAD könnte eine Untersuchung potenzieller Moderatoren zu einem detaillierten Verständnis genauerer Mechanismen beitragen.

Schließlich sollten zukünftige Studien untersuchen, inwiefern ABT bei sozialer Angst auch bei tatsächlichen sozialen Interaktionen zu finden sind. Hier bietet sich die Technologie des mobilen Eye-tracking an, um Aufmerksamkeitsprozesse unmittelbar abzubilden. Dabei lässt sich einerseits eine ökologisch validere Erfassung von ABT bei sozialer Angst erwarten. Andererseits wäre auch ein erhöhter technischer Aufwand zu berücksichtigen, vor allem im Hinblick auf nicht standardisierte Gesichtsausdrücke im Gegenüber und die stark erschwerte Messung von Blickbewegungen in Bezug auf bewegliche Objekte.

Bisherige Ansätze zur Reduktion sozial ängstlicher Symptomatik anhand von Aufmerksamkeitsmodifikationstrainings geben keine Hinweise auf langfristige Effektivität (Heeren et al., 2015). Unter der Voraussetzung, dass zunächst die genauere Beschaffenheit von ABT bei SAD aufgeklärt wird, könnte zukünftige Forschung auch hier neue Richtungen einschlagen. Ein erster Ansatz dazu könnte, im Gegensatz zu bestehenden Trainings und entsprechend unserer Ergebnisse, darauf aufbauen die Vermeidung bedrohlicher sozialer Reize gerade nicht verstärken. Darüber hinaus könnte die Erforschung von Achtsamkeitstrainings zur Reduktion von Hypervigilanz vielversprechend sein. Es gilt dabei jedoch grundsätzlich zu beachten, dass aus therapeutischer Sicht das Erleben von Patienten zentral ist (Weierich, Treat, & Hollingworth, 2008). Bisher konnte kein kausaler Zusammenhang zwischen ABT und dem Erleben sozialer Angst nachgewiesen werden konnte. Forschung zu ABT kann nur dann hilfreich zu Besserung von SAD sein, wenn daraus abgeleitete Interventionen auch das Erleben von Betroffenen verändern. Dennoch könnte unser Befund einer Vermeidung bedrohlicher sozialer Reize als Bestärkung bestehender therapeutischer Interventionen nach dem kognitiven Modells von Clark und Wells (1995) dienen. Aufmerksamkeit auf externe, statt auf interne Reize (Selbstaufmerksamkeit) zu richten konnte als wirksamer Bestandteil kognitiver Therapie identifiziert werden (Mörtberg, Hoffart, Boecking, & Clark, 2013). Diese Umlenkung der Aufmerksamkeit könnte laut unseren Ergebnissen besonders in Bezug auf bedrohliche soziale Reize wichtig sein.

In Anbetracht der weiterhin inkonsistenten Befundlage zu ABT bei SAD bedarf es hier weiterer Grundlagenforschung. Dabei gilt es die genauere Beschaffenheit von ABT sowie ihren Zusammenhang zum Erleben sozialer Angst zu verstehen, bevor therapeutische Interventionen daraus abgeleitet werden. Unsere Ergebnisse sprechen für die Bedeutung von Vermeidung bedrohlicher sozialer Reize bei SAD und stehen damit im Gegensatz zur verbreiteten Annahme einer erleichterten und gesteigerten Hinwendung. Das verwendete umfassende experimentelle Paradigma der gegenwärtigen Arbeit zeigt das Themenfeld aus neuen Blickwinkeln und gibt Impulse für zukünftige Forschung, die verwendete experimentelle Paradigmen genauer hinterfragen und die Aspekte Vermeidung und Hypervigilanz stärker berücksichtigen sollte.

8. Literaturverzeichnis

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. *Arlington: American Psychiatric Publishing*.

Amir, N., Elias, J., Klumpp, H., & Przeworski, A. (2003). Attentional bias to threat in social phobia: Facilitated processing of threat or difficulty disengaging attention from threat? *Behaviour Research and Therapy*, *41*(11), 1325–1335. https://doi.org/10.1016/S0005-7967(03)00039-1

Baker, S. L., Heinrichs, N., Kim, H. J., & Hofmann, S. G. (2002). The Liebowitz social anxiety scale as a self-report instrument: A preliminary psychometric analysis. *Behaviour Research and Therapy*, *40*(6), 701–715. https://doi.org/10.1016/S0005-7967(01)00060-2

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin*, *133*(1), 1–24. https://doi.org/10.1037/0033-2909.133.1.1

Barlow, D. H. (2002). The nature of anxious apprehension. *Anxiety and its disorders: The nature and treatment of anxiety and panic*, 64–104.

Beck, A., Steer, R., & Brown, G. (1993). *Beck Depression Inventory-II (BDI-II)*. https://doi.org/10.1037/t00742-000

Beck, A. T., Emery, G., & Greenberg, R. L. (2005). *Anxiety disorders and phobias: A cognitive perspective*. Basic Books.

Bögels, S. M. (2006). Task concentration training versus applied relaxation, in combination with cognitive therapy, for social phobia patients with fear of blushing, trembling, and sweating. *Behaviour Research and Therapy*, *44*(8), 1199–1210. https://doi.org/10.1016/j.brat.2005.08.010

Bradley, B. P., Mogg, K., White, J., Groom, C., & de Bono, J. (1999). Attentional bias for emotional faces in generalized anxiety disorder. *The British Journal of Clinical Psychology / the British Psychological Society*, *38 (Pt 3)*, 267–278. https://doi.org/10.1348/014466599162845

Brosschot, J. F., De Ruiter, C., & Kindt, M. (1999). Processing bias in anxious subjects and repressors, measured by emotional Stroop interference and attentional allocation. *Personality and Individual Differences*, *26*(5), 777–793. https://doi.org/10.1016/S0191-8869(98)00173-1

Brown, H. M., Eley, T. C., Broeren, S., MacLeod, C., Rinck, M., Hadwin, J. A., & Lester, K. J. (2014). Psychometric properties of reaction time based experimental paradigms measuring anxiety-related information-processing biases in children. *Journal of Anxiety Disorders*, *28*(1), 97–107. https://doi.org/10.1016/j.janxdis.2013.11.004

Buckner, J. D., Maner, J. K., & Schmidt, N. B. (2010). Difficulty disengaging attention from social threat in social anxiety. *Cognitive Therapy and Research*, *34*(1), 99–105. https://doi.org/10.1007/s10608-008-9205-y

Chen, N. T. M., Thomas, L. M., Clarke, P. J. F., Hickie, I. B., & Guastella, A. J. (2015). Hyperscanning and avoidance in social anxiety disorder: The visual scanpath during public speaking. *Psychiatry Research*, *225*(3), 667–672. https://doi.org/10.1016/j.psychres.2014.11.025

Cisler, J. M., & Koster, E. H. W. (2010). Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. *Clinical Psychology Review*, *30*(2), 203–216. https://doi.org/10.1016/j.cpr.2009.11.003

Clark, D. M. (2001). A cognitive perspective on social phobia. *The Essential Handbook of Social Anxiety for Clinicians*, *42*(1), 193–218. https://doi.org/10.1016/S0006-3223(97)87445-8

Clark, D. M., & Ehlers, A. (2002). *Soziale Phonie: Eine kognitive Perspektive*. *soziale Phobie und Soziale Angsstörung*.

Clark, D. M., & Wells, A. (1995). A cognitive model of social phobia. In R. Heimberg, M. Liebowitz, D. Hope, & R. Schneier (Eds.), *Social phobia: Diagnosis, assessment and treatment*, 69–93. New York: Guilford Press.

Cooper, R. M., Bailey, J. E., Diaper, A., Stirland, R., Renton, L. E., Benton, C. P., … Munafo, M. R. (2011). Effects of 7.5% CO(2) inhalation on allocation of spatial attention to facial cues of emotional expression. *Cogn Emot*, *25*(4), 626–638.

https://doi.org/10.1177/0269881108096981

Cristea, I. A., Kok, R. N., & Cuijpers, P. (2015). Efficacy of cognitive bias modification interventions in anxiety and depression: Meta-analysis. *British Journal of Psychiatry*, *206*(1), 7–16. https://doi.org/10.1192/bjp.bp.114.146761

Dalgleish, T., Taghavi, R., Neshat-Doost, H., Moradi, A., Canterbury, R., & Yule, W. (2003). Patterns of processing bias for emotional information across clinical disorders: A comparison of attention, memory, and prospective cognition in children and adolescents with depression, generalized anxiety, and posttraumatic stress disorder. *Journal of Clinical Child and Adolescent Psychology: The Official Journal for the Society of Clinical Child and Adolescent Psychology, American Psychological Association, Division 53*, *32*(1), 10–21. https://doi.org/10.1207/S15374424JCCP3201_02

Derryberry, D., & Reed, M. A. (2002). Anxiety-related attentional biases and their regulation by attentional control. *Journal of Abnormal Psychology*, *111*(2), 225–236. https://doi.org/10.1037/0021-843X.111.2.225

Eastwood, J., Smile, D., Oakman, J., Farvolden, P., van Ameringen, M., Mancini, C., & Merikle, P. (2005). Individuals with social phobia are biased to become aware of negative faces. *Visual Cognition*, *12*(1), 159–179. https://doi.org/10.1080/13506280444000175

Egloff, B., & Hock, M. (2003). Assessing attention allocation toward threat-related stimuli: A comparison of the emotional Stroop task and the attentional probe task. *Personality and Individual Differences*, *35*(2), 475–483. https://doi.org/10.1016/S0191-8869(02)00265-9

Eide, P., Kemp, A., Silberstein, R. B., Nathan, P. J., & Stough, C. (2002). Test-retest reliability of the emotional stroop task: Examining the paradox of measurement change. *The Journal of Psychology*, *136*(5), 514–520. https://doi.org/10.1080/00223980209605547

Eysenck, M. W. (1992). *Anxiety: The cognitive perspective*. Hove, England: Erlbaum.

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion*, *7*(2), 336–353. https://doi.org/10.1037/1528-3542.7.2.336

Fehm, L., Pelissolo, A., Furmark, T., & Wittchen, H. U. (2005). Size and burden of social phobia in

Europe. *European Neuropsychopharmacology*, *15*(4), 453–462. https://doi.org/10.1016/j.euroneuro.2005.04.002

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do threatening stimuli draw or hold visual attention in subclinical anxiety? *Journal of Experimental Psychology: General*, *130*, 681–700. https://doi.org/10.1037/0096-3445.130.4.681

Furmark, T. (2002). Social phobia: Overview of community surveys. *Acta Psychiatrica Scandinavica*, *105*, 84–93. https://doi.org/10.1034/j.1600-0447.2002.1r103.x

Gamble, A. L., & Rapee, R. M. (2010). The time-course of attention to emotional faces in social phobia. *Journal of Behavior Therapy and Experimental Psychiatry*, *41*(1), 39–44. https://doi.org/10.1016/j.jbtep.2009.08.008

Garner, M., Mogg, K., & Bradley, B. P. (2006). Orienting and maintenance of gaze to facial expressions in social anxiety. *Journal of Abnormal Psychology*, *115*(4), 760–770. https://doi.org/10.1037/0021-843X.115.4.760

Gilboa-Schechtman, E., Foa, E. B., & Amir, N. (1999). Attentional biases for facial expressions in social phobia: The face-in-the-crowd paradigm. *Cognition and Emotion*, *13*(3), 305–318. https://doi.org/10.1080/026999399379294

Gotlib, I. H., Kasch, K. L., Traill, S., Joormann, J., Arnow, B. A., & Johnson, S. L. (2004). Coherence and specificity of information-processing biases in depression and social phobia. *Journal of Abnormal Psychology*, *113*(3), 386–398. https://doi.org/10.1037/0021-843X.113.3.386

Gould, R. A., Buckminster, S., Pollack, M. H., Otto, M. W., & Yap, L. (1997). Cognitive-behavioral and pharmacological treatment for social phobia: A meta-analysis. *Clinical Psychology: Science and Practice*, *4*(4), 291–306. https://doi.org/10.1111/j.1468-2850.1997.tb00123.x

Gutiérrez-Garcia, A., & Calvo, M. G. (2017). Social anxiety and threat-related interpretation of dynamic facial expressions: Sensitivity and response bias. *Personality and Individual Differences*, *107*, 10–16. https://doi.org/10.1016/j.paid.2016.11.025

Harb, G. C., & Heimberg, R. G. (2002). Kognitiv-behaviorale Behandlung der sozialen Phobie: Ein Überblick. In U. Stangier & T. Fydrich (Eds.), *Soziale Phobie und Soziale Angsstörung*, 311–338.

Hautzinger, M., Keller, F., & Kühner, C. (2006). *Beck Depressions-Inventar (BDI-II)*. Frankfurt/Main: Harcourt Test Services.

Heeren, A., Mogoase, C., Philippot, P., & McNally, R. J. (2015). Attention bias modification for social anxiety: A systematic review and meta-analysis. *Clinical Psychology Review*, *40*, 76–90. https://doi.org/10.1016/j.cpr.2015.06.001

Heimberg, R. G., Brozovich, F. A., & Rapee, R. M. (2010). A Cognitive Behavioral Model of Social Anxiety Disorder: Update and Extension. In *Social Anxiety*, 395–422. Elsevier. https://doi.org/10.1016/B978-0-12-375096-9.00015-8

Heinrichs, N., & Hofmann, S. G. (2001). Information processing in social phobia: A critical review. *Clinical Psycholology Review*, *21*(5), 751–770. https://doi.org/10.1016/S0272-7358(00)00067-2

Hoffman, J. E. (1998). Visual attention and eye movements. In H. Pashler (Ed.), *Attention,* 384, 119–153. Psychology Press.

Horley, K., Williams, L. M., Gonsalvez, C., & Gordon, E. (2003). Social phobics do not see eye to eye: A visual scanpath study of emotional expression processing. *Journal of Anxiety Disorders*, *17*(1), 33–44. https://doi.org/10.1016/S0887-6185(02)00180-9

Horley, K., Williams, L. M., Gonsalvez, C., & Gordon, E. (2004). Face to face: Visual scanpath evidence for abnormal processing of facial expressions in social phobia. *Psychiatry Research*, *127*(1–2), 43–53. https://doi.org/10.1016/j.psychres.2004.02.016

Juth, P., Lundqvist, D., Karlsson, A., Ohman, A., & Öhman, A. (2005). Looking for foes and friends: Perceptual and emotional factors when finding a face in the crowd. *Emotion*, *5*(4), 379–395. https://doi.org/10.1037/1528-3542.5.4.379

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice*, *10*(2), 144–156. https://doi.org/10.1093/clipsy/bpg016

Knye, M., Roth, N., Westhus, W., & Heine, A. (2003). *Continuous performance test*. Göttingen: Hogrefe.

Kowler, E., Anderson, E., Dosher, B., & Blaser, E. (1995). The role of attention in the programming of saccades. *Vision Research*, *35*(13), 1897–1916. https://doi.org/10.1016/0042-6989(94)00279-U

Langner, O., Dotsch, R., Bijlstra, G., Wigboldus, D. H. J., Hawk, S. T., & van Knippenberg, A. (2010). Presentation and validation of the Radboud Faces Database. *Cognition & Emotion*, *24*(8), 1377–1388. https://doi.org/10.1080/02699930903485076

Laux, L., Glanzmann, P., Schaffner, P., & Spielberger, C. D. (1981). *Das State-Trait-Anxiety-Inventory (STAI)*. *Theoretical Foundations and Instructions*. Weinheim: Beltz.

Leber, S., Heidenreich, T., Stangier, U., & Hofmann, S. G. (2009). Processing of facial affect under social threat in socially anxious adults: Mood matters. *Depression and Anxiety*, *26*(2), 196–206. https://doi.org/10.1002/da.20525

Liang, C., Tsai, J., & Hsu, W. (2017). Sustained visual attention for competing emotional stimuli in social anxiety: An eye tracking study. *Journal of Behavior Therapy and Experimental Psychiatry*, *54*, 178–185. https://doi.org/10.1016/j.jbtep.2016.08.009

Liebowitz, M. R. (1987). Social phobia. *Modern Problems of Pharmacopsychiatry*, (22), 141–173.

Mansell, W., & Clark, D. M. (1999). How do I appear to others? Social anxiety and processing of the observable self. *Behaviour Research and Therapy*, *37*(5), 419–434. https://doi.org/10.1016/S0005-7967(98)00148-X

Mansell, W., Clark, D. M., Ehlers, A., & Chen, Y.-P. (1999). Social anxiety and attention away from emotional faces. *Cognition and Emotion*, *13*(6), 673–690. https://doi.org/10.1080/026999399379032

Mogg, K., Bradley, B., Miles, F., & Dixon, R. (2004). Time course of attentional bias for threat scenes: Testing the vigilance-avoidance hypothesis. *Cognition & Emotion*, *18*(5), 689–700. https://doi.org/10.1080/02699930341000158

Mogg, K., & Bradley, B. P. (2002). Selective orienting of attention to masked threat faces in social anxiety. *Behaviour Research and Therapy*, *40*(12), 1403–1414. https://doi.org/10.1016/S0005-7967(02)00017-7

Mogg, K., Bradley, B. P., Dixon, C., Fisher, S., Twelftree, H., & McWilliams, A. (2000). Trait anxiety, defensiveness and selective processing of threat: An investigation using two measures of attentional bias. *Personality and Individual Differences*, *28*(1), 1063–1077. https://doi.org/10.1016/S0191-8869(99)00157-9

Mogg, K., Holmes, A., Garner, M., & Bradley, B. P. (2008). Effects of threat cues on attentional shifting, disengagement and response slowing in anxious individuals. *Behaviour Research and Therapy*, *46*(5), 656–667. https://doi.org/10.1016/j.brat.2008.02.011

Mogg, K., Millar, N., & Bradley, B. P. (2000). Biases in eye movements to threatening facial expressions in generalized anxiety disorder and depressive disorder. *Journal of Abnormal Psychology*, *109*(4), 695–704. https://doi.org/10.1037//0021-843X.

Mogg, K., Philippot, P., & Bradley, B. P. (2004). Selective attention to angry faces in clinical social phobia. *Journal of Abnormal Psychology*, *113*(1), 160–5. https://doi.org/10.1037/0021-843X.113.1.160

Mörtberg, E., Hoffart, A., Boecking, B., & Clark, D. M. (2013). Shifting the focus of one's attention mediates improvement in cognitive therapy for social anxiety disorder. *Behavioural and Cognitive Psychotherapy*, 1–11. https://doi.org/10.1017/S1352465813000738

Nothdurft, H. C. (1999). Focal attention in visual search. *Vision Research*, *39*(14), 2305–2310. https://doi.org/10.1016/S0042-6989(99)00006-1

Quigley, L., Nelson, A. L., Carriere, J., Smilek, D., & Purdon, C. (2012). The effects of trait and state anxiety on attention to emotional images: An eye-tracking study. *Cognition & Emotion*, *26*, 1–22. https://doi.org/10.1080/02699931.2012.662892

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy*. https://doi.org/10.1016/S0005-7967(97)00022-3

Richards, H. J., Benson, V., Donnelly, N., & Hadwin, J. A. (2014). Exploring the function of selective attention and hypervigilance for threat in anxiety. *Clinical Psychology Review*, *34*(1), 1–13. https://doi.org/10.1016/j.cpr.2013.10.006

Rinck, M., Becker, E. S., Kellermann, J., & Roth, W. T. (2003). Selective attention in anxiety:

Distraction and enhancement in visual search. *Depression and Anxiety*, *18*(1), 18–28. https://doi.org/10.1002/da.10105

Rinck, M., Reinecke, A., Ellwart, T., Heuer, K., & Becker, E. S. (2005). Speeded detection and increased distraction in fear of spiders: Evidence from eye movements. *Journal of Abnormal Psychology*, *114*(2), 235–248. https://doi.org/10.1037/0021-843X.114.2.235

Ruhmland, M., & Margraf, J. (2001). Effektivität psychologischer Therapien von generalisierter Angststörung und sozialer Phobie: Meta-Analysen auf Störungsebene. *Verhaltenstherapie*, *11*(1), 27–40.

Schmukle, S. C. (2005). Unreliability of the dot probe task. *European Journal of Personality*, *19*(7), 595–605. https://doi.org/10.1002/per.554

Schofield, C. A., Johnson, A. L., Inhoff, A. W., & Coles, M. E. (2012). Social anxiety and difficulty disengaging threat: Evidence from eye-tracking. *Cognition & Emotion*, *26*, 300–311. https://doi.org/10.1080/02699931.2011.602050

Singh, J. S., Capozzoli, M. C., Dodd, M. D., & Hope, D. A. (2015). The Effects of Social Anxiety and State Anxiety on Visual Attention: Testing the Vigilance Avoidance Hypothesis. *Cognitive Behaviour Therapy*, *44*(5), 377–388. https://doi.org/10.1080/16506073.2015.1016447

Stagner, R. (1977). On the Reality and Relevance of Traits. *The Journal of General Psychology*. https://doi.org/10.1080/00221309.1977.9920815

Stangier, U., & Heidenreich, T. (2005). Liebowitz Soziale Angst-Skala (LSAS) [Liebowitz Social Anxiety Scale]. In Collegium Internationale Psychiatriae Scalarum (Ed.), *Internationale Skalen für Psychiatrie*, 299–305. Göttingen: Hogrefe.

Staugaard, S. R. (2009). Reliability of two versions of the dot-probe task using photographic faces. *Psychology Science Quarterly*, *51*(3), 339–350.

Stein, M. B., & Kean, Y. M. (2000). Disability and quality of life in social phobia: Epidemiologic findings. *American Journal of Psychiatry*, *157*(10), 1606–1613. https://doi.org/10.1176/appi.ajp.157.10.1606

Stopa, L., & Clark, D. M. (2000). Social phobia and interpretation of social events. *Behaviour*

Research and Therapy, *38*(3), 273–283. https://doi.org/10.1016/S0005-7967(99)00043-1

Tancer, M. (1997). Social phobia: Diagnosis, assessment, and treatment. *Depression and Anxiety*, *5*(1), 50–50. https://doi.org/10.1002/(SICI)1520-6394(1997)5:1<50::AID-DA11>3.0.CO;2-6

Wadlinger, H. a, & Isaacowitz, D. M. (2011). Fixing our focus: Training attention to regulate emotion. *Personality and Social Psychology Review: An Official Journal of the Society for Personality and Social Psychology, 15*(1), 75–102. https://doi.org/10.1177/1088868310365565

Waechter, S., Nelson, A. L., Wright, C., Hyatt, A., & Oakman, J. (2014). Measuring attentional bias to threat: Reliability of dot probe and eye movement indices. *Cognitive Therapy and Research*, *38*(3), 313–333. https://doi.org/10.1007/s10608-013-9588-2

Waechter, S., & Stolz, J. A. (2015). Trait Anxiety, State Anxiety, and Attentional Bias to Threat: Assessing the Psychometric Properties of Response Time Measures. *Cognitive Therapy and Research*, *39*(4), 441–458. https://doi.org/10.1007/s10608-015-9670-z

Weierich, M. R., Treat, T. A., & Hollingworth, A. (2008). Theories and measurement of visual attentional processing in anxiety. *Cognition and Emotion*, *22*(6), 985–1018. https://doi.org/10.1080/02699930701597601

Wermes, R., Lincoln, T. M., & Helbig-Lang, S. (under review). Anxious and alert? Hypervigilance in social anxiety disorder. *Psychiatry Research*.

