Belief biased reasoning in anxiety disorders

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Belief biased reasoning in anxiety disorders

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Chapter 1

General introduction

Anxiety disorder patients suffer from a disabling disorder. By definition, anxiety disorder patients experience intense fears which interfere with normal functioning (American Psychiatric Association, 2000). Anxiety disorders thereby severely affect the quality of life (Olantunji, Cisler, & Tolin, 2007) and are, in addition, very costly for society (Lépine, 2002; Smit et al., 2006). Life-time prevalence of anxiety disorders is estimated to be 19.3 % for the Dutch population (Bijl, Ravelli, & van Zessen, 1998) and approximately 16.6 % for English speaking countries (Somers, Goldner, Waraich, & Hsu, 2006). Only 40.5 % of Dutch patients suffering from anxiety disorder seek treatment (as measured in a one-year period). Similar rates are found in various English speaking countries (Andrews, Henderson, & Hall, 2001; Bijl & Ravelli, 2000). If left untreated, anxiety disorders run a chronic course (American Psychiatric Association, 2000). The current standard for diagnosing anxiety disorders, the DSM-IV-TR (American Psychiatric Association, 2000), defines seven common anxiety disorders. These are: Panic disorder with or without agoraphobia (PD, fear for and occurrence of panic attacks), specific phobia (fear limited to a specific animal, situation or object such as spiders or heights), social anxiety disorder (SAD, fear of rejection in social or performance situations), obsessive-compulsive disorder (OCD, recurrent obsessive thoughts and repetitive behaviours), post-traumatic stress disorder (PTSD, after exposure to a traumatic event: prolonged re-experiencing of the traumatic experience, avoidance and arousal), acute stress disorder (development of anxiety and other symptoms within one month after exposure to a traumatic event), and generalized anxiety disorder (GAD, excessive anxiety and worry on various topics/events).

Cognitive model of anxiety disorders

Leading theories propose that similar mechanisms underlie all anxiety disorders, even though the focus of anxiety in these disorders is different: According to cognitive models of anxiety disorders, anxiety disorder patients hold dysfunctional convictions about the harmfulness of certain stimuli. These anxiogenic convictions are triggered automatically, and can logically induce anxiety if believed to be true. Panic disorder patients may, for instance, hold the conviction that palpitations are the first sign of an impending heart attack, and social anxiety disorder patients may believe that they will be ridiculed when caught blushing. Understandably, if one truly believes that palpitations signal a heart attack or that blushing results in being ridiculed, it is conceivable that one becomes anxious. Also, such conviction will lead to a variety of behaviours to minimize the risk of the occurrence of the feared outcome. Furthermore, the anxious modus that is induced will lead to a shift in focus of information processing (e.g., Beck, 1976; Clark, 1986; Clark & Wells, 1995; Ehlers & Clark, 2000; Salkovskis, 1999; Wells, 1999).

Shifts or biases in information processing have recently received much attention in anxiety disorder research. Research has set out to understand how information processing biases contribute to the development and maintenance of these disorders: It is now established that anxiety disorder patients have a low threshold for threat perception (cf. attentional bias), causing them to notice more threat-related stimuli than non-anxious people. As such, it may be that a spider phobic patient 'encounters' (viz., notices) more spiders than a non-phobic person. Anxiety disorder patients further show a difficulty to disengage their attention from threatening stimuli compared to non-anxious controls during the first hundreds of millisecond of presentation of the stimulus. Further, they show avoidance from the threatening cue when it is presented for a longer duration (2000 ms as compared to 200 ms) (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Cisler & Koster, 2010; Mathews & MacLeod, 2005; Mogg & Bradley, 2006). Also, research indicates that anxiety disorder patients tend to interpret ambiguous situations as threatening (cf. interpretation bias), which results in, for instance, spider phobic patients *perceiving* to encounter even more spiders than they actually do and the social anxiety disorder patient *perceiving* to be rejected. Combined with the avoidance of threatening cues, these false alarms (viz., these initial incorrect interpretations of ambiguous stimuli as alarming due to the interpretation bias) will not be recognized as false. Furthermore, anxiety disorder patients lack the optimistic interpretations of ambiguous situations that people free from psychopathology generally display. Contrary to depressive patients, anxiety disorder patients generally do not display encoding- or retrieval- related memory biases (Mathews & MacLeod, 2005). It has recently been found that both interpretation bias and attentional bias can contribute causally to the development and maintenance of anxiety disorders (Koster, Fox, & MacLeod, 2009; Mathews & MacLeod, 2002).

Reasoning in anxiety disorder patients

It seems to be assumed that once stimuli (or data) have overcome biases in for instance interpretation, the information is correctly incorporated in the system. Yet, this information is still subject to reasoning processing. Reasoning is an aspect of information processing that has received relatively little attention within the field of psychopathology, even though mood-states (like feeling anxious) are known to influence a variety of cognitive tasks (Eysenck, 1985), among which reasoning. Although research is still inconclusive, most studies show that experimentally induced depressed and elated mood impair deductive reasoning (Melton, 1995; Oaksford, Morris, Grainger, & Williams, 1996; Palfai & Salovey, 1993). Anxiety has not been studied in relation to deductive reasoning, but has been found to hamper inferential and analogical reasoning (Darke, 1988; Tohill & Holyoak, 2000). Also, there are some indications from research in children that anxiety can create an emotional reasoning style, in which an anxious feeling is seen as evidence for the presence of danger (Muris, Mayer, & Bervoets, 2010). Emotional reasoning in the context of anxiety disorders will be discussed later on. Research thus indicates that mood states can influence reasoning performance negatively. It is assumed that this negative influence of mood states on reasoning performance is caused by mood congruent memory retrieval or worry (when feeling anxious). Memory retrieval and worry partially occupy working memory, thereby leaving less working memory capacities (WMC) for reasoning processes (Eysenck, 1985; Oaksford et al., 1996).

Recentely, Blanchette and colleagues argued that not only the mood in which one performs reasoning, but also the emotionality of the content of the reasoning materials itself can influence reasoning performance. In a first series of studies, it was found that participants' logical reasoning performance decreased when emotional materials were used in reasoning tasks (e.g., 'If a person is being punished, she will feel hurt') compared to when neutral materials were used in the reasoning task. In this study, participants were asked to evaluate the conclusion following from a conditional (e.g., 'Conditional: If a person is being punished, she will feel hurt; Fact: someone is being punished; Conclusion: she will feel hurt'). These conditionals conveyed happy, sad and anxious content. It was also found that the detrimental effect of emotionality of the content on reasoning performance was not linked to the semantic value of emotional versus neutral words, as the effect was also evident when the emotional value of the words was conditioned (as compared to intrinsic) (Blanchette & Richards, 2004). In a follow-up study (Blanchette, 2006), participants were asked to evaluate conclusions following from conditionals (as in Blanchette & Richards, 2004), and were additionally questioned about various aspects of the perception of the conditionals[1]. Participants were asked about the perceived strength of the relationship described in the conditionals, which is relevant since a high strength-perception can lead to the unjustified conclusion of 'P' based on the presence of 'Q'. They were in addition asked about the plausibility of the relationship, which is relevant since a low plausibility can lead to the misperception that 'P' does not necessarily lead to 'Q'), as well as the sufficiency for 'P' to lead to 'Q' and the necessity for 'Q' to be preceded by 'P'. Based on the

[1] For explanatory purposes, the conditionals will further be described in abstract terms: 'if P then Q'

results, Blanchette concluded that the deteriorating effect of emotional content on reasoning performance was not caused by a different perception of emotional versus neutral materials presented: The emotional and neutral relationships presented were both perceived as unidirectional, equally believable and equally strong. This has led to the conclusion that emotionality does not lead to a different perception of reasoning rules, but actually leads to decreased reasoning performance (Blanchette, 2006).

In line with the influence of emotionality of the content on reasoning performance, there are indications that disorder-related content can influence reasoning performance as well: Studies involving hypochondriac patients and spider phobic patients have found that, when it comes to the topic of their concerns, these patients seek out information that may aid to confirm their fearful beliefs, and neglect information that can disconfirm their convictions (cf. confirmation bias, as measured with the Wason Selection Task, e.g., Evans, Newstead, & Byrne, 1993). Confirmation bias is a common process seen in the context of general threat. Interestingly, anxiety disorder patients seem to apply the same strategy when confronted with materials related to their anxiogenic dysfunctional convictions also (de Jong, Mayer, & van den Hout, 1997; Smeets, de Jong, & Mayer, 2000). While anxiety disorder patients' heightened estimates of threat or risk lead to a confirmatory information seeking style, a heightened perception of risk in OCD patients has additionally been found to lead to impaired decision making. OCD patients and non-anxious controls show similar difficulties in decision making when reasoning with high risk materials. OCD patients display the same difficulty for low-risk and OCD-related materials (Foa et al., 2003). Overall, disorder-related and low-risk materials can have a detrimental effect on reasoning performance in anxiety disorder patients. However, this detrimental effect does not seem deviant in itself: The enhanced threat evaluation for low threatening materials leads anxiety disorder patients to apply a common threat-related reasoning bias to an uncommon area.

An aspect of reasoning that does seem to be more generally deviant lies within the field of conditional reasoning ('if P then Q', see e.g, Evans, Newstead et al., 1993). Anxiety disorder patients use the information about how anxious they feel as a source of information for threat evaluation: 'If I feel anxious this means I am in danger'. This bias in reasoning is known as emotional reasoning or ex-consequentia reasoning (see Antz, Rauner, & van den Hout, 1995). In a study measuring spider phobic, panic disorder, social anxiety, and other anxiety disorder patients, it was found that emotional reasoning in anxiety patients was not limited to materials which were in content related to their disorder, but that it reflected a more general reasoning tendency. This finding of a general tendency could be interpreted as an indication for emotional reasoning as a trait instead of state factor. This is however still a matter of debate (Antz et al., 1995;

Muris et al., 2010) In a similar line of reasoning, there is some tentative evidence that OCD patients use their feelings of guilt as a source of information to estimate their responsibility and/or influence over situations (Gangemi, Mancini, & van den Hout, 2007). Furthermore, PTSD patients use both intrusions and emotion as a source of information (Engelhard, Macklin, McNally, van den Hout, & Arntz, 2001; Engelhard, van den Hout, Arntz, & McNally, 2002).

Emotional reasoning concerns the fallacy of assuming a bidirectional relationship between 'If I am in danger, then I feel anxious', while the fact that one feels anxious does not necessarily imply that one is in danger. This error is known as 'affirmation of the consequence'. Affirmation of the consequence is a well-documented reasoning error generally measured by having participants evaluate or formulate the conclusion of conditionals (e.g., 'If P then Q, Q is given, can we conclude P?'), whereas emotional reasoning has only been studied using vignettes and has therefore merely focussed on emotional content. The design of the vignette studies preclude knowledge about the nature of this reasoning bias: Do people with a tendency for emotional reasoning show enhanced Affirmation of the Consequence fallacies in general or is this emotional reasoning fallacy restricted to the domain of anxiety.

The general idea that rises from the abovementioned studies is that mood and content can result in faulty reasoning, but that, apart from mood and content, patients suffering from anxiety disorders do perform as non-anxious controls. Indeed, this notion was confirmed in various studies comparing OCD patients with non-anxious controls: Inductive and deductive reasoning performance with non-disorder-related or non-threat-related materials was found to be normal (Pélissier & O'Connor, 2002; Simpson, Cove, Fineberg, Msetfi, & Ball, 2007[2]). These results are however in apparent contrast with findings related to so-called belief biased reasoning.

Belief biased reasoning

In a study comparing spider phobic patients and non-phobic controls, de Jong, Weertman, Horselenberg and van den Hout (1997) found that on a deductive reasoning task, the spider phobic patients displayed more general belief-based reasoning errors than the non-phobic controls. This effect was not determined by mood or emotionality of the content, but by the believability of the reasoning materials: Belief bias is the interference of believability on logical reasoning

[2] The results from the deductive syllogistic reasoning task within the study of Simpson et al. (2007) are not interpreted here, since the pattern of results is very deviant from what is commonly reported, indicating that the task did not perform as it should have.

performance. Belief bias is a common process generally displayed for strongly held convictions (Evans, Over, & Manktelow, 1993).

The phenomenon of belief bias is well documented (e.g., Evans, Barston, & Pollard, 1983; Evans, Newstead et al., 1993; Manktelow, 1999). Belief bias is commonly measured using syllogisms. A syllogism consists of two premises, which one needs to assume are true, and a conclusion, which has to derive from the premises in order to make the syllogism logically valid. When measuring belief bias, participants are asked to evaluate the logical validity of the conclusion. A conclusion can be either valid or invalid. An example of both possibilities is shown in Table 1.1.

Table 1.1
An example of a syllogism that is valid (viz., for which the conclusion logically follows from the premises) and of a syllogism that is invalid.

	valid syllogism	invalid syllogism
Premise 1	A is larger than B	A is larger than B
Premise 2	B is larger than C	B is larger than C
Conclusion	**A is larger than C**	**C is larger than A**

The example used in Table 1.1 is abstract in content. When introducing realistic content it becomes clear that believability of the conclusion can interfere with logical reasoning performance. Consider the following syllogism:

Premise 1	A mouse is bigger than a dog
Premise 2	A dog is bigger than an elephant
Conclusion	**A mouse is bigger than an elephant**

The above-presented syllogism is logically valid, yet its conclusion is unbelievable. When there is no match between the logical validity and the believability of the conclusion, participants generally need more time to judge the logical validity of the syllogism and make more errors in doing so. Table 1.2 displays the four possible variations in logical validity and believability of the conclusion. Belief bias is defined as the relative difficulty (viz., longer latencies and more errors) with which valid-unbelievable and invalid-believable syllogisms are solved compared to valid-believable and invalid-unbelievable syllogisms.

Table 1.2
An example of a syllogism systematically varying in logical validity and believability of the conclusion.

	valid syllogism	invalid syllogism
believable conclusion	An elephant is bigger than a dog A dog is bigger than a mouse **An elephant is bigger than a mouse**	A mouse is bigger than a dog A dog is bigger than an elephant **An elephant is bigger than a mouse**
un-believable conclusion	A mouse is bigger than a dog A dog is bigger than an elephant **A mouse is bigger than an elephant**	An elephant is bigger than a dog A dog is bigger than a mouse **A mouse is bigger than an elephant**

Belief biased reasoning can be explained by two different systems involved in reasoning processes. The first system, System 1, concerns rapid and automatic processing based on associative networks. As such, it makes use of heuristics. The second system, System 2, concerns slower, more abstract, analytical and hypothetical thinking. It makes use of working memory and is linked to general intelligence (e.g., Evans, 2003; Stanovich & West, 1997, 2000). It is unclear how the two systems collaborate. For instance, does System 2 override System 1? Do System 1 and System 2 work parallel? How are conflicts in System 1 and System 2 outcome detected and handled? It is by now assumed that there is some form of low-effort automatic monitoring system (e.g., De Neys & Franssens, 2009; Evans, 2007; Franssens & De Neys, 2009; Goal & Dolan, 2003) which seems to always detect conflicts between the two systems, but may not always succeed in inhibiting the System 1 response (De Neys & Franssens, 2009; Franssens & De Neys, 2009). It is yet unclear what eventually determines the success/failure of this inhibition.

In the case of belief bias, System 1 will always rely on the 'what is believable is true' heuristic to determine the outcome of the reasoning process, whereas System 2 will make an effort to come up with an answer based on an analytical analysis. In situations where the logical validity and the believability of the conclusion do not match, the systems may come up with conflicting outcome (though this is not guaranteed, since System 2 does not necessarily produce logically correct answers; Evans, 2003). Whether this results in the inhibition of the System 1 response is determined by many still unknown factors.

Factors that have been found to influence belief bias are cognitive abilities (intelligence or WMC), thinking disposition, logical reasoning instructions, training, cognitive load, and time constraints: People with higher intelligence have been found to be better able to suppress belief biased responses (e.g., Evans, Handley, Neilens, & Over, 2010; Newstead, Handley, Harley, Wright, & Farrelly, 2004; Sá, West, & Stanovich, 1999). Also, people show decreased levels of belief bias when being instructed to focus on the logical aspects of the syllogism and to ignore the believability (e.g., DeWall, Baumeister, & Masicampo, 2008; Dickstein, 1975). When these instructions are elaborative and/or contain an interactive aspect, it is considered training. Training in logical reasoning can further decrease belief bias (Neilens, Handley, & Newstead, 2009). Related to the influence of instruction and training, open-minded thinking disposition has been found to relate to lesser belief bias (e.g., Stanovich & West, 1998, 1999, and see conceptually similar findings of a positive correlation between faith in intuition and belief bias, e.g., Klaczynski, Gordon, & Fauth, 1997). Belief bias can also be *increased*, by increasing cognitive load on working memory (e.g., DeWall et al., 2008) and by reducing the time available to solve the syllogisms (e.g., Evans & Curtis-Holmes, 2005; Evans, Handley, & Bacon, 2009). Also, belief bias has been found to increase with age (Gilinsky & Judd, 1994).

Belief bias and anxiety disorders

Belief bias is a functional process that serves to keep cognitive demand low. By default, situations are analysed by System 1. This principle of cognitive economy is practical as it leaves us with enough cognitive resources for important other tasks (e.g., De Neys & Franssens, 2009; Evans, Over et al., 1993). Yet, as a result, what one believes is by default accepted as being true, and what one does not believe by default as untrue. Although this is oftentimes correct, it provides a handicap for those people who hold anxiogenic dysfunctional beliefs. For those people, belief bias logically helps to consolidate their problematic beliefs. It is to be expected that patients suffering from anxiety disorders indeed apply belief bias to their anxiogenic dysfunctional convictions, as these are strongly held beliefs. Belief bias is only problematic where it is applied to problematic convictions. This domain-specific belief bias may logically help maintain anxiety disorders through the maintenance of anxiogenic dysfunctional beliefs. Domain-specific belief bias is one of the more direct and powerful processes through which anxiogenic dysfunctional beliefs can be maintained.