Wermes, R., Lincoln, T. M., & Helbig-Lang, S. (2017). How well can we measure visual attention? Psychometric properties of manual response times and first fixation latencies in a visual search paradigm. *Cognitive Therapy and Research*, *41*(4), 588–599. https://doi.org/10.1007/s10608-016-9830-9

Wermes, R., Lincoln, T. M., & Helbig-Lang, S. (2018). Attentional biases to threat in social anxiety disorder: Time to focus our attention elsewhere? *Anxiety, Stress, & Coping*. https://doi.org/10.1080/10615806.2018.1483497

Williams, J. M., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin*, *120*(1), 3–24. https://doi.org/Doi 10.1037/0033-2909.120.1.3

Wittchen, H.-U., Zaudig, M., & Fydrich, T. H. (1997). SKID - Strukturiertes Klinisches Interview für DSM-IV. Achse I und II Handanweisungen [Structured Clinical Interview for DSM-IV]. Göttingen: Hogrefe. https://doi.org/10.1026//0084-5345.28.1.68

Wittchen, & Hoyer, J. (2011). Klinische Psychologie & Psychotherapie. Heidelberg: Springer.

Woody, S. R. (1996). Effects of focus of attention on anxiety levels and social performance of individuals with social phobia. *Journal of Abnormal Psychology*, *105*(1), 61–69. https://doi.org/10.1037/0021-843X.105.1.61

9. Publikationen

9.1. Studie 1: Methodische Grundlagen

Wermes, R., Lincoln, T. M., & Helbig-Lang, S. (2017). How well can we measure visual attention? Psychometric properties of manual response times and first fixation latencies in a visual search paradigm. *Cognitive Therapy and Research*, *41*(4), 588–599. https://doi.org/10.1007/s10608-016-9830-9

Cogn Ther Res (2017) 41:588–599
DOI 10.1007/s10608-016-9830-9

ORIGINAL ARTICLE

How Well Can We Measure Visual Attention? Psychometric Properties of Manual Response Times and First Fixation Latencies in a Visual Search Paradigm

Richard Wermes[1] · Tania M. Lincoln[1] · Sylvia Helbig-Lang[1]

Published online: 25 January 2017

Abstract Attentional biases are considered to be important for the development and maintenance of anxiety disorders, but despite widespread research in this area, the psychometric properties of measures targeting attentional allocation processes have rarely been evaluated. The current study assessed the reliability and validity of manual response times and first fixation latencies within a visual search paradigm, including data from one hundred twenty-two participants (n = sixty-two participants with social anxiety disorder). We found raw manual response times to be highly reliable, while raw first fixation latencies, in most cases, were not. Bias scores were neither reliable for manual responses nor for first fixation latencies. However, we found indicators of convergent validity, as raw values and also bias scores of both measures were significantly correlated. These results raise doubts about our ability to accurately measure visual attention, especially via eye-tracking procedures.

Keywords Attentional biases · Psychometric properties · Visual search · Eye movements · Social anxiety disorder

Introduction

According to cognitive-behavioral models, anxiety is related to a selective attention to threatening stimuli, so-called attentional biases to threat (ABT). Recent formulations suggest that ABT may comprise different components such as a facilitated orientation towards threatening stimuli (vigilance), difficulties in disengagement from threatening stimuli (delayed disengagement), or an avoidance of threatening stimuli (Cisler and Koster 2010). Less often, a distraction by threatening stimuli is discussed as an additional component (Rinck et al. 2005).

In case of social anxiety disorder (SAD), these biases could, for example, concern selective attention towards signs of disapproval by others, such as frowning or yawning, or an avoidance of social cues, such as eye-contact (Rapee and Heimberg 1997). However, empirical findings concerning the question which biases actually occur in SAD and how those are related to anxious responding are often inconsistent and inconclusive (Chen et al. 2012; Mansell et al. 1999; Sposari and Rapee 2007).

The divergent findings on ABT in anxiety disorders may at least partially stem from the different methodological approaches applied to measure attentional processes. Experimental research on attentional biases involves various paradigms that directly or indirectly capture the allocation of attention towards visual stimuli (Cisler and Koster 2010). The vast majority of studies on ABT rely on manual response paradigms, which include emotional dot probe (e.g., Bradley et al. 1999), emotional cueing (e.g., Fox et al. 2001), emotional stroop (e.g., Williams et al. 1996), and visual search (e.g., Juth et al. 2005) paradigms. All of these paradigms have in common that they present visual stimuli to participants and capture their manual responses towards these stimuli as an indirect measure of visual attention.

Electronic Supplementary Material The online version of this article (doi:10.1007/s10608-016-9830-9) contains supplementary material, which is available to authorized users.

✉ Richard Wermes
richard.wermes@uni-hamburg.de

[1] Department of Clinical Psychology and Psychotherapy, University of Hamburg, Von-Melle-Park 5, 20146 Hamburg, Germany

Although the dot probe task is the most frequently applied paradigm in anxiety research, it has been repeatedly criticized for its unsatisfactory psychometric properties (e.g., Schmukle 2005; Staugaard 2009).

The visual search paradigm (e.g., Ohman et al. 2001; Rinck et al. 2003) may provide a promising alternative in this regard. Compared to dot probe or spatial cueing paradigms, it provides the opportunity to present more than two different stimuli simultaneously and it allows for different variations of tasks. This makes the paradigm more comparable to real-life attention allocation processes, in which various stimuli compete for attention. Although less often applied, visual search paradigms were capable of identifying the different components of ABT in social anxiety (Eastwood et al. 2005; Gilboa-Schechtman et al. 1999; Juth et al. 2005). Here, arrays of several stimuli (e.g. a crowd of facial images) are presented to participants who are asked to manually respond to them as quickly as possible by pressing specific keys, depending on whether a defined target-stimulus is present or not. Typically, visual search tasks require participants to indicate whether all stimuli within the display are equal or whether one of them is different or, alternatively, whether a specific stimulus can be identified in the display or not. Differences in the manual response times to threatening and non-threatening stimuli are interpreted as indicators of ABT. Specifically, facilitated attention is indicated by faster responses to threat target cues compared to non-threat cues, and delayed disengagement is indicated by slower responses to non-threat target cues in a display of threat distractors.

In contrast to manual response paradigms, eye-tracking paradigms are used to assess visual attention more directly, as they measure eye-movements via infrared cameras (Mogg et al. 2000). The perception of visual stimuli involves directing the fovea, a small part of the retina, towards a stimulus (Hoffman 1998). Accordingly, eye-movements are assumed to be closely related to visual attention (Kowler et al. 1995). Eye-tracking paradigms capture spatial and temporal attention allocation processes by means of several parameters. These include the time until an area of interest is fixated for the first time (first fixation latency), the duration of fixations, the number of fixations, and the overall scan path. Eye-tracking paradigms often involve free viewing tasks, in which different stimuli are presented to participants without asking for any responses. Less often, eye-tracking paradigms involve antisaccade tasks (Chen et al. 2014) and occasionally, eye-tracking is combined with manual response paradigms (e.g., Rinck et al. 2005). Only a few studies have used eye-tracking paradigms to research ABT in anxious participants. However, findings have been inconclusive: Evidence was found for facilitated attention (Gamble and Rapee 2010; Garner et al. 2006; Rinck et al. 2005), delayed disengagement (Byrne and Eysenck 1995), attentional avoidance (Garner et al. 2006; Pflugshaupt et al. 2005), or none of these (Derakshan and Koster 2010).

Given the apparent lack of consistency in findings both within and across the different paradigms, it needs to be questioned whether the applied tasks measure what they are supposed to measure. Specifically, reliability and validity have to be considered. Reliability values below .60 are commonly regarded as unacceptably low while values above .80 are considered to be good (Murphy and Davidshofer 2005). Validity is often estimated using correlations between different measures targeting similar constructs or based on associations with criterion variables.

Surprisingly, only a few studies have examined the psychometric properties of manual response paradigms assessing ABT. Those that did, most often found acceptable to excellent reliabilities for raw response times for single types of stimuli (e.g., Brown et al. 2014; Eide et al. 2002; Waechter et al. 2014). In contrast, bias scores, that are applied to indicate attentional biases, were found to be unreliable in most cases (e.g., Brown et al. 2014; Eide et al. 2002; Schmukle 2005; Staugaard 2009; Waechter et al. 2014; Waechter and Stolz 2015). Moreover, a majority of studies has found low (Brosschot et al. 1999; Brown et al. 2014; Egloff and Hock 2003; Waechter and Stolz 2015) or even non-existent (Dalgleish et al. 2003; Gotlib et al. 2004; Mogg et al. 2000) correlations between bias scores from different manual response paradigms, casting serious doubts on their validity.

So far, only one study has examined reliability and validity of an eye-tracking paradigm assessing ABT (Waechter et al. 2014). Here, eye-tracking bias scores calculated within the first 1500 ms of trials were found to be unreliable, while those calculated over the full 5000 ms of each trial were highly reliable. In regard to validity, bias scores derived from the eye-tracking data and bias scores derived from a dot probe task in the same sample were largely uncorrelated (Waechter et al. 2014).

Taken together, psychometric properties of direct and indirect measures of visual attention are largely inconclusive. Nevertheless, reliability and validity are often taken for granted, which might explain why empirical findings based on these measures are so inconsistent (Cooper et al. 2011; Waechter and Stolz 2015).

The Current Study

The current study examines psychometric properties of direct and indirect measures used to assess ABT in emotional disorders. Given the increasing interest in attentional processes and their relation to psychopathology, it is mandatory to clarify how well visual attention can be measured, before final conclusions on the impact of ABT

can be drawn. This is the first study to evaluate the psychometric properties of manual response times and eye-tracking parameters that were simultaneously assessed within a visual search paradigm. We are therefore able to compare direct and indirect measures of visual attention within the same methodological framework. As information on psychometric properties of both eye-tracking parameters and manual response times derived in visual search paradigms is still scarce, results might help to improve our understanding of these methods and furthermore clarify inconclusive results on ABT in the current literature. We analyzed raw scores and bias scores indicating selective attention towards threatening stimuli in terms of their reliability and validity. Data was collected in an overarching research project that was designed to further elucidate the associations between attention allocation for social stimuli and state and trait social anxiety. We therefore compared individuals diagnosed with SAD to healthy controls. As previous studies indicated that ABT might only occur under conditions of threat (e.g. Koster et al. 2006; Quigley et al. 2012), we experimentally manipulated levels of state anxiety in both groups. Thus, the final study design consisted of a 2 (group: trait anxiety) × 2 (condition: state anxiety) plan. The detailed results concerning group and condition differences in attention allocation for different stimuli will be reported in another paper (Wermes et al., in prep.). The current manuscript focuses on the psychometric properties of the attention measures applied in this study.

In line with the majority of previous findings (cf. Waechter and Stolz 2015), we expected the raw manual response times in our visual search paradigm to be reliable (hypothesis 1a), and the respective bias scores to be unreliable (hypothesis 1b). Considering eye-tracking parameters, only one study examined respective psychometric properties so far (Waechter et al. 2014). Although this study indicates that bias scores derived from eye-tracking parameters might also be unreliable, it did not directly look at first fixation latency raw values. As we assume first fixation latencies to be a more direct and likewise better reflection of visual attention than manual response times, we hypothesized that first fixation latency raw values should be more reliable than manual response times (hypothesis 1c). We also expected bias scores derived from first fixation latencies in our clinical sample to be reliable (hypothesis 1d) as the negative findings by Waechter et al. (2014) might be due to sampling effects and divergent instructions for participants in free viewing tasks. Finally, since the manual response time towards a specific stimulus reflects the respective first fixation latency, we expected these two measures to be highly correlated (hypothesis 2).

Methods

Participants

Individuals with a current DSM-IV diagnosis of SAD and healthy controls took part in our study. Exclusion criteria for all participants were left- or two-handedness, uncorrected visual impairments or hard contact lenses, and specific medication that might influence cognitive processes, including benzodiazepines, antihistamines, prescribed pain medication, and eye drops. Participants were considered as healthy controls, if they had no lifetime diagnoses of any affective, psychotic or substance use disorders, and if they did not meet criteria of any other mental disorder within the past 5 years (except for nicotine dependence). Exclusion criteria for the clinical group included a lifetime diagnosis of a bipolar or psychotic disorder, a current substance use disorder, and a recent onset (less than 6 weeks) of a psychopharmacological treatment. All study procedures were approved by the Ethic Committee of the German Society of Psychology (Reference No. SHL012014).

The current analyses comprised data of $N = 122$ participants (SAD group: $n = 62$). While 138 participants completed the entire experiment, twelve participants were excluded due to insufficient calibration results for the eye-tracking procedure and four participants were excluded due to technical problems during the data collection. According to two diagnostic groups and two experimental conditions, the total sample comprised four subgroups. In all subgroups, age ($F(3) = .09$, $p = .967$) as well as gender ($\chi^2(3) = .39$, $p = .942$) were equally distributed. The mean age of all participants was 29.7 years; 80 of them were women and 42 men. The SAD group scored significantly higher in trait social anxiety, as revealed by differences in the LSAS total score ($F(1) = 186.60$, $p < .001$). The stress induction significantly increased state social anxiety, as revealed by comparisons of the pre-post STAI-S values ($F(1) = 99.44$, $p < .001$). Table 1 depicts the descriptive sample information.

Materials/Apparatus

Diagnostic Assessment

Structured Clinical Interview for DSM-IV (SCID-I; Wittchen et al. 1997*)* The SCID-I, a widely used assessment tool with good psychometric properties (Zanarini et al. 2000), was used to determine the diagnostic status. The SCID has proven a good inter-rater reliability for social anxiety disorder (Skre et al. 1991) and can, thus, be regarded as valid.

Table 1 Descriptive results for demographic information and questionnaire data by diagnostic group and experimental condition

	HC		SAD	
	No stress ($n=30$)	Stress ($n=30$)	No stress ($n=32$)	Stress ($n=30$)
Age, M (SD)	30.1 (6.1)	29.2 (6.9)	30.0 (8.6)	29.4 (9.2)
Gender in % men/women	37/63	37/63	34/66	30/70
LSAS, M (SD)	15.9 (11.3)	21.8 (15.9)	68.5 (25.5)	65.0 (21.4)
STAI-S t1, M (SD)	32.0 (5.3)	33.4 (7.6)	44.3 (7.5)	41.3 (7.4)
STAI-S t2, M (SD)	30.9 (5.1)	44.1 (10.3)	43.5 (6.9)	56.5 (10.3)

HC healthy controls, *SAD* participants with social anxiety disorder, *No stress* control condition, *Stress* stress condition, *LSAS* Liebowitz Social Anxiety Scale (Stangier and Heidenreich 2005), *STAI-S* State Trait Anxiety Inventory (Laux et al. 1981), t_1 assessment prior to experimental manipulation, t_2 after experimental manipulation

Self-report Measures

Liebowitz Social Anxiety Scale (LSAS; Liebowitz 1987; Stangier and Heidenreich 2005*)*. The LSAS self-rating is a 24-item measure that assesses anxiety and avoidance in social situations. The total score indicates overall social anxiety severity and can range from 0 to 144. Internal consistency, convergent and discriminant validity are considered to be good (Fresco et al. 2001).

State Anxiety Inventory (STAI-S; Spielberger et al. 1970; Laux et al. 1981 *)*. The STAI-S measures current state anxiety with 20 items that have to be judged on a 4-point Likert scale. The scale provides excellent psychometric properties with Cronbach's alpha = .90 and several indicators for its validity (Kendall et al. 1976; Laux et al. 1981).

Computer Tasks

Stimuli The stimulus material for the visual search task comprised facial photographs with happy, neutral, and angry expressions taken from the Radboud Faces Database (Langner et al. 2010). Three male and three female models were selected according to their validation data (Langner et al. 2010) with clarity of expression as main criterion.

Visual Search Tasks Stimulus sets consisted of a circular structure of eight faces, as applied before, for example by Juth et al. (2005), in order to present stimuli in equal distances from the fixation cross preceding each stimulus set and to rule out the preference of the central stimulus location that might occur in conventional stimulus sets with rows of stimuli. All stimulus sets consisted of pictures of neutral, happy, or angry faces, which were combined to different set types. These set types were used in three different experimental subtasks:

A "Detection Task" required participants to press the key on the left hand side of a response box if one stimulus within a stimulus set was different from the others and the key on the right hand side if all stimuli were the same. The task comprised a total number of 100 trials, 36 trials consisting of stimulus sets including the same stimulus eight times (non-target trials) and 64 trials consisting of stimulus sets each including a deviant facial expression (target trials). Non-target trials included the set types "non-target angry faces" (a), "non-target happy faces" (h), and "non-target neutral faces" (n). Target-trials included the set types "angry face among a neutral crowd" (an), "happy face among a neutral crowd" (hn), "neutral face among an angry crowd" (na), and "neutral face among a happy crowd" (nh).

A "Search Angry Task" required participants to press the key on the left hand side of a response box, if an angry face could be seen and the key on the right hand side, if an angry face could not be seen. The task comprised a total number of 64 trials, 16 non-target trials of the set type "happy face among a neutral crowd" (hn), 16 target trials of the set type "angry face among a neutral crowd" (an), and 32 target trials of the set type "angry face and happy face (distractor) among a neutral crowd" (ahn).

A "Search Happy Task" required participants to press the key on the left hand side of a response box, if a happy face could be seen and the key on the right hand side, if a happy face could not be seen. The task also comprised 64 trials, 16 non-target trials of the set type "angry face among a neutral crowd" (an), 16 target trials of the set type "happy face among a neutral crowd" (hn), and 32 target trials of the set type "happy face and angry face (distractor) among a neutral crowd" (han).

In all subtasks, stimulus sets were presented for four seconds, preceded by a fixation cross shown for 500 ms. The subtasks were randomized in order, and preceded by 12 practice trials each, showing different face stimuli than the actual experimental trials. Within all subtasks, the position of target (and distractor) stimuli was completely balanced across trials. Stimulus sets were shown in a pseudo-random order. During each task, an infrared eye-tracking system captured eye movements simultaneously.

Apparatus

All computer tasks were implemented using E-Prime 2.0 and presented on a Dell OptiPlex 790 computer attached to a 22-inch Dell P2210 monitor, using a 1680×1050 resolution mode. Stimulus sets had a diameter of 20.1 cm and single stimuli had a diameter of 5.3 cm on the monitor while the distance between participants and monitor was roughly set to 70 cm. Manual responses were recorded using a Serial Response Box 200 A (Psychology Software Tools) combined with E-Prime 2.0 and eye movements were recorded using a SensoMotoric Instruments RED500 desktop mounted eye tracking system combined with the manufacturers software iViewX 2.8 at a data rate of 60 Hz. Calibration was done using a 9-point procedure and only values below 1° visual angle were accepted, providing for an estimated maximal difference between measured and actual fixation locations of 12 mm.

Procedure

We recruited participants mainly via a university-related job-offering website and printed announcements. After a short telephone screening, those who met the inclusion criteria were invited for a diagnostic assessment. At this first appointment, participants were informed about study aims and procedures and asked to provide a written consent. The subsequent intake assessment comprised the diagnostic interview SCID-I and several self-report questionnaires assessing social anxiety, self-regulation capacities, and cognitive schemata. We invited participants who were eligible for the study for a second session that included additional questionnaires, followed by an experimental manipulation, and an assessment of visual attention towards social stimuli. The average time lag between diagnostic assessment and experimental testing was ten days.

In order to investigate effects of state anxiety, participants were randomly assigned to either a stress or a control condition. Within the stress condition, the investigator informed participants that they were asked to provide a short speech on a controversial topic in front of an audience at the end of the experiment and that they could prepare for this speech within the next 5 min. Participants in the control condition had a five-minute break. Prior and after the experimental manipulation, all participants completed the STAI-S as part of the manipulation check. At the end of the experiment, participants in the stress condition were debriefed and completed a short questionnaire on the credibility of the manipulation. Participants received 10 € compensation per hour.

The SCID interviews were conducted by psychology students who had received extensive training and had passed a test interview with an experienced clinical psychologist.

Data Preparation

Eye movement data was processed using BeGaze 3.5 (SensoMotoric Instruments 2015), which we essentially used to mark all target stimuli as areas of interest and to define fixations as gaze stability of at least 100 ms. All further data preparation was done using R 3.1.2 (R Development Core Team 2009). In order to prepare data for our reliability analyses, we restructured data on manual response times and first fixation latency values as individual matrices for each set type. Each row of these matrices presented a participant, and each column referred to either the manual response times or the first fixation latencies for a given stimulus set. Manual response time values were only included if they were correct responses according to the instructions given within the experiment. Incorrect or no responses were defined as missing values. First fixation latency values were considered as missing if either a participant did not fixate the respective target or if fixations were not recorded due to technical limitations of the eye tracking procedure. Moreover, first fixation latency values were defined as missing, if the respective simultaneously recorded manual response time values were either smaller or missing. 4.81% of manual response times and 4.31% of first fixation latencies were initially missing. After correcting first fixation latencies by respective manual response times, the number of missing values increased to 13.21%. Missing values were excluded from the analyses.

In correspondence with the literature (cf., Cisler and Koster 2010), we calculated bias scores as indicators of different attentional biases. Whenever possible, bias scores were calculated for both manual reaction times and the corresponding fixation latencies. We calculated a facilitation bias by subtracting responses to the set type *hn* from the responses to the set type *an* in the Detection Task. Further, we determined a disengagement bias by comparing reactions towards the set types *a* and *n, a* and *h, na* and *nh*. Finally, both Search Tasks provided data for a distraction bias that was calculated by subtracting set types with from set types without distractor stimuli (e.g. *ahn* and *an*).

Analyses

To determine the psychometric properties of the visual search tasks and the eye-tracking procedure, we collapsed data of all participants. For analysing first fixation latencies, only set types including target stimuli were taken into account, and for those set types that included both, target- and distractor-stimuli, we analysed first fixation latencies for target-stimuli only.

Reliability of manual response time and first fixation latency raw values were evaluated using Cronbach's Alpha. In accordance with prior research, we assessed reliability

of bias scores using a permutation approach (cf., MacLeod et al. 2010), which provides a method of computing the average of all possible split-halves. Specifically, raw values of all relevant responses were split into two random halves for 1000 times. For each of the resulting two halves, bias scores were calculated and hereafter correlated. Conclusively, the average of all correlations was calculated and corrected for test length using the Spearman–Brown prophecy formula.

Validity was evaluated as convergent validity, which we calculated by correlating manual response times and first fixation latencies, considering means of raw values and bias scores. All analyses were conducted using SPSS 23 (SPSS Inc., Chicago, IL). Missing values were excluded from the analyses.

Results

Internal Consistency

Reliability of manual response times turned out to be good for all stimulus sets. Cronbach's alpha was constantly above .82, with an overall mean of $\alpha = .87$. Reliability of first fixation latencies was unacceptably low for seven out of ten set types and above $\alpha = .80$ for only one set type. Notably, fixation latencies for the set types *ahn* and *han* were found to be reliable. Results are shown in Fig. 1.

Reliability of bias scores (see Appendix 1 for descriptive results for manual response time and first fixation latency bias scores) was unacceptably low both for manual response times and for first fixation latencies. Spearman–Brown corrected permutation reliability estimates never exceeded .28. The results are shown in Fig. 2.

Convergent Validity

As estimate of convergent validity, manual reaction times and first fixation latencies in the corresponding trials were correlated. Correlation coefficients were high for all set types (mean $r = .74$) and intermediate to high for the different bias scores (mean $r = .66$). Results are summarized in Table 2.

Explorative Analyses

We conducted explorative analyses to further evaluate the unexpectedly low reliability estimates for first fixation latency raw values. Within a first analysis, we considered the subgroups of participants separately in order to rule out that the unsatisfactory reliability was due to a specific condition. Fewer reliability estimates attained acceptable

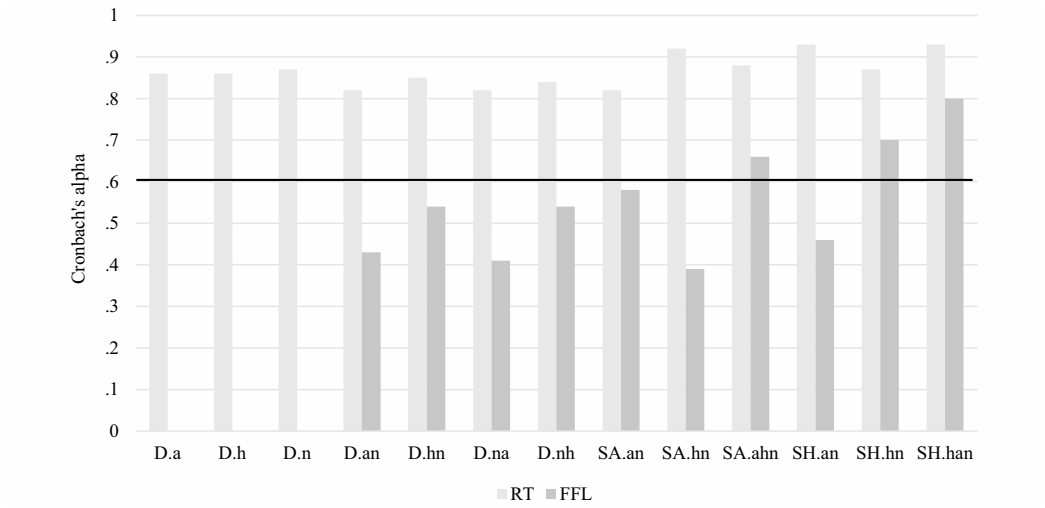

Fig. 1 Internal consistency of manual response time and first fixation latency raw values by task and set type. *Horizontal line* acceptable reliability threshold, *RT* manual response time, *FFL* first fixation latency (cannot be measured for trials without target stimulus), *D* detection task, *SA* search angry task, *SH* search happy task, *a* non-target trial: angry faces, *h* non-target trial: happy faces, *n* non-target trial: neutral faces, *an* angry target among a neutral crowd, *hn* happy target among a neutral crowd, *na* neutral target among an angry crowd, *nh* neutral target among a happy crowd, *ahn* angry target and happy distractor among a neutral crowd, *han* happy target and angry distractor among a neutral crowd

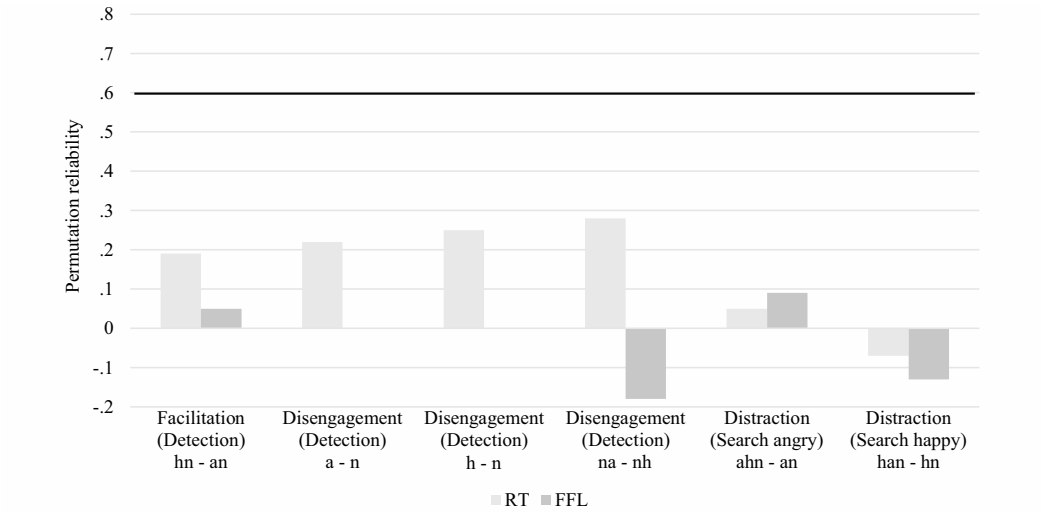

Fig. 2 Permutation reliability of manual response time and first fixation latency bias scores. *Horizontal line* acceptable reliability threshold, *RT* manual response time, *FFL* first fixation latency (cannot be measured for trials without target stimulus), *a* non-target trial: angry faces, *h* non-target trial: happy faces, *n* non-target trial: neutral faces, *an* angry target among a neutral crowd, *hn* happy target among a neutral crowd, *na* neutral target among an angry crowd, *nh* neutral target among a happy crowd, *ahn* angry target and happy distractor among a neutral crowd, *han* happy target and angry distractor among a neutral crowd

Table 2 Convergent validity of manual response time and first fixation latency raw values and bias scores (Pearson's r)

Task	Detection				Search angry			Search happy		
Set type	an	hn	na	nh	an	hn	ahn	an	hn	han
r	.70	.73	.75	.77	.82	.51	.84	.63	.85	.83
Bias	Facilitation (hn–an)		Disengagement (na–nh)		Distraction (ahn–an)			Distraction (han–hn)		
r	.44		.66		.81			.71		

an angry target among a neutral crowd, *hn* happy target among a neutral crowd, *na* neutral target among an angry crowd, *nh* neutral target among a happy crowd, *ahn* angry taraget and happy distractor among a neutral crowd, *han* happy target and angry distractor among a neutral crowd

*For all correlations $p < .001$

levels in subgroups including the stress induction (three and four estimates out of ten) as compared to subgroups without the stress induction (five and six estimates out of ten). In a second analysis, we compared trials within the first and the second halves of all subtasks to test for habituation or exhaustion effects and found no evidence for poorer performances in the second halves of trials. Finally, we checked for effects of different target and distractor locations by separating the upper three stimuli positions from the lower ones. Clustering target or distractor stimuli in lower positions led to an increased number of acceptable reliability estimates (seven estimates out of ten), while clustering stimuli in upper positions did not lead to more acceptable reliability estimates (two estimates out of ten) as compared to the analyses that did not differentiate target and distractor locations (three out of ten acceptable reliability estimates).

To further elucidate the lack of reliability of bias scores, we analyzed group differences in manual response times and first fixation latencies considering all four subgroups (control group without treatment, control group with treatment, clinical group without treatment, and clinical group with treatment) and bias scores, using oneway ANOVAs. Differences could only be found for the distraction bias within the search happy task for manual response times ($F(3) = 4.24$, $p = .007$) and first fixation latencies ($F(3) = 4.33$, $p = .006$).

Corresponding data is provided in Online Resource 1.

Discussion

The current study aimed to evaluate the psychometric properties of two paradigms measuring attention allocation in clinical conditions. More specifically, we examined the reliability and the convergent validity of manual response times and first fixation latencies assessed in a visual search paradigm. We also tried to elucidate whether state or trait anxiety impact these psychometric properties. The corresponding results are discussed below.

Reliability

In line with previous research and our hypotheses, we found the reliability of raw manual response times to be high (hypothesis 1a) and that of respective bias scores to be unacceptably low (hypothesis 1b). Contrary to our expectations, reliability estimates of first fixation latencies were smaller than those of manual response times, both in respect to raw values (hypothesis 1c) and to the derived bias scores (hypothesis 1d).

Reliability of raw manual response times ranged from .82 to .93 indicating that response times assessed in a visual search task reliably measure individual information processing speed to social stimuli (cf., Brown et al. 2014). However, in clinical research the main focus is to determine differences in processing emotional stimuli between clinical and non-clinical groups. These are assessed using bias scores, which were found to be unreliable for both manual response times and first fixation latencies. Our results are especially perturbing, given that a range of recently developed interventions to modify attention processes in clinical conditions are based on such bias scores. These so-called attention bias modification trainings are derived from contingent learning principles and attempt to teach participants to direct their attention to positive or neutral stimuli. Although some studies provided impressive results of these training procedures (e.g. Amir et al. 2009; Schmidt et al. 2009), other studies have failed to demonstrate any effect (e.g. Boettcher et al. 2013; Neubauer et al. 2013). Insufficient reliability of the underlying training tasks might explain the failure to provide consistent evidence for their effectiveness (Cristea et al. 2015).

It has to be noted that our results are somewhat limited by the fact that we could not verify the existence of an anxiety-specific ABT in our sample. The permutation approach (MacLeod et al. 2010) that we and previous researchers applied to measure reliability, neglects the importance of correlations between the different measures that are used to calculate bias scores. In particular, high correlations between such measures lead to decreased reliability of bias scores (Murphy and Davidshofer 2005). A lack of group specific biases will increase the correlation between reliable measures, which are used to calculate a respective bias score, and therefore decrease its reliability. The unacceptably low estimates of reliability of bias scores we found should be interpreted cautiously with regard to this circumstance. Research on psychometric properties of attentional bias scores should as well consider this issue, which impairs our ability to verify the reliability of a bias score, if no bias can be found. However, previous findings also indicated that bias scores derived from different manual response and eye-tracking paradigms were unreliable (Eide et al. 2002; Waechter et al. 2014), adding to a general doubt about the suitability of these measures to demonstrate deviance in attention allocation processes in clinical samples.

The lack of group differences in attention allocation is somewhat surprising given that assumptions of ABT in social anxiety disorder were supported by several studies using different designs including visual search (Gilboa-Schechtman et al. 1999; Juth et al. 2005, study 5; Miskovic and Schmidt 2012; Mogg et al. 2004; Pishyar et al. 2004). However, null findings concerning an ABT in social anxiety disorder were also previously reported (Amir et al. 2003; Chen et al. 2012; Eastwood et al. 2005; Juth et al. 2005, study 1–3). Up to date, it is not clear whether these inconsistencies stem from methodological differences between the studies or whether ABT is not a stable condition (cf., Heeren et al. 2015). Our study design was based on previous studies such as Juth et al. (2005), however, there were also changes to the stimulus material used, the number of trials, and the presentation times. Thus, we cannot rule out that our results might be attributed to our specific research design. Consequently, effects of methodological variations in attention assessment should be studied more rigorously to provide better explanations for the inconsistent findings on ABT in social anxiety.

Contrary to our expectations, we found eye-tracking measures to be less reliable than manual response times. When interpreting the unexpectedly low reliability of first fixation latency raw values, however, the number of included trials for each set type has to be considered. Within the current study, we calculated the internal consistency for each set type, while the number of trials varied between twelve, sixteen and thirty-two. This might have affected the internal consistency of first fixation latency raw values, as set types with high trial numbers attained more acceptable levels of internal consistency ($\alpha > .6$). Future studies may thus need to include larger numbers of trials referring to one set type in order to reach internally consistent first fixation latency raw values. Nevertheless, it seems unlikely that an increased number of trials would make first fixation latencies more reliable than manual response times, as that was not the case for any set type within the current study.

Convergent Validity

In support of hypothesis 2, manual response times and first fixation latencies were correlated in all cases, both in terms of raw values and in terms of derived bias scores, indicating convergent validity of these measures. This finding is surprising at first sight, given that acceptable reliability is considered a precondition for the validity of a measure. However, within the current study, reliability was estimated as internal consistency for both raw values and bias scores, considering individual values for the different stimulus sets, while convergent validity was estimated using means over all stimulus sets belonging to one set type. Although the individual values of first fixation latencies for stimulus sets are not reliable in most cases, their means considering set types highly correlate with the means of manual response times. This indicates convergent validity of mean values for both measures and therefore, we speculate that their reliability as a precondition of validity might also be assumed. However, further research on psychometric properties of eye-tracking procedures, including test–retest reliability estimates, are required. Furthermore, our correction of first fixation latencies through corresponding manual response times is likely to have increased the measured correlations. However, we argue that this correction is necessary in order to exclude measurement errors, whereas, consequently convergent validity values could be overestimated.

Our results are somewhat at odds with findings by Waechter et al. (2014) who did not find significant relations between dot probe and eye-tracking indices of attention allocation. However, Waechter et al. did not inspect first fixation latencies but fixation frequencies and viewing times which might not equally correspond to reaction times as first fixation latencies do. As we focused on first fixation latencies only, it is difficult to compare our results to previous studies. Future studies examining the psychometric properties of attention paradigms should thus incorporate different eye-tracking indices in comparisons to manual response times to facilitate our understanding which paradigm actually measures which process. Up to this point, our results point out that raw values for first fixation latencies are not reliable in most cases, while we assume mean values to be reliable and valid. Consequently, mean values of both manual response times and first fixation latencies can be used to determine visual attention.

Explorative Analyses

We also tried to elucidate potential effects of state anxiety by comparing reliability estimates between our stress and our non-stress condition. The stress condition led to fewer acceptable reliability estimates for first fixation latency raw values. In line with both, studies showing changes in attention processes after state anxiety induction (e.g., Quigley et al. 2012) and the attentional control theory (Eysenck et al. 2007), we assume that state anxiety actually leads to shift in attentional systems in favor of stimulus-driven processing. More resources are required to sustain attention to the task, which might lead to a less stable viewing pattern and lower reliability scores in visual search tasks. Nevertheless, even for the non-stress condition, we found that only about half of all reliablity estimates attained acceptable levels and those which did barely exceeded the threshold of $\alpha = .60$. Thus, it appears that the stress condition alone cannot be held responsible for the low reliability estimates of first fixation latency raw values in general.

Reliability of first fixation latencies might also be negatively affected by individual viewing preferences as this was the case in previous studies (Waechter et al. 2014). We tried to overcome this problem by choosing a circular presentation of stimuli, each in equal distance to a fixation cross, however, participants might nevertheless perform the visual search with certain viewing "habits". Our exploratory analyses supported this view as differentiating target and distractor stimuli according to lower and upper positions within the stimulus sets led to an increased number of acceptable reliability estimates for lower positions as compared to upper positions and undifferentiated analyses. According to the visualizations of our eye-tracking data, we got the impression that stimuli in the three upper positions of stimulus sets were preferentially fixated. Accordingly, excluding stimuli in these positions led to an increased number of acceptable reliability estimates. The lack of improvement considering only upper positions may be due to the smaller number of stimulus positions, according to the Spearman–Brown formula, as well as due to confounding of a general preference and stimulus-dependend fixations. Future studies should further advance the presentation of stimuli to overcome position effects, e.g. by varying the presented displays in their arrangement or using random stimuli displays.

Limitations

The current study refers to a specific experimental design, and other designs might, of course, produce different results. In particular, the number of coherent trials is important for any measure of internal consistency, and trial duration as well as laboratory setting are also likely to be relevant. Furthermore, the findings of the current study cannot easily be translated to other paradigms, such as dot-probe, emotional cueing or emotional stroop, although similar results were found for these paradigms as well (Brown et al. 2014; Waechter et al. 2014).

Moreover, the current study did not investigate test–retest reliabilities of applied measures. There is at least some evidence that ABT might temporarily fluctuate within individuals (Heeren et al. 2015), which would require assessment strategies that take dynamic processes into account.

As already mentioned above, the lack of group specific ABT limits the generalizability of our results concerning bias scores. As previous studies using the visual search design provided mixed results regarding an ABT in social anxiety, it cannot finally be concluded whether our null findings are based on measurement problems or an actual lack of attention biases in our sample. In order to answer this question, experimental studies are needed that systematically vary experimental setups used to measure the ABT, including variations in stimulus materials (schematic pictures vs. photographs, words vs. pictures), number and arrangement (square vs. circular) of stimuli in one set, the instructions and tasks given within the visual search paradigm and so on. It should also be considered whether different search types (serial and parallel processing) lead to different results (Nothdurft 1999).

A strength of our study is the clinical sample of individuals with social anxiety disorder. This sample seems rather representative as the level of social anxiety was comparable to other clinical samples (Baker et al. 2002). About 60% of clinical participants were diagnosed with generalized social anxiety disorder which further underlines the clinical status of the sample. Our control group was carefully matched to the clinical group in regard to age, gender and education. This might in fact have impacted our results as the control group might not be representative in terms of the general healthy population. Although unlikely, it cannot be ruled out that the non-clinical sample had some characteristics that were related to specificities in the attention allocation.

Conclusion

Contrary to what we expected, we did not find eye-tracking to be the better measure of visual attention, as first fixation latencies were mostly not internally consistent, whereas manual response times were internally consistent throughout. However, the mean values of first fixation latencies for the different set types highly correlated with respective mean values of manual response times, indicating convergent validity and likewise reliability of both. Nevertheless, the question of how well we can measure visual attention requires further research. Future studies should include further indices of reliability and validity and also should consider other experimental paradigms and designs to investigate ABT. The literature on ABT should be regarded more cautiously, due to the rather unclear psychometric properties of applied measures, that might contribute to the inconclusive findings and the at most medium effect sizes of attentional biases that were previously found (cf., Bar-Haim et al. 2007). The current study adds to the overall impression that the nature of ABT is not yet understood and the research field might be well advised to take a step back from this question or even therapeutic applications and further explore the mechanisms of applied measures of ABT.

Acknowledgements Financial support for this study was provided by a grant from the German Research Foundation provided to the last author.

Compliance with Ethical Standards

Conflict of interest Richard Wermes, Tania M. Lincoln and Sylvia Helbig-Lang declare that they have no conflicts of interest.

Research involving Human and Animal Rights No animal studies were carried out for this article.

Informed Consent All study procedures were in accordance with ethical standards of the responsible ethics committee. All participants provided a written informed consent before they were enrolled in the study.

Appendix 1

See Table 3.

Table 3 Manual response time and first fixation latency bias scores by subgroup, bias and task

Bias (task)	HC		SAD	
	No stress	Stress	No stress	Stress
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*
Facilitation (detection)				
RT: hn–an	−240 (193)	−206 (202)	−277 (207)	−234 (198)
FFL: hn–an	−99 (156)	−145 (188)	−146 (234)	−109 (123)
Disengagement (detection)				
RT: a–n	−115 (211)	−117 (248)	−32 (226)	−52 (205)
RT: a–h	69 (264)	115 (228)	117 (174)	113 (212)
RT: na–nh	286 (246)	205 (181)	232 (213)	238 (244)
FFL: na–nh	123 (179)	89 (151)	79 (184)	89 (183)
Distraction (search angry)				
RT: ahn–an	51 (161)	59 (184)	60 (167)	72 (150)
FFL: ahn–an	54 (189)	117 (156)	67 (182)	67 (130)
Distraction (search happy)				
RT: han–hn	−16 (70)	51 (124)	−28 (114)	29 (87)
FFL: han–hn	−37 (71)	13 (63)	−50 (138)	19 (76)

HC healthy controls, *SAD* participants with social anxiety disorder, *No stress* control condition, *Stress* stress condition, *RT* manual response time, *FFL* first fixation latency, *a* non-target angry faces, *h* non-target happy faces, *n* non-target neutral faces, *an* angry face among a neutral crowd, *hn* happy face among a neutral crowd, *na* neutral face among an angry crowd, *nh* neutral face among a happy crowd, *ahn* angry face and happy face (distractor) among a neutral crowd, *han* happy face and angry face (distractor) among a neutral crowd

References

Amir, N., Beard, C., Taylor, C. T., Klumpp, H., Elias, J., Burns, M., & Chen, X. (2009). Attention training in individuals with generalized social phobia: a randomized controlled trial. *Journal of Consulting and Clinical Psychology, 77*(5), 961–973. doi: 10.1037/a0016685.

Amir, N., Elias, J., Klumpp, H., & Przeworski, A. (2003). Attentional bias to threat in social phobia: Facilitated processing of threat or difficulty disengaging attention from threat? *Behaviour Research and Therapy, 41*(11), 1325–1335. doi: 10.1016/S0005-7967(03)00039-1.

Baker, S. L., Heinrichs, N., Kim, H. J., & Hofmann, S. G. (2002). The Liebowitz social anxiety scale as a self-report instrument: A preliminary psychometric analysis. *Behaviour Research and Therapy, 40*(6), 701–715. doi: 10.1016/S0005-7967(01)00060-2.

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: a meta-analytic study. *Psychological Bulletin, 133*(1), 1–24. doi: 10.1037/0033-2909.133.1.1.

Boettcher, J., Leek, L., Matson, L., Holmes, E. A., Browning, M., MacLeod, C., Andersson, G., & Carlbring, P. (2013). Internet-based attention bias modification for social anxiety: a randomised controlled comparison of training towards negative and training towards positive cues. *PLoS ONE, 8*(9), 1–14. doi: 10.1371/journal.pone.0071760.

Bradley, B. P., Mogg, K., White, J., Groom, C., & de Bono, J. (1999). Attentional bias for emotional faces in generalized anxiety disorder. *The British Journal of Clinical Psychology/The British Psychological Society, 38*(3), 267–278. doi: 10.1348/014466599162845.

Brosschot, J. F., De Ruiter, C., & Kindt, M. (1999). Processing bias in anxious subjects and repressors, measured by emotional Stroop interference and attentional allocation. *Personality and Individual Differences, 26*(5), 777–793. doi: 10.1016/S0191-8869(98)00173-1.

Brown, H. M., Eley, T. C., Broeren, S., MacLeod, C., Rinck, M., Hadwin, J. A., & Lester, K. J. (2014). Psychometric properties of reaction time based experimental paradigms measuring anxiety-related information-processing biases in children. *Journal of Anxiety Disorders, 28*(1), 97–107. doi: 10.1016/j.janxdis.2013.11.004.

Byrne, A., & Eysenck, M. W. (1995). Trait anxiety, anxious mood, and threat detection. *Cognition and Emotion, 9*(6), 549–562. doi: 10.1080/02699939508408982.

Chen, N. T. M., Clarke, P. J. F., MacLeod, C., & Guastella, A. J. (2012). Biased attentional processing of positive stimuli in social anxiety disorder: an eye movement study. *Cognitive Behaviour Therapy, 41*(2), 96–107. doi: 10.1080/16506073.2012.666562.