The findings by de Jong, Weertman et al. (1997) give rise to another potential role of belief bias in anxiety disorders: They found that spider phobic patients also displayed more belief bias than non-clinical controls outside the domain of their disorder. The finding of an enhanced belief bias for neutral materials, which are presumed to be equally believable to all participants, may indicate that belief bias is also tied to the development of anxiety disorders. It seems plausible that people with a general belief-biased reasoning ‘deficit’ (a stronger than usual habitual reliance on beliefs in logical reasoning performance) are at risk for consolidating somehow acquired ideas. If these ideas are coincidentally anxiety provoking, this habitually enhanced confirmatory reasoning strategy may prevent such ideas from being corrected, thus further putting the person at risk for acquiring anxiogenic dysfunctional convictions. As a cross-sectional design was used, with patients already suffering from spider phobia, an alternative interpretation of the results would be that an enhanced reliance on heuristic processing is a side-effect of anxiety disorders.

In a first study following up on the idea that belief bias may be involved in the development of anxiety disorders, Smeets and de Jong (2005) sought to find evidence for a relationship between belief bias and pre-clinical symptoms of anxiety disorders in a general, non-clinical, sample. In this study, it was assumed that if belief bias is indeed causally related to anxiety disorders, this relationship should already be evident in non- and/or pre-clinical participants. Using only neutral syllogisms, the study failed to find any correlations between anxiety and belief bias. Smeets and de Jong argued however that the set-up of their study lacked control over the presence of (and the intensity of) learning experiences, which may have hindered the detection of the relationship between belief bias and anxiety symptoms. Anxiogenic dysfunctional ideas usually develop as a result of particular (direct or vicarious) learning experiences. Without these learning experiences, anxiogenic dysfunctional ideas will likely not be formed, and belief bias will thus have no materials to mould into anxiogenic dysfunctional convictions. Learning experiences may thus be a prerequisite to establishing a relationship between belief bias and anxiety symptoms in a normal sample. In addition, they argued that the relationship between belief bias and anxiety disorders may be restricted to emotionally valenced (e.g., threat-related) materials, since anxiogenic dysfunctional convictions related to anxiety disorders are generally not emotionally neutral.

The present thesis

The present thesis sets out to further explore the potential role of belief bias in anxiety disorders. The focus of the research in this thesis is two-fold: In order to establish whether indeed belief bias may be involved in the development of anxiety disorders, the search for a relationship in a general population is continued along the lines initiated by Smeets and de Jong (2005). The second focus concerns the generality and specificity of belief bias in various anxiety disorder patient groups.

Chapter 2 follows up on the idea from Smeets and de Jong (2005) that their failure to find correlations between anxiety symptoms and belief bias is due to the fact that neutral syllogisms were used. Accordingly, the present study tested whether a correlation between belief bias and anxiety can be found when using threat- and safety-related syllogisms. Chapter 3 follows up on Chapter 2 and continues on the suggestions from Smeets and de Jong (2005) by bringing learning experiences under experimental control using a differential fear conditioning paradigm. In two studies, it was tested whether belief bias is related to delayed extinction of experimentally acquired beliefs.

Chapters 4, 5 and 6 focus on the question whether the effects found by de Jong, Weertman et al. (1997) represent a robust phenomenon which can be replicated in other clinical samples also (namely panic disorder patients and social anxiety disorder patients). Chapter 4 extends the previous study of de Jong, Weertman et al. by including a clinical control group, allowing to test whether the domain-specific belief bias (in this chapter, panic disorder-specific belief bias) was indeed specific to the panic disorder patients group. The study reported on in Chapter 5 focuses on social anxiety disorder, using an analogue design, in an attempt to further increase the sensitivity of the syllogistic reasoning task: Social anxiety convictions concern (social) comparisons, which facilitates the improvement of the match with the syllogisms, as linear syllogisms are also based on comparisons. In Chapter 6, the better matched syllogisms from Chapter 5 are used in a social anxiety disorder patient-group. Here, again, it was tested whether patients are characterized by a generally enhanced and a domain-specific belief bias. Also, in line with Chapter 4, the specificity of the domain-specific belief bias was tested. Chapter 7 provides an integration and discussion of the results presented in the empirical chapters (Chapters 2 to 6).

Chapter 2

Threat-confirming belief bias and symptoms of anxiety disorders

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Abstract

This study tested the hypothesis that a generally enhanced threat-confirming reasoning style would set people at risk for the development of anxiety disorders. Therefore, a non-clinical student sample (*N* = 146) was presented with a series of linear syllogisms referring to threatening and safety themes and with the anxiety subscale of the SCL-90 and trait anxiety in order to correlate reasoning with anxiety. Half of the syllogisms' conclusions were in line and half were in conflict with generally believable threat and safety related convictions (e.g., potassium cyanide is more toxic than Tylenol; The Netherlands are safer than Afghanistan). For each type of syllogism, half was logically valid and half invalid. Overall, participants showed a clear interference of believability on logical reasoning, which is known as the belief bias effect. Furthermore, in line with the idea that people are generally characterised by a better safe than sorry strategy, the pattern indicated that the participants took more time to solve invalid threat related syllogisms as well as valid safety related syllogisms. This threat-confirming belief bias was however not especially pronounced in participants reporting relatively intense anxiety symptoms. Thus, the present findings do not lend support to the idea that a generally enhanced threat-confirming belief bias is a diathesis for the development of anxious psychopathology.

Introduction

Dysfunctional beliefs are assumed to play an important role in the acquisition and persistence of anxiety disorders (e.g., Beck, 1976; McNally, 2001). A striking feature of these dysfunctional beliefs is that they are both stable and irrational (i.e. that they are unhealthy and mostly even untrue). Why do patients hold on to unhealthy beliefs that are not in accordance with the empirical world?

Recently it has been proposed that individual differences in common deductive reasoning patterns may be involved in the development and/or persistence of irrational fears (e.g., Smeets & de Jong, 2002, September). Modifying (irrational) beliefs in the face of disconfirming evidence requires that people deduce the logical implications of the evidence for the validity of their beliefs. It is well documented that, in general, people have a tendency to endorse conclusions that are in line with their prior beliefs as valid and those that are in conflict with their view as invalid ("belief bias"; e.g., Evans, Newstead, & Byrne, 1993). The stronger this tendency, the more people will be liable to not correcting their prior beliefs. In other words, a strong "belief bias" may act in a way to immunize against refutation of once acquired (e.g., anxiogenic) beliefs. To the extent that anxiogenic convictions are critically involved in anxiety disorders, individuals with an enhanced belief bias would be at risk for developing such disorder.

The interference of believability with logical reasoning (i.e. belief bias) is commonly measured using a syllogistic reasoning task (e.g., Evans, Newstead et al., 1993), in which participants are instructed to judge as quickly as possible the logical validity of syllogisms consisting of two statements (the premises) and a conclusion. Logical validity refers to the necessity of a conclusion, assuming that the premises are true. If it is true that 'A is faster than B' and that 'B is faster than C', it follows that 'A must be faster than C'. Logical validity would be violated when one concludes that 'C is faster than A' based on the given premises. When judging the validity, participants are instructed to ignore the believability of the conclusions. Believability refers to the meaning of the syllogism's conclusion. Thus, participants have to judge whether a syllogism is logically valid, while ignoring its meaning. An example of a generally believable conclusion would be: 'A tree is larger than a plant', whereas 'a plant is larger than a tree' represents an example of a generally unbelievable conclusion. A valid yet unbelievable syllogism would be as follows:

Premise 1	A plant is larger than a bush
Premise 2	A bush is larger than a tree
Conclusion	**A plant is larger than a tree**

People are typically faster in reaching a decision about the validity of a syllogism when there is a match than when there is a mismatch between the validity and believability of the conclusion. This is known as the belief bias effect (cf. e.g., Evans, Newstead et al., 1993). The syllogistic reasoning task measures how people evaluate the validity of prior beliefs in light of (new and possibly disconfirming) information. The belief is represented in the conclusion of the syllogisms, and the data/information on which the reasoning takes place are represented in the premises.

The beliefs for which belief bias has been found generally concern beliefs that are in accordance with the empirical world or with prejudice (e.g., elephants are larger than mice, de Jong, Weertman, Horselenberg, & van den Hout [1997]; some Muslims are terrorists, Blanchette, Richards, Melnyk, & Lavda, [2007]), whereas beliefs of anxiety disorder patients concern untrue beliefs. This could well be an indication that patients suffering from anxiety disorder indeed have more difficulty separating logical truth from believable truth. In line with the hypothesis that a generally enhanced belief bias is a diathesis for the development of irrational fears, there is tentative evidence that spider phobic individuals show a stronger belief bias regarding universal convictions (e.g., elephants are larger than mice) than non-phobic controls (de Jong, Weertman et al., 1997). Yet, a subsequent study in a non-clinical sample failed to find a correlation between the strength of belief bias regarding universal convictions and symptoms of anxiety and depression (Smeets & de Jong, 2005). It should be noted that this study focused on universal beliefs regarding emotionally neutral themes. Conceptually similar work on other cognitive biases (such as attentional bias) has shown that the mood (or valence) of the materials that are used can be an important moderator. For instance, the relationship between attentional bias and psychopathology is particularly evident in negatively valenced materials (e.g., MacLeod & Hagan, 1992; van den Hout, Tenney, Huygens, & Merckelbach, 1995). In a similar vein, it might well be that enhanced belief bias regarding emotionally relevant rather than neutral themes might be especially relevant for the development of psychopathological symptoms. Therefore, in the present study we added syllogisms concerning emotionally valenced materials. More specifically, given the overly threatening content of the convictions of anxiety patients, this study focused on syllogisms regarding generally threatening themes and tested the relationship between the strength of a generally enhanced belief bias regarding threatening themes and symptoms of anxiety disorders in a non-clinical sample. If indeed generally enhanced belief bias regarding threatening themes sets people at risk for developing anxiety disorders, the relationship between belief bias and anxiety symptoms should also be evident in the preclinical range.

Method

Participants

Participants (*N* = 146, 48 male and 98 female) were undergraduate students of various faculties (e.g., psychology, *n* = 84, medicine, *n* = 17, pedagogy, *n* = 10). The mean age was 20.7 years (*SD* = 2.89). The participating psychology students received course credits, the other students received a small financial reward.

Materials and apparatus

Belief bias task

Belief bias was measured using a computerized syllogistic reasoning task. Participants were asked to judge as quickly as possible the logical validity of syllogisms. The presented syllogisms varied in logical validity and in believability of the conclusions. A belief bias effect is found when participants find it relatively easy to judge valid-believable and invalid-unbelievable syllogisms (i.e., when there is a match between validity and believability) and relatively difficult to judge the logical validity of valid-unbelievable and invalid-believable syllogisms (i.e., when there is a mismatch). An example of a syllogism varying in validity and believability is presented in Table 2.1.

Table 2.1
Example of a linear syllogisms varying in believability and logical status.

	Believable conclusion	Unbelievable conclusion
	An elephant is bigger than a dog	A mouse is bigger than a dog
valid	A dog is bigger than a mouse	A dog is bigger than an elephant
	An elephant is bigger than a mouse	**A mouse is bigger than an elephant**
	A mouse is bigger than a dog	An elephant is bigger than a dog
invalid	A dog is bigger than an elephant	A dog is bigger than a mouse
	An elephant is bigger than a mouse	**A mouse is bigger than an elephant**

The syllogistic reasoning task used in the current experiment involves the evaluation of a given conclusion. This was done to mimic the way information is processed in daily life: The premises contain the data (viz. the experiences that provide the information that is either in line or in contrast with a given belief), and the conclusions represent beliefs the participants hold (or do not hold, in the case of unbelievable conclusions). Through the use of top down processing, participants need to evaluate whether the conclusion (viz. their belief) holds (viz. logically follows from) in face of the presented data/information.

We used both generally believable neutral and generally believable emotionally valent syllogisms. Threat and safety themes were used as generally emotional stimuli: It seems reasonable to assume that people who are liable to reason in a confirmatory style in light of threat-related information are at risk for the consolidation of anxiogenic beliefs. The same holds for discarding safety information as a result of a diminished safety-confirming belief bias. Both a surplus of threat-confirming reasoning and/or a lack of safety-confirming reasoning may strengthen the predisposition for the development of symptoms of anxiety disorders.

The computerized syllogistic reasoning task was adapted from Smeets and de Jong (2005) and extended with themes from the domain of threat (e.g., 'potassium cyanide is more toxic than Tylenol) and safety (e.g., 'The Netherlands are safer than Afghanistan'), see the Appendix for a complete list of the syllogisms used. The neutral themes were adjusted to correct for length of sentences. There were 4 different topics within each domain, resulting in 12 topics. Each topic was presented in a valid-believable, an invalid-unbelievable, a valid-unbelievable and an invalid-believable type. Every syllogism was presented in two orders (a > b, b > c, therefore a > c and b > c, a > b, therefore a > c) to counter possible reading-strategies (cf. Smeets & de Jong, 2005).

In total, 96 syllogisms were presented in two blocks of 48. The blocks were separated by a 30-second break. The stimuli were presented in a fixed random order with some restrictions: topic should differ with every stimulus presentation, type of syllogism should differ after a maximum of two stimulus presentations, and order should differ after a maximum of three stimulus presentations. The outcome measures were reaction time (RT) and amount of errors.

Believability check

To confirm that the syllogisms that were defined as 'believable' were indeed believable, the participants were asked to rate the alleged believable conclusions of all the syllogisms used in the syllogistic reasoning task[3]. These conclusions were presented as statements on the computer screen. Four statements were presented per screen, and each statement had to be rated on a visual analogue scale (VAS) ranging from 'unbelievable' to 'believable'. Each VAS was presented directly under the statement. Using the mouse, participants could click on a position on the line for their answer, and could change the position of their answer if desired. The VASs were 17 cm in length, but the responses of the participants were rescaled into a 0-100 range.

[3] Due to miscommunication, a last minute change in one of the syllogisms was not carried through in the believability check. Therefore, the syllogism 'a scrape is more innocent than a heart attack' from the safety domain was not rated on believability.

Anxiety symptoms

We used the Anxiety (ANX) subscale of the Dutch version of the Symptom Checklist, an index for anxiety symptoms (SCL-90, Arrindell & Ettema, 2003). Internal consistency was satisfactory (α = .76).

Trait anxiety

Trait anxiety was measured with a Dutch version of the STAI-T (Spielberger, Gorsuch, & Lushene, 1970) (i.e., ZBV, van der Ploeg, Defares, & Spielberger, 1980), consisting of 20 self-statements which can be rated on a scale of 1 (almost never) to 4 (almost always). High scores indicate high trait anxiety. Test-retest reliability shows that the ZBV is a stable measure of trait anxiety (r = .75 for both male and female students over a period of 4 months). Internal consistency in the current sample was good (α = .90).

Depression questionnaire

To test the alleged *specificity* of enhanced belief bias for threatening information as a diathesis for the development of *anxiety symptoms* we also included the Center for Epidemiological Studies Depression scale (CES-D). The CES-D is a self-report questionnaire designed to measure depressive symptoms in community-samples. It consists of 20 items concerning feelings and behaviours over the past week which can be rated on a scale from 0 (seldom or never) to 3 (mostly or always), resulting in a range of 0 – 60 with 60 indicating extreme depressive symptoms (Bouma, Ranchor, Sandermans, & Van Sonderen, 1995). Internal consistency proved to be good in the current sample (α = .88).

Rigidity

As a subsidiary issue, we tested whether belief bias is related to rigidity. It seems plausible to argue that an information-processing style that neglects available disconfirming information is a representation of the more general personality characteristic rigidity. We therefore included a subscale of the NPV (Nederlandse Persoonlijkheids Vragenlijst [Dutch Personality Questionnaire], Luteijn, Starren, & Van Dijk, 2000) as a measure of trait rigidity in our study. The rigidity-scale (RG) of the NPV consists of 25 self-statements (e.g., 'once I have made a decision, I stick to it') that can be scored as 'correct', 'incorrect' or '?'. High scores (frequent use of 'correct') indicate a need to have things going as planned, fixed habits and principles, and sometimes intellectual rigidity. Internal consistency was fair in the current sample (α = .73).

Procedure

Participants were tested in small groups of between 1 and 7 individuals. After filling out an informed consent form, they were asked to start the syllogistic reasoning task. Participants were instructed to judge the validity of the syllogisms ('is this conclusion valid?') as quickly as possible by pressing a red

'NO' key on the left side or a green 'YES' key on the right side of the keyboard. Participants were given four practice items with feedback on the correctness of their response. Further explanation on the validity of the conclusion was given for the first and second practice items. Instructions were repeated at the start of the second block.

Each stimulus was preceded by a blank screen (500 ms) and a screen reading 'pay attention!' (1500 ms). Each stimulus disappeared as soon as a response was given with a maximum of a 20-second delay before the response was coded 'incorrect'. No feedback was given during the test-phase.

After having completed the reasoning task, the participants completed a second reasoning task (for pilot purposes; these will not be discussed in this paper) and the believability check, after which the participants filled out the questionnaires in a fixed order: SCL-90, CES-D, STAI-T and NPV.