Chen, N. T. M., Clarke, P. J. F., Watson, T. L., MacLeod, C., & Guastella, A. J. (2014). Biased saccadic responses to emotional stimuli in anxiety: an antisaccade study. *PLoS ONE, 9*(2), 1–7. doi:10.1371/journal.pone.0086474.

Cisler, J. M., & Koster, E. H. W. (2010). Mechanisms of attentional biases towards threat in anxiety disorders: an integrative review. *Clinical Psychology Review, 30*(2), 203–216. doi: 10.1016/j.cpr.2009.11.003.

Cooper, R. M., Bailey, J. E., Diaper, A., Stirland, R., Renton, L. E., Benton, C. P., … & Munafo, M. R. (2011). Effects of 7.5% CO_2 inhalation on allocation of spatial attention to facial cues of emotional expression. *Cognition and Emotion, 25*(4), 626–638. doi: 10.1177/0269881108096981.

Cristea, I. A., Kok, R. N., & Cuijpers, P. (2015). Efficacy of cognitive bias modification interventions in anxiety and depression: Meta-analysis. *British Journal of Psychiatry, 206*(1), 7–16. doi: 10.1192/bjp.bp.114.146761.

Dalgleish, T., Taghavi, R., Neshat-Doost, H., Moradi, A., Canterbury, R., & Yule, W. (2003). Patterns of processing bias for emotional information across clinical disorders: a comparison of attention, memory, and prospective cognition in children and adolescents with depression, generalized anxiety, and posttraumatic stress disorder. *Journal of Clinical Child and Adolescent Psychology 32*(1), 10–21. doi: 10.1207/S15374424JCCP3201_02.

Derakshan, N., & Koster, E. H. W. (2010). Processing efficiency in anxiety: Evidence from eye-movements during visual search. *Behaviour Research and Therapy, 48*(12), 1180–1185. doi: 10.1016/j.brat.2010.08.009.

Eastwood, J., Smile, D., Oakman, J., Farvolden, P., van Ameringen, M., Mancini, C., & Merikle, P. (2005). Individuals with social phobia are biased to become aware of negative faces. *Visual Cognition, 12*(1), 159–179. doi: 10.1080/13506280444000175.

Egloff, B., & Hock, M. (2003). Assessing attention allocation toward threat-related stimuli: A comparison of the emotional Stroop task and the attentional probe task. *Personality and Individual Differences, 35*(2), 475–483. doi: 10.1016/S0191-8869(02)00265-9.

Eide, P., Kemp, A., Silberstein, R. B., Nathan, P. J., & Stough, C. (2002). Test–retest reliability of the emotional stroop task: examining the paradox of measurement change. *The Journal of Psychology, 136*(5), 514–520. doi: 10.1080/00223980209605547.

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: attentional control theory. *Emotion, 7*(2), 336–353. doi: 10.1037/1528-3542.7.2.336.

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do threatening stimuli draw or hold visual attention in subclinical anxiety?. *Journal of Experimental Psychology, 130*, 681–700. doi: 10.1037/0096-3445.130.4.681.

Fresco, D. M., Coles, M. E., Heimberg, R. G., Liebowitz, M. R., Hami, S., Stein, M. B., & Goetz, D. (2001). The Liebowitz social anxiety scale: a comparison of the psychometric properties of self-report and clinician-administered formats. *Psychological Medicine, 31*(6), 1025–1035. doi: 10.1017/S0033291701004056.

Gamble, A. L., & Rapee, R. M. (2010). The time-course of attention to emotional faces in social phobia. *Journal of Behavior Therapy and Experimental Psychiatry, 41*(1), 39–44. doi: 10.1016/j.jbtep.2009.08.008.

Garner, M., Mogg, K., & Bradley, B. P. (2006). Orienting and maintenance of gaze to facial expressions in social anxiety. *Journal of Abnormal Psychology, 115*(4), 760–770. doi: 10.1037/0021-843X.115.4.760.

Gilboa-Schechtman, E., Foa, E. B., & Amir, N. (1999). Attentional biases for facial expressions in social phobia: The face-in-the-crowd paradigm. *Cognition and Emotion, 13*(3), 305–318. doi: 10.1080/026999399379294.

Gotlib, I. H., Kasch, K. L., Traill, S., Joormann, J., Arnow, B. A., & Johnson, S. L. (2004). Coherence and specificity of information-processing biases in depression and social phobia. *Journal of Abnormal Psychology, 113*(3), 386–398. doi: 10.1037/0021-843X.113.3.386.

Heeren, A., Mogoase, C., Philippot, P., & McNally, R. J. (2015). Attention bias modification for social anxiety: A systematic review and meta-analysis. *Clinical Psychology Review, 40*, 76–90. doi: 10.1016/j.cpr.2015.06.001.

Hoffman, J. E. (1998). Visual attention and eye movements. *Attention, 384*, 119–153.

Juth, P., Lundqvist, D., Karlsson, A., Ohman, A., & Öhman, A. (2005). Looking for foes and friends: perceptual and emotional factors when finding a face in the crowd. *Emotion, 5*(4), 379–395. doi: 10.1037/1528-3542.5.4.379.

Kendall, P. C., Finch, A. J. Jr., Auerbach, S. M., Hooke, J. F., Mikulka, P. J. (1976). The state-trait anxiety inventory: a systematic evaluation. *Journal of Consulting and Clinical Psychology, 44*(3), 406–412. doi: 10.1037/0022-006X.44.3.406.

Koster, E. H. W., Crombez, G., Verschuere, B., & De Houwer, J. (2006). Attention to threat in anxiety-prone individuals: Mechanisms underlying attentional bias. *Cognitive Therapy and Research, 30*(5), 635–643. doi: 10.1007/s10608-006-9042-9.

Kowler, E., Anderson, E., Dosher, B., & Blaser, E. (1995). The role of attention in the programming of saccades. *Vision Research, 35*(13), 1897–1916. doi: 10.1016/0042-6989(94)00279-U.

Langner, O., Dotsch, R., Bijlstra, G., Wigboldus, D. H. J., Hawk, S. T., & van Knippenberg, A. (2010). Presentation and validation of the Radboud Faces Database. *Cognition and Emotion, 24*(8), 1377–1388. doi: 10.1080/02699930903485076.

Laux, L., Glanzmann, P., Schaffner, P., & Spielberger, C. D. (1981). *State-Trait-Anxiety-Inventory (STAI). Theoretical Foundations and Instructions*. Weinheim: Beltz.

MacLeod, J. W., Lawrence, M. A., McConnell, M. M., Eskes, G. A., Klein, R. M., & Shore, D. I. (2010). Appraising the ANT: Psychometric and theoretical considerations of the attention network test. *Neuropsychology, 24*(5), 637–651. doi: 10.1037/a0019803.

Mansell, W., Clark, D. M., Ehlers, A., & Chen, Y.-P. (1999). Social anxiety and attention away from emotional faces. *Cognition and Emotion, 13*(6), 673–690. doi: 10.1080/026999399379032.

Miskovic, V., & Schmidt, L. A. (2012). Social fearfulness in the human brain. *Neuroscience and Biobehavioral Reviews, 36*(1), 459–478. doi: 10.1016/j.neubiorev.2011.08.002.

Mogg, K., Bradley, B., Miles, F., & Dixon, R. (2004). Time course of attentional bias for threat scenes: testing the vigilance-avoidance hypothesis. *Cognition and Emotion, 18*(5), 689–700. doi: 10.1080/02699930341000158.

Mogg, K., Bradley, B. P., Dixon, C., Fisher, S., Twelftree, H., & McWilliams, A. (2000). Trait anxiety, defensiveness and selective processing of threat: an investigation using two measures of attentional bias. *Personality and Individual Differences, 28*(1), 1063–1077. doi: 10.1016/S0191-8869(99)00157-9.

Mogg, K., Millar, N., & Bradley, B. P. (2000). Biases in eye movements to threatening facial expressions in generalized anxiety disorder and depressive disorder. *Journal of Abnormal Psychology, 109*(4), 695–704. doi: 10.1037//0021-843X.

Murphy, K. R., & Davidshofer, C. O. (2005). *Psychological testing: principles and applications*. New Jersey: Upper Saddle River.

Neubauer, K., von Auer, M., Murray, E., Petermann, F., Helbig-Lang, S., & Gerlach, A. L. (2013). Internet-delivered attention modification training as a treatment for social phobia: A randomized controlled trial. *Behaviour Research and Therapy, 51*(2), 87–97. doi: 10.1016/j.brat.2012.10.006.

Nothdurft, H. C. (1999). Focal attention in visual search. *Vision Research, 39*(14), 2305–2310. doi: 10.1016/S0042-6989(99)00006-1.

Ohman, A., Flykt, A., Esteves, F., Öhman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: detecting the snake in the grass. *Journal of Experimental Psychology, 130*(3), 466–478. doi: 10.1037/0096-3445.130.3.466.

Pflugshaupt, T., Mosimann, U. P., Von Wartburg, R., Schmitt, W., Nyffeler, T., & Müri, R. M. (2005). Hypervigilance-avoidance pattern in spider phobia. *Journal of Anxiety Disorders, 19*(1), 105–116. doi: 10.1016/j.janxdis.2003.12.002.

Pishyar, R., Harris, L. M., & Menzies, R. G. (2004). Attentional bias for words and faces in social anxiety. *Anxiety, Stress and Coping, 17*(1), 23–36. doi: 10.1080/10615800310001601458.

Quigley, L., Nelson, A. L., Carriere, J., Smilek, D., & Purdon, C. (2012). The effects of trait and state anxiety on attention to emotional images: An eye-tracking study. *Cognition and Emotion, 26*, 1–22. doi: 10.1080/02699931.2012.662892.

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy, 35*(8), 741–756. doi: 10.1016/S0005-7967(97)00022-3.

Rinck, M., Becker, E. S., Kellermann, J., & Roth, W. T. (2003). Selective attention in anxiety: distraction and enhancement in visual search. *Depression and Anxiety, 18*(1), 18–28. doi: 10.1002/da.10105.

Rinck, M., Reinecke, A., Ellwart, T., Heuer, K., & Becker, E. S. (2005). Speeded detection and increased distraction in fear of spiders: evidence from eye movements. *Journal of Abnormal Psychology, 114*(2), 235–248. doi: 10.1037/0021-843X.114.2.235.

Schmidt, N. B., Richey, J. A., Buckner, J. D., & Timpano, K. R. (2009). Attention training for generalized social anxiety disorder. *Journal of Abnormal Psychology, 118*(1), 5–14. doi: 10.1037/a0013643.

Schmukle, S. C. (2005). Unreliability of the dot probe task. *European Journal of Personality, 19*(7), 595–605. doi: 10.1002/per.554.

Skre, I., Onstad, S., Torgensen, S., & Kringlen, E. (1991). High interrater reliability for the structured clinical interview for DSM-III-R axis I (SCID-I). *Acta Psychiatrica Scandinavica, 84*(2), 167–173. doi: 10.1111/j.1600-0447.1991.tb03123.x.

Sposari, J. A., & Rapee, R. M. (2007). Attentional bias toward facial stimuli under conditions of social threat in socially phobic and nonclinical participants. *Cognitive Therapy and Research, 31*(1), 23–37. doi: 10.1007/s10608-006-9073-2.

Stangier, U., & Heidenreich, T. (2005). Liebowitz Soziale Angst-Skala (LSAS) [Liebowitz Social Anxiety Scale]. In Collegium Internationale Psychiatriae Scalarum (Ed.), *Internationale Skalen für Psychiatrie* (pp. 299–305). Göttingen: Hogrefe.

Staugaard, S. R. (2009). Reliability of two versions of the dot-probe task using photographic faces. *Psychology Science Quarterly, 51*(3), 339–350. http://www.psychologie-aktuell.com/fileadmin/download/PschologyScience/3-2009/07_staugaard.pdf.

Waechter, S., Nelson, A. L., Wright, C., Hyatt, A., & Oakman, J. (2014). Measuring attentional bias to threat: Reliability of dot probe and eye movement indices. *Cognitive Therapy and Research, 38*(3), 313–333. doi: 10.1007/s10608-013-9588-2.

Waechter, S., & Stolz, J. A. (2015). Trait anxiety, state anxiety, and attentional bias to threat: assessing the psychometric properties of response time measures. *Cognitive Therapy and Research, 39*(4), 441–458. doi: 10.1007/s10608-015-9670-z.

Williams, J. M., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin, 120*(1), 3–24. doi: 10.1037/0033-2909.120.1.3.

Wittchen, H.-U., Zaudig, M., & Fydrich, T. H. (1997). *SKID - Strukturiertes Klinisches Interview für DSM-IV. Achse I und II Handanweisungen [Structured Clinical Interview for DSM-IV]*. Göttingen: Hogrefe. doi: 10.1026//0084-5345.28.1.68.

Zanarini, M. C., Skodol, A. E., Bender, D., Dolan, R., Sanislow, C., Schaefer, E., … Gundersono, J. G. (2000). The collaborative longitudinal personality disorders study: Reliability of axis I and II diagnoses. *Journal of Personality Disorders, 14*(4), 291–299. doi: 10.1521/pedi.2000.14.4.291.

9.2. Studie 2: Selektive Aufmerksamkeit

Wermes, R., Lincoln, T. M., & Helbig-Lang, S. (2018). Attentional biases to threat in social anxiety disorder: Time to focus our attention elsewhere? *Anxiety, Stress, & Coping*. https://doi.org/10.1080/10615806.2018.1483497

ANXIETY, STRESS, & COPING
https://doi.org/10.1080/10615806.2018.1483497

Attentional biases to threat in social anxiety disorder: time to focus our attention elsewhere?

Richard Wermes, Tania M. Lincoln and Sylvia Helbig-Lang

Department of Clinical Psychology and Psychotherapy, University of Hamburg, Hamburg, Germany

ABSTRACT

Background: Cognitive models propose that attentional biases to threat contribute to the maintenance of social anxiety disorder (SAD). However, the specific characteristics of such biases are still object to debate.

Objectives: The current study aimed to disentangle effects of trait and state social anxiety on attention allocation towards social stimuli.

Methods: Participants with SAD ($n = 67$) and healthy controls ($n = 62$) completed three visual search tasks while their eye movements were recorded. Half of the participants in each group were randomly assigned to a state anxiety induction.

Results: Contrary to our predictions, neither trait nor state social anxiety was associated with a facilitated attention to or a delayed disengagement from threat. However, participants with SAD did show reduced fixation durations for threatening stimuli, indicating an avoidance of threat. Induction of state anxiety led to an increased distractibility by threat.

Conclusions: We suggest that attention allocation in SAD is characterized by an avoidant rather than a vigilant attentional bias. Accordingly, our results contradict previous results that associate SAD with facilitated attention to threat and existing approaches to modify attentional biases, that aim to decrease attention towards threatening stimuli.

ARTICLE HISTORY
Received 6 September 2017
Revised 27 May 2018
Accepted 28 May 2018

KEYWORDS
Attentional biases; social anxiety disorder; state anxiety; visual search; eye tracking

Attentional biases to threat play a prominent role in cognitive models of social anxiety disorder (SAD). Accordingly, socially anxious individuals selectively attend to any stimuli indicating social threat, including signs of disapproval by others, such as frowning or yawning.

However, the specific characteristics of these attentional biases remain to be controversial: while different clinical models of SAD consistently proclaim an initially facilitated attention to socially threatening stimuli, theories disagree about subsequent attentional processes. Clark and Wells (1995) assume that socially anxious individuals avoid threatening social stimuli by turning attention towards a detailed monitoring of themselves, thus ignoring information that might disconfirm their fear. This model thus implies a vigilant-avoidant pattern of attention with an initially facilitated attention to threat, followed by an attentional avoidance of threatening stimuli (vigilance-avoidance hypothesis; e.g., Mogg, Bradley, Miles, & Dixon, 2004). In contrast, Rapee and Heimberg (1997, see also Heimberg, Brozovich, & Rapee, 2010) claim that attention towards threatening social stimuli is generally enhanced in socially anxious individuals, leading to a delayed disengagement after an initially facilitated attention. Similarly, a recent integrative model by Wong and Rapee (2016) emphasizes the role of an enhanced attention towards threatening social stimuli as a primary cognitive process relevant for the maintenance of SAD.

CONTACT Richard Wermes Richard.Wermes@uni-hamburg.de
Supplemental data for this article can be accessed at https://doi.org/10.1080/10615806.2018.1483497.

Empirical studies on attentional biases in social anxiety and SAD were indeed able to find indicators of facilitated attention (Eastwood et al., 2005; Gamble & Rapee, 2010; Gilboa-Schechtman, Foa, & Amir, 1999; Juth, Lundqvist, Karlsson, Ohman, & Öhman, 2005, study 5; Mogg & Bradley, 2002; Mogg, Philippot, & Bradley, 2004) and avoidance (Garner, Mogg, & Bradley, 2006; Singh, Capozzoli, Dodd, & Hope, 2015), although most studies failed to demonstrate the temporal pattern proposed by the vigilance-avoidance hypothesis (e.g. Mogg, Bradley, et al., 2004). Other studies demonstrated delayed disengagement from threatening social stimuli (Amir, Elias, Klumpp, & Przeworski, 2003; Buckner, Maner, & Schmidt, 2010; Schofield, Johnson, Inhoff, & Coles, 2012) or found no evidence for attentional biases to threat in social anxiety at all (Juth et al., 2005, studies 1–3; Rinck, Becker, Kellermann, & Roth, 2003). In addition, some studies suggested that selective attention to threat might also be reflected by delayed responses to neutral stimuli in the presence of distracting threat stimuli (Rinck et al., 2003). Thus, despite ample evidence that individuals with SAD selectively attend to social threat (see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007 for a meta-analysis), the specific characteristics of such biases as well as their relation to anxiety symptoms remain largely unknown.

Several explanations could account for these inconsistent findings. One explanation refers to the distinction between trait anxiety as a rather stable disposition (as it is indicated by a diagnosis of SAD) and state anxiety as a momentarily response to acute threat. It is yet unclear, whether selective attention to threat is an inherent characteristic of high social trait anxiety or whether it is triggered by state anxiety. From a theoretical perspective, state and trait anxiety might even interact in evoking selective attention to threat. The Attentional Control Theory (Eysenck, Derakshan, Santos, & Calvo, 2007), a more general model of anxiety-related information processing, assumes that attentional processes are shaped by the interaction of a stimulus-driven and a goal-directed attentional system. The stimulus-driven system reacts to salient stimuli, whereas the goal-directed system is regulated by current goals, expectations and situational demands. According to this theory, state anxiety increases the impact of the stimulus-driven attentional system, which is indicated by an increased allocation of attention towards threat in terms of facilitated attention and delayed disengagement (see Eysenck et al., 2007). In contrast, trait social anxiety is commonly understood to be associated with avoidance of threat at the level of goal-directed processing, which might also result in attentional avoidance (Clark, 2001).

Up to date, only few studies have directly compared effects of trait and state anxiety whereas both are often confounded, as individuals with higher trait anxiety tend to perceive presented stimuli as more threatening (e.g., Stopa & Clark, 2000). Studies directly manipulating levels of state anxiety (e.g., Quigley, Nelson, Carriere, Smilek, & Purdon, 2012) indicated that a facilitated attention to the threat was attributable to state, but not to trait social anxiety. Moreover, Berggren, Koster, and Derakshan (2012) found effects of an anxiety induction to interact with task demands, as anxious compared to non-anxious participants demonstrated deteriorated detection performances in tasks with the higher cognitive load. These results nicely fit the Attentional Control Theory as effects of anxiety might be compensated with self-regulation skills in low demanding but not in high demanding tasks.

Assuming that attention allocation to threat might depend on various factors, including state anxiety and tasks demands, inconsistencies in findings on attentional biases might also result from the different experimental paradigms being applied. Research on specific phobias has actually found performance across different paradigms not to be correlated, indicating that these actually might tap into different attentional processes underlying clinical anxiety (Waters, Mogg, Bradley, & Pine, 2011). With regard to SAD, most studies relied on manual response time paradigms, such as visual probe or spatial cueing paradigms, even though these have repeatedly been criticized for their unsatisfactory psychometric properties (e.g., Kappenman, Farrens, Luck, & Proudfit, 2014; Schmukle, 2005; Staugaard, 2009). Thus, in order to increase the validity of findings on attentional biases, these should be assessed using different strategies. In terms of other manual response time measures, visual search has rarely been applied in SAD research (Gilboa-Schechtman et al., 1999). Here, various stimuli are presented simultaneously, which is thought to be more ecologically

valid as compared to the more commonly applied visual probe (e.g., Mogg, Philippot, et al., 2004) or spatial cueing (e.g., Amir et al., 2003) paradigms. Typically, visual search paradigms include "odd-one-out"-tasks, in which participants decide whether all presented stimuli are the same or if one of them is deviant. Moreover, "search for target"-tasks are applied to examine attention for distracting, task-irrelevant threat stimuli. A drawback of response time-based assessments is that they do not allow to depict precise spatiotemporal attention allocation. Eye tracking paradigms seek to overcome this limitation as they capture eye movements via infrared cameras and therefore provide a more direct and encompassing account to attention allocation (Kowler, Anderson, Dosher, & Blaser, 1995; Mogg, Millar, & Bradley, 2000). However, only a minority of the previous studies on attentional biases to threat in SAD have relied on eye tracking (Buckner et al., 2010; Gamble & Rapee, 2010; Garner et al., 2006; Schofield et al., 2012; Singh et al., 2015). As described above, these studies were able to depict different attentional biases. For a further clarification of how attentional processes are altered in clinical anxiety it appears promising to combine indirect and direct measurements of visual attention, in order to disentangle its constitutive elements.

The aim of the current study was to elucidate specific characteristics of attentional biases to threat in SAD by disentangling differences in attentional processes attributable to trait and state components of social anxiety. Given that attentional biases to threat are thought to be crucially important for the maintenance of SAD, clarifying conflicting findings on attentional biases may help to inform empirically based models of SAD and to improve therapeutic interventions that target the modification of attentional processes. We used a visual search paradigm with two different search procedures in combination with an eye tracking procedure, in order to examine attentional processing thoroughly.

We hypothesized that both trait (hypothesis 1a) and state (hypothesis 1b) social anxiety would enhance stimulus-driven processing, leading to facilitated attention towards threatening stimuli. Based on assumptions of the Attentional Control Theory and previous findings, we further assumed that state anxiety would be associated with increased attention allocation towards threat, indicated by delayed disengagement from threatening stimuli (hypothesis 2). As cognitive models suggest that individuals with SAD avoid external threat cues as a result of schema-driven processing, we further assumed that individuals with SAD would show an avoidance of threat stimuli after threat detection (hypothesis 3). Finally, we expected that the presentation of task-irrelevant threat stimuli would inhibit responses to non-threat targets, due to the disruption of goal-directed attentional processing. As the Attentional Control Theory suggests that this effect might especially be observable under conditions of threat, we expected all participants to show higher distractibility by task-irrelevant threatening stimuli after the induction of state anxiety (hypothesis 4).