Data analysis

Participants, distribution of anxiety symptoms

The distribution of anxiety symptoms was explored by calculating the means and standard deviations of the various scales of the current sample. These were compared with the Dutch normal population norm groups of the various questionnaires by means of independent sample t-tests.

Believability check

The believability ratings were averaged for each domain. The ratings for the three domains were compared by means of a repeated measures ANOVA with domain as within subject factor. Also, correlations between the believability ratings and the anxiety and depression measures were calculated.

Belief bias and anxiety symptoms

Per cell of the design, a single reaction time score was calculated by averaging the median scores of the two blocks of the belief bias task. Only correct responses were included in the calculation of the RT scores. The RT scores were normalized using a square root transformation. The normalized mean median reaction times scores will from here on be referred to as RTs. For the errors, the sum of errors over the two blocks was computed, again per cell of the design.

In line with previous research we computed belief bias summary scores (BB scores). For each domain a separate BB score was computed by subtracting RTs for the matched syllogisms from the RTs for mismatched syllogisms (viz. BB = [valid-unbelievable + invalid-believable] – [valid-believable + invalid-unbelievable]). The BB scores for errors were calculated in a similar vein.

Prior to exploring the relationship between belief bias and psychopathology, we checked whether belief bias was indeed present by means of two repeated measures ANOVA's with domain (neutral, threat, safety) as within subject factor and BB score for RTs and errors as dependent variables. We looked for a significant deviation from zero for the intercept. In addition, we explored the differences between the domains. When present, we further explored these differences by interpreting the observed scores.

Because we compared BB scores comprised of within subject interactions (validity*believability), there was no need to correct for length of sentences within the analyses (the syllogisms within each interaction were of equal length due to the design of the task).

The six BB scores (3 domains * 2 outcome measures) were correlated with the measures of anxiety, depression and rigidity. If correlations between the believability ratings and the psychopathology measures are present, we will repeat the belief bias – psychopathology correlational analyses while correcting for the potential influences of these believability ratings.

For all analyses $\alpha = .05$ was adopted.

Results

Participants, distribution of psychopathological symptoms

Observed means, standard deviations and range as well as norm group statistics are displayed in Table 2.2. No differences occurred between man and woman for ANX, STAI, CES-D or RG (multivariate F(4,139) = 1.14, p = .34, all univariate tests were also non-significant, with high p-values). The observed means did not differ from the Dutch normal subjects (norm group II) for ANX (t(2234) = -0.0010, p >.10; Arrindell & Ettema, 2003). For ANX, four participants (2.8%) scored in the category 'very high' of the normal population norm group as well as the 'average' category of the out-patient psychiatric norm group.

The observed mean for the STAI-T did not differ from the Dutch normal subjects, t(549) = -.0500, p > .10 (norm group 'all students'; van der Ploeg et al., 1980). Also, there were no differences between our sample and the selected norm groups for the CES-D (student norm group 3b t(418) = 0.06, p > .10; general sample norm group 2a t(2705) = 0.01, p >.10).

Believability check

On average, all domains were considered highly believable. The mean believability rating for the neutral conclusions was 95.32 (*SD* = 8.43), for the safety conclusions was 94.51 (*SD* = 6.54) and for the threat conclusions was 95.12 (*SD* = 6.79). The repeated measures ANOVA with domain as within subject factor and believability rating as outcome measure showed that these believability scores do not significantly differ, $F(2,143) = 0.90$, $p = .41$. On average, all domains were considered equally believable by the participants.

Believability for the safety domain was negatively correlated with trait anxiety as measured by the STAI-T (r = -.21, p = .01), and marginally significantly correlated with generalized anxiety as measured by the ANX subscale (r = -.15, p = .07). The higher trait anxiety or generalized anxiety (respectively), the less believable the safety related conclusions were perceived. Also, believability for the threat domain were marginally significantly and negatively correlated with trait anxiety (STAI-T, r = -.16, p = .07). The higher trait anxiety, the less believable the threat related conclusions were perceived. Other correlations proved to be non-significant.

Table 2.2
Means, standard deviations, range and N for ANX, STAI-T, CES-D, and RG for the current sample as well as for the various norm groups.

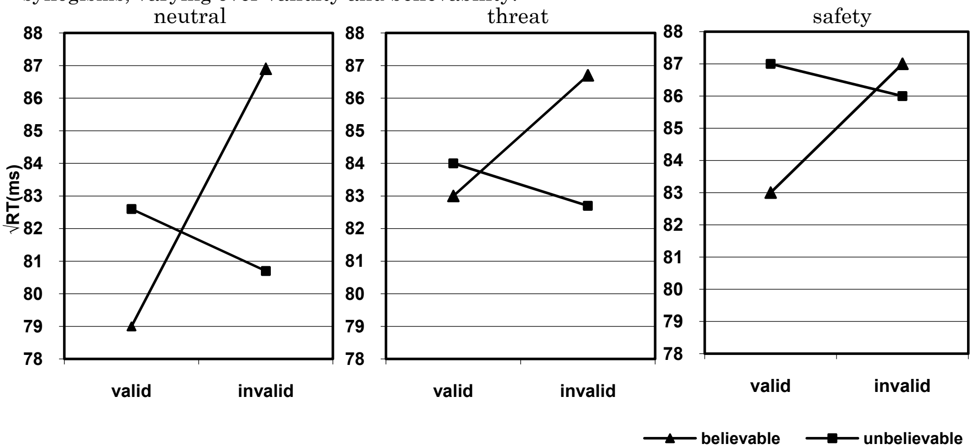
	ANX	STAI-T	CES-D	NPV-RG
Current sample				
M	12.78	33.40	8.76	27.97
SD	3.14	8.35	7.29	7.00
range	10 - 29	20 - 64	0 – 37	34 - 73
N	144	144	144	144
Norm group sample				
M	12.83	36.9	8.3	*
SD	4.39	6.13	8.5	*
N	2092	407	276	*

* No norm group available comparable to current sample.
Note. For norm group data see Arrindell & Ettema (2003) for ANX, see van der Ploeg et al. (1980) for STAI-T, and see Bouma et al. (1995) for CES-D.

Belief bias and anxiety symptoms

The repeated measures ANOVA for RT BB scores with domain as within subject factor revealed a significant deviation from zero of the intercept, $F(1,139) = 44.22$, p < .01, $\eta^2 = .24$. In addition, a significant effect of domain was present ($F[2,138] = 6.93$, $p < .01$, $\eta^2 = .05$). Post hoc analyses showed that neutral BB scores were significantly higher than threat and safety BB scores (repeated measures ANOVA with neutral and threat as domains: $F[1,139] = 11.57$, $p < .01$, $\eta^2 = .08$; repeated measures ANOVA with neutral and safety as domains: $F[1,139] = 8.62$, $p < .01$, $\eta^2 = .06$) and that the BB scores for threat and safety did not differ significantly from each other (repeated measures ANOVA with threat and safety as domains: $F(1,139) = 0.24$, p =.63). The observed (square rooted mean median) RTs for the various cells of the design are displayed in Figure 2.1. When looking at the observed RTs (Figure 2.1), it can be seen that the belief bias effect is most pronounced for neutral materials. Furthermore, the influence of believability on reasoning performance is markedly stronger for invalid syllogisms when it comes to threat related materials and stronger for valid syllogisms when it comes to safety related materials.

Figure 2.1. Square root normalized mean median RT (ms) on neutral, threat and safety syllogisms, varying over validity and believability.



Note: Post hoc analyses showed that the domain*believability interaction is significant (F[2,138] = 10.88, p < .01, η^2 = .14) but is due to the believability ratings of the syllogisms (domain*believability interaction with believability rating as covariate, (F[2,134] = 0.71, p = .49) instead of a true difference of how believability is treated over the various domains.

The error data showed considerable variability. Overall, participants differed substantially in how many errors they made. Also, the amount of errors differed over the various cells of the design. The BB scores as well as the scores of which they are comprised can be seen in Table 2.3. There seems to be a belief bias effect for errors on all three domains. Indeed, the repeated measures ANOVA for error BB scores with domain as within subject factor revealed a significant deviation from zero of the intercept, $F(1,143) = 17.95$, $p < .01$, $\eta^2 = .11$. No significant differences over domains occurred, $F(1,143) = 1.82$, $p = .17$. The belief bias as measured on errors was equally strong for all domains.

All the above-mentioned analyses were repeated with gender as between subject variable. There were no differences in BB scores between the genders.

Table 2.3
Mean (and SD) belief bias scores (BB scores) for the amount of errors per domain, and the mean amount of errors (and SD) per syllogism type, of which the BB scores are comprised.

	Neutral		Threat		Safety	
BB score	0.83 (2.74)		0.66 (2.60)		0.99 (2.56)	
	believable	unbelievable	believable	unbelievable	believable	unbelievable
valid	0.47 (0.74)	1.02 (1.55)	0.62 (1.10)	0.99 (1.54)	0.67 (0.87)	1.26 (1.62)
	range 0-3	range 0-8	range 0-6	range 0-8	range 0-4	range 0-8
invalid	1.17 (1.57)	0.89 (1.07)	0.86 (1.42)	0.58 (1.08)	1.13 (1.43)	0.72 (1.20)
	range 0-8	range 0-6	range 0-8	range 0-8	range 0-8	range 0-8

The BB scores for the neutral, threat and safety domain were correlated with ANX, STAI-T, CES-D and RG scores. The correlations are shown in Table 2.4. None of the correlations reached significance at $\alpha = .05$[4]. We repeated the correlational analysis, partialing out the potential influence of the believability ratings of the specific domains. The correlations for threat related belief bias and measures of anxiety and depression, when corrected for the threat believability ratings, proved to be non-significant. The results were similar for safety belief bias when correcting for the safety believability ratings, and for neutral belief bias when correcting for the neutral believability ratings.

Table 2.4
Correlations between neutral, threat- and safety-related belief bias (BB), ANX, STAI-T, CES-D and RG.

	RT			errors		
	BB_neutral	BB_threat	BB_safety	BB_neutral	BB_threat	BB_safety
ANX	.05	-.09	-.13	-.04	.00	.00
STAI-T	-.09	-.06	-.08	-.01	-.08	-.04
CES-D	.00	.00	-.15	.00	-.05	-.03
RG	.03	-.03	.06	-.10	-.08	-.06

Note. None of the correlations reached significance at $\alpha = .05$.

Discussion

This study was designed to investigate the potential predisposing role of threat-confirming reasoning for the development of anxiety disorders. We used a non-clinical sample that was comparable to other non-clinical samples on all measures of psychopathology. Firstly, as expected, there was a clear belief bias

[4] The BB scores were computed in a different way than Smeets and de Jong (2005) did. We used difference-scores whereas Smeets and de Jong used ratios. We repeated our analysis using BB ratios. Results were similar to those reported above.

effect for neutral materials. The slower responses of participants on trials for which the believability is in contrast with the logical validity are in line with the idea of a dual-process theory for belief bias: Initially, the syllogism is processed by the implicit, automatic, associative system (System 1). When a conflict in believability and logical validity is detected, the explicit, rational system (System 2) overrides the initial processing and engages in deliberate reasoning (cf. Evans, 2003): The primary response initiated by System 1 is located in the ventral medial prefrontal cortex, associated with intuitive affective processing. When the conflict within the stimulus is detected, the right lateral prefrontal cortex, associated with logical reasoning, is involved in the inhibition of this primary response and will create a logically correct response (Goel & Dolan, 2003). This route of processing takes more time, and thus results in slower responses.

Secondly, as predicted, participants also showed a threat-confirming belief bias. Participants were slower and made more errors when there was a mismatch between validity and believability. Interestingly, the validity*believability interaction patterns for the threat and the safety themes are consistent with the adaptive conservatism bias (Hendersen, 1985): In line with the idea that it is adaptive to be especially reluctant to falsify danger signals (cf. de Jong, Mayer, & van den Hout, 1997), participants had greater difficulty distinguishing believability from logical validity only on invalid trials when the content was threat related. The confirmation of danger seems to have priority over the confirmation of beliefs: Only when it was not dangerous to make a mistake in logical reasoning performance (viz. when one is not about to erroneously deny danger) the influence of beliefs on reasoning became apparent. Thus participants' responding as a function of validity and believability of the threat-related syllogisms (see Figure 1) matches the notion of belief bias and confirmation bias: Participants are generally quick in solving the syllogism when being valid or being unbelievable and invalid (a match between believability and validity). They are only slow when having to disconfirm danger (invalid) when the conclusion is believable (believable-invalid syllogisms). The opposite is true for safety themes: Here, the participants had great difficulty distinguishing believability from validity only on valid trials. Only when one is not about to erroneously accept safety information will beliefs influence reasoning performance. At first sight, it seems unexpected that participants are generally slower in solving invalid syllogisms (one would expect both the invalid and the believable-valid syllogisms to be solved more rapidly). This is however probably caused by the validity main effect: it is well known that participants generally find it more difficult to solve invalid than valid syllogisms (Evans, Newstead et al., 1993).

Thirdly, although the participants generally displayed belief bias over all domains, there was considerable variation in the strength of these effects, which suggests that the present findings cover a sufficient range to be meaningfully related to the psychopathology variables. Contrary to expectations, the threat-related belief bias effects were not only independent of depression, but also unrelated to the level of participants' anxiety symptoms. Furthermore, belief bias was unrelated to the personality trait rigidity, indicating that the belief bias effect reflects something different than 'just being rigid'.

Cognitive models of anxiety disorders underline the importance of dysfunctional beliefs in the aetiology of anxiety symptoms. In line with this there is ample evidence that anxiety disordered individuals indeed are characterized by inflated levels of believability for disorder-specific convictions. Treatment studies confirm the importance of anxiogenic beliefs in the generation of irrational fears by demonstrating that symptoms disappear by taking the edge off underlying beliefs (Arntz, 2003). Correcting (irrational) beliefs requires that people deduce the logical implications of disconfirming experiences (or information) for their beliefs. Building on this, we hypothesized that especially people who tend not to correct their somehow acquired convictions in the face of incompatible data/information would be at risk for developing persistent irrational beliefs. And since fear related beliefs are central to the development of anxiety disorders, it is people who generally tend to mistake believability for logical validity in the face of *threat* related concerns that are at risk for the development of these disorders. If threat-related belief bias is indeed a diathesis for the development of symptoms, a relationship between enhanced belief bias and symptoms of psychopathology should also be evident in the pre-clinical range. In a similar line of reasoning, we assumed that a reasoning style that ignores the validation of safety-information would also serve as a threat-confirming reasoning bias. In apparent contrast, there was no relationship between fear-confirming reasoning and anxiety symptoms. Consistent with the findings by Smeets and de Jong (2005), there was neither a relationship between generally enhanced (neutral) belief bias and psychopathological symptoms. Thus, the present findings lend no support to the idea that a generally enhanced threat-confirming belief bias sets people at risk for developing persistent anxiety symptoms.

It should be acknowledged however that there were some limitations to our study. A first remark concerns the use of an analogue sample. Although the current sample had a considerable range in both the anxiety symptom scores and the belief bias scores, it cannot be ruled out that we had an insufficient number of participants high on anxiety and/or extreme on belief bias to be able to show the alleged relationship.

Second, the use of a student sample may have hampered the sensitivity of the belief bias task: Belief bias scores decrease with intelligence and with training in analytical reasoning (MacPherson & Stanovich, 2007 and Evans, Newstead, Allan, & Pollard, 1994, respectively), both of which are likely to be present in highly educated groups. We did however find strong interference effects of believability on logical reasoning in the current sample, which indicates that belief bias was present.

Finally and perhaps most important, it should be acknowledged that there was no experimental control over participants' prior anxiogenic learning experiences in the current study. Obviously, belief bias can only promote the generation of psychopathological symptoms if there are experiences that could lead to irrational anxiogenic beliefs. Therefore, it might be helpful in future research to model the experience of aversive learning in a laboratory setting. One possibility would be to test for differential acquisition and extinction in high and low fear-confirming individuals in the context of an aversive conditioning paradigm. If enhanced fear-confirming belief bias is causally related to psychopathology, this should facilitate the acquisition of conditioned fear and/or delay of extinction effects.

The absence of a relationship between generally enhanced belief bias and symptoms of anxiety in the present study seems in apparent contrast with the finding by de Jong, Weertman et al. (1997). They found a generally enhanced belief bias effect in women with spider phobia irrespective of the domain of their concerns. In light of the present results these findings can therefore perhaps best be interpreted as representing a consequence rather than a cause of the disorder. This could potentially be caused by an anxiety-induced general sense of insecurity and stress. Scanning patterns may therefore become chaotic and individuals may leap into unjustified conclusions (e.g., Kienan, 1987). There is also evidence that working memory capacity is reduced in anxious individuals, which affects attention and the temporary storage and manipulation of information (e.g., Eysenck, 1985; MacLeod & Donnellan, 1993; Tohill & Holyoak, 2000). Following this, enhanced belief bias in highly anxious individuals may be the result of a restriction in the available working memory capacity.

Belief bias effects have been found in patients when reasoning with *disorder-specific* syllogisms (see de Jong, Weertman et al., 1997). Since belief bias is commonly found for strongly held beliefs, it is not surprising that patients display belief bias when it comes to their strongly held psychopathological convictions. The present finding of the absence of a relationship between a neutral and/or threat related extreme belief bias and psychopathology symptoms provide no evidence for the notion that enhanced belief bias sets people at risk for the development of psychopathological symptoms. This does not imply that belief bias is irrelevant in psychopathology. Although probably not causal in the development of psychopathology, (disorder-specific) belief bias may still serve to maintain dysfunctional convictions once they are acquired. Through the maintenance of convictions, belief bias may logically help maintain psychopathological symptoms (cf. de Jong, Weertman et al., 1997) and may hamper treatment interventions through the non-integration of corrective experiences. To test these issues we are currently examining the malleability of belief bias following treatment and explore the role of residual belief bias in the return of fear at follow up.