Methods

Participants

We included participants with SAD as well as healthy controls (HC). Participants were recruited via printed announcements on local public notice boards and a local job-offering website. Our announcement for the SAD group broadly asked for participants who feel anxious in the presence of others, while our announcement for the control group simply asked for participants who are interested in taking part in a study on attentional processes. The announcements also included essential inclusion criteria as well as information about the study procedures. A total number of 445 individuals initially expressed interest in the study and 315 of them took part in a telephone screening on general inclusion criteria. A total of 187 participants underwent the diagnostic assessment and 140 of them completed the entire study. Supplemental material 1 depicts the detailed study flow, including dropout rates for all stages of our study.

General inclusion criteria comprised (a) age between 18 and 65 years, (b) informed consent, (c) fluent German language skills, (d) right-handedness, (e) no uncorrected visual impairments or hard

contact lenses, and (f) no specific medication that might influence attention or response times (including benzodiazepines, antihistamines, pain medication and eye drops). Individuals were considered eligible for the HC group if they had no lifetime diagnoses of any affective, psychotic or substance use disorder and if they did not meet criteria of any other mental disorder within the past five years (except for nicotine dependence). For the SAD group, participants had to meet the DSM-IV diagnostic criteria of a social anxiety disorder. Additionally, they were not allowed to have a lifetime diagnosis of a bipolar or psychotic disorder, a current substance use disorder, or a recent onset or change of psychopharmacological treatment (<six weeks prior to intake). All study procedures were approved by the Ethic Committee of the German Society of Psychology (Reference No SHL012014). All participants provided a written informed consent before they were enrolled in the study.

Measures and materials

Diagnostic assessment

The Structured Clinical Interview for DSM-IV (SCID-I; First & Gibbon, 2004; German: Wittchen, Zaudig, & Fydrich, 1997) was used to determine diagnostic status in both study groups. The SCID-I is a widely used semi-structured interview with good psychometric properties (Zanarini et al., 2000), including excellent inter-rater reliability for SAD (Cohen's kappa = .83; Lobbestael, Leurgans, & Arntz, 2011). Interviews were conducted by four trained assessors, of whom three were undergraduate psychology students. One held a master's degree in psychology. All assessors received a one-day training workshop and had to pass a certification interview. In case of diagnostic uncertainties, interviews were supervised by a licensed clinical psychologist.

Self-report measures

Liebowitz Social Anxiety Scale *(LSAS; Liebowitz, 1987; German: Stangier & Heidenreich, 2005).* The self-report version of the LSAS is a 24-item measure of anxiety and avoidance in social situations. The total score indicates social anxiety severity and can range from 0 to 144. The LSAS has demonstrated good internal consistency as well as convergent and discriminant validity (Fresco et al., 2001). Internal consistency of LSAS total scores was excellent for the current study (Cronbach's alpha = .97).

State-Trait Anxiety Inventory (STAI-S; Spielberger, Gorsuch, & Lushene, 1970; German: Laux, Glanzmann, Schaffner, & Spielberger, 1981). We used the state version of the STAI for a manipulation check of our stress condition. The STAI-S is a 20-item measure assessing current state anxiety. The scale provides excellent psychometric properties with Cronbach's alpha = .90 as well as several indicators for its validity (Kendall et al., 1976; Laux et al., 1981). Internal consistency of STAI-S scores was excellent for the current study, both before and after the experimental manipulation (Cronbach's alpha = .95 each).

Beck Depression Inventory-Revised (BDI-II; Beck, Steer, & Brown, 1993; German: Hautzinger, Keller, & Kühner, 2006). Depressive symptoms were considered as a control variable for explorative analyses and were assessed via the BDI-II, a 21-item self-rating measure for current depression severity. Reliability and validity of this scale were shown to be excellent in both clinical and non-clinical populations (Kühner, Bürger, Keller, & Hautzinger, 2007). Internal consistency of BDI-II scores was excellent for the current study (Cronbach's alpha = .92).

Assessment of attention allocation

Stimuli. We used facial photographs with happy, neutral and angry expressions taken from the Radboud Faces Database (Langner et al., 2010) as stimulus material (see Figure 1). Specifically, we selected the three male and the three female models whose clarity of expression was rated the highest according to a validation study (see Langner et al., 2010). Individual stimuli were presented

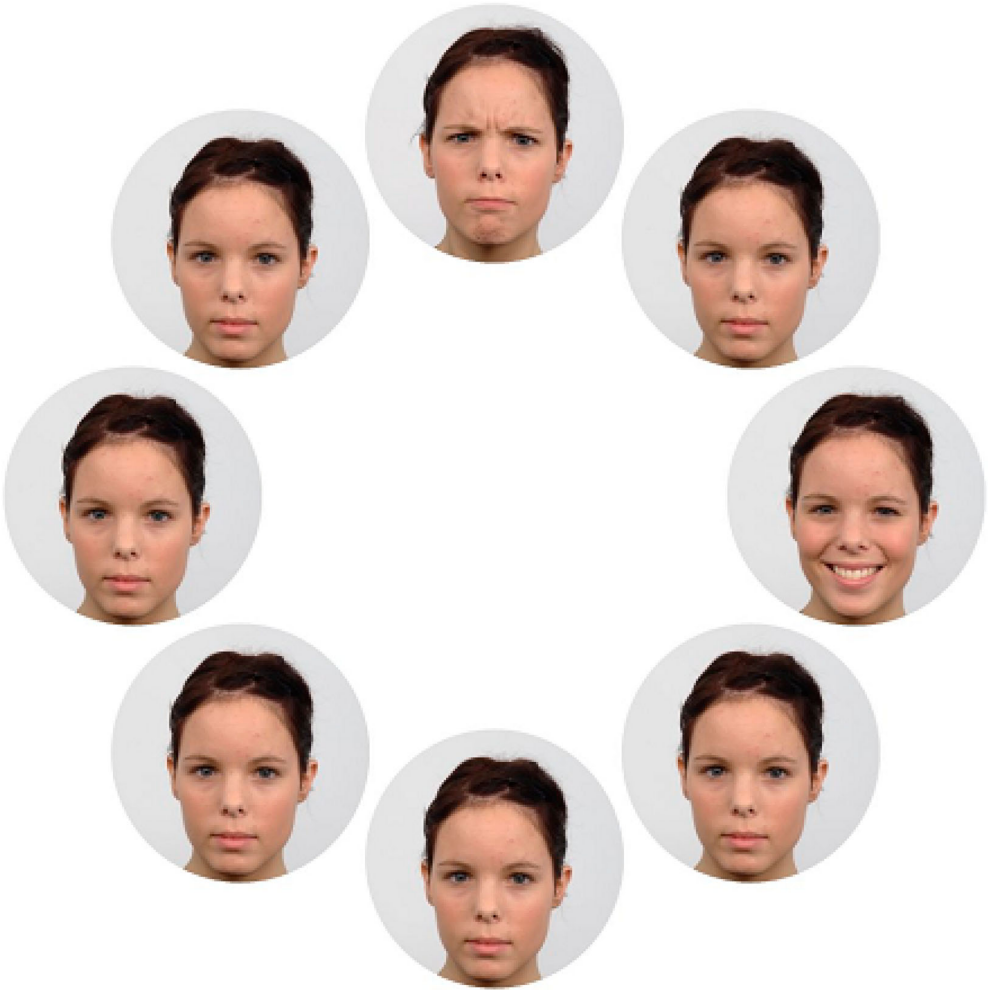

Figure 1. Exemplary stimulus material: Angry target among neutral crowd with happy distractor/happy target among neutral crowd with angry distractor.

as stimulus sets consisting of a circular structure of eight faces (Juth et al., 2005, see Figure 1). Different types of stimuli were combined in different set types: (a) non-target trials including stimulus sets with only one emotional expression (angry, happy or neutral), (b) target trials including stimulus sets with one deviant emotional expression against a homogeneous crowd and (c) trials including stimulus sets with two deviant stimuli, one target and one distractor stimulus. The positions of target and distractor stimuli were balanced across trials. In order to capture attention allocation after an initial orientation, all stimulus sets were shown for 4000 ms, each preceded by a fixation cross shown for 500 ms.

Visual search tasks. We used a *detection ("odd-one-out") task* that required participants to press the key on the left-hand side of a response box, if a stimulus set comprised a deviant facial expression (target trial) and the key on the right-hand side, if all facial expressions shown in a stimulus set were the same (non-target trial). The task comprised 36 non-target and 64 target trials that were presented in random order.

Furthermore, we used a *search task* that required participants to press the key on the left-hand side of a response box, if a stimulus set comprised a pre-defined facial expression (target trial) and the key on the right-hand side, if this was not the case (non-target trial). Participants either had to search angry or happy targets. Both of these subtasks comprised each 16 target trials without distractors, 32 target trials with distractors and 16 trials including only distractor stimuli.

All tasks were presented in random order and preceded by 12 practice trials each. Within all tasks, the position of target and distractor stimuli was completely balanced across trials.

Apparatus

All computer tasks were implemented using E-Prime 2.0 and presented on a Dell OptiPlex 790 computer attached to a 22-inch Dell P2210 monitor, using a 1680 × 1050 resolution mode. Stimulus sets had a diameter of 20.1 cm (16.3°) and single stimuli had a diameter of 5.3 cm (4.3°) on the monitor while the distance between participants and monitor was roughly set to 70 cm. Manual responses were recorded using a Serial Response Box 200A (Psychology Software Tools) combined with E-Prime 2.0 and eye movements were recorded using a SensoMotoric Instruments RED500 desktop mounted eye tracking system combined with the manufacturers software iViewX 2.8 at a data rate of 60 Hz. Calibration was done using a 9-point procedure and only calibration values below 1° visual angle were accepted, providing for an estimated maximal difference between measured and actual fixation locations of 12 mm.

Procedure

Individuals who were positively screened were invited for an intake assessment that took place in our laboratory. At this first appointment, participants received information about study aims and procedures and were asked to provide a written informed consent. The subsequent intake assessment comprised the diagnostic interview SCID-I and several self-report questionnaires. Participants who met our inclusion criteria were invited to a second appointment, including an experimental session, that took place about ten days after the intake assessment ($M = 11$, $SD = 7$). The experimental session included additional self-report questionnaires and an adapted version of the Continuous Performance Test (Knye, Roth, Westhus, & Heine, 2003), which we applied as a test of general visual attention. Subsequently, participants were randomly assigned to either an anxiety induction or no intervention. Following a procedure originally suggested by Mansell and Clark (1999) and successfully applied to induce state social anxiety in several studies since (e.g., Leber, Heidenreich, Stangier, & Hofmann, 2009; Mansell, Clark, Ehlers, & Chen, 1999), participants in the anxiety induction condition were told that they would have to give a short speech on a controversial topic in front of an audience, following the completion of the computer tasks. Participants were furthermore instructed to prepare their speech within the next five minutes. They did not actually have to give a speech as the expectation thereof during its preparation was thought to induce anxiety, which they were informed about at the end of the experiment. Participants in the control condition were given a five-minute break without formal instructions. Prior and after the experimental manipulation, all participants completed the STAI-S as part of the manipulation check and then started the visual search tasks. At the end of the experiment, participants in the anxiety induction condition were debriefed and completed a short questionnaire on the credibility of the manipulation. Participants received 10 € compensation per hour.

Data preparation

Eye movement data were processed using BeGaze 3.5 (SMI, 2015), which we essentially used to mark all target stimuli as areas of interest and to define fixations as gaze stability of at least 100 ms. All

further data preparation was done using R 3.1.2 (R Core Team, 2009). Eye tracking parameters considered were (a) first fixation latency (duration until first target fixation), (b) mean fixation duration (mean time spent fixating a target stimulus), and (c) total fixation duration (total time spent fixating a target stimulus).

Manual response time values were only included in the analyses if they were correct responses according to the instructions given within the experiment, while incorrect or no responses were defined as missing values (4.8%). First fixation latency values were excluded from the analyses if either a participant did not fixate the respective target or if fixations were not recorded due to technical limitations of the eye tracking procedure (4.3%). Moreover, first fixation latency values were excluded, if the respective simultaneously recorded manual response time values were either smaller or missing. We thereby assumed that the excluded values were measurement errors and not actually first fixation latencies. After correcting first fixation latencies by respective manual response times, the number of excluded values increased to 13.2%.

Outliers were analyzed in a stepwise procedure. First, considering the Continuous Performance Test, participants with response time values or a total of missing values exceeding three *SD* of the sample mean were excluded from all analyses ($n = 4$). Secondly, manual response time (1.8%), first fixation latency (2.0%), fixation duration mean (2.7%) and total fixation duration (2.5%) values for individual set types were excluded, if they exceeded three SD of the sample mean or if the number of missing values considering a set type exceeded three SD of the sample mean. Thirdly, participants were excluded from the analyses considering manual response times ($n = 2$), first fixation latencies ($n = 8$), fixation duration mean ($n = 7$) and fixation duration total ($n = 7$) values individually, if their number of initially missing and excluded mean values considering a respective parameter exceeded three SD of the sample mean, yielding varying sample sizes in different analyses. Finally, participants that were excluded from the manual response time parameters were also excluded from all other parameters, assuming that the collected data was based on incorrect task performances ($n = 2$).

Analyses

In order to analyze attentional biases according to diagnostic groups and experimental conditions and to overcome limitations of previous experimental designs (see Clarke, MacLeod, & Guastella, 2013), we calculated bias scores in correspondence with the previous literature (Cisler & Koster, 2010). We thereby compared threatening to non-threatening stimuli, based on manual response times, first fixation latencies and fixation durations as well as varying target positions. The detection task provided data for facilitation, disengagement and avoidance biases while the search task provided data for the distraction bias.

A *facilitation bias* was calculated by subtracting manual response times and likewise first fixation latencies for angry targets among neutral crowds and stimulus sets with happy targets among neutral crowds. A positive score would indicate a facilitation bias towards threat. A *disengagement bias* was on the one hand calculated by subtracting manual response times and likewise first fixation latencies for neutral targets among angry and happy crowds. As a second calculation for this bias, mean fixation durations for angry and happy targets among neutral crowds were subtracted. We adjusted the alpha level to alpha = .017 using the Bonferroni procedure as our analyses for this bias included multiple comparisons. An *avoidance bias* was calculated by subtracting total fixation durations for angry targets and happy targets among neutral crowds. A positive score would indicate avoidance of threat. Finally, a *distraction bias* was on the one hand calculated by subtracting manual response times and likewise first fixation latencies for happy targets without and happy targets with angry distractors among neutral crowds.

All analyses were conducted using procedures of the general linear model and SPSS 23 (SPSS Inc., Chicago, IL), as reported below.

Results

Descriptive results

The current analyses were based on data of $N = 129$ participants (SAD group: $n = 67$). Across the four subgroups (group × condition), gender ($\chi^2(3) = 0.94$, $p = .816$) as well as age ($F(3, 125) = 0.14$, $p = .938$) were equally distributed. The mean age of all participants was $M = 30.0$ (SD = 8.0) years; 87 of them were women and 42 men. The SAD group scored significantly higher in trait social anxiety as revealed by differences in LSAS total values ($F(1, 127) = 177.60$, $p < .001$, $\eta^2_{partial} = .58$), whereas there was no interaction effect of diagnostic group and experimental condition on LSAS total values ($F(1, 125) = 1.90$, $p = .171$, $\eta^2_{partial} = .02$). 58% of the participants in SAD group were diagnosed with generalized SAD, considering social anxiety in several and various situations. Furthermore, the SAD group scored significantly higher BDI values ($F(1, 127) = 68.95$, $p < .001$, $\eta^2_{partial} = .35$). Thirty-four percent of the participants in the SAD group were diagnosed with current depressive disorder, while 43% met the criteria for a current anxiety disorder other than SAD. Three participants currently received psychopharmacological treatment. The anxiety induction condition significantly increased state social anxiety, as revealed by comparisons of pre-post STAI-S values ($F(1, 127) = 104.85$, $p < .001$, $\eta^2_{partial} = .45$), indicating the success of our experimental manipulation. Moreover, the interaction of diagnostic groups and experimental conditions revealed that state social anxiety increased to an equal extent in both diagnostic groups ($F(1, 125) = 2.11$, $p = .149$, $\eta^2_{partial} = .02$). Table 1 depicts the descriptive sample information.

Descriptive results for all bias scores are shown in Table 2. See the supplemental material 2–5 for descriptive results on individual set types considering manual response times, target first fixation latencies, mean target fixation durations and total target fixation durations.

Facilitation bias

Contrary to hypothesis 1a, we found no significant differences between diagnostic groups in *facilitation bias* scores, $n = 113$, $\Lambda = .98$, $F(2, 110) = 1.16$, $p = .319$, $\eta^2_{partial} = .02$, indicating that trait social anxiety did not lead to facilitated attention towards angry faces.

We also found no significant differences between experimental conditions, $n = 113$, $\Lambda = .97$, $F(2, 110) = 1.66$, $p = .194$, $\eta^2_{partial} = .03$, indicating that state social anxiety was also not associated to facilitated attention towards angry faces. Thus, neither hypothesis 1a nor hypothesis 1b were supported by our data.

Disengagement bias

Contrary to hypothesis 2, state anxiety induction did not lead to a delayed disengagement from angry faces; there were neither significant differences between experimental conditions in

Table 1. Descriptive results for demographic information and questionnaire data by diagnostic group and experimental condition.

	HC		SAD	
	No state anxiety ($n = 32$)	State anxiety ($n = 30$)	No state anxiety ($n = 36$)	State anxiety ($n = 31$)
Gender in % (men/women)	38/62	30/70	28/72	35/65
Age, *M* (SD)	29.8 (6.0)	29.8 (8.1)	30.8 (9.4)	29.6 (8.3)
BDI-II, *M* (SD)	3.4 (5.2)	4.9 (4.3)	15.0 (9.0)	15.5 (10.1)
LSAS, *M* (SD)	15.0 (11.5)	22.6 (16.4)	66.7 (24.8)	64.6 (23.4)
STAI-S t_1, *M* (SD)	31.9 (5.2)	33.6 (7.3)	43.6 (7.3)	41.7 (7.1)
STAI-S t_2, *M* (SD)	30.8 (5.0)	44.3 (10.2)	43.1 (7.0)	56.9 (10.3)

Note: HC: healthy controls; SAD: participants with social anxiety disorder; No state anxiety: control condition; State anxiety: anxiety induction condition; BDI-II: Beck Depression Inventory-Revised (Hautzinger et al., 2006); LSAS: Liebowitz Social Anxiety Scale (Stangier & Heidenreich, 2005); STAI-S: State-Trait Anxiety Inventory (Laux et al., 1981); t_1: assessment prior to experimental manipulation; t_2: assessment after experimental manipulation.

Table 2. Bias scores in ms by subgroup, bias and measure.

	HC		SAD	
Type of bias	No state anxiety *M* (SD)	State anxiety *M* (SD)	No state anxiety *M* (SD)	State anxiety *M* (SD)
Facilitation bias				
Manual response times	−245 (190)	−212 (205)	−300 (218)	−243 (186)
First fixation latencies	−99 (156)	−134 (175)	−136 (155)	−102 (129)
Disengagement bias				
Manual response times	292 (240)	238 (186)	241 (212)	258 (234)
First fixation latencies	123 (179)	96 (151)	63 (165)	85 (157)
Mean fixation durations	0 (79)	−7 (94)	−14 (90)	−28 (57)
Avoidance bias				
Total fixation durations	−84 (217)	−24 (189)	−6 (195)	57 (203)
Distraction bias				
Manual response times	−12 (70)	41 (106)	−13 (104)	28 (91)
First fixation latencies	−37 (71)	8 (62)	−42 (121)	18 (73)

Note: HC: healthy controls; SAD: participants with social anxiety disorder; No state anxiety: control condition; State anxiety: anxiety induction condition.

disengagement bias scores related to angry non-target trials, $n = 126$, $\Lambda = 1.00$, $F(2, 123) = .20$, $p = .822$, $\eta^2_{partial} = .00$, nor in terms of neutral targets among angry crowds, $n = 114$, $\Lambda = .99$, $F(2, 111) = .73$, $p = .483$, $\eta^2_{partial} = .01$, or in terms of angry targets among neutral crowds, $n = 119$, $F(1, 117) = .50$, $p = .481$, $\eta^2_{partial} = .00$.

Avoidance bias

In line with hypothesis 3, we found significant differences between diagnostic groups in *avoidance bias* scores, $n = 118$, $F(1, 116) = 4.43$, $p = .037$, $\eta^2_{partial} = .04$, indicating that the SAD group showed an avoidance of angry faces (see Figure 2).

Distraction bias

In line with hypothesis 4, we found significant differences between the experimental conditions in *distraction bias* scores, $n = 112$, $\Lambda = .91$, $F(2, 109) = 5.34$, $p = .006$, $\eta^2_{partial} = .09$, indicating that

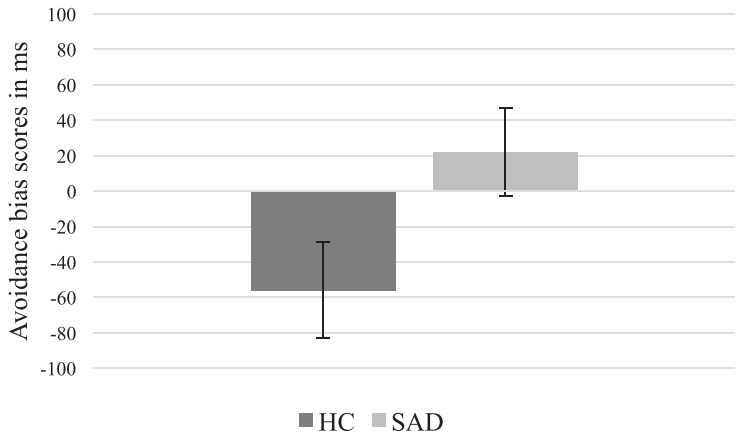

Figure 2. Avoidance bias scores and error bars (standard errors) in participants with social anxiety disorder (SAD) and healthy controls (HC). Positive scores indicate avoidance of angry in comparison to happy faces.

participants who underwent an anxiety induction were more easily distracted by task-irrelevant angry distractor stimuli (see Figure 3).

In order to explore whether this distraction bias was specific to angry distractor faces, we conducted equivalent analyses targeting happy distractors, but did not find evidence for an increased distractibility due to happy stimuli.

In order to disentangle whether the distraction bias actually reflects a stronger attention towards threat, we further explored mean fixation durations for distractor stimuli. However, we found no differences in mean fixation duration for angry distractor faces between the conditions.

Explorative analyses

To rule out that the reliability of our measures of attentional biases to threat differed according to diagnostic groups or experimental conditions, we calculated the reliability of manual response times within all subgroups of participants. Considering both raw values and bias scores, we found no differences in reliability between diagnostic groups or experimental conditions. For an in-depth analysis of psychometric properties of the measures applied in the current study we refer to Wermes, Lincoln, and Helbig-Lang (2017).