Appendix: List of the syllogisms, in believable-valid form (translated from Dutch)

Neutral syllogisms
An oak tree is larger than a rhododendron
A rhododendron is larger than a dandelion
An oak tree is larger than a dandelion

An airplane is faster than a car
A car is faster than a bicycle
An airplane is faster than a bicycle

A caravan is smaller than a mansion
A mansion is smaller than a castle
A caravan is smaller than a castle

A shrew-mouse is smaller than a dog
A dog is smaller than an African elephant
A shrew-mouse is smaller than an African elephant

Threat related syllogisms
Lung cancer is more dangerous than a pneumonia
Pneumonia is more dangerous than the flue
Lung cancer is more dangerous than the flue

A boa constrictor is more threatening than a rat
A rat is more threatening than a mouse
A boa constrictor is more threatening than a mouse

A burn is more painful than a scrape
A scrape is more painful than a mosquito sting
A burn is more painful than a mosquito sting

Potassium cyanide is more toxic than tar
Tar is more toxic than Tylenol
Potassium cyanide is more toxic than Tylenol

Safety related syllogisms
The Netherlands are safer than Russia
Russia is safer than Afghanistan
The Netherlands are safer than Afghanistan

A crash helmet is safer than a cap
A cap is safer than a bare head
A crash helmet is safer than a bare head

Chapter 2

A scrape is more innocent than a fracture
A fracture is more innocent than a heart attack
A scrape is more innocent than a heart attack

Travelling by train is safer than by car
Travelling by car is safer than by motorcycle
Travelling by train is safer than by motorcycle

Chapter 3

Belief bias and the extinction of induced fear

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Abstract

Phobic individuals expect aversive UCSs when encountering phobic stimuli, while in reality such a sequential relationship is non-existent. It is unclear why these UCS expectancies do not extinguish in the face of disconfirming evidence. Extinction requires that people deduce the logical implication of corrective experiences that challenge the previously learned CS-UCS contingency. Therefore, a strong tendency to confirm a priori beliefs may be a relatively direct and powerful mechanism immunizing against refutation of once acquired UCS expectancies. The present study was designed to investigate whether individual differences in habitual (belief biased) reasoning may help explaining individual differences in the pattern of extinction. We tested whether relatively strong belief-confirming reasoning (belief bias) predicts delayed extinction of experimentally induced UCS expectancies. In a differential aversive conditioning paradigm, we used UCS-irrelevant (Exp. 1, N = 74) and UCS-relevant (Exp. 2, N = 176) pictorial stimuli as the CS^+ and electrical stimulation as the UCS. Belief bias was not or negatively related to extinction when a priori CS-UCS belongingness was absent (Exp. 1), whereas belief bias did predict delayed extinction of UCS expectancies when there was a high a priori CS-UCS belongingness (as is typically the case for phobic stimuli, Exp. 2). Together these findings indicate that enhanced belief bias may indeed play a role in the persistence of non-realistic anxiogenic UCS expectancies, thereby contributing to the development and persistence of anxiety disorders. It also points to the relevance of reasoning tendencies in the search for predictors of delayed extinction of UCS expectancies.

Introduction

Early learning theory accounts of anxiety disorders have claimed that anxiety disorders are caused by aversive learning experiences (either directly or vicariously; e.g., Öst & Hugdahl, 1981; Watson & Rayner, 1920). Contemporary learning theories emphasize the additional importance of the influence of prior experiences, post event processing, on-site interpretations and individual variability in sensitivity for aversive learning experiences (Mineka & Zinbarg, 2006). Individual variability in the sensitivity for aversive and corrective experiences is assumed to be an important factor in the likelihood for developing an anxiety disorder. In line with this, recent conditioning research shows that people with panic disorder display delayed extinction of conditioned fear compared to healthy controls (Michael, Blechert, Vriends, Margraf, & Wilhelm, 2007). Yet, thus far little is known about what exactly constitutes these individual differences in conditionability (i.e., rate of extinction).

Successful extinction requires that people are sensitive to corrective experiences that challenge the previously learned CS-UCS contingency (e.g., this time the CS^+ was not followed by the UCS). If people have a (habitual) difficulty with incorporating disconfirming information, somehow acquired UCS expectancies will be more difficult to extinguish. Individual differences in extinction may thus be (partly) explained by individual differences in people's habitual tendency to neglect information that is inconsistent with these prior beliefs.

One reasoning tendency that directly relates to the incorporation of threat-disconfirming information (which is presented during extinction) is belief bias: Belief bias refers to the difficulty to distinguish what one believes from what is logically valid (e.g., Evans, Newstead, & Byrne, 1993). Belief bias is a common reasoning bias which serves to maintain strongly held beliefs: If people are confronted with evidence that goes against what they strongly believe, they tend to focus more on the believability of the information than on the logical validity (e.g., Evans, Over, & Manktelow, 1993). In line with the hypothesis that a relatively strong habitual belief bias may immunize against refutation of biased UCS expectancies, there is evidence that phobic individuals are characterized by a generally enhanced belief bias (de Jong, Weertman, Horselenberg, & van den Hout, 1997).

The interference of prior beliefs on logical reasoning performance is commonly measured using syllogisms. Previous research on belief biased reasoning in the context of anxiety (e.g., de Jong, Weertman et al., 1997; Vroling & de Jong, 2010b) relied on linear syllogisms: A linear syllogism consists of two premises and a conclusion. Participants need to assume that the premises are true, and need to determine whether or not the conclusion is logically valid.

Logically valid refers to the conclusion necessarily following from the premises. An example of a logically valid syllogism is:

Premise 1	A is larger than B
Premise 2	B is larger than C
Conclusion	**A is larger than C**

Given that these premises are true, it would be a violation of the rules of logic to conclude that 'C is larger than A'. In order to measure belief bias, participants are asked to indicate whether or not syllogisms are logically valid, while both the logical validity and the believability of the conclusions are varied. Participants are instructed to ignore the believability of the syllogisms. An example of the four possible variations of a syllogism is presented in Table 3.1. When the content of the syllogisms is related to strongly held beliefs, participants show slower responses and/or more errors for syllogisms in which the logical validity and the believability do not match. This is known as the belief bias effect (e.g., Evans, Newstead et al., 1993).

Table 3.1
Example of a linear syllogism varying in believability of the conclusion and logical validity.

	Believable conclusion	Unbelievable conclusion
valid	A mouse is smaller than a dog A dog is smaller than an elephant **A mouse is smaller than an elephant**	An elephant is smaller than a dog A dog is smaller than a mouse **An elephant is smaller than a mouse**
invalid	An elephant is smaller than a dog A dog is smaller than a mouse **A mouse is smaller than an elephant**	A mouse is smaller than a dog A dog is smaller than an elephant **An elephant is smaller than a mouse**

People with a relatively strong belief bias will likely tend to persist in their somehow acquired belief that the CS^+ is a predictor of the UCS and will thus show a difficulty to learn that a formerly threatening stimulus is now safe (viz. in the extinction phase the CS^+ is no longer followed by the UCS). The major aim of the present study was to test whether relatively strong belief bias is indeed associated with delayed extinction of experimentally induced UCS expectancies in the context of a differential aversive conditioning paradigm. As a secondary issue, we explored whether belief bias may also moderate the acquisition of differential UCS expectancies.

Experiment 1

Method

Participants

Participants (N = 74, 23 male and 51 female) were undergraduate students in psychology (83.8%) and other faculties. Their mean age was 20.46 years (SD = 2.20). The participating psychology students received course credits, the other students received a small financial reward. Students who were not fluent in Dutch, who suffered from dyslexia, or who had received training in logical reasoning were excluded from entering the study to avoid artificial noise in the belief bias data.

Materials and apparatus

Belief bias task. Belief bias was measured using a computerized syllogistic reasoning task. Participants were asked to judge as quickly as possible whether the conclusion logically followed from the premises. The presented syllogisms varied in logical validity and in believability of the conclusion. A belief bias effect is found when participants are faster and/or make less mistakes when there is a match between the logical validity and the believability of a syllogism (i.e., the valid-believable and the invalid-unbelievable syllogisms) than when solving syllogisms for which logical validity and believability do not match (i.e., the valid-unbelievable and the invalid-believable syllogisms).

The belief bias task consisted of neutral syllogisms similar to the neutral syllogisms used in Vroling and de Jong (2010b). There were four different syllogisms, and each syllogism was varied as a function of believability and validity. Furthermore, each syllogism was presented in two orders to counter possible reading strategies (a > b, b > c, therefore a > c and b > c, a > b, therefore a > c). The 4 (syllogisms) * 4 (types) * 2 (orders) = 32 resulting syllogisms were presented in two blocks[5]. The blocks were separated by a 30 s. break (cf. Vroling & de Jong, 2010b). The syllogisms were presented in a fixed random order, with the following restrictions: The topic should differ with every stimulus presentation, type of syllogism should differ after a maximum of two stimulus presentations, and order should differ after a maximum of three stimulus presentations. The outcome measures were reaction time (RT) and number of errors.

Errors and RTs reflect two different processes: Both belief bias measured in errors and measured in RTs indicate interference of believability in logical

[5] For pilot-purposes, we also included four threat related syllogisms, which we also varied as a function of believability and validity. Therefore the complete reasoning task consisted of 64 (two blocks of 32) syllogisms.

reasoning performance, yet people who make belief-based reasoning *mistakes* have more difficulty to distinguish between believability and logical validity than people who just need more time to come up with the correct answer. In a lab setting, participants scoring high on RT-based belief bias can be described as critical reasoners, since they correctly identify that their initial belief-based response-tendency is in fact incorrect.[6]

Differential fear conditioning task. Two intrinsically neutral stimuli were used throughout the fear conditioning task: a blue half circle, rotated 45° to the left and a blue half circle rotated 45° to the right. The stimuli were presented on a gray-shaded background, and were projected with a beamer on a white screen approximately 3 m in front of the subject. On-line probability estimates were measured with a rotary lever on a 0-100 scale (range 180°), positioned in front of the seated subject.

The aversive electrical tactile shock was administered on the middle and ring finger of the dominant hand by means of two Ag/AgCl electrodes (diameter 8 mm). To guarantee the safety of the participants, the shock was only administered after the current had been directed through an SHK1 isolation shocker (PsyLab) with a range of 0 to 5 mA.

Fear conditioning questionnaire. Participants were asked to indicate which of the two stimuli was (sometimes) followed by a shock, and had to rate how certain they were of their decision on a visual analogue scale (VAS, 0-100 mm ranging from ‘very uncertain’ to ‘very certain’).

Procedure

After filling out an informed consent, participants started with the belief bias task. Participants were instructed to judge the validity of the syllogisms as quickly as possible by pressing a red ‘NO’ key on the left side or a green ‘YES’ key on the right side of an E-prime response box. Participants were given four practice items with feedback on the correctness of their response. Further explanation on the validity of the conclusion was given on the first two exemplars. Instructions were repeated after the 30 s break.

Each stimulus was preceded by a blank screen (500 ms) and a screen reading ‘pay attention!’ (1500 ms). Each stimulus disappeared as soon as a response was given, with a maximum of a 20 second delay before the response was coded ‘incorrect’. No feedback was given during the test-phase.

When participants had completed the belief bias task, they were seated in front of a projection screen for the differential fear conditioning task. Participants

[6] It should be noted that people showing high RT-based belief bias measured in the controlled environment of a lab will probably show belief-based reasoning *errors* in everyday life, since everyday life does not usually provide a single-task 20 s decision opportunity.

were informed that, for this part of the experiment, stimuli would be presented on the screen and that a shock would sometimes follow a stimulus. The electrodes were attached to the participant, after which a shock work-up procedure was carried out to set the intensity level of the shock: Stepwise, the electrical current was increased until the participant indicated that the shock was very uncomfortable but not painful. The participant was instructed to give on-line estimates of shock occurrence during each stimulus presentation, and was told that shocks could occur in the next part of the task. After this, the task continued with the acquisition and extinction phase. In the acquisition phase (six presentations of CS^+ and CS^-), a shock was administered directly after the 8 second CS^+ presentation. Shock duration was 200 ms. Stimuli were presented for 8 s, with a 15 – 25 s variable delay before the next stimulus was presented. In the extinction phase (nine presentations of CS^+ and CS^-), no shocks were administered. The stimulus-presentation order is presented in Table 3.2.

After the fear conditioning procedure was completed, participants were presented with the fear conditioning questionnaire.

Ethical approval of this study was obtained through the Ethical Committee Psychology of the University of Groningen.

Data-analysis

Per cell of the belief bias design, a single RT score was computed by averaging the median RTs of the two blocks. Only correct responses were included in the calculation of the RT scores. Error scores were computed by summing the errors within each cell of the design. Belief bias scores were computed for the RTs and the errors. The RT belief bias score was computed by subtracting the RTs for the matches from the RTs for the mismatches (cf., Vroling & de Jong, 2010b). Error belief bias scores were calculated in a similar vein.

For the on-line probability estimates, the answer that was given at the end of the stimulus presentation time was defined as the response. The probability estimates for the CS^+ and CS^- within the acquisition and extinction phase were compared by means of MANOVAs. In each MANOVA (acquisition and extinction), stimulus (CS^+, CS^-) was treated as within subject factor and shock expectancies per trail (1 – 6 and 1 – 9 for acquisition and extinction, respectively) were treated as outcome measure.

To be able to correlate acquisition and extinction with belief bias, two partial summary scores were computed for the acquisition and the extinction phase. The shock expectancies for the initial CS^+ and CS^- presentations were used to check for initial expectancy differences between the stimuli (see above mentioned MANOVAs), but cannot be used to determine the acquisition of fear. The acquisition expectancies have been divided in two parts (Acq1 and Acq2). The first half (Acq1) consisted of the second, third and fourth CS^+ and CS^-

Table 3.2

Stimulus and shock division in both the acquisition and extinction phase (which were summarized in two parts: Acq1 and Acq2 and Ext1 and Ext2 respectively for correlational purposes) of the differential fear conditioning procedure.

Acquisition		Acq1		Acq1														
trialnumber	**1***	**2**	3*	4	**5**	6	7	**8**	9	**10**	**11**	12						
CS^+/CS^-	+	+	-	-	+	-	-	+	-	+	+	-						
									Acq2									
Extinction				Ext1														
trialnumber	13	14*	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
CS^+/CS^-	-	+	-	+	-	-	+	-	-	+	+	-	+	-	+	+	-	+
	Acq2											Ext2						

Note. When a shock follows the CS^+, this is indicated by a bold **+**.
* new information presented directly after stimulus presentation

presentations (trials 2, 5, 8 and 4, 6, 7 respectively, which were averaged per CS type), the second half (Acq2) consisted of the fifth, sixth and seventh[7] CS^+ and CS^- presentations (trials 10, 11, 14 and 9, 12 and 13 respectively, which were averaged per CS type). The extinction phase was divided accordingly: the first half, Ext1, consisted of the trials 16, 19, 22, 23 and 17[8], 18, 20, 21 for CS^+ and CS^- respectively (which were averaged per CS type), the second half, Ext2, consisted of the trials 25, 27, 28, 30 and 24, 26, 29 for CS^+ and CS^-, respectively.

Results

Due to technical difficulties, one participant had to be excluded. Furthermore, one participant requested to abort the experiment during the differential fear conditioning task. Participants who were incorrect in identifying the CS^+, or who were less than 50% certain of their identification of the CS^+ (as reported on the fear conditioning questionnaire) were excluded from the analyses, as well as those participants who had not completed the reasoning task according to the instructions (this was determined during the debriefing). In total, 53 participants were included in the final analyses.

Belief bias task

On average, participants showed both positive belief bias RT scores (M = 1962.66 [in ms], SD = 2579.31) and positive belief bias error scores (M = 0.43, SD = 1.15). These belief bias scores deviated significantly from zero, $t(52)$ = 5.5487, $p < .01$ and $t(52) = 2.74$, $p < .05$ respectively, indicating that the participants generally showed belief bias which was reflected in both RTs and errors.[9]

Differential fear conditioning task

Many people (22.06%) were inaccurate in identifying the CS^+, or were less than 50% certain of their (correct) identification. These people were excluded from the analyses (see above).

[7] Note that the seventh CS^+ and CS^- presentations are actually the beginning of the extinction phase. Yet, because the new information (of both the CS^+ and the CS^- not being followed by a shock) is only presented directly after the stimulus presentation, the seventh presentation is still part of the acquisition with respect to expectancies.

[8] Note that trial 15 is skipped for the CS^-. This is done because participants can only develop an understanding of the new rules for shock administration after they have experienced the absence of a shock at CS^+ and then at CS^- (many participants expected the shock would now be paired with the CS^-).

[9] The threat related syllogisms that had been included for pilot purposes did not significantly differ from zero, indicating that on average, no threat related belief bias was present. We therefore did not include threat related belief bias in our analyses.