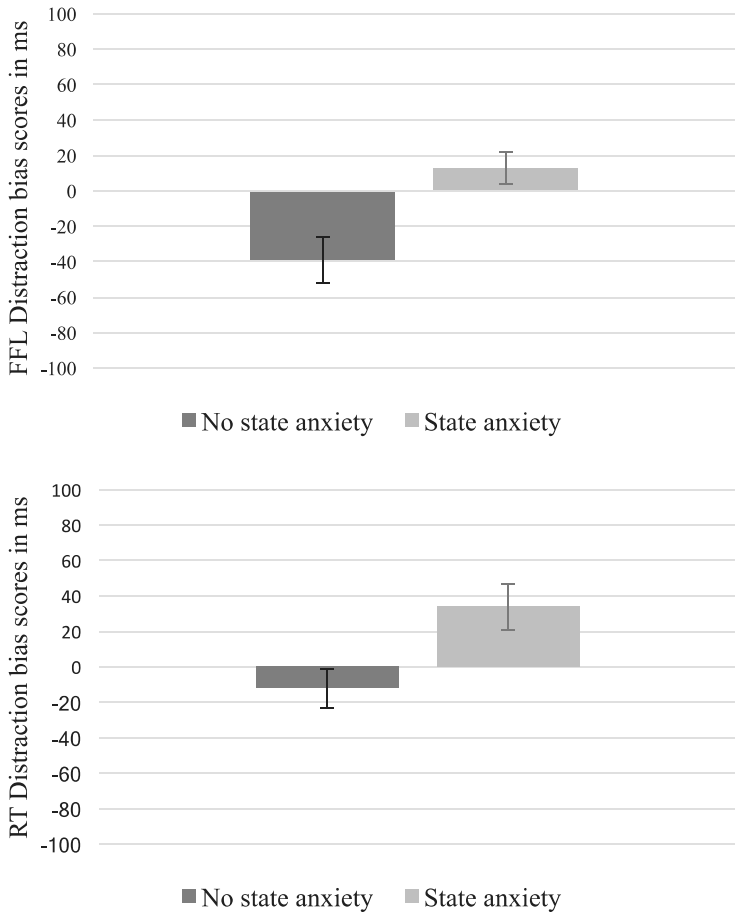

Figure 3. Distraction bias scores and error bars (standard errors) with and without state anxiety induction. Upper panel: First fixation latencies; Lower panel: Manual response times.

In order to control for confounding effects of the diagnostic group on *disengagement* or *distraction bias* scores, we calculated corresponding main effects, which, however, were not significant. Likewise, we controlled for main effects of the experimental condition on *avoidance bias* scores as well as for interaction effects of the diagnostic group and the experimental condition on all bias scores, which again were not significant.

To elaborate the role of different subtypes of SAD, we did several exploratory analyses with a narrowed selection of participants, including only participants with generalized SAD as well as HC. Results confirmed an avoidance of threat in the generalized SAD group ($F(1, 90) = 7.14$, $p = .009$, $\eta^2_{partial} = .07$), whereas this effect was larger than the effect found for the complete SAD group. Moreover, our anxiety induction condition was now also associated with an avoidance of threat ($F(1, 90) = 5.21$, $p = .025$, $\eta^2_{partial} = .06$). Other attentional biases did not reveal differences to our main analyses.

As previous studies have indicated that depressive disorders might affect attention allocation to threat (e.g., LeMoult & Joormann, 2012), we post-hoc analyzed effects of depression. Including BDI scores as a covariate did eliminate the reported *avoidance bias* of the SAD group ($F(2, 115) = 2.93$, $p = .058$, $\eta^2_{partial} = .05$), while the reported *distraction bias* ($\Lambda = .91$, $F(2, 108) = 5.32$, $p = .006$, $\eta^2_{partial} = .09$) and other results were not essentially affected. Including the diagnosis of Major Depressive Disorder as an additional factor did eliminate both reported biases.

As the Attentional Control Theory suggests that both efficiency and effectiveness are relevant components of performance, we also explored error rates in visual search tasks. We found no significant main effects considering differences between diagnostic groups ($F(1, 133) = 3.00$, $p = .085$, $\eta^2_{partial} = .02$) or experimental conditions ($F(1, 133) = .99$, $p = .322$, $\eta^2_{partial} = .01$) in overall error rates. Overall error rates in the HC group were 3.22% without and 4.97% with anxiety induction, while the SAD group showed error rates of 5.49% without and 5.50% with anxiety induction.

Discussion

The current study was designed to specifically assess various indices of attentional biases to threat according to trait and state social anxiety. We neither found evidence for facilitated attention to threat in trait nor in state social anxiety (hypotheses 1a, 1b). These results are contrary to cognitive models of SAD and the Attentional Control Theory, which consistently propose that anxiety leads to a facilitated attention to threat. However, the Attentional Control Theory notes that maintaining goal-directed attention is related to self-regulation skills, such as attentional control, through increased effort (see Derakshan & Eysenck, 2009). Therefore, our findings might not entirely oppose the assumptions made by the Attentional Control Theory. Even under conditions of threat, increased efforts are thought to lead to effectiveness (i.e. response accuracy) at the expense of a decreased performance efficiency (i.e. response time). Our findings suggest this effect to be reciprocal, as we found response times not to be different, but error rates to be descriptively higher in SAD. Future analyses should, thus, take individual differences in self-regulation into account. Aside the few studies that also failed to demonstrate a facilitated attention to threat stimuli in social anxiety (e.g., Rinck et al., 2003; Schofield et al., 2012), our findings are opposed to a wide range of previous findings on attentional biases to threat. Given that findings vary with the experimental paradigms used, the specifications of our study design need to be considered. Visual search paradigms ask participants to find aberrant or specific stimuli, such as facial photographs. In contrast, free viewing paradigms do not dictate any attentional behavior and spatial cueing as well as dot probe paradigms use such specific stimuli only as primes, while participants have to react to neutral probes. Accordingly, variability of attentional behavior may be specifically decreased in visual search paradigms through the given conditions, in terms of situational pressure (Stagner, 1977). However, we found visual search to be more appropriate to account for attentional behavior in SAD, as socially anxious individuals experience fear in rather complex situations with competing stimuli (e.g., giving a presentation). Visual search paradigms provided evidence for facilitated attention to threat in the past (Eastwood et al., 2005; Gilboa-Schechtman et al., 1999; Juth et al., 2005, study 5). Two of these studies used

schematic pictures as stimuli, while our stimuli showed emotional expressions as facial photographs. It cannot be ruled out that the situational pressure of our stimuli was too high and that they were similarly recognized as threatening or not by all participants, regardless of social anxiety. Accordingly, future studies should directly compare effects of different types of stimuli, including masked or schematic stimuli. Moreover, previous research found individuals with SAD to generally show deviations in their orientation towards visual stimuli, regardless of the emotional valence of the stimuli (e.g., Heeren, Maurage, & Philippot, 2015). Even though our SAD group may thus be slower to attend to target stimuli in general, we assume the bias scores to nevertheless be adequate, because attentional processing is only considered via relating different set types. Therefore, we assume any dispositions to process non-emotional visual stimuli to be canceled out.

We also found no evidence for delayed disengagement from angry faces after the induction of state anxiety (hypothesis 2). Accordingly, our data does not support the assumption of the Attentional Control Theory that attention shifts towards stimulus-driven processing when an individual is feeling anxious. Our results add to findings of other visual search studies that also failed to support delayed disengagement from threat (Eastwood et al., 2005; Gilboa-Schechtman et al., 1999; Juth et al., 2005) and to previous eye tracking paradigms finding delayed disengagement to be associated with trait social anxiety only (Buckner et al., 2010; Schofield et al., 2012). Again, differences between applied experimental paradigms might be important in this case, specifically the characteristic of visual search paradigms to comprise several competing stimuli. This might be associated with other information processing strategies that preclude attention allocation from staying engaged with one stimuli.

In line with our hypotheses, we found that individuals with SAD exhibited shorter total fixation durations towards angry faces, indicating attentional avoidance of threat (hypothesis 3). This is consistent with assumptions of the vigilance-avoidance hypothesis and the cognitive model by Clark and Wells (1995), which both propose a reduced tendency to process external threat stimuli. Moreover, our findings support cognitive behavioral models of SAD, that consistently assume avoidance behavior to be essential for the maintenance of the disorder. Interestingly, the vast majority of existing attention bias modification trainings (e.g., Amir et al., 2009) were based on the assumption of facilitated attention to threat and train participants to avoid threatening stimuli. Our results may therefore explain the lack of long-term effects of such trainings (e.g., Cristea, Kok, & Cuijpers, 2015; Heeren, Mogoase, Philippot, & McNally, 2015), as those might actually increase pathological behavior and thus only result in momentarily improvement. Our results propose to reconsider the focus of attentional bias modification trainings and to develop programs that decrease avoidance in attention towards social stimuli. Considering fundamental attentional bias research, future studies should include eye tracking parameters in order to depict spatiotemporal attention allocation and therefore provide a possibly more valid measure. It has to be noted though, that the effect of diagnostic group on avoidance was only small, and it decreased to trend level, when BDI scores were included as a covariate in the analyses. This might raise some doubt about the meaningfulness of the effect, however, small to at most medium effects are common in attentional bias research (Bar-Haim et al., 2007) and most individuals suffering from SAD also experience depressive symptoms. Based on the self-rated levels of social anxiety (LSAS) and the percentage of individuals with generalized symptoms, our clinical sample appears to be representative (e.g., Baker, Heinrichs, Kim, & Hofmann, 2002). Thus, we feel encouraged to assume that our findings are relevant for clinical practice. Moreover, our explorative analyses indicate a specific clinical relevance of attentional avoidance for generalized SAD. Contrary to what we expected (hypothesis 2), these analyses furthermore indicate avoidance to be relevant under conditions of social evaluative threat. This result opposes the assumption that different attentional processes underlie trait and state social anxiety but rather speak for attentional avoidance to be an overarching mechanism.

In line with hypothesis 4 and the assumptions made by the Attentional Control Theory, the induction of state anxiety was associated with an inhibition of goal-directed attention when task-irrelevant

threat distractors were present. This effect appears to be stable, as it was maintained even when outliers were not excluded (see Wermes et al., 2017) and when depressive symptoms were taken into account as a covariate. Following the Attentional Control Theory, threatening distractor stimuli should disrupt goal-driven attentional processing and therefore inhibit orientation towards target stimuli. However, post-hoc analyses revealed that the reported distraction bias was not attributable to delayed disengagement from angry distractor faces. Nevertheless, our results may not essentially contradict the underlying assumption. The attentional shift towards stimulus-driven processing caused by the induction of state social anxiety might also lead to a more random or hypervigilant scanning pattern.

Limitations

Besides the considerations about our experimental design discussed above, some limitations need to be noted. One issue that could have affected the results of the current study are the psychometric properties of our applied measures. None of the bias scores within the current study were found to be internally consistent. However, as elaborated in Wermes et al. (2017), our ability to verify their reliability using the applied permutation approach is limited. Further research, specifically on test–retest reliability, is therefore mandatory. Accordingly, we assume that our measures can nevertheless be used to determine visual attention. We believe our design to be generally sound, as it included direct as well as indirect measures of visual attention, allowed to present several stimuli simultaneously, and therefore provides good ecological validity. Still, our findings are limited to our specific experimental design, which was based on previous studies such as Juth et al. (2005), but included changes to stimulus material, numbers of trials and presentation times.

In order to measure fixation durations, we took the entire four seconds of a trial into account instead of analyzing smaller time periods as has been done in other studies (e.g., Amir, Zvielli, & Bernstein, 2016). We assumed anxiety-related delayed disengagement or avoidance to be apparent in whole trial lengths, even though a closer look at certain time periods after initial fixations might provide further insights. A dynamic approach could therefore be a promising direction for further studies.

Conclusion

Taken together, we found no indicators of facilitated attention or delayed disengagement according to trait or state social anxiety. In line with the diversity of other empirical findings, our results raise doubts about the stability and the relevance of different manifestations of attentional biases to threat in SAD. However, we found avoidance of threat in the SAD group and distraction by threat after the induction of state social anxiety. Our findings therefore support the assumption that avoidance behavior is especially important for the clinical picture of SAD. This provides some explanation for the lack of long-term effects of attention modification trainings that attempt to modify facilitated attention but ignore attentional avoidance of threat. Future studies are needed that incorporate eye tracking in order to depict spatiotemporal attention allocation and our differential findings for trait and state levels of social anxiety call for further evaluations of general theories on attentional processing in anxiety. We advocate future research to further explore the fundamental characteristics of attentional biases to threat in clinical disorders before deriving therapeutic applications.

Acknowledgements

The authors thank all study participants, and all graduate students for their assistance in recruitment, data collection and data entry. They also thank Jürgen Kempkensteffen for his assistance with eye tracking procedures.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the German Research Foundation [grant number SHL012014].

References

Amir, N., Beard, C., Taylor, C. T., Klumpp, H., Elias, J., Burns, M., & Chen, X. (2009). Attention training in individuals with generalized social phobia: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *77*, 961–973. doi:10.1037/a0016685

Amir, N., Elias, J., Klumpp, H., & Przeworski, A. (2003). Attentional bias to threat in social phobia: Facilitated processing of threat or difficulty disengaging attention from threat? *Behaviour Research and Therapy*, *41*, 1325–1335. doi:10.1016/S0005-7967(03)00039-1

Amir, I., Zvielli, A., & Bernstein, A. (2016). (De)coupling of our eyes and our mind's eye: A dynamic process perspective on attentional bias. *Emotion*, *16*, 978–986. doi:10.1037/emo0000172

Baker, S. L., Heinrichs, N., Kim, H. J., & Hofmann, S. G. (2002). The Liebowitz Social Anxiety Scale as a self-report instrument: A preliminary psychometric analysis. *Behaviour Research and Therapy*, *40*, 701–715. doi:10.1016/S0005-7967(01)00060-2

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin*, *133*, 1–24. doi:10.1037/0033-2909.133.1.1

Beck, A., Steer, R., & Brown, G. (1993). *Beck Depression Inventory-II (BDI-II)*. doi:10.1037/t00742-000

Berggren, N., Koster, E. H. W., & Derakshan, N. (2012). The effect of cognitive load in emotional attention and trait anxiety: An eye movement study. *Journal of Cognitive Psychology*, *24*, 79–91. doi:10.1080/20445911.2011.618450

Buckner, J. D., Maner, J. K., & Schmidt, N. B. (2010). Difficulty disengaging attention from social threat in social anxiety. *Cognitive Therapy and Research*, *34*, 99–105. doi:10.1007/s10608-008-9205-y

Cisler, J. M., & Koster, E. H. W. (2010). Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. *Clinical Psychology Review*, *30*, 203–216. doi:10.1016/j.cpr.2009.11.003

Clark, D. M. (2001). A cognitive perspective on social phobia. *The Essential Handbook of Social Anxiety for Clinicians*, *42*, 193–218. doi:10.1016/S0006-3223(97)87445-8

Clark, D. M ., & Wells, A. (1995). A cognitive model of social phobia. In R. Heimberg, M. Liebowitz, D. Hope, & R. Schneier (Eds.), *Social Phobia: Diagnosis, assessment and treatment* (pp. 69–93). New York: Guilford Press.

Clarke, P.J. F., MacLeod, C., & Guastella, A. J. (2013). Assessing the role of spatial engagement and disengagement of attention in anxiety-linked attentional bias: A critique of current paradigms and suggestions for future research directions. *Anxiety, Stress & Coping*, *26*, 1–19. doi:10.1080/10615806.2011.638054

Cristea, I. A., Kok, R. N., & Cuijpers, P. (2015). Efficacy of cognitive bias modification interventions in anxiety and depression: Meta-analysis. *British Journal of Psychiatry*, *206*, 7–16. doi:10.1192/bjp.bp.114.146761

Derakshan, N., & Eysenck, M. W. (2009). Anxiety, processing efficiency, and cognitive performance. *European Psychologist*, *14*, 168–176. doi:10.1027/1016-9040.14.2.168

Eastwood, J., Smile, D., Oakman, J., Farvolden, P., van Ameringen, M., Mancini, C., & Merikle, P. (2005). Individuals with social phobia are biased to become aware of negative faces. *Visual Cognition*, *12*, 159–179. doi:10.1080/13506280444000175

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion*, *7*, 336–353. doi:10.1037/1528-3542.7.2.336

First, M. B., & Gibbon, M. (2004). The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) and the Structured Clinical Interview for DSM-IV Axis II Disorders (SCID-II). *Comprised Handbook of Psychological Assessment*.

Fresco, D. M., Coles, M. E., Heimberg, R. G., Liebowitz, M. R., Hami, S., Stein, M. B., & Goetz, D. (2001). The Liebowitz Social Anxiety Scale: A comparison of the psychometric properties of self-report and clinician-administered formats. *Psychological Medicine*, *31*, 1025–1035. doi:10.1017/S0033291701004056

Gamble, A. L., & Rapee, R. M. (2010). The time-course of attention to emotional faces in social phobia. *Journal of Behavior Therapy and Experimental Psychiatry*, *41*, 39–44. doi:10.1016/j.jbtep.2009.08.008

Garner, M., Mogg, K., & Bradley, B. P. (2006). Orienting and maintenance of gaze to facial expressions in social anxiety. *Journal of Abnormal Psychology*, *115*, 760–770. doi:10.1037/0021-843X.115.4.760

Gilboa-Schechtman, E., Foa, E. B., & Amir, N. (1999). Attentional biases for facial expressions in social phobia: The face-in-the-crowd paradigm. *Cognition and Emotion*, *13*, 305–318. doi:10.1080/026999399379294

Hautzinger, M., Keller, F., & Kühner, C. (2006). *Beck Depressions-Inventar (BDI-II)*. Frankfurt: Harcourt Test Services.

Heeren, A., Maurage, P., & Philippot, P. (2015). Revisiting attentional processing of non-emotional cues in social anxiety: A specific impairment for the orienting network of attention. *Psychiatry Research*, *228*, 136–142.

Heeren, A., Mogoase, C., Philippot, P., & McNally, R. J. (2015). Attention bias modification for social anxiety: A systematic review and meta-analysis. *Clinical Psychology Review*, *40*, 76–90. doi:10.1016/j.cpr.2015.06.001

Heimberg, R. G., Brozovich, F. A., & Rapee, R. M. (2010). *A cognitive behavioral model of social anxiety disorder: Update and extension*. San Diego, CA: Elsevier.

Juth, P., Lundqvist, D., Karlsson, A., Ohman, A., & Öhman, A. (2005). Looking for foes and friends: Perceptual and emotional factors when finding a face in the crowd. *Emotion*, *5*, 379–395. doi:10.1037/1528-3542.5.4.379

Kappenman, E. S., Farrens, J. L., Luck, S. J., & Proudfit, G. H. (2014). Behavioral and ERP measures of attentional bias to threat in the dot-probe task: Poor reliability and lack of correlation with anxiety. *Frontiers in Psychology*, *5*. doi:10.3389/fpsyg.2014.01368

Kendall, P., Finch, Jr., A., Auerbach, S., Stephen, M., Hooke, J. F., & Milkulka, P. J. (1976). The State-Trait Anxiety Inventory: A systematic evaluation. *Journal of Consulting and Clinical Psychology*, *44*, 406–412. doi:10.1037/0022-006X.44.3.406

Knye, M., Roth, N., Westhus, W., & Heine, A. (2003). *Continuous performance test*. Göttingen: Hogrefe.

Kowler, E., Anderson, E., Dosher, B., & Blaser, E. (1995). The role of attention in the programming of saccades. *Vision Research*, *35*, 1897–1916. doi:10.1016/0042-6989(94)00279-U

Kühner, C., Bürger, C., Keller, F., & Hautzinger, M. (2007). Reliabilität und Validität des revidierten Beck-Depressionsinventars (BDI-II)[Reliability and validity of the revised Beck Depression Inventory]. *Der Nervenarzt*, *78*, 651–656. doi:10.1007/s00115-006-2098-7.

Langner, O., Dotsch, R., Bijlstra, G., Wigboldus, D. H. J., Hawk, S. T., & van Knippenberg, A. (2010). Presentation and validation of the Radboud Faces Database. *Cognition & Emotion*, *24*, 1377–1388. doi:10.1080/02699930903485076

Laux, L., Glanzmann, P., Schaffner, P., & Spielberger, C. D. (1981). *Das State-Trait-Anxiety-Inventory (STAI)*. Weinheim: Beltz.

Leber, S., Heidenreich, T., Stangier, U., & Hofmann, S.G. (2009). Processing of facial affect under social threat in socially anxious adults: Mood matters. *Depression and Anxiety*, *26*, 196–206. doi:10.1002/da.20525

LeMoult, J., & Joormann, J. (2012). Attention and memory biases in social anxiety disorder: The role of comorbid depression. *Cognitive Therapy and Research*, *36*, 47–57. doi:10.1007/s10608-010-9322-2

Liebowitz, M. R. (1987). Social phobia. *Modern Problems of Pharmacopsychiatry*, *22*, 141–173.

Lobbestael, J., Leurgans, M., & Arntz, A. (2011). Inter-rater reliability of the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID I) and Axis II Disorders (SCID II). *Clinical Psychology and Psychotherapy*, *18*, 75–79. doi:10.1002/cpp.693

Mansell, W., & Clark, D. M. (1999). How do I appear to others? Social anxiety and processing of the observable self. *Behaviour Research and Therapy*, *37*, 419–434. doi:10.1016/S0005-7967(98)00148-X

Mansell, W., Clark, D. M., Ehlers, A., & Chen, Y.-P. (1999). Social anxiety and attention away from emotional faces. *Cognition and Emotion*, *13*, 673–690. doi:10.1080/026999399379032

Mogg, K., & Bradley, B. P. (2002). Selective orienting of attention to masked threat faces in social anxiety. *Behaviour Research and Therapy*, *40*, 1403–1414. doi:10.1016/S0005-7967(02)00017-7

Mogg, K., Bradley, B., Miles, F., & Dixon, R. (2004). Brief report time course of attentional bias for threat scenes: Testing the vigilance-avoidance hypothesis. *Cognition & Emotion*, *18*, 689–700. doi:10.1080/02699930341000158

Mogg, K., Millar, N., & Bradley, B. P. (2000). Biases in eye movements to threatening facial expressions in generalized anxiety disorder and depressive disorder. *Journal of Abnormal Psychology*, *109*, 695–704. doi:10.1037//0021-843X

Mogg, K., Philippot, P., & Bradley, B. P. (2004). Selective attention to angry faces in clinical social phobia. *Journal of Abnormal Psychology*, *113*, 160–165. doi:10.1037/0021-843X.113.1.160

Quigley, L., Nelson, A. L., Carriere, J., Smilek, D., & Purdon, C. (2012). The effects of trait and state anxiety on attention to emotional images: An eye-tracking study. *Cognition & Emotion*, *26*, 1–22. doi:10.1080/02699931.2012.662892

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy*, *35*, 741–756. doi:10.1016/S0005-7967(97)00022-3

R Core Team. (2009). *R: A language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing.

Rinck, M., Becker, E. S., Kellermann, J., & Roth, W. T. (2003). Selective attention in anxiety: Distraction and enhancement in visual search. *Depression and Anxiety*, *18*, 18–28. doi:10.1002/da.10105

Schmukle, S. C. (2005). Unreliability of the dot probe task. *European Journal of Personality*, *19*, 595–605. doi:10.1002/per.554

Schofield, C. A., Johnson, A. L., Inhoff, A. W., & Coles, M. E. (2012). Social anxiety and difficulty disengaging threat: Evidence from eye-tracking. *Cognition & Emotion*, *26*, 300–311. doi:10.1080/02699931.2011.602050

SensoMotoric Instruments. (2015). *BeGaze: Manual version 3.5*. Teltow, Germany: SMI.

Singh, J. S., Capozzoli, M. C., Dodd, M. D., & Hope, D. A. (2015). The effects of social anxiety and state anxiety on visual attention: Testing the vigilance avoidance hypothesis. *Cognitive Behaviour Therapy*, *44*, 377–388. doi:10.1080/16506073.2015.1016447

Spielberger, C., Gorsuch, R., & Lushene, R. (1970). *Test manual for the state-trait anxiety inventory*. Palo Alto, CA: Consulting Psychologists Press.

Stagner, R. (1977). On the reality and relevance of traits. *The Journal of General Psychology*, *96*, 185–207. doi:10.1080/00221309.1977.9920815

Stangier, U., & Heidenreich, T. (2005). Liebowitz Soziale Angst-Skala (LSAS) [Liebowitz Social Anxiety Scale]. In Collegium Internationale Psychiatriae Scalarum (Ed.), *Internationale Skalen für Psychiatrie* (pp. 299–305). Göttingen: Hogrefe.

Staugaard, S. R. (2009). Reliability of two versions of the dot-probe task using photographic faces. *Psychology Science Quarterly*, *51*, 339–350.

Stopa, L., & Clark, D. M. (2000). Social phobia and interpretation of social events. *Behaviour Research and Therapy*, *38*, 273–283. doi:10.1016/S0005-7967(99)00043-1

Waters, A., Mogg, K., Bradley, B., & Pine, D. (2011). Attention bias for angry faces in children with social phobia. *Journal of Experimental Psychopathology*, *2*, 475–489. doi:10.5127/je8111p.01

Wermes, R., Lincoln, T. M., & Helbig-Lang, S. (2017). How well can we measure visual attention? Psychometric properties of manual response times and first fixation latencies in a visual search paradigm. *Cognitive Therapy and Research*, *41*, 588–599. doi:10.1007/s10608-016-9830-9

Wittchen, H.-U., Zaudig, M., & Fydrich, T. H. (1997). *SKID – Strukturiertes Klinisches Interview für DSM-IV. Achse I und II Handanweisungen [Structured clinical interview for DSM-IV]*. Göttingen: Hogrefe. doi:10.1026//0084-5345.28.1.68

Wong, Q. J. J., & Rapee, R. M. (2016). The aetiology and maintenance of social anxiety disorder: A synthesis of complimentary theoretical models and formulation of a new integrated model. *Journal of Affective Disorders*, *203*, 84–100. doi:10.1016/j.jad.2016.05.069

Zanarini, M. C., Skodol, A. E., Bender, D., Dolan, R., Sanislow, C., Schaefer, E., & Gundersono, J. G. (2000). The collaborative longitudinal personality disorders study: Reliability of axis I and II diagnoses. *Journal of Personality Disorders*, *14*, 291–299. doi:10.1521/pedi.2000.14.4.291

9.3. Studie 3: Hypervigilanz

Wermes, R., Lincoln, T. M., & Helbig-Lang, S. (under review). Anxious and alert? Hypervigilance in social anxiety disorder. *Psychiatry Research*.

Manuscript Details

Manuscript number	PSY_2017_1722_R2
Title	Anxious and Alert? Hypervigilance in Social Anxiety Disorder
Article type	Full Length Article

Abstract

The vast majority of research on attentional biases to threat focusses on selective attention, even though several cognitive-behavioral models furthermore assume hypervigilance to be important in this regard. Thus, the current study examined hypervigilance in trait and state social anxiety. We analyzed visual scanpath lengths and fixation counts of participants with Social Anxiety Disorder (SAD) (n = 61) and healthy controls (n = 60) in a combined visual search and eye tracking paradigm, including photographs of facial expressions. Half of all participants were randomly assigned to a state anxiety induction. Interaction effects revealed opposed attentional patterns of participants with SAD as compared to healthy controls considering overall visual scanpath lengths ($F(1,117) = 5.32$, $p = 0.023$, $\eta 2partial = 0.043$) and fixation counts ($F(1,117) = 5.10$, $p = 0.026$, $\eta 2partial = 0.042$). Accordingly, participants with SAD showed signs of hypervigilance in the anxiety induction condition. In contrast, there was no main effect of diagnostic group, indicating that individuals with SAD shift their attentional focus to broad scanning behavior only under conditions of threat. Our results add to the small number of existing studies on hypervigilance in SAD and suggest the topic to be promising for future research.

Keywords	social anxiety disorder; hypervigilance; state anxiety; visual search; eye tracking
Corresponding Author	Richard Wermes
Corresponding Author's Institution	Clinical Psychology and Psychotherapy, University of Hamburg
Order of Authors	Richard Wermes, Tania Lincoln, Sylvia Helbig-Lang
Suggested reviewers	Adam Guastella, Georg W. Alpers, Craig Gonsalvez, Leanne Williams, Nigel Chen

Submission Files Included in this PDF

File Name [File Type]

Cover Letter.docx [Cover Letter]

Response to Reviewers.docx [Response to Reviewers]

Highlights.docx [Highlights]

Abstract.docx [Abstract]

Revised Manuscript.docx [Manuscript File]

Figures.pptx [Figure]

Tables.docx [Table]

To view all the submission files, including those not included in the PDF, click on the manuscript title on your EVISE Homepage, then click 'Download zip file'.

Anxious and Alert? Hypervigilance in Social Anxiety Disorder

Richard Wermes*, Tania M. Lincoln, & Sylvia Helbig-Lang

Department of Clinical Psychology and Psychotherapy, University of Hamburg, Germany

Corresponding author:

Richard Wermes, M. Sc.

Von-Melle-Park 5, 20146 Hamburg, Germany

E-mail: richard.wermes@uni-hamburg.de

Telephone: 0049 40 42838-9699

Fax: 0049 40 42838-6170

Abstract

The vast majority of research on attentional biases to threat focusses on selective attention, even though several cognitive-behavioral models furthermore assume hypervigilance to be important in this regard. Thus, the current study examined hypervigilance in trait and state social anxiety. We analyzed visual scanpath lengths and fixation counts of participants with Social Anxiety Disorder (SAD) (n = 61) and healthy controls (n = 60) in a combined visual search and eye tracking paradigm, including photographs of facial expressions. Half of all participants were randomly assigned to a state anxiety induction. Interaction effects revealed opposed attentional patterns of participants with SAD as compared to healthy controls considering overall visual scanpath lengths ($F(1,117) = 5.32$, $p = 0.023$, $\eta^2_{partial} = 0.043$) and fixation counts ($F(1,117) = 5.10$, $p = 0.026$, $\eta^2_{partial} = 0.042$). Accordingly, participants with SAD showed signs of hypervigilance in the anxiety induction condition. In contrast, there was no main effect of diagnostic group, indicating that individuals with SAD shift their attentional focus to broad scanning behavior only under conditions of threat. Our results add to the small number of existing studies on hypervigilance in SAD and suggest the topic to be promising for future research.

Keywords: social anxiety disorder, hypervigilance, state anxiety, visual search, eye tracking

1. Introduction

Cognitive models of Social Anxiety Disorder (SAD) propose that attentional processes play an important role in the development and maintenance of social anxiety (Clark, 2001; Heimberg et al., 2010). Numerous studies have demonstrated that individuals with anxiety disorders indeed selectively attend to threat cues (see Bar-Haim et al., 2007 for a meta analysis) and that such selective attention might comprise facilitated attention, difficulties in disengagement, or attentional avoidance (Cisler and Koster, 2010). Furthermore, several cognitive-behavioral models propose hypervigilance to be relevant for the disorder, as another manifestation of attentional biases to threat (Richards et al., 2014). However, only few studies examined this more general attentional pattern so far.

Whereas the term vigilance denotes facilitated attention to threat (Cisler and Koster, 2010), hypervigilance refers to increased alertness for threat by means of either excessive scanning of the environment or keeping a broad focus of attention (Richards et al., 2014). Evolutionary models propose that hypervigilance generally serves the survival by ensuring that individuals readily detect potential threat signals (Posner and Petersen, 1990). In line with this assumption, the Attentional Control Theory (Eysenck et al., 2007) proposes that anxious individuals are hypervigilant prior to threat detection and narrow their attention once a threat is detected. However, continuous environmental scanning might also lead to increased distractibility by task-irrelevant threat (Reinholdt-Dunne et al., 2012) and to difficulties in focusing attention on ongoing tasks (Richards et al., 2014). For the case of SAD, hypervigilance may thus be linked to insufficient processing of important social information. Similar to impairments due to self-focused attention (Clark and Wells, 1995), this may result in a lack of disconfirmation of negative beliefs and persistent anxiety in social situations.

While numerous studies assessed selective attention to threat in SAD (Amir et al., 2003; Gamble and Rapee, 2010; Mogg et al., 2004), only few empirical results refer to social anxiety and hypervigilance. Existing studies examined both scanpath lengths and fixation counts in eye tracking paradigms to measure hypervigilance. Accordingly, increased eye movements (i.e. scan path lengths) and numerous attentional alignments (i.e. fixation counts) are assumed to indicate excessive scanning behavior. Horley et al. (2003, 2004) examined visual scanpath lengths of individuals with SAD within a free viewing paradigm using photographs of different facial expressions, one at a time. Both studies indicate that participants with SAD, as compared to healthy controls, show increased scanpath lengths for neutral, sad, and angry faces, indicating hypervigilance for threat-related and ambiguous stimuli. Chen et al. (2015) used a free viewing paradigm presenting videos of a crowd containing 16 pre-recorded individuals displaying different facial expressions. The study examined attention allocation under conditions of state anxiety (as a momentarily response to acute threat), since participants were asked to give a presentation in front of this pre-recorded audience. Here as well, participants with SAD showed increased scanpath lengths but did not differ from healthy controls in terms of fixation counts. However, as all participants received a state anxiety induction, effects of trait and state social anxiety were not distinguished.

The current study aimed to extend findings by Horley et al. (2003, 2004) and Chen et al. (2015) on hypervigilance in SAD. Specifically, we separately analyzed effects of both trait and state social anxiety and captured visual scanpath lengths and fixation counts of participants using eye tracking in a visual search paradigm. In line with cognitive models of SAD and previous findings, we expected trait (hypothesis 1a) as well as state (hypothesis 1b) social anxiety to be associated with overall hypervigilant scanning behavior. Secondly, we expected hypervigilance

to be specifically evident in ongoing search for threatening stimuli (hypothesis 2), due to its definition as a threat detection mechanism.

2. Methods

2.1. Participants

Participants were recruited via printed announcements and a local job-offering website for a research project on social anxiety and attentional processes (Wermes, Lincoln, & Helbig-Lang, sub.). Individuals with a current DSM-IV diagnosis of SAD and healthy controls, matched for sex and age took part in our study. General inclusion criteria were a) age between 18 and 65 years, b) informed consent, c) fluent German language skills, d) right-handedness, e) no uncorrected visual impairments or hard contact lenses, and f) no specific medication that might influence attention or response times (including benzodiazepines, antihistamines, pain medication, and eye drops).

2.2. Measures

Diagnostic status was assessed with a structured clinical evaluation based on the *Structured Clinical Interview for DSM-IV* (SCID-I; Wittchen et al., 1997). The SCID-I is a widely used structured interview with good psychometric properties (Zanarini et al., 2000), including good inter-rater reliability for SAD (Skre et al., 1991). Interviews were conducted by specifically trained students and master psychologists.

Trait social anxiety was further assessed using the self-report version of the *Liebowitz Social Anxiety Scale* (LSAS; Liebowitz, 1987; German: Stangier and Heidenreich, 2005). The LSAS has demonstrated good internal consistency as well as convergent and discriminant validity (Fresco et al., 2001). Internal consistency of LSAS total scores was excellent for the current study (Cronbach's alpha = 0.97). Success of the experimental state anxiety manipulation

was determined by the *State Trait Anxiety* Inventory (STAI-S; Laux et al., 1981; German: Spielberger et al., 1970). The scale provides excellent psychometric properties with Cronbach's alpha = 0.90 as well as several indicators for its validity (Kendall et al., 1976; Laux et al., 1981).

2.3. Stimuli, visual search tasks, and apparatus

Colored facial photographs with happy, neutral, and angry expressions taken from the Radboud Faces Database (Langner et al., 2010) served as stimulus material. Individual stimuli were combined to stimulus sets consisting of a circular structure of eight stimuli (see Juth et al., 2005, Figure 1). Stimulus sets were prepared with regard to three different visual search tasks, in order to analyze different types of selective attention to threat, including facilitated attention, delayed disengagement, and avoidance as well as distraction. A detection ("odd-one-out") task required participants to indicate whether all facial expressions were equal (non-target trials) or not (target trials), and two search tasks required participants to indicate whether a certain facial expression (either happy or angry) was present or not. All tasks asked to press the key on the left-hand side of a response box, if a respective target stimulus was present and the key on the right-hand side in case of a non-target trial. The detection task comprised 36 non-target trials and 64 target trials, of which 32 trials included either a happy or an angry target among a neutral crowd. Each search task consisted of 16 target trials without an additional distractor stimulus, 32 target trials with a distractor stimulus, and 16 trials including only distractor stimuli. Target and non-target trials as well as positions of target and distractor stimuli were completely balanced across trials. The entire visual search task included a total number of 228 stimulus sets, whereas detection as search tasks were presented in random order and preceded by twelve practice trials each.

please insert Figure 1 about here

Eye movements were recorded using a SensoMotoric Instruments RED500 desktop mounted eye tracking system combined with the manufacturers software iViewX 2.8 at a data rate of 60 Hz. Calibration was done at the beginning and after the first half of the visual search task, in order to provide for valid eye tracking throughout the experiment. We therefore used a nine-point procedure and only calibration values below 1° visual angle were accepted, providing for an estimated maximal difference between measured and actual fixation locations of 12 mm. The visual search tasks were implemented using E-Prime 2.0 and presented on a Dell OptiPlex 790 computer attached to a 22-inch Dell P2210 monitor, using a 1680x1050 resolution mode. Stimulus sets had a diameter of 20.1 cm and single stimuli had a diameter of 5.3 cm on the monitor while the distance between participants and monitor was roughly set to 70 cm. Manual responses were recorded using a Serial Response Box 200A (Psychology Software Tools).

2.4. Procedure

Individuals, who were positively screened in a telephone interview, were invited for an intake assessment that took place at our laboratory. At this first appointment, participants received information about study aims and procedures and were asked to provide a written informed consent. The subsequent intake assessment comprised the diagnostic interview SCID-I, to assess diagnostic status of all participants, as well as several self-report questionnaires. Participants who met inclusion criteria were invited to an experimental session, that took place about ten days after the intake assessment (M = 11, SD = 7 days). During this session, participants of both diagnostic groups were randomly assigned to either an anxiety induction or a waiting control condition. In the anxiety induction condition, the investigator informed

participants that they were asked to provide a short speech on a controversial topic in front of an audience at the end of the experiment, which they now had to prepare within 5 min. Participants in the control condition were given a five-minute break without formal instructions. Prior and after the experimental manipulation, all participants completed the STAI-S as part of the manipulation check and then started the eye tracking calibration procedure and visual search tasks. At the end of the experiment, participants in the anxiety induction condition were debriefed and completed a short questionnaire on the credibility of the manipulation. Participants received 10 € compensation per hour. All study procedures were approved by the Ethic Committee of the German Society of Psychology (Reference No SHL012014).

2.5. Data analysis

Eye tracking data was processed using BeGaze 3.5 (SensoMotoric Instruments 2015), which we used to extract visual scanpath lengths as well as fixation counts. A fixation was defined as gaze stability of at least 100 ms. All further data preparation was done using R 3.1.2 (R Development Core Team 2009).

We analyzed outliers in a stepwise procedure: Firstly, mean values for individual set types (e.g. angry target among neutral crowd) were excluded, if more than half of the underlying values (individual trials) was missing. Thereby, we excluded mean values that relied on insufficient data quality. Secondly, mean values for individual set types were excluded, if they differed more than three SD from the sample mean (exclusion of outliers). As a result of both steps, 0.63% of mean scanpath lengths and 1.14% of mean fixation counts were excluded. Thirdly, participants were excluded from the analyses, if their number of initially missing and excluded mean values for individual set types exceeded half the number of all set types,

considering scanpath lengths and fixation counts (n = 1). We thereby excluded participants for who data quality was insufficient.

Considering our first hypothesis, we examined effects of diagnostic groups (trait anxiety) and experimental conditions (state anxiety) on overall scanpath lengths and fixation counts comprising all visual search tasks and types of stimulus sets (i.e. set types). We used four one-way ANOVAs (group and condition) with either overall scanpath lengths or overall fixation counts as dependent variable. For our second hypothesis, we analyzed data from the search angry task including threatening (angry target among a neutral crowd) and non-threatening set types (happy target among a neutral crowd). Therefore, we applied four 2x2 ANOVAs (group x set type and condition x set type) with scanpath length and alternatively fixation counts as dependent variable. All analyses were conducted using SPSS 23 (SPSS Inc., Chicago, IL).

3. Results

The current analyses were based on data of $N = 121$ participants (SAD group: $n = 61$). While 140 participants completed the entire experiment, two participants were excluded because they took part twice in the investigation. Sixteen participants were excluded due to insufficient calibration results or entirely missing data for one or more visual search tasks and one participant was excluded due to our analyses of outliers. Across the four subgroups (group x condition), gender ($\chi^2(3) = 0.45$, $p = 0.931$) as well as age ($F(3,117) = 0.10$, $p = 0.960$) were equally distributed. The mean age of all participants was $M = 29.7$ ($SD = 7.8$) years; 80 of them were women and 41 men. The SAD group was significantly higher in trait social anxiety, as indicated by differences in the LSAS total scores ($F(1,119) = 184.89$, $p < 0.001$). Furthermore, the SAD group scored significantly higher in BDI values ($F(1,119) = 84.04$, $p < 0.001$, $\eta^2_{partial} = 0.41$). The anxiety induction condition significantly increased state social anxiety, as revealed by

comparisons of pre-post STAI-S values ($F(1,119) = 98.97$, $p < 0.001$), indicating the success of our experimental manipulation. An interaction analysis of diagnostic groups and experimental conditions revealed that state social anxiety increased to an equal extent in both diagnostic groups ($F(1,117) = 2.48$, $p = 0.118$, $\eta^2_{partial} = 0.02$). Fifty-nine percent of the participants in SAD group were diagnosed with generalized SAD, considering social anxiety in several and various situations. 42% of the participants in the SAD group were diagnosed with current depressive disorder, while 49% met the criteria for a current anxiety disorder other than SAD. Three participants currently received psychopharmacological treatment. Table 1 depicts the descriptive sample information as well as descriptive results regarding scanpath lengths and fixation counts.

please insert Table 1 about here

In order to test our first hypothesis, we used four one-way ANOVAs (group and condition) with either overall scanpath lengths or overall fixation counts as dependent variable. Contrary to hypothesis 1a, we found no significant differences between diagnostic groups in overall scanpath lengths $F(1,119) = 0.33$, $p = 0.566$, $\eta^2_{partial} = 0.00$. Neither did our state anxiety induction (hypothesis 1b) lead to differences in overall scanpath lengths $F(1,119) = 0.827$, $p = 0.365$, $\eta^2_{partial} = 0.01$. This indicates that neither trait nor state social anxiety were associated with hypervigilance. Our analyses of fixation counts revealed similar results, as compared to scanpath lengths. We found no main effects of diagnostic groups (hypothesis 1a), $F(1,119) = 0.60$, $p = 0.441$, $\eta^2_{partial} = 0.01$, or experimental conditions (hypothesis 1b), $F(1,119) = 0.46$, $p = 0.500$, $\eta^2_{partial} = 0.01$, on overall fixation counts as second indicator of hypervigilance.

In order to make sure that overall hypervigilance did not differ between detection and search tasks, we explored overall scanpath lengths of both tasks separately, which however led to equivalent results.

We furthermore did two exploratory analyses on the interaction of diagnostic groups and experimental conditions (2x2 ANOVAs) considering overall scanpath lengths and alternatively overall fixation counts as dependent variables. Results revealed significant cross-over interaction effects considering scanpath lenghts, (F (1,117) = 5.32, p = 0.023, $\eta^2_{partial}$ = 0.04), as well as fixation counts, (F (1,117) = 5.10, p = 0.026, $\eta^2_{partial}$ = 0.04). Accordingly, in the state anxiety condition, participants with SAD showed signs of hypervigilance, whereas healthy controls showed decreased scanpath lengths and fixation counts (see Figures 2 and 3).

please insert Figures 2 and 3 about here

In order to test our second hypothesis, we applied four 2x2 ANOVAs (group x set type and condition x set type) with scanpath length and alternatively fixation counts as dependent variable. Comparing scanpath lengths in stimulus sets with and without threatening stimuli, we found no significant differences between diagnostic groups (hypothesis 2a), F (1,238) = 0.95, p = 0.331, $\eta^2_{partial}$ = 0.00, and experimental conditions (hypothesis 2b), F (1,238) = 0.02, p = 0.899, $\eta^2_{partial}$ = 0.00. Moreover, our exploratory analyses revealed that the interaction of diagnostic groups and experimental conditions was also not associated with differences in scanpath lengths considering stimulus sets with threatening and without threatening stimuli. Accordingly, we found no significant differences between diagnostic groups (hypothesis 2a), F (1,236) = 0.96, p = 0.433, $\eta^2_{partial}$ = 0.00, or experimental conditions (hypothesis 2b), F (1,236) = 0.01, p = 0.918,

$\eta^2_{partial} = 0.00$, in fixation counts considering stimulus sets with and without threatening stimuli. Furthermore, our exploratory analyses revealed that the interaction of diagnostic groups and experimental conditions was also not associated with differences in fixation counts considering stimulus sets with and without threatening stimuli.

Thus, neither trait nor state social anxiety were associated with hypervigilance while searching for threat stimuli.

As depressive symptoms were found be related to attentional biases to threat (e.g., LeMoult & Joormann, 2012), we furthermore included BDI values as a covariate to all analyses reported above, however, this did not significantly change any of our results.

4. Discussion

The current study examined the occurrence of hypervigilance as an attentional pattern in SAD. Contrary to our expectations, there were no indicators of overall hypervigilance according to trait or state social anxiety alone. However, we found significant cross-over interaction effects of diagnostic group and experimental condition, indicating that participants with SAD – as compared to healthy controls – display signs of hypervigilance under conditions of threat. Specifically, in the anxiety induction condition, participants with SAD showed increased overall scanpath lengths, as compared to healthy controls. At a descriptive level, the same held true for overall number of fixation counts. This result extends findings by Chen et al. (2015), who also demonstrated increased scanpath lengths in socially anxious individuals compared to non-anxious individuals under conditions of social threat but who did not disentangle effects of state and trait anxiety.