Acquisition. On the first trial, there was no difference in UCS expectancy for the CS^+ and the CS^-, $F(1,52) = 1.42$, $p = .24$. Already after the first presentation of the shock (following the CS^+) the shock expectations differed between the stimuli, $F(1,52) = 13.13$, $p < .01$, $\eta^2 = .20$ (for the second trial). The difference in UCS expectancy between the CS^+ and the CS^- continued to enlarge (up until $\eta^2 = .92$ at the first CS^+ and CS^- presentation of the extinction phase).
Extinction. When the CS^+ was no longer followed by a shock in the extinction phase, the UCS expectancy for the CS^+ decreased from 95.00 to 21.36, while the UCS expectancy on CS^- trials mildly increased from 6.63 to 16.94. The difference in shock expectation between the CS^+ and the CS^- however remained significant until the eighth presentation. The difference was no longer significant at the final presentation: $F_{trial9}(1,52) = 2.86$, $p = .097$, $\eta^2 = .05$. The differential expectations in the acquisition and in the extinction phase can be seen in Figure 3.1.

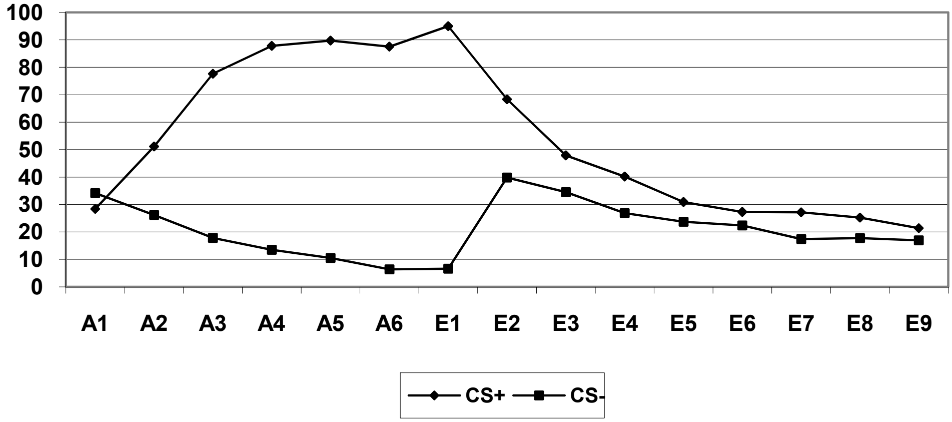
Correlations between belief bias and fear conditioning
As can be seen in Table 3.3, no meaningful correlations were found between error-based belief bias and differential UCS expectancies during extinction or acquisition. Contrary to our expectations, higher levels of RT-based belief bias were related to lesser differences in UCS expectancy ratings between CS^+ and CS^- during the first part of extinction, $r = -.27$, $p = .05$. In a similar vein, belief bias was also negatively correlated with the first phase of acquisition, $r = -.29$, $p = .04$. Thus, participants scoring high on belief bias (measured in RTs) showed *less* differential UCS expectancies during both extinction and acquisition.

Table 3.3. Correlations between belief bias (measured in both errors and RT) and the differential shock expectancy scores for the first and second half of the acquisition and the extinction phase of the fear conditioning procedure of Exp. 1.

	Belief bias errors	Belief bias RT
Acq1: CS^+ - CS^-	-.12	**-.29***
Acq2: CS^+ - CS^-	.05	-.19
Ext1: CS^+ - CS^-	-.03	**-.27+**
Ext2: CS^+ - CS^-	.01	-.02

$^+p < .10$, $^*p < .05$, $^{**}p < .01$

Figure 3.1. On-line shock expectancies per CS presentation for both the CS^+ and the CS^- in the acquisition and extinction phase of the fear conditioning experiment (Exp. 1).



Discussion

The major aim of Experiment 1 was to test whether the extinction of (differential) UCS expectancies varies as a function of people's habitual belief bias. Contrary to expectations, belief bias as indexed by reaction times was negatively correlated to the rate of extinction of differential UCS expectancies.

The pattern of UCS expectancies indicate that both the acquisition and the extinction of differential UCS expectancies were successful. Participants increasingly expected a shock for the CS^+ and no shock for the CS^- during acquisition and this differential expectancy decreased and finally disappeared during extinction. Participants on average displayed a positive belief bias effect, which indicates that they had more difficulty to respond to syllogisms on which believability and validity did not match. Furthermore, there was considerable variation in the belief bias scores.

It was hypothesized that heightened belief-confirming reasoning (belief bias) would predict delayed extinction. We argued that people with heightened belief bias would have difficulty with incorporating evidence that opposes the previously learned predictive validity of the CS^+. The present results do not support this view. If anything, the results show the opposite pattern: People with relatively high belief bias showed faster instead of delayed extinction. In a similar vein, participants with relatively strong belief bias also showed relatively slow signal-learning during the acquisition. Thus participants with enhanced belief bias found it relatively difficult to learn the CS-UCS association, and relatively easy to again unlearn this association when the CS^+ was no longer followed by the electrical shock during extinction.

One explanation for these unexpected results could be that we used neutral stimuli as the CS^+/CS^- which had no intrinsic relationship with the aversive UCS. The low initial UCS expectancies confirm that participants had no strong a priori beliefs regarding the predictive validity of the CS^+ for shock occurrence. If anything, they seemed to belief that the CS^+ would not be followed by the UCS. Perhaps then it may not be surprising that people with a heightened belief bias showed a relatively strong reluctance to form beliefs regarding the predictive validity of the CS^+ during acquisition, as the CS-UCS pairings ran counter their initial belief (cf. Hamm, Vaitl, & Lang, 1989). In a similar vein, this may explain why people with enhanced belief bias showed less resistance to extinction.

To test whether indeed the unexpected pattern of results can be attributed to the low initial CS-UCS belongingness, we carried out a second experiment, using stimuli with high CS-UCS belongingness.

Experiment 2

In Experiment 2, we manipulated the a priori UCS belongingness of the CS^+/CS^- In half of the participants we used a CS^+ with low UCS belongingness (i.e., a sunflower) as was the case in Exp. 1, whereas we used a CS^+ with high belongingness (i.e., a cactus) in the other half of the participants. Based on our findings in Exp. 1, we hypothesized to find (again) a negative correlation between habitual belief bias and differential UCS expectancies during extinction when the sunflower was used as the CS^+, but a positive correlation when the cactus was used as the CS^+. As a secondary issue we also explored the influence of enhanced belief bias on the acquisition of differential UCS expectancies as a function of a priori CS-UCS belongingness. Since we have now included a between subject factor in our design, our goal was to double the number of participants.

Method

Participants

People who were not fluent in Dutch, who suffered from dyslexia, or who had received training on logical reasoning were excluded from entering the study. Participants (N = 176, 48 male and 128 female) were undergraduate students in psychology (86.4%) and other faculties. The mean age was 20.16 years (SD = 3.59). The participating psychology students received either course credits or, if they had already completed their course credit requirements, a small financial reward. The other students always received a small financial reward.

Materials and apparatus

The materials and apparatus were similar to those of Exp. 1, except for the stimuli used in the differential fear conditioning task. The stimuli were a cactus and a sunflower. For half of the participants the cactus served as CS^+ and the sunflower as CS^- (high belongingness condition) and for half the sunflower served as CS^+ and the cactus as CS^- (low belongingness condition).

Procedure

The procedure of this experiment was similar to that of Exp. 1, with the following exception: Belongingness condition was randomly determined between participants.

Ethical approval of this study was obtained through the Ethical Committee Psychology of the University of Groningen.

Data-analysis

The data for the high and the low belongingness conditions were analysed separately. The analyses (per belongingness condition) were similar to those of Exp. 1.

Results

Due to technical difficulties, six participants had to be excluded. Also, three participants requested to abort the experiment during the differential fear conditioning task. Furthermore, participants who were incorrect in identifying the CS^+, or who were less than 50% certain of their identification of the CS^+ were excluded from the analyses, as well as those participants (n = 6) who had not completed the reasoning task according to the instructions (this was determined during the debriefing). In total, 151 participants remained in the final analyses, of whom 76 underwent the high belongingness condition and 75 underwent the low belongingness condition.

Belief bias task

On average, participants showed both positive neutral belief bias RT scores (M = 1365.23 [in ms], SD = 2546.04) and positive neutral belief bias error scores (M = 0.35, SD = 1.70). These neutral belief bias scores deviated significantly from zero, $t(150) = 6.61$, $p < .01$ and $t(150) = 2.52$, $p < .05$ respectively, indicating that the participants showed belief bias for the neutral themes both on RTs and on errors.[10]

[10] Again, we did not find an (on average) belief bias effect for the threat related syllogisms.

Differential fear conditioning task

Low belongingness condition. Six people (out of the initial 81 in the low belongingness condition, 7.41%) were inaccurate in identifying the CS^+ or were less than 50% certain of their (correct) identification and were excluded from the analyses.

Acquisition: On average, participants initially held higher expectancies for the shock to be followed by the cactus than the sunflower: on the first trial, there was a moderately strong difference in probability estimation between the CS^+ (sunflower, M = 29.21) and the CS^- (cactus, M = 46.48), $F(1,74) = 11.85$, $p < .01$, $\eta^2 = .14$. This expectation correctly shifted to higher UCS expectancies for the CS^+ as soon as the first shock was administered ($F[1,74] = 25.55$, $p < .01$, $\eta^2 = .26$ for the second trial). The difference in UCS expectancy between the CS^+ and the CS^- continued to enlarge (up until $\eta^2 = .94$ at the first CS^+ and CS^- presentation of the extinction phase).

Extinction: When the CS^+ (sunflower) was no longer followed by a shock in the extinction phase, the shock expectation for the CS^+ decreased from 95.35 to 20.26, while the CS^- shock expectancy (cactus) mildly increased from 6.50 to 14.38. The difference in shock expectation between the CS^+ and the CS^- however remained significant even in the final presentations: $F(1,74) = 6.41$, $p = .01$, $\eta^2 = .08$.

High belongingness condition. Four participants (out of the initial 80 in the high belongingness condition, 5 %) were inaccurate in identifying the CS^+ or were less than 50% certain of their (correct) identification and were excluded from the analyses.

Acquisition: Similar to the low belongingness condition, participants initially reported higher UCS expectancies for the cactus than for the sunflower: on the first trial, there was a strong difference in probability estimation between the CS^+ (cactus, M = 54.12) and the CS^- (sunflower, M = 23.19), $F(1,75) = 37.85$, $p < .01$, $\eta^2 = .34$. The difference in UCS expectancy between the CS^+ and the CS^- continued to enlarge (up until $\eta^2 = .98$ at the first CS^+ and CS^- presentation of the extinction phase).

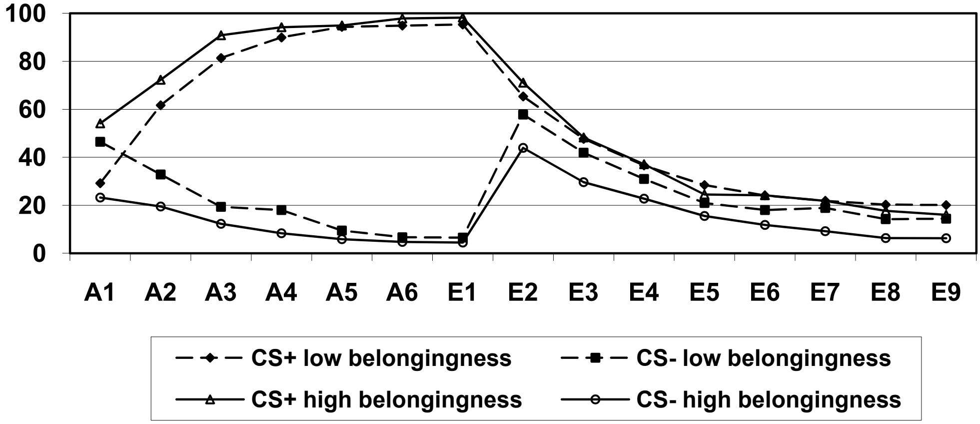
Extinction: When the CS^+ was no longer followed by a shock in the extinction phase, the shock expectation for the CS^+ (cactus) decreased from 98.18 to 17.67, while the CS^- shock expectancy (sunflower) remained relatively stable from directly prior to the extinction information (M = 4.44) to the final presentation within the extinction phase (M = 6.28). The difference in shock expectation between the CS^+ and the CS^- however remained significant even in the final presentations: $F(1,75) = 21.19$, $p < .01$, $\eta^2 = .22$.

The differential shock expectancies in the low and the high belongingness condition for the acquisition and the extinction phase are shown in Figure 3.2.

Correlations between belief bias and low belongingness fear conditioning

No significant correlations were found between belief bias and differential shock expectancies in the low belongingness condition.

Figure 3.2. On-line shock expectancies for the high belongingness (cactus as CS^+, sunflower as CS^-) and the low belongingness condition (sunflower as CS^+, cactus as CS^-) per CS presentation for both the CS^+ and the CS^- in the acquisition and extinction phase of the fear conditioning experiment (Exp. 2).



Correlations between belief bias and high belongingness fear conditioning

In line with our hypothesis, higher belief bias error scores were related to larger differential expectancies in both phases of the extinction, $r_{Ext1,BBerror} = .23$, $p < .05$ and $r_{Ext2,BBerror} = .24$, $p < .05$, respectively. Participants high on belief bias (measured in errors) indeed showed delayed extinction. This pattern was absent for the RT-based belief bias scores. In addition, no significant correlations were found between belief bias and differential UCS expectancies during the acquisition phases. The correlations for the high belongingness condition are presented in Table 3.4.

Table 3.4
Correlations between belief bias (measured in both errors and RT) and the differential shock expectancy scores for the first and second half of the acquisition and the extinction phase of the fear conditioning procedure of the high belongingness condition of Experiment 2.

	Belief bias errors	Belief bias RT
Acq1: CS^+ - CS^-	-.09	.04
Acq2: CS^+ - CS^-	-.16	.04
Ext1: CS^+ - CS^-	**.23***	-.06
Ext2: CS^+ - CS^-	**.24***	-.06

$^+p < .10$, $^*p < .05$, $^{**}p < .01$

Discussion

The major aim of Exp. 2 was to test whether in case of high prior CS-UCS belongingness, belief bias would be related to delayed extinction. This is indeed what we found: People with a higher tendency to engage in belief-biased reasoning fallacies showed slower extinction of UCS expectancies on CS^+ trials when the CS^+ was a picture of a cactus (viz. the high belongingness condition).

Supporting the validity of stimulus selection, participants in both conditions initially showed higher UCS expectancies for the cactus than for the sunflower. Yet, regardless of belongingness, the acquisition and extinction of fear was successful in both conditions, although shock expectancies remained slightly higher for the CS^+ than the CS^- at the end of the extinction phase (again in both conditions).

Our predictions were only confirmed for error-based belief bias and not for reaction time based belief bias. People who have a tendency for biased reasoning but who manage to correct themselves, the critical and therefore careful reasoners, do not show delayed extinction in this experiment. The time-frame within which participants were asked to rate their UCS-expectancy was 8 seconds. An 8-second time-frame facilitates the correction of initial belief-based UCS expectancies in critical reasoners. In daily-life however, decision-time is usually much smaller and situations are more ambiguous, which will likely leave too little time and attention for the critical reasoner to signal his initial reasoning error and to correct it. Following this, also reaction time based belief bias will be predictive of delayed extinction when the situation would require an immediate indication of participants' UCS expectancy.

In apparent contrast to the results of Exp. 1, there was no relationship between belief bias and the acquisition of UCS expectancies for the high belongingness condition. However, in Exp. 1, the relationship between belief bias and acquisition was limited to the first phase of the acquisition. The pattern of acquisition of Exp. 2 differs from Exp. 1 on exactly this phase: initial differential expectancies are larger in Exp. 2 and therefore acquisition is somewhat more rapid, therefore probably leaving less room for belief bias to affect expectancies. The same holds for the acquisition phase of the low belongingness condition. Also, the results from the fear conditioning questionnaire indicate that detecting the CS^+-UCS relationship was easier in Exp. 2 than Exp. 1, which will likely further decrease variability in Exp. 2.

In apparent contrast to Exp. 1, there was no relationship between the strength of belief bias and the rate of extinction in the low belongingness condition. However, one important difference between both experiments is that in Exp. 1 we used neutral CS^+/CS^- stimuli without any belongingness with the UCS, whereas in the low belongingness condition of Exp. 2 the CS^- had a strong belongingness with the UCS. Because the CS-UCS contingency ran counter the strong a priori belongingness between cactus-and-shock and sunflower-and-no-shock, participants were generally very quick in learning that the sunflower was no longer followed by a shock during extinction. Clearly, this reduced the variability in participants' rate of extinction, thereby reducing the room for enhanced belief bias to increase further the rate of extinction. Thus the absence of a relationship between belief bias and both rate of acquisition and extinction in the low belongingness condition can be explained by the reduced variability of participants' pattern of UCS expectancies in Exp. 2.

General Discussion

Classical conditioning theory is still one of the most influential theories on phobic anxiety. Contemporary learning theories have added the notion of individual variability in conditionability. Various studies have made clear that anxiety disorder patients show stronger conditionability (on either extinction or both acquisition and extinction; e.g., Michael et al., 2007; Orr et al., 2000) yet there have been only few studies attempting to predict (or explain) this variability in conditionability. These few studies have mainly focussed on personality traits (e.g., Davey & Matchett, 1994; Orr et al., 2000; Otto et al., 2007; Pineles, Vogt, & Orr, 2009). Although it has become clear in recent years that information processing biases are influential in the maintenance and sometimes also the development of anxiety disorders (e.g., Mathews & MacLeod, 2005), no studies have been reported that attempt to predict individual differences in conditionability by individual differences in such cognitive biases. The present study provided evidence to suggest that differential information-processing biases might nevertheless be considered likely candidates in the unravelling of individual differences in resistance to extinction of UCS expectancies and, more generally, potentially also in the unravelling of differences in resistance to the extinction of fear.

The goal of the present experiments was to investigate whether individual differences in habitual belief bias may be one of the factors that can help explain individual differences in the rate of fear extinction. These differences have already been linked to anxiety disorders: Previous work showed that for instance panic disorder patients are characterized by a slower extinction of fear than non-anxious controls (Michael et al., 2007), yet little is known on what constitutes this delayed extinction. The present findings show that enhanced belief bias may be one of the factors that may help explaining such delayed extinction of UCS expectancies. In addition, the present pattern of findings clearly show that the influence of enhanced belief bias critically depends on the nature of the stimuli used to condition fear: If the stimuli are UCS-relevant, belief bias was found to be related to delays in the extinction of UCS expectancies (Exp. 2, high belongingness condition). If, however, the stimuli involved in the fear conditioning show no a priori meaningful relationship with the UCS, enhanced belief bias may serve as a protective factor (Exp. 1). Given that most anxiety disorders usually concern fear-relevant stimuli with high a priori UCS belongingness (e.g., Seligman, 1971), belief bias will most often serve to maintain anxiety disorders.

The finding of belief bias as predictor for delayed extinction fits in with and adds to earlier findings in the field of belief bias and psychopathology: de Jong, Weertman and colleagues (1997) found that spider phobic patients are characterized by a generally enhanced belief bias and they concluded that perhaps belief bias may have contributed to the development of the phobia. Later studies failed to find a relationship between belief bias and psychopathologic symptoms in general samples (Smeets & de Jong, 2005; Vroling & de Jong, 2010b), yet it was noted that no experimental control was exerted over the learning experiences that may contribute to the development of anxiety symptoms. The present findings, which were found by exerting experimental control over the learning experiences, do support such relationship and fit in with the notion that belief bias may contribute to the development of a specific phobia by contributing to a continued UCS expectancy for high UCS belongingness stimuli (cf. Merckelbach, de Jong, Muris, & van den Hout, 1996). Also, the present findings are in line with the recent suggestion by Mitchell, De Houwer and Lovibond (2009) that reasoning is critically involved in classically conditioned fear learning.

It would be interesting for future research to bring belief bias under experimental control. Given the present findings, it is expected that experimentally induced low belief biased reasoning will facilitate the extinction of differential UCS expectancies when there is a strong a priori belongingness between the CS^+ and the UCS, whereas experimentally induced high levels of belief bias will result in a delayed extinction of UCS expectancies. If so, it would be worth looking into the possibilities to implement a belief bias modification training as a preventive measure (cf. e.g., Holmes, Lang, & Shah, 2009; Schartau, Dalgleish, & Dunn, 2009).

To summarize, the present findings support the view that a habitual belief-confirming reasoning strategy (viz. belief bias) may be involved in delayed extinction of UCS expectancies and can therefore be seen as one of the factors that may contribute to the consolidation of dysfunctional convictions through which anxiety disorders may develop/maintain. The present study underlines the importance of investigating the possible contribution of reasoning biases in aversive conditioning, and may help explaining individual differences in the extinction of fear.

Chapter 4

Belief bias in panic disorder: Domain and disorder specificity

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Submitted for publication

Abstract

Previous work in spider phobic patients showed that high fearful individuals display a fear-confirming belief biased reasoning pattern that logically acts in a way to confirm (rather than falsify) prior beliefs. To corroborate and extend these earlier findings, this study investigated whether (i) enhanced belief bias can also be found in a group of individuals suffering from panic disorder, (ii) this bias is in content specific to panic disorder patients, and (iii) this bias is restricted to the domain of concern or reflects a more generally enhanced belief bias. Panic disorder patients (PD patients n = 34), a clinical control group of obsessive-compulsive patients (OCD patients n = 25), and non-clinical controls (NCCs n = 21) completed a belief bias task consisting of neutral and panic disorder relevant materials prior to treatment. No evidence emerged for a generally enhanced belief bias in PD patients or OCD patients. Consistent with previous research, PD patients showed a belief bias for panic disorder related materials. However, the OCD patients displayed an even stronger belief bias, casting doubt on the specificity of the belief bias effect in PD.

Introduction

Cognitive theories of psychopathology propose that dysfunctional beliefs provide the causal basis for the catastrophic misappraisals that are typical for anxiety disorders (Beck, 1976). According to these theories, anxiety patients overestimate the dangerousness of the situation due to an underlying belief and misinterpret harmless stimuli as forerunners of oncoming catastrophe (e.g., McNally, 2001). These theories propose that each anxiety disorder is associated with one or more specific dysfunctional beliefs that cause people to draw erroneous conclusions that are characteristic for the various disorders (e.g., Clark, 1986; Clark & Wells, 1995; Ehlers & Clark, 2000; Salkovskis, 1999). For example, panic patients who believe that palpitations signify impending cardiac arrest might get a panic attack, merely by misinterpreting some harmless interoceptive cues (e.g., Clark, 1986).

Given the fact that anxiogenic beliefs are mostly unrealistic, the question arises why these beliefs are so persistent. For therapeutic purposes, particular attention has been paid to the factors that prevent anxiety patients from changing their negative beliefs about the dangers they fear (e.g., Clark, 1999). Oftentimes, anxiety patients engage in avoidance and safety-seeking behaviours that hamper disconfirmation of their irrational beliefs (APA, 1994; Salkovskis, Clark, Hackmann, Wells, & Gelder, 1999). However, although avoidance and safety-seeking behaviours may play an important role in the persistence of symptoms, it provides no satisfying explanation for the observation that dysfunctional beliefs also persist when disconfirming evidence *is* available (and when it is not being [or cannot be] ignored, in contrast to confirmation bias). For example, why does a panic disorder patient hold on to his conviction that every next attack of dizziness and palpitations will be fatal, even after having experienced dozens of panic attacks that turned out to be harmless? In other words, a crucial question that remains is why panic disorder patients persist in concluding that particular physical symptoms are dangerous even in the presence of disconfirming evidence (e.g., palpitations are typically not followed by a heart attack). Satisfying answers to questions like these may provide a valuable contribution to the understanding of the maintenance of anxiety disorders and the improvement of treatments.

One mechanism that may play a fairly direct role in patients' failure to correct their dysfunctional beliefs is their deductive reasoning style. Correcting erroneous beliefs requires the ability to accurately deduce the logical implications of empirical evidence for certain beliefs. In general, people are characterized by a bias in deductive reasoning that acts in a way to confirm rather than to falsify prior beliefs ("belief bias"; e.g., Evans, Over, & Manktelow, 1993). That is, belief bias is demonstrated in a general tendency to endorse conclusions which are a priori believable as valid and those which are unbelievable as invalid, regardless of their actual logical status. This interference of prior beliefs is at least partly automatic in the sense that it is unintentional and involuntary (e.g., Evans & Curtis-Holmes, 2005). There is considerable evidence that some degree of belief bias is characteristic of human reasoning (e.g., see Evans, Newstead, & Byrne, 1993). In everyday life, some degree of belief bias can be considered functional. In potentially dangerous situations for example, it seems adaptive to rely on prior beliefs and act on quick and dirty conclusions, rather than to pause and consider the logical validity of those conclusions. However, if the perceived threat is based on pathogenic convictions, the same strategy becomes counterproductive. In that case, jumping to a conclusion would hinder the falsification of the underlying argument and logically immunize against the refutation of phobogenic views.

Earlier research in the context of spider phobia (de Jong, Weertman, Horselenberg, & van den Hout, 1997) provided preliminary evidence to suggest that an enhanced belief bias in psychopathology may take two forms. First, enhanced belief bias may be evident in the domain of disorder-related concerns that are relevant for the patient. If enhanced belief bias is restricted to the domain of concerns this would be consistent with the idea that the incorrigibility of anxiogenic beliefs may not itself result from a reasoning abnormality, but represents a normal manifestation of tenacity for important and strongly held beliefs (cf. Garety & Hemsley, 1997). Second, a strong belief bias might (also) be a general cognitive characteristic of individuals suffering from psychopathological symptoms, exerting its influence in complaint-irrelevant domains as well. As such, this reasoning bias may reflect a trait-like information processing bias that acts as a diathesis in the development of psychopathology in general (cf. Arntz, Rauner, & van den Hout, 1995). Note that a relatively strong belief bias will impede the correction of somehow acquired erroneous and potentially pathogenic convictions, which in turn may render people liable to psychopathology because the presence of an enhanced belief bias might prevent participants from giving up such beliefs (e.g., “I am worthless”) in the face of logically incompatible data (cf. de Jong, Weertman et al., 1997; Smeets & de Jong, 2005). In other words, generally enhanced belief bias would immunize against refutation and thus enable the consolidation of all kinds of pathogenic views.

The aim of the present study was therefore to replicate and extend the finding of a domain-specific reasoning bias in anxiety disorders other than spider phobia and to test whether anxiety disorder patients can indeed also be characterized by a generally enhanced belief bias irrespective of the domain of concerns (which would be in line with the findings of de Jong, Weertman et al., 1997). Therefore, we measured domain-specific and general belief bias prior to treatment in panic disordered patients as well as in a group of normal controls. If indeed belief bias plays a critical role in the development and/or maintenance of anxiety disorders, individuals suffering from panic disorder should display generally enhanced levels of belief bias compared to individuals without symptoms as well as domain-specific belief bias. Moreover, if belief bias is a general premorbid characteristic that contributes to the development of dysfunctional beliefs, enhanced belief bias in anxiety patients should not only be present in the domain of their concerns, but in the neutral domain as well. To test the *specificity* of the domain specific belief bias, we also measured belief bias in a clinical control group (obsessive-compulsive disorder patients).

Method

Participants

Thirty-four patients with primary diagnosis panic disorder (27 women) and twenty-five patients with primary diagnosis obsessive-compulsive disorder (16 women) were recruited among individuals seeking treatment at the community mental health care centre in Maastricht, the Netherlands. The mean age was 34.8 years (*SD* = 10.3) in the panic disorder (PD) group and 30.5 years (*SD* = 9.3) in the obsessive-compulsive (OCD) group. Modal educational level (range ‘no education’ to ‘university degree’) was pre-vocational secondary education in the PD group (but mean close to secondary education) and secondary vocational education in the OCD group.

All patients met DSM-IV criteria for panic disorder with or without agoraphobia or obsessive-compulsive disorder, as assessed with the Structural Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1995). Of the 34 PD patients, 27 (79%) suffered from PD with agoraphobia. Fifty-nine percent of the PD patients had additional comorbidity: 11 patients of the PD group had one additional diagnosis, 3 had two additional diagnoses, 3 had three additional diagnoses and 3 had four additional diagnoses. Among the additional diagnoses were 16 mood disorders (depressive episodes), 11 other anxiety disorders (4 generalized anxiety disorder, 1 OCD, 3 social anxiety, 2 specific phobia, 1 post-traumatic stress disorder), six somatic disorders (2 hypochondriasis, 4 pain disorder), three substance-related disorders (2 alcohol dependence, 1 substance abuse), one eating disorder NOS and one intermittent explosive disorder.

In the OCD group, 84% suffered from comorbid disorders: 9 patients had one additional diagnosis, 7 had two additional diagnoses, 2 had three additional diagnoses, 1 had four additional diagnoses and 2 had five additional diagnoses. Among the additional diagnoses were 19 mood disorders (15 depressive

Table 4.1
Example of a neutral syllogism with conclusions varying in logical validity and believability.

	Believable conclusion	Unbelievable conclusion
valid	An adult is older than an adolescent An adolescent is older than a toddler **An adult is older than a toddler** **(Type 1)**	A toddler is older than an adolescent An adolescent is older than an adult **A toddler is older than an adult** **(Type 3)**
invalid	A toddler is older than an adolescent An adolescent is older than an adult **An adult is older than a toddler** **(Type 2)**	An adult is older than an adolescent An adolescent is older than a toddler **A toddler is older than an adult** **(Type 4)**

Table 4.2
Example of a PD congruency syllogism with conclusions varying in logical validity and PD congruency.

	PD congruent conclusion	PD non-congruent conclusion
valid	Palpitations are more dangerous than a wasp's sting A wasp's sting is more dangerous than a mosquito bite **Palpitations are more dangerous than a mosquito bite** **(Type 1)**	A mosquito bite is more dangerous than a wasp's sting A wasp's sting is more dangerous than palpitations **A mosquito bite is more dangerous than palpitations** **(Type 3)**
invalid	A mosquito bite is more dangerous than a wasp's sting A wasp's sting is more dangerous than palpitations **Palpitations are more dangerous than a mosquito bite** **(Type 2)**	Palpitations are more dangerous than a wasp's sting A wasp's sting is more dangerous than a mosquito bite **A mosquito bite is more dangerous than palpitations** **(Type 4)**

episodes, 4 dysthymia), nine anxiety disorders (1 PD, 1 generalized anxiety disorder, 7 social anxiety, 1 post-traumatic stress disorder), three somatic disorders (1 hypochondriasis, 2 pain disorder), six substance-related disorders (3 alcohol dependence, 3 substance abuse), one eating disorder NOS, one pathological gambling, one Tourette's disorder and one delusional disorder.

Twenty-one healthy control participants (14 women) were recruited through advertisements in local newspapers. They received a small financial remuneration for their participation in the study (€10,-). Controls were included after screening on the presence of any DSM-IV axis-I disorder. Their mean age was 35.3 years (*SD* = 14.4) and the modal educational level was higher professional education.

There were no significant differences between the three groups of participants with respect to gender ($\chi^2[2] = 1.77$, $p = .43$), age ($F[2,79] = 2.79$, $p = .20$) or educational level ($\chi^2[16] = 19.82$, $p = .21$), although there was a tendency for the educational level of the PD group to be lower than that of both other groups.

Materials

Reasoning task

The reasoning task that was used in the present study was an adapted version of the computerized task used by de Jong, Weertman et al. (1997; see also Smeets & de Jong, 2005). The task consisted of three sets of four different linear syllogisms. The three sets concerned neutral themes (e.g., a mouse is larger than an elephant), PD-relevant themes (e.g., palpitations are more dangerous than a mosquito bite), and a third set that was included for pilot purposes (these themes will not be discussed in this paper). The PD-relevant themes were developed in consultation with experienced therapists. These were based on the most frequently reported concerns relevant for panic disorder and included palpitations, dizziness, gasping, and pain on the chest. A list of the themes that were used for the two experimental sets is included in the Appendix.

For each of the neutral syllogisms, four different types were constructed by systematically varying the logical validity and believability of the conclusions. An example of these four types can be seen in Table 4.1. For each of the syllogisms, two types had a conclusion in line with participants' prior view of the world, one of which was logically valid (believable and valid; Type 1), and one of which was invalid (believable but invalid; Type 2). Furthermore, there were two types with a conclusion opposing the participants' prior view of the world, again one of which was logically valid (unbelievable but valid; Type 3), and one which was logically invalid (unbelievable and invalid; Type 4). Belief bias would be reflected by a relatively poor performance (i.e., many errors; long latencies) if the conclusions were in line with participants' prior beliefs but logically invalid or when the conclusion was opposite to participants' prior beliefs but logically valid. More specifically, belief bias would be reflected in an interaction effect between the believability and the logical validity of the syllogisms' conclusions.

For the panic-related syllogisms, a lack of consensus regarding 'believability' of the conclusions is expected across the groups. We therefore refer to the 'believability' of the conclusions of the panic related themes as 'PD congruent' and 'PD non-congruent'. With this distinction, the four different types of syllogisms were created in a similar vein as the neutral syllogisms: two PD congruent types, one logically valid and one logically invalid (type 1 and 2 respectively), and two PD non-congruent types, again one logically valid and one logically invalid (type 3 and 4 respectively). An example of the four types of a PD-relevant syllogism are presented in Table 4.2.

To counter possible reading strategies each syllogism was presented in two orders (a > b, b > c, therefore a > c and b > c, a > b, therefore a > c). In total, there was a pool of 3 (domains) * 4 (themes) * 4 (types) * 2 (orders) = 96 syllogisms.

All participants were exposed to the same pool of 96 syllogisms. Syllogisms were presented in fixed random order. To prevent that fatigue would influence the responses as the reasoning task progressed, participants had to take a rest period for at least two minutes after the first and the second set of 32 syllogisms. Outcome measures are the number of errors and the time required for solving each syllogism.

Believability ratings

As an explicit measure of the believability of the syllogisms that were used, participants were asked to rate all conclusions on believability using a Visual Analogue Scale (VAS). This 100 mm scale ranged from very unbelievable (0 mm) to very believable (100 mm).

Self-reported measures of psychopathology

To index level of symptoms, the Fear Questionnaire (FQ; Marks & Mathews, 1979) and the Symptom Checklist (SCL-90; Arrindell & Ettema, 1986; Derogatis, Lipman, & Covi, 1973) were administered[11]. The FQ is a frequently used measure in anxiety disorder research, measuring avoidance symptoms. One of the subscales concerns the intensity of the patients' main phobia (i.e., the

[11] We have chosen not to use disorder specific measures such as the PDSS (Shear et al., 1997) or the BAI (Beck, Epstein, Brown, & Steer, 1988) for the PD group and the Y-BOCS (Goodman, Price, Rasmussen, Mazure, Delgado et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann et al., 1989) or the PADUA (Sanavio, 1988) for the OCD-group, because this would exclude the option of comparing both groups on these measures or collapsing the groups for further analysis. Instead we have chosen to use a general psychopathology measure commonly used in clinical practice (SCL-90) and an anxiety measure widely used in research (FQ).

disorder for which treatment is requested). The main phobia subscale provides a global indication of the severity of the disorder. This subscale could not be assessed for the normal controls due to the nature of the question. Another subscale relevant to this population is the agoraphobia subscale, which measures agoraphobic symptoms. This scale was assessed for all participants. The SCL-90 is a widely used multidimensional index of psychopathological symptoms. The SCL-90 sum score gives an indication of the overall level of psychopathology. Both questionnaires have acceptable psychometric properties (Arrindell & Ettema, 1986; Marks & Mathews, 1979).