The lack of main effects in the presence of interaction effects points out the importance of state anxiety as a moderator of biased attentional processes (Quigley et al., 2012). Individuals

with SAD may thus not permanently monitor their environment for threat, at least in the specific setting of our visual search paradigm. An imminent threat, however, may activate the alerting network that is thought to be related to hypervigilance (Posner and Petersen, 1990; Richards et al., 2014). Moreover, our results fit the more general model of defensive behavior by Fanselow (1994), which proposes that hypervigilance is shown in potentially dangerous situations as long as the actual threat (e.g. a predator) has not yet been detected.

In contrast to these general assumptions regarding the effects of state anxiety, healthy controls did not show respective indicators of hypervigilance. We found these participants to show decreased scanpath lengths and, at a descriptive level, decreased fixation counts under conditions of state anxiety. It might be speculated that these opposite patterns in scanning behavior reflect group differences in self-regulation strategies such as attentional control, which is thought to compensate for effects of anxiety on attentional processes (Derryberry and Reed, 2002; Eysenck et al., 2007). The hypervigilant attentional pattern observed in participants with SAD might also constitute a dysfunctional mechanism under conditions of threat: The resulting lack of attentional focus might inhibit the recognition of important environmental information that could reduce social anxiety and anxious apprehension within and prior to social situations. A similar mechanism is proposed for self-focused attention in SAD (Clark, 2001), which was consistently found to be associated with the maintenance of social anxiety (see Bogels and Mansell, 2004).

Our results somehow diverge from previous findings that found increased scanpath lengths in SAD without state anxiety induction (Horley et al., 2003, 2004). However, these studies relied on free viewing paradigms, which allow participants to attend to given visual stimuli in any way they want. In our design, participants were instructed to search for specific

stimuli, thus, the variability of individual viewing behavior might have been restricted, leading to less pronounced group differences. In addition, previous studies did not control for state anxiety, making it difficult to conclude whether the observed differences can really be attributed to differences in trait social anxiety.

Finally, it remains unclear how hypervigilance is related to actual threat detection. The Attentional Control Theory and cognitive models propose that hypervigilance might serve as a precondition to enhanced threat detection and thus occurs prior to threat detection (Rapee and Heimberg, 1997; Tancer, 1997). However, we could not find any evidence that hypervigilance depends on whether threatening stimuli are present or not. Horley et al. (2004) even found scanpath lengths of socially anxious participants to be increased when threatening social stimuli were presented, one at a time. Moreover, with regard to our findings on hypervigilance, one could expect facilitated attention to threat according to the interaction of trait and state social anxiety. However, a previous analysis of our data on manual response times and first fixation latencies does not confirm this assumption (Wermes et al., sub.), raising doubts about the actual relationship between hypervigilance and facilitated attention. However, it has to be noted that the current study as well as previous research did not allow to specifically depict scanpath lengths and fixation counts before and after threat detection, but rather compared threatening to not threatening stimuli. Moreover, our participants might have been able to evaluate whether threatening stimuli were present or not rather quickly, implying no further need to stay hypervigilant for threat. Further research should thus incorporate designs that allow to disentangle viewing behavior prior to and after threat detection. A promising approach might be the use of videos that contain threat stimuli at certain points in time.

5. Conclusion

Contributing to the small number of existing findings on hypervigilance, we found participants with SAD to show signs of hypervigilance under conditions of state anxiety. In light of often inconsistent results on selective attention to threat (cf., Cisler and Koster, 2010), further research on hypervigilant scanning behavior as a potential contributor to the maintenance of SAD appears to be promising. Moreover, our findings may help to further reflect on existing attentional bias modification trainings that aim to reduce selective attention to threat, but cannot provide long term effectiveness (Cristea et al., 2015; Heeren et al., 2015). On condition that future research clarifies the specific characteristics of hypervigilance and its relation to SAD as a first step, trainings that counter hypervigilance could be considered. On that note, mindfulness-based interventions (e.g., Kabat-Zinn, 2003), which counter unsteady attentional patterns such as hypervigilance, might also help pathological attentional processing of feared social situations. Further research on hypervigilance might thus be promising to both understanding and treating SAD.

Acknowledgements Financial support for this study was provided by a grant from the German Research Foundation provided to the last author (SHL012014).

Conflicts of Interest Richard Wermes, Tania Lincoln, and Sylvia Helbig-Lang declare that they have no Conflict of Interest.

Informed Consent All study procedures were in accordance with ethical standards of the responsible ethics committee. All participants provided a written informed consent before they were enrolled in the study.

Animal rights No animal studies were carried out for this article.

References

Amir, N., Elias, J., Klumpp, H., Przeworski, A., 2003. Attentional bias to threat in social phobia: Facilitated processing of threat or difficulty disengaging attention from threat? Behav. Res. Ther. 41, 1325–1335. https://doi.org/10.1016/S0005-7967(03)00039-1

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M.J., van IJzendoorn, M.H., 2007. Threat-related attentional bias in anxious and nonanxious individuals: a meta-analytic study. Psychol. Bull. 133, 1–24. https://doi.org/10.1037/0033-2909.133.1.1

Bogels, S.M., Mansell, W., 2004. Attention processes in the maintenance and treatment of social phobia: hypervigilance, avoidance and self-focused attention. Clin. Psychol. Rev. https://doi.org/doi:10.1016/j.cpr.2004.06.005

Chen, N.T.M., Thomas, L.M., Clarke, P.J.F., Hickie, I.B., Guastella, A.J., 2015. Hyperscanning and avoidance in social anxiety disorder: The visual scanpath during public speaking. Psychiatry Res. 225, 667–672. https://doi.org/10.1016/j.psychres.2014.11.025

Cisler, J.M., Koster, E.H.W., 2010. Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. Clin. Psychol. Rev. 30, 203–216. https://doi.org/10.1016/j.cpr.2009.11.003

Clark, D.M., 2001. A cognitive perspective on social phobia. Essent. Handb. Soc. anxiety Clin. 42, 193–218. https://doi.org/10.1016/S0006-3223(97)87445-8

Clark, D.M., Wells, A., 1995. A cognitive model of social phobia, in: Heimberg, R., Liebowitz, M., Hope, D., Schneier, R. (Eds.), Social Phobia: Diagnosis, Assessment and Treatment. Guilford Press, New York, pp. 69–93.

Cristea, I.A., Kok, R.N., Cuijpers, P., 2015. Efficacy of cognitive bias modification interventions in anxiety and depression: Meta-analysis. Br. J. Psychiatry 206, 7–16.

https://doi.org/10.1192/bjp.bp.114.146761

Derryberry, D., Reed, M. a, 2002. Anxiety-related attentional biases and their regulation by attentional control. J. Abnorm. Psychol. 111, 225–236. https://doi.org/10.1037/0021-843X.111.2.225

Eysenck, M.W., Derakshan, N., Santos, R., Calvo, M.G., 2007. Anxiety and cognitive performance: attentional control theory. Emotion 7, 336–353. https://doi.org/10.1037/1528-3542.7.2.336

Fanselow, M.S., 1994. Neural organization of the defensive behavior system responsible for fear. Psychon. Bull. Rev. 1, 429–438. https://doi.org/10.3758/BF03210947

Fresco, D.M., Coles, M.E., Heimberg, R.G., Liebowitz, M.R., Hami, S., Stein, M.B., Goetz, D., 2001. The Liebowitz Social Anxiety Scale: a comparison of the psychometric properties of self-report and clinician-administered formats. Psychol. Med. 31, 1025–1035. https://doi.org/10.1017/S0033291701004056

Gamble, A.L., Rapee, R.M., 2010. The time-course of attention to emotional faces in social phobia. J. Behav. Ther. Exp. Psychiatry 41, 39–44. https://doi.org/10.1016/j.jbtep.2009.08.008

Heeren, A., Mogoase, C., Philippot, P., McNally, R.J., 2015. Attention bias modification for social anxiety: A systematic review and meta-analysis. Clin. Psychol. Rev. 40, 76–90. https://doi.org/10.1016/j.cpr.2015.06.001

Heimberg, R.G., Brozovich, F.A., Rapee, R.M., 2010. A Cognitive Behavioral Model of Social Anxiety Disorder: Update and Extension, in: Social Anxiety. Elsevier, pp. 395–422. https://doi.org/10.1016/B978-0-12-375096-9.00015-8

Horley, K., Williams, L.M., Gonsalvez, C., Gordon, E., 2004. Face to face: Visual scanpath

evidence for abnormal processing of facial expressions in social phobia. Psychiatry Res. 127, 43–53. https://doi.org/10.1016/j.psychres.2004.02.016

Horley, K., Williams, L.M., Gonsalvez, C., Gordon, E., 2003. Social phobics do not see eye to eye: A visual scanpath study of emotional expression processing. J. Anxiety Disord. 17, 33–44. https://doi.org/10.1016/S0887-6185(02)00180-9

Juth, P., Lundqvist, D., Karlsson, A., Ohman, A., Öhman, A., 2005. Looking for Foes and Friends: Perceptual and Emotional Factors When Finding a Face in the Crowd. Emotion 5, 379–395. https://doi.org/10.1037/1528-3542.5.4.379

Kabat-Zinn, J., 2003. Mindfulness-based interventions in context: Past, present, and future. Clin. Psychol. Sci. Pract. 10, 144–156. https://doi.org/10.1093/clipsy/bpg016

Kendall, P., Jr, A.F., Auerbach, S., Stephen, M., Hooke, J.F., Milkulka, P.J., 1976. The State-Trait Anxiety Inventory: A systematic evaluation. J. Consult. 44, 406–412. https://doi.org/10.1037/0022-006X.44.3.406

Langner, O., Dotsch, R., Bijlstra, G., Wigboldus, D.H.J., Hawk, S.T., van Knippenberg, A., 2010. Presentation and validation of the Radboud Faces Database. Cogn. Emot. 24, 1377–1388. https://doi.org/10.1080/02699930903485076

Laux, L., Glanzmann, P., Schaffner, P., Spielberger, C.D., 1981. Das State-Trait-Anxiety-Inventory (STAI), Theoretical Foundations and Instructions. Beltz, Weinheim.

Liebowitz, M.R., 1987. Social phobia. Mod. Probl. Pharmacopsychiatry 141–173.

Mogg, K., Philippot, P., Bradley, B.P., 2004. Selective attention to angry faces in clinical social phobia. J. Abnorm. Psychol. 113, 160–5. https://doi.org/10.1037/0021-843X.113.1.160

Posner, M.I., Petersen, S.E., 1990. The Attention System of the Human Brain. Annu. Rev. Neurosci. 13, 25–42. https://doi.org/10.1146/annurev.ne.13.030190.000325

Quigley, L., Nelson, A.L., Carriere, J., Smilek, D., Purdon, C., 2012. The effects of trait and state anxiety on attention to emotional images: An eye-tracking study. Cogn. Emot. 26, 1–22. https://doi.org/10.1080/02699931.2012.662892

Rapee, R.M., Heimberg, R.G., 1997. A cognitive-behavioral model of anxiety in social phobia. Behav. Res. Ther. https://doi.org/10.1016/S0005-7967(97)00022-3

Reinholdt-Dunne, M.L., Mogg, K., Benson, V., Bradley, B.P., Hardin, M.G., Liversedge, S.P., Pine, D.S., Ernst, M., 2012. Anxiety and selective attention to angry faces: An antisaccade study. J. Cogn. Psychol. 24, 54–65. https://doi.org/10.1080/20445911.2011.560111

Richards, H.J., Benson, V., Donnelly, N., Hadwin, J.A., 2014. Exploring the function of selective attention and hypervigilance for threat in anxiety. Clin. Psychol. Rev. 34, 1–13. https://doi.org/10.1016/j.cpr.2013.10.006

Skre, I., Onstad, S., Torgensen, S., Kringlen, E., 1991. High interrater reliability for the Structured Clinical Interview for DSM-III-R axis I (SCID-I). Acta Psychiatr. Scand. 84, 167–173. https://doi.org/10.1111/j.1600-0447.1991.tb03123.x

Spielberger, C., Gorsuch, R., Lushene, R., 1970. Test manual for the state-trait anxiety inventory. Consulting Psychologists in Press, Palo Alto, CA.

Stangier, U., Heidenreich, T., 2005. Liebowitz Soziale Angst-Skala (LSAS) [Liebowitz Social Anxiety Scale], in: Collegium Internationale Psychiatriae Scalarum (Ed.), Internationale Skalen Für Psychiatrie. Hogrefe, Göttingen, pp. 299–305.

Tancer, M., 1997. Social phobia: Diagnosis, assessment, and treatment. Depress. Anxiety 5, 50–50. https://doi.org/10.1002/(SICI)1520-6394(1997)5:1<50::AID-DA11>3.0.CO;2-6

Wittchen, H.-U., Zaudig, M., Fydrich, T.H., 1997. SKID - Strukturiertes Klinisches Interview für DSM-IV. Achse I und II Handanweisungen [Structured Clinical Interview for DSM-IV].

Hogrefe, Göttingen. https://doi.org/10.1026//0084-5345.28.1.68

Zanarini, M.C., Skodol, A.E., Bender, D., Dolan, R., Sanislow, C., Schaefer, E., Morey, L.C., Grilo, C.M., Shea, M.T., McGlashan, M.T., Gundersono, J.G., 2000. The collaborative longitudinal personality disorders study: Reliability of axis I and II diagnoses. J. Pers. Disord. 14, 291–299. https://doi.org/10.1521/pedi.2000.14.4.291

Running head: HYPERVIGILANCE IN SOCIAL ANXIETY DISORDER

Table 1

Descriptive results by diagnostic group and experimental condition

	HC		SAD	
	No state anxiety (n = 30)	State anxiety (n = 30)	No state anxiety (n = 31)	State anxiety (n = 30)
Gender in % men/women	37/63	37/63	32/68	30/70
Age, *M (SD)*	30.1 (6.1)	29.2 (6.9)	30.1 (8.7)	29.4 (9.2)
BDI-II, *M (SD)*	3.7 (5.3)	4.8 (4.3)	16.8 (8.8)	16.9 (10.3)
LSAS, *M (SD)*	15.9 (11.2)	21.8 (15.9)	67.3 (25.0)	65.0 (21.4)
STAI-S t_1, *M (SD)*	32.0 (5.3)	33.4 (7.6)	44.4 (7.6)	41.3 (7.4)
STAI-S t_2, *M (SD)*	30.9 (5.1)	44.1 (10.3)	43.4 (7.0)	56.5 (10.3)
Overall scanpath length in mm, *M* (SD)	702 (100)	649 (81)	674 (96)	697 (79)
Overall fixation count, *M* (SD)	12 (1)	11 (1)	11 (1)	12 (1)
Threatening stimuli scanpath length in mm, *M* (SD)	582 (110)	547 (105)	549 (115)	555 (99)
Not threatening stimuli scanpath length in mm, *M* (SD)	881 (149)	816 (116)	844 (141)	889 (122)
Threatening stimuli fixation count, *M* (SD)	11 (1)	10 (1)	10 (1)	10 (1)
Not threatening stimuli fixation count, *M* (SD)	14 (1)	14 (1)	13 (1)	14 (1)

Note. HC = healthy controls; SAD = participants with social anxiety disorder; No state anxiety = control condition; State anxiety = anxiety induction condition; BDI = Beck Depression Inventory (Hautzinger, Keller, & Kühner, 2006); LSAS = Liebowitz Social Anxiety Scale (Stangier & Heidenreich, 2005); STAI-S = State Trait Anxiety Inventory (Laux et al. 1981); t_1 = assessment prior to experimental manipulation; t_2 = after experimental manipulation; Threatening stimuli = angry face (target) among a neutral crowd; Not threatening stimuli = happy face (distractor) among a neutral crowd

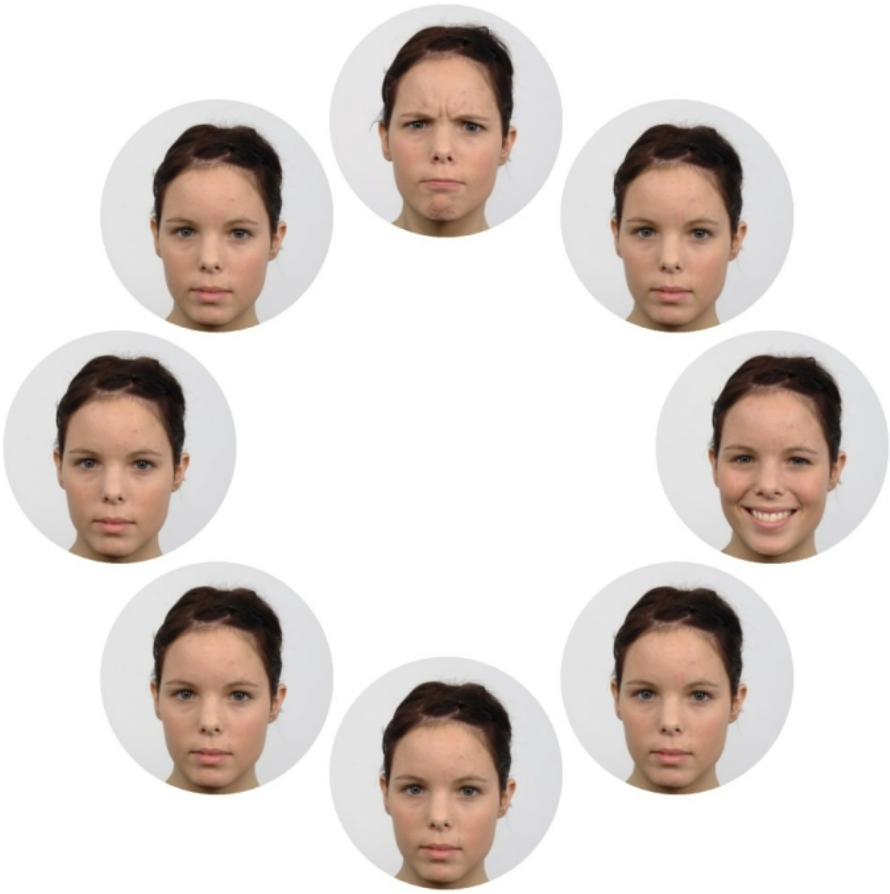

Figure 1. Exemplary stimulus material: Angry target among neutral crowd with happy distractor / happy target among neutral crowd with angry distractor

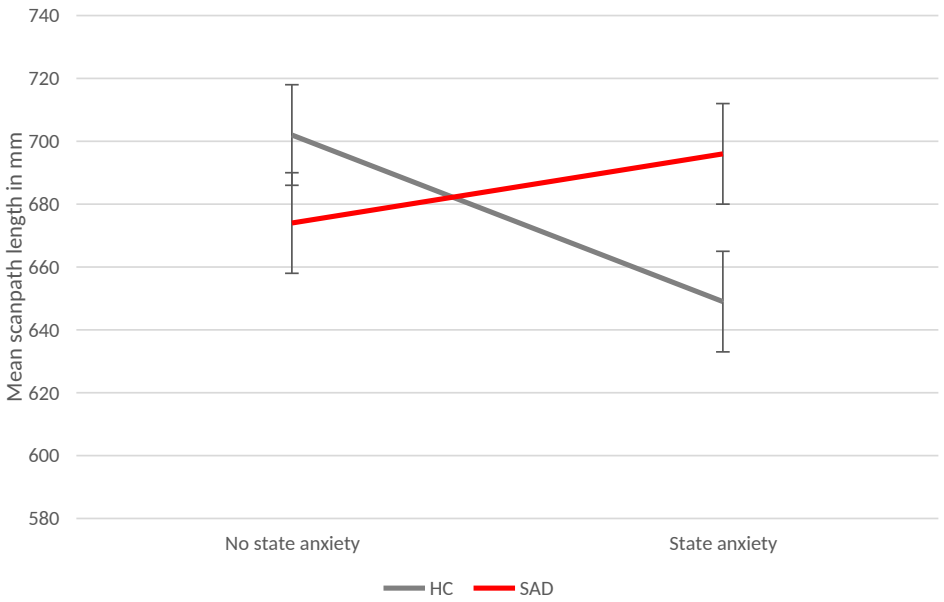

Figure 2. Mean scanpath lengths and error bars (standard errors). HC = healthy controls; SAD = participants with social anxiety disorder; No State anxiety = control condition; State anxiety = anxiety induction condition

Simple comparisons for diagnostic groups revealed a main effect within the anxiety induction condition, F (1,58) = 5.24, p = 0.026, $\eta^2_{partial}$ = 0.08, but not within the control condition, F (1,59) = 1.23, p = 0.272, $\eta^2_{partial}$ = 0.02.

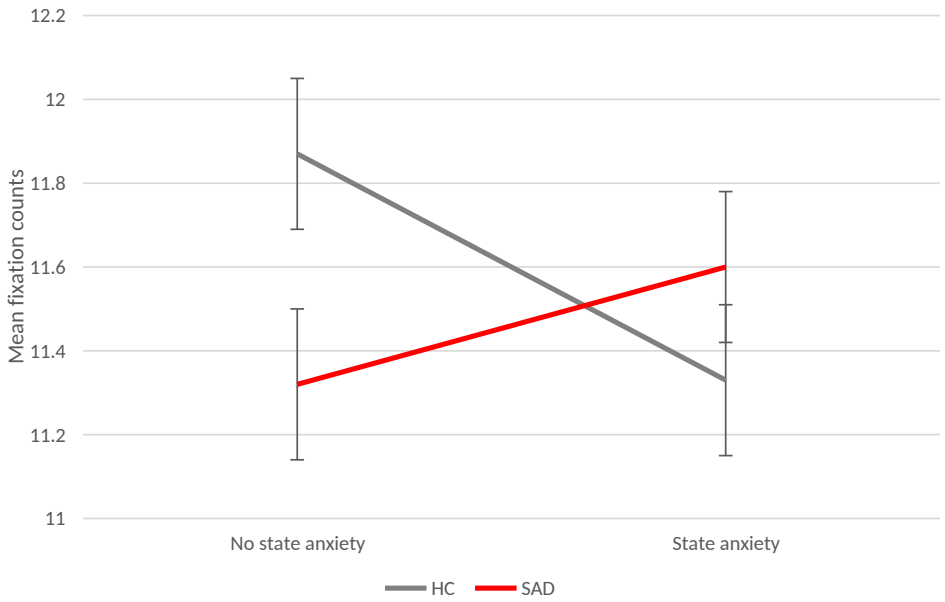

Figure 3. Mean fixation counts and error bars (standard errors). HC = healthy controls; SAD = participants with social anxiety disorder; No State anxiety = control condition; State anxiety = anxiety induction condition

Simple comparisons for diagnostic groups revealed a trend effect within the control condition, F (1,59) = 3.79, p = 0.056, $\eta^2_{partial}$ = 0.06, but no differences within the anxiety induction condition, F (1,58) = 1.41, p = 0.240, $\eta^2_{partial}$ = 0.02.