Procedure

Patients were tested one week prior to the start of their treatment. All measures were administered in the following order: reasoning task; believability ratings; SCL-90; FQ.

In a sound attenuated room, the participant was seated in front of a 14-inch monitor on which the syllogisms and the standard instructions were presented. Participants were instructed to decide as quickly as possible whether or not the conclusion was correct (i.e., logically valid) given the two premises. It was emphasized that the reality basis (i.e., the believability or the PD congruency) neither of the premises nor of the conclusions should be taken into account. To get familiarized with the reasoning task, participants received four examples. After the first two examples, the participants received feedback about the correctness of their decision, along with a standard explanation about the validity of the conclusion to be sure that the participants would understand their task. After the third and fourth example, the participants received feedback about the correctness of their decision without further explanation. While the feedback and explanation were presented, the particular syllogism remained on the screen. After the example syllogisms, the instructions for the reasoning task were summarized. The participant could start the actual reasoning task by pushing the space bar whenever he or she was ready.

Preceding every single stimulus presentation the sentence "*pay attention!*" appeared on the screen to alert the participant for the next syllogism. The participant indicated whether he or she considered the syllogism valid or not by pushing either the 'valid' or the 'not valid' button. The syllogism disappeared from the screen immediately after the participant had pushed one of the two buttons. Every next stimulus presentation appeared after a 2000 ms interval. The program recorded the participants' decisions (valid or invalid) as well as their response latencies (in milliseconds) on a trial by trial basis. During the experiment, the participants received no feedback about their performance.

After the first and the second set of 32 syllogisms, the computer paused and displayed the text "*This was the first (second) set of syllogisms. Please take a break for at least two minutes. Whenever you are ready, you may push the space bar to continue*". During the rest period, the computer did not respond for two minutes.

Data-reduction and analysis

For each type of syllogism within each domain, all errors are summed, resulting in 8 (2 domains * 4 types) error scores per participant. It can be expected that many participants will make zero errors on the belief bias task (linear syllogisms are relatively easy to solve, cf. de Jong, Weertman et al., 1997), and as such, it can be expected that the distribution of the error data on the belief bias task will be extremely skewed. If transformation can not sufficiently repair the skewness, we will perform no analysis of variance on the error data. Reaction times scores will be calculated by averaging the reaction times of the correct responses, again per type of syllogisms within each domain. For both types of syllogisms the responses will be subjected to repeated measures ANOVAs.

Results

Groups and psychopathology

The mean scores and standard deviations for the levels of psychopathology for the three groups are shown in Table 4.3. A multivariate ANOVA with group as between subject factor and FQ agoraphobia, FQ total and SCL total as outcome measures showed that the groups differed from each other on all measures, multivariate $F(6,146) = 18.05$, $p < .01$, $\eta^2 = .44$. For both FQ agoraphobia and FQ total, the PD group scored higher than the OCD group (contrast estimate = 13.56, $p < .01$ and contrast estimate = 17.50, $p < .01$ respectively) and the NCC group (contrast estimate = 19.60, $p < .01$ and contrast estimate = 35.87, $p < .01$ respectively). Also, the OCD group scored higher than the NCC group (contrast estimate = 6.04, $p = .024$ and contrast estimate = 18.27, $p < .01$ respectively). For SCL total, the PD group scored higher than the NCC group (contrast estimate = 100.56, $p < .01$) and the OCD group scored equal to the PD group (contrast estimate = 12.00, $p < .42$; also, the OCD group scored higher than the NCC group, contrast estimate = 112.56, $p < .01$). An additional one-way ANOVA, comparing the PD group and the OCD group on FQ main phobia, showed that the two groups did not differ in the strength of their main phobia ($F[1,59] = 0.16$, $p = .70$).

Table 4.3
Mean levels (and SD) of psychopathology for the three groups as measured with the FQ (main phobia and agoraphobia subscale, and sum score [total]) as well as the SCL-90.

	Panic Disorder group	Obsessive-Compulsive Disorder group	Non Clinical Control group
FQ main phobia	6.36 (1.78)	6.16 (2.21)	- [a]
FQ agoraphobia	22.00 (11.07)	8.79 (7.87)	2.40 (3.86)
FQ total	49.81 (21.74)	32.63 (17.56)	13.95 (8.96)
SCL total	210.76 (56.58)	221.54 (73.22)	110.20 (18.80)

[a]The main phobia subscale cannot be answered by non-clinical controls, since they do not have a main phobia.

Self-reported believability ratings

Due to miscommunication 8 participants were not presented with the self-report believability ratings, resulting in N = 72 for the believability analysis. The groups did not differ in their believability ratings for the believable neutral themes (F[2,69] = .37, p = .69): The themes were rated as very believable (M = 92.77). The unbelievable neutral themes were rated as unbelievable. Unexpectedly, the NCC group rated them as less unbelievable (M = 22.63) than the PD and the OCD group (M = 7.44 and M = 4.54 respectively), F(2,69) = 14.62, $p < .01$, $\eta^2 = .30$.

The PD congruent themes were rated as overall believable (M = 81.59), and the PD non-congruent themes as overall unbelievable (M = 15.98). Unexpectedly, there were no differences between the groups: $F_{PDcongruent}(2,69) = 0.55$, p = .58 and $F_{PDnon\text{-}congruent}(2,69) = 0.29$, p = .76, respectively. All groups perceived the PD congruency themes as believable, whereas we had expected that only (or especially) the PD group would consider them believable.

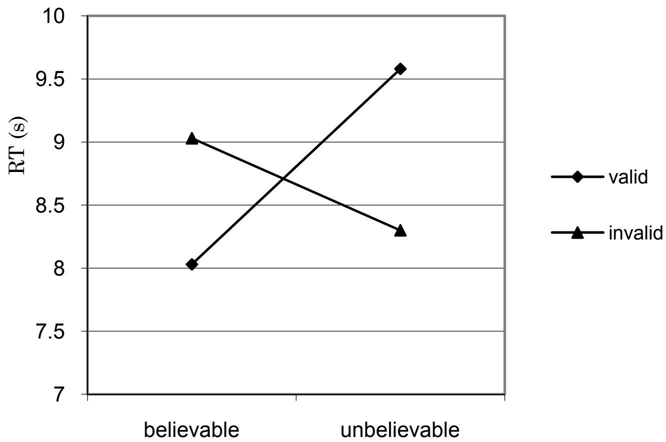
Differences in belief bias effects over groups

The error data were too skewed to be able to successfully transform them to meet assumptions for testing in repeated measures analyses of variance. Therefore, only the RT data are analyzed.

Generally enhanced belief bias?

For 11 participants it was impossible to compute belief bias RT scores for the neutral syllogisms because they made too many errors on at least one of the types of syllogisms, resulting in N = 69 for this part of the analysis. A repeated measures ANOVA with group as between subject factor and believability and validity as within subject factors showed a very large belief bias effect (viz. believability*validity effect, F[1,64] = 49.17, $p < .01$, $\eta^2 = .44$). The belief bias effect is shown in Figure 4.1. Participants needed more time to solve believable-invalid and unbelievable-valid syllogisms than to solve believable-valid and unbelievable-invalid syllogisms. This effect did, however, not differ significantly over the groups (F[2,64] = 2.21, p = .12)[12]. Furthermore, there was a significant main effect of believability (F[1,64] = 4.45, p = .04, η^2 = .07). Participants were faster solving believable syllogisms than solving unbelievable syllogisms.

Figure 4.1. Neutral belief bias effect (measured in s) averaged over the various groups.



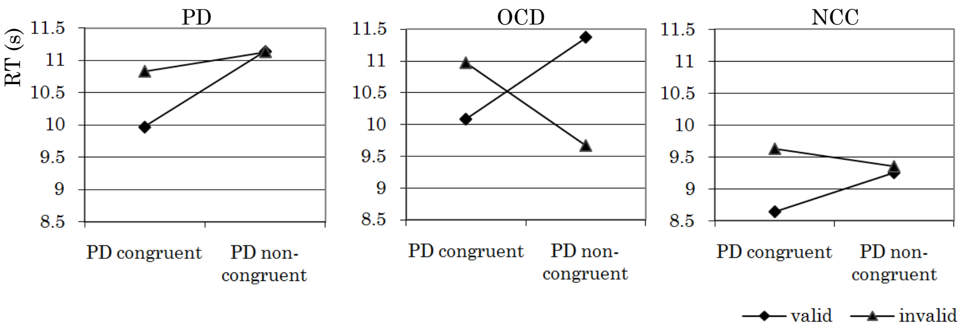
Domain specific belief bias?

For 10 participants it was impossible to compute the belief bias RT scores for the PD-relevant syllogisms because they made too many errors on at least one of the types of syllogisms, resulting in N = 70 for this part of the analysis. A repeated measures ANOVA with group as between subject factor and PD congruency and validity as within subject factors showed a strong belief bias effect (viz. PD congruency*validity effect, F[1,65] = 18.59, p < .01, η^2 = .22). The belief bias effects of the three groups are displayed in Figure 4.2. Participants needed more time to solve PD congruent-invalid and PD non-congruent-valid syllogisms than to solve PD congruent-valid and PD non-congruent -invalid syllogisms. Furthermore, there was a moderately strong group*validity interaction (F[2,65] = 4.26, p = . 02, η^2 =.12; $M_{\text{PD-valid}}$ = 10.56, $M_{\text{PD-invalid}}$ = 10.98, $M_{\text{OCD-valid}}$ = 10.73, $M_{\text{OCD-invalid}}$ = 10.32, $M_{\text{NCC-valid}}$ = 8.94, $M_{\text{NCC-invalid}}$ = 9.49).

[12] Because of the unexpected group differences in believability ratings of the neutral themes, we checked whether including the believability ratings as covariate would change the non-significant outcome of the group*believability*validity interaction. It did not: F(2,60) = 1.92, p = .16.

Most pertinent to the present study, the group*PD congruency*validity interaction effect approached the conventional level of significance (F[2,65] = 2.89, p = .07, η^2 = .08), indicating that the groups tended to differ in PD-relevant belief bias effect. Since this interaction is most relevant to our a priori hypothesis, we further explored the belief bias effect as expressed by each of the groups: As expected, the PD group indeed showed a belief bias effect ($F_{PDconguency*validity}$[1,33] = 4.23, p = .048, η^2 = .11), whereas the NCC group did not display belief bias for the PD congruency syllogisms ($F_{PDconguency*validity}$[1,20] = 0.82, p = .38, η^2 = .06). Unexpectedly, also the OCD group displayed a belief bias effect for the PD congruency syllogisms ($F_{PDconguency*validity}$[1,20] = 16.21, p < .01, η^2 = .45). A post hoc ANOVA restricted to the OCD and PD groups showed a significant group*PD congruency*validity interaction (F[1,49] = 4.96, p = .03, η^2 = .09), indicating that the OCD group displayed an even stronger belief bias than the PD group.

Figure 4.2. Panic disorder-related belief bias effects (measured in s.) for the various groups.



Discussion

This study investigated the relationship between belief bias and panic disorder. The main results can be summarized as follows: All groups showed a clear belief bias effect for the neutral themes. This belief bias effect was however not especially pronounced in the clinical (PD/OCD) groups. Only the clinical groups also showed a belief bias effect for the PD-themes, supporting the notion that belief bias may be involved in the maintenance of anxiety disorders. Unexpectedly, this effect appeared most pronounced for the OCD group.

The present study provides provisional evidence for a disorder-related belief-confirming reasoning bias. The finding that the OCD group displayed a similar (and even stronger) PD belief-confirming bias may indicate that the domain-specific belief bias (which was found in the present study for PD patients, but also in spider phobia patients; de Jong, Weertman et al., 1997) is in fact not domain-specific (viz. in content related to the convictions specific to the disorder) but a general tendency for anxiety patients to engage in fear-confirming reasoning when presented with anxiety related materials. However, in apparent conflict with this line of reasoning, previous research in a non-clinical sample has found no evidence for the existence of a relationship between general fear-confirming reasoning and anxiety disorder symptoms (Vroling & de Jong, 2010b). More likely, therefore, the present pattern of findings indicate that the syllogisms we used were not sufficiently specific for PD and/or did not sufficiently reflect the critical PD convictions. Panic is not uniquely related to panic disorder: panic attacks frequently occur in many anxiety disorders (e.g., APA, 1994; Barlow et al., 1985; MacAndrew, Heimberg, & Mennin, 1999). The OCD patients in the present sample have probably experienced panic attacks themselves, and are thus not unfamiliar with the PD congruent themes, which could have decreased the specificity of the themes for PD patients. Also, the use of linear syllogisms may have further decreased the specificity: Linear syllogisms require the use of a comparison category, which limits the possibility to closely match the syllogisms with dysfunctional beliefs. It seems plausible that statements such as ‘dizziness is scarier than sniffing a flower’ are more generally acceptable than convictions such as ‘if I feel palpitations, then I am going to have a heart attack’, which are typically reported by PD patients. This is also echoed in the self-reported believability ratings: all groups rated the PD congruency statements equally believable. It may therefore be helpful to look for alternative ways to measure belief bias which allow for a more close resemblance of the reasoning materials to dysfunctional beliefs (such as in conditional reasoning tasks, in which ‘if P then Q’ statements are used).

Previous research provided preliminary evidence that women suffering from spider phobia are characterized by a more extreme belief bias for general materials. The present study found no evidence to sustain these earlier findings. The anxiety patients in the present study showed a similarly enhanced belief bias as the non-clinical controls. In other words, we found no evidence for the notion that panic disordered and obsessive-compulsive patients differ from normal controls with respect to their reasoning strategies concerning neutral materials. These findings are consistent with two recent studies testing non-clinical samples that neither found evidence for a relationship between the strength of a generally enhanced belief bias and the intensity of people’s anxiety symptoms (Smeets & de Jong, 2005; Vroling & de Jong, 2010b). This casts further doubt on the role of a generally enhanced belief bias in the origin of anxiety disorders.

The present results do nevertheless fit to earlier findings reported by Pélissier and O'Connor (2002). Using a series of reasoning tasks concerning neutral themes, these authors tested whether obsessive-compulsive and generalized anxiety disordered patients differed from non-anxious controls with respect to inductive and deductive reasoning patterns. Although the experimental paradigms used by Pélissier and O'Connor did not focus directly on the influence of subjective believability of the premises and conclusions in their deductive reasoning tasks (i.e., belief bias), they too failed to find evidence to sustain the idea that the clinical groups differ from normal controls with respect to their ability to make correct deductions.

Even though we found no evidence for the notion that anxiety patients' reasoning is deviant, there is reason to assume that their reasoning will be heavily belief-biased when patients are confronted with fearful situations: As anxiety increases, working memory capacity becomes limited, which limits the reasoning to heuristic belief-based processing (viz. System 1 processing, as opposed to System 2 processing, which involves more deliberate complex reasoning; see Evans, 2003). This will further consolidate the dysfunctional beliefs (Evans & Curtis-Holmes, 2005; Tohill & Holyoak, 2000). Future studies should look into the effects of (induced) anxiety on deductive reasoning performance to validate this assumption.

Limitations

The most important limitation concerns the discrepancy between PD beliefs and the conclusions of the syllogisms. The believability ratings indicate that there is room for improvement in the resemblance of the PD congruency themes and dysfunctional PD convictions. This may well have diminished the sensitivity of the domain-specific part of the reasoning task. Also, the equally high believability ratings for the PD congruency themes by the OCD group hinders firm conclusions concerning the domain-specificity (or content-specificity) of the belief bias effect.

Conclusion

As expected, we found a domain-specific belief bias for PD patients. Unexpectedly, a similar (and even somewhat stronger) effect was found for the OCD patients. Future research needs to determine whether the present results represent a lack of sensitivity of the (PD congruency part of the) reasoning task. The present study provided no evidence for the existence of a generally enhanced belief bias within PD or OCD patient groups. As we found no differences between patients and normal controls, it seems unlikely that a generally enhanced belief bias plays an important role in the development of anxiety disorders. In sum, we found no evidence for belief bias being involved in the development of anxiety disorders, but did find evidence for a domain-relevant belief bias which logically serves to maintain the disorder.

Appendix: Syllogism content used in the experiment*

Neutral themes

castle > house > caravan	(bigger)
airplane > car > bicycle	(faster)
tree > bush > plant	(bigger)
elephant > dog > mouse	(bigger)

PD congruency themes

palpitations > wasp's sting > mosquito bite	(more dangerous)
dizziness > hearing an ambulance > sniffing a flower	(scarier)
gasping > dark cellar > romantic movie	(scarier)
pain on the chest > broken leg > cold	(more dangerous)

* Note: The neutral syllogisms varied systematically in believability and validity; the PD congruency syllogisms varied systematically in PD congruency and validity. See Tables 4.1 and 4.2 for an example of this systematic variation.

Chapter 5

Deductive reasoning and social anxiety: Evidence for a fear-confirming belief bias

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Abstract

This study investigated the relationship between belief bias and fear of negative evaluation. Belief bias refers to a bias in deductive reasoning that acts to confirm rather than falsify prior beliefs. Participants (N = 52) with varying levels of fear of negative evaluation completed a belief bias task by means of linear syllogisms, with stimuli covering both social anxiety convictions and factual neutral statements. A linear relationship was found between fear of negative evaluation and belief bias for the social anxiety conviction syllogisms. No differences in reasoning were found for the neutral syllogisms. These results support the view that highly socially anxious individuals do not have a reasoning abnormality, but do have difficulty judging anxiogenic information as false and reassuring convictions-contradicting information as true. Such belief bias logically prevents dysfunctional cognitions from being corrected, thereby sustaining phobic fear.

Introduction

Dysfunctional cognitions about rejection or shame are central in social anxiety disorder. The fear stemming from these convictions leads to a range of behaviours characteristic of social anxiety disorder (Clark & Wells, 1995; Rapee & Heimberg, 1997). Current cognitive models emphasize the role of information processing biases such as judgmental bias, attentional bias and interpretation bias in maintaining socially anxious convictions (for reviews see Bögels & Mansell, 2004; Clark & McManus, 2002; Hirsch & Clark, 2004). The major focus of current treatment strategies (e.g., Clark & Wells, 1995; CPA, 2006; Trimbos-instituut, 2003) is to somehow challenge these convictions in an attempt to replace dysfunctional and oftentimes irrational beliefs by more rational ones. The alleged crucial role of irrational beliefs in the persistence of symptoms points to the vital importance of individuals' ability to draw adequate conclusions. The inability to draw appropriate conclusions on the basis of available evidence seems a particularly direct way to impede the adjustment of irrational, anxiogenic beliefs. In cognitive psychology, the relatively poor performance in drawing appropriate conclusions when reasoning with materials that are counterintuitive (i.e., have a mismatch between the believability and the logical validity) is known as the belief bias effect. Despite its apparent importance, the ability to evaluate (dysfunctional) beliefs in light of evidence has received little attention in psychopathology research.

Belief bias refers to a bias in deductive reasoning that acts to confirm rather than falsify prior beliefs. This bias is demonstrated in a tendency to endorse a priori believable conclusions as valid and unbelievable conclusions as invalid, regardless of their actual logical status (Evans, Newstead, & Byrne, 1993). It is assumed to facilitate the maintenance of a relatively stable belief system from which the world and experiences can be interpreted without great effort, leaving the attentional capacities for more urgent and complex tasks. Therefore, in everyday life some degree of belief bias might be considered functional. Also in potentially dangerous situations, it may well be adaptive to rely on prior beliefs and act on plausible conclusions, rather than to consider whether those conclusions meet the standards of formal logic (e.g., Evans, Over, & Manktelow, 1993). If, however, the perceived threat is based on dysfunctional convictions (for instance, 'If I say something odd, people will ridicule me'), belief bias may become counterproductive. In that case, such a bias in deductive reasoning could impede the disconfirmation of anxiogenic beliefs, which in turn may lead to stable cognitions feeding the anxiety disorder (cf. de Jong, Weertman, Horselenberg, & van den Hout, 1997). Accordingly, belief bias may play a fairly direct role in the maintenance of fearful preoccupations.

Belief bias can be measured using a linear syllogistic reasoning task (e.g., Smeets & de Jong, 2005). In performing this task participants are asked to judge as quickly as possible the logical validity of syllogisms consisting of two statements, the premises, and a conclusion. Logical validity refers to the necessity of a conclusion, assuming that the premises are true. If it is true that 'A is larger than B' and that 'B is larger than C', it follows that 'A must be larger than C'. Logical validity would be violated when one concludes that 'C is larger than A' based on the given premises. When judging the validity, participants are instructed to ignore the believability of the conclusions. Believability refers to the meaning of the syllogism's conclusion. An example of a generally believable conclusion would be: 'An elephant is bigger than a mouse', whereas 'A mouse is bigger than an elephant' represents an example of a generally unbelievable conclusion. A valid yet unbelievable linear syllogism would be as follows:

Premise 1	A mouse is bigger than a dog
Premise 2	A dog is bigger than an elephant
Conclusion	**A mouse is bigger than an elephant**

Thus, participants have to judge whether a syllogism is logically valid, while ignoring its meaning. People are typically faster in reaching a decision about the validity of a syllogism when there is a match than when there is a mismatch between the validity and believability of the conclusion.

In a first attempt to explore this relationship, de Jong, Weertman et al. (1997) tested spider phobic participants and non-phobic controls for belief bias when reasoning with spider phobia relevant materials. They failed to find a convincing difference between the phobic and the non-phobic group. This might well have been due to methodological problems. Most important, spider phobia relevant beliefs (e.g., as indexed by the Spider Phobia Questionnaire by Arntz, Levy, van den Berg, & van Rijsoort, 1993) are hard to translate into linear syllogisms, which are based on comparison (e.g., A spider is creepier than a fish, a fish is creepier than a pigeon, hence a spider is creepier than a pigeon). The necessary inclusion of a comparison category decreases the resemblance between the syllogisms' conclusions and the dysfunctional beliefs, thereby probably decreasing the sensitivity of the task. In addition, it is doubtful whether spider phobia is the optimal candidate for testing this hypothesis. Although there is evidence that spider phobic individuals do report high believability ratings for irrational spider related beliefs (e.g., 'the spider will kill me'; Arntz et al., 1993; Thorpe & Salkovskis, 1995), it is still a matter of debate whether dysfunctional beliefs indeed play a crucial role in the aetiology and maintenance of the phobic symptoms. Some authors describe spider phobia as a prototypical "non-cognitive" (evolutionary prepared) fear (e.g., Seligman, 1971).

Accordingly, spider fearful individuals find it extremely difficult to articulate what they actually fear (e.g., Davey, 1992).

Therefore, the present study focussed on social anxiety (rather than spider phobia) to test further the potential role of belief bias in anxiety disorders. Dysfunctional beliefs are generally assumed to be central to social anxiety disorder (e.g., Clark & Wells, 1995), and a striking feature of these beliefs is their persistence in the face of incompatible data. That is, because socially anxious individuals cannot so easily avoid the situations they strongly fear (as spider phobic individuals can), most socially anxious individuals will have been involved in many social situations that contradicted their fearful convictions (e.g., situations in which they are not ridiculed for saying something odd). Moreover, social anxiety beliefs often imply social comparison, making social anxiety convictions more suitable for translation into linear syllogisms (e.g., 'I am not likeable' translates into 'I am less likeable than others' or into a linear syllogism such as 'I am less likeable than Jane and Jane is less likeable than John'). The main aim of the present study was thus to test the hypothesis that socially anxious individuals are characterized by belief bias when reasoning about social anxiety themes. Therefore, a group of individuals varying in their level of fear of negative evaluation (one of the central cognitive concepts within social anxiety, e.g., Clark & Wells, 1995) was presented with a series of linear syllogisms concerning themes relevant to social anxiety.

If enhanced belief bias is only evident for dysfunctional convictions, this would be consistent with the idea that the rigidity of anxiogenic beliefs may not itself result from a reasoning abnormality, but may represent a normal tenacity of important and strongly held beliefs (cf. Garety & Hemsley, 1997). Yet, research in the context of spider phobia (de Jong, Weertman et al., 1997) provided preliminary evidence to suggest that psychopathology patients show a generally enhanced belief bias (i.e., not restricted to the domain of the psychopathological concerns). This raises the possibility that this reasoning bias reflects a trait-like information processing bias that acts as a diathesis in the development of psychopathological disorders in general (cf. Arntz, Rauner, & van den Hout, 1995). As a subsidiary issue it was therefore tested whether socially anxious individuals are (also) characterized by enhanced belief bias for factual information that is irrelevant for their social anxiety concerns.

To summarize, content interferes with logical reasoning when reasoning with highly believable materials. As socially anxious people hold strong social anxiety convictions, one can expect to find a belief bias effect concerning social anxiety related materials for the high social anxiety group and not for the low social anxiety group. In addition to this content-specificity hypothesis, it is explored, based on the earlier finding by de Jong, Weertman et al. (1997), whether high socially anxious people have a general tendency to apply belief bias more often compared to low anxious people. Therefore, we also tested whether socially anxious individuals will show a relatively strong belief bias when reasoning with neutral, generally believable, materials.

Method

Participants

As part of their course requirement, first-year psychology students (N = 339) participated in a mass-screening during the start of the first semester. The majority of these students (N = 234) gave permission to contact them for further research[13]. On the basis of their scores on the brief Fear of Negative Evaluation scale (BFNE, Leary, 1983; for more details see below) we pre-selected extreme groups. High and low scoring students on the scale were approached for the current study, six months after the mass screening. Participants from the extreme ends of the distribution of the BFNE scores were contacted until 30 students[14] were willing to participate for each group (to include 30 willing participants per group, 25 % of the lowest scoring participants and 20% of the highest scoring participants were contacted; BFNE scores ranged from 1 to 15 and 30 to 48 respectively). Of these 30 participants, 26 of each group showed up at the lab. The final sample consisted of 15 men (7 high anxiety and 8 low anxiety) and 37 women (19 high anxiety and 18 low anxiety), with a mean age of 20 (SD = 1.65). Participants received course credits, or a small financial reward if they had already fulfilled course requirements.

Participants again completed the BFNE as part of the experiment. Unexpectedly, participants' BFNE scores during the actual experiment no longer showed a bi-modal distribution. In fact, participants' BFNE scores were now distributed over almost the entire range of the BFNE (range = 1 – 42, M = 22.65, SD = 11.37, $P25$ = 13.5, $P50$ = 22.5, $P75$ = 33.75). The average BFNE scores of untreated Dutch social anxiety disorder patients in the Netherlands is around 34[15] (e.g., Voncken, Bögels, & de Vries, 2003 M = 33.9; Voncken, Bögels, & Peeters, 2007 M = 28.7-38.0; Bögels, Sijbers, & Voncken, 2006 M = 36.67). Looking at the percentiles of our distribution, we can thus conclude that about

[13] These students did not differ in their BFNE-scores (permission BFNE = 22.6, no-permission BFNE = 22.0, t [337] = 0.63, p > .05).

[14] Power-analysis indicated that with an expected large effect and with 80% power and α = .05, n per group should be at least 25. Anticipating potential technical problems during data acquisition and/or participants not showing up, it was decided that 30 subjects should be selected per group.

[15] The Dutch BFNE uses a 0 – 4 scale, whereas some English versions use a 1 – 5 scale. This explains the seemingly large differences in Dutch and English-speaking patients' BFNE scores.

25 % of the BFNE scores that were assessed on the day of the experiment were as high as or higher than the average social anxiety disordered patient score. A paired sample t-test revealed no changes in average BFNE score over time ($M_{\text{preselection}}$ = 23.87, $M_{\text{experiment}}$ = 22.65, $t(51) = 1.01$, $p = .317$).

Materials and apparatus

Syllogistic reasoning task

Linear syllogisms in the form 'a > b, b > c, therefore a > c' were constructed for the social anxiety convictions domain. In an attempt to cover the most relevant convictions, eight topics were selected based on the Social Phobia Beliefs Questionnaire (SPBQ[16], e.g., *I am more vulnerable than others in social situations*, *Everybody watches me in social situations*, and *I am less skilled than others in social situations*; List based on description of cognitions in social anxiety by Beck, Emery, & Greenberg, 1985). To rule out the possible influence of idiosyncratic associations between particular names and particular characteristics, the terms 'person 1' and 'person A' were used rather than concrete names as the neutral reference persons in the syllogisms. Each topic was presented in two perspectives: a public self-referent (e.g., *Others find me less interesting than person 1*) and a private self-referent (e.g., *I am less interesting than person 1*) perspective. This was done because the literature seems unclear in whether social anxiety disorder concerns negative public or private self-referent convictions, or both (e.g.,Hofmann & Scepkowski, 2006; Mansell & Clark, 1999), and to ensure targeting the convictions that are most relevant for social anxiety patients.

To test reasoning with factual (neutral) materials, eight complaint-irrelevant, neutral syllogisms were included that refer to common knowledge (e.g., 'A leopard is faster than a human being. A human being is faster than a snail. Therefore, a leopard is faster than a snail'). See the Appendix for a list of all social anxiety congruent convictions and neutral syllogisms that were used in this study.

Traditionally, the belief bias effect has been defined as the interaction between logical validity and believability, with higher latencies and more errors for syllogisms that are valid yet unbelievable and syllogisms that are invalid yet believable (i.e., when there is a mismatch between logical validity and believability) (Evans, Newstead et al., 1993). In the present study, the term 'believability' is not used. The term 'reality value', with the dimensions 'true' and 'untrue', is used to refer to the content of the neutral common knowledge syllogisms and the term 'social anxiety convictions' (SA convictions), with the

[16] The psychometric properties of the SPBQ are reported in an unpublished master-thesis (Bezemer, 1995).

Table 5.1

Example of a social anxiety convictions syllogism, varying in logical validity and SA congruency.

	SA congruent conclusion	SA non-congruent conclusion
valid	Others find me less capable than person A Others find person A less capable than person 1 **Others find me less capable than person 1**	Others find person 1 less capable than person A Others find person A less capable than me **Others find person 1 less capable than me**
invalid	Others find person 1 less capable than person A Others find person A less capable than me **Others find me less capable than person 1**	Others find me less capable than person A Others find person A less capable than person 1 **Others find person 1 less capable than me**

Table 5.2

Example of a neutral syllogism, varying in logical validity and reality value.

	Believable conclusion	Unbelievable conclusion
valid	An elephant is bigger than a dog A dog is bigger than a mouse **An elephant is bigger than a mouse**	A mouse is bigger than a dog A dog is bigger than an elephant **A mouse is bigger than an elephant**
invalid	A mouse is bigger than a dog A dog is bigger than an elephant **An elephant is bigger than a mouse**	An elephant is bigger than a dog A dog is bigger than a mouse **A mouse is bigger than an elephant**

dimensions 'SA congruent' and 'SA non-congruent', to refer to the content of the social anxiety themes.[17] Thus for the neutral themes, a belief bias effect is manifested in the interaction between logical validity and reality value, with higher latencies and more errors when there is a mismatch between the reality value of a conclusion and its logical validity, whereas reasoning performance is enhanced (faster responding, less errors) when there is a match between a conclusion's logical validity and reality value. The domain-specific belief bias is manifested in the interaction between the congruency of the individual's social-anxiety-relevant convictions (social anxiety congruent or non-congruent) and logical validity of the syllogisms. Thus, for socially anxious individuals, relative poor performance (i.e., slow and more mistakes) is expected when solving SA congruent-invalid and SA non-congruent-valid syllogisms, but relatively good performance (fast and few errors) when answering SA congruent-valid and SA non-congruent-invalid syllogisms.

Each topic from the SA convictions category was presented in a SA congruent-valid, a SA non-congruent-invalid, a SA congruent-invalid, and a SA non-congruent-valid manner. Each topic from the neutral common knowledge category was presented in a true-valid, an untrue-invalid, a true-invalid, and an untrue-valid manner; see Tables 5.1 and 5.2 for an example of each combination. For all syllogisms the two premises were presented in two orders (a > b, b > c and conclusion a > c against b > c, a > b and conclusion a > c) to counter possible reading strategies that could undermine the task's sensitivity as a measure of reasoning bias (cf. Smeets & de Jong, 2005).

For the social anxiety relevant part 8 topics * 2 perspectives * 4 types * 2 premise orders = 128 syllogisms were used. For the neutral common knowledge themes 8 topics * 4 types * 2 premise orders = 64 neutral syllogisms were used. Both categories of syllogisms were presented intermixed in four blocks of trials, separated by a fixed 30-second break. Each block started with three filler syllogisms used in a previous experiment to ensure participants were focused on the task when answering the experimental syllogisms. The outcome measures were reaction time (RT) and number of errors.

Stimuli were divided over the four blocks and were presented in a fixed random order with the following restrictions – topic and perspective should differ between all consecutive stimulus presentations, a particular syllogism type (e.g., true-invalid) could not occur more than twice in a row and premise order should differ at every fourth stimulus presentation at least. To ensure

[17] Contrary to common practice, the term 'believability' is not used, because in our study, there is an important distinction between the neutral and the SA convictions themes: the neutral themes relate to factual information while the SA convictions relate to beliefs people have. For these latter themes, the factual status of the beliefs cannot be known.

that all blocks resembled each other, all syllogism topics were presented equally frequently in each block, and premise order and syllogism type were balanced as a function of category and perspective within blocks. Hence, each topic of the neutral common knowledge category was presented twice and each social anxiety relevant topic was presented twice for each perspective, public or private self-referent, per block. With these restrictions, four similar fixed random stimulus lists were created.

To counter possible carry-over effects between blocks, multiple stimulus list combinations were created. First, reversed (z-a) duplicates were made out of the four stimulus lists described above. After that, the resulting eight different lists were combined into six different list combinations. Participants were randomly assigned to one of the list combinations.

Belief check

To confirm that the social anxiety syllogisms were indeed congruent with social anxiety concerns, participants were asked to indicate how believable they rated the SA congruent and the SA non-congruent conclusions used in the syllogistic reasoning task. The conclusions were presented as statements on a computer screen, four at a time. Believability was rated for each statement by means of a Visual Analogue Scale (VAS). These VASs were 17 cm in length with 'unbelievable' displayed left of the VAS, and 'believable' right of the VAS. The VASs were presented below each statement. Participants had to click on a position on the line with the mouse for their answer, with which a vertical dash appeared on the line. Participants could change the position of the dash if they liked. After having completed all four VASs per screen, participants clicked a 'continue' button for the next screen. The final VAS answers were rescaled into a 0-100 range. Final believability ratings per statement thus ranged from 0 to100.

Fear of negative evaluation

The 12-item brief Fear of Negative Evaluation scale (Leary, 1983) was used to measure core concerns of social anxiety. Items of the BFNE (e.g., *I am often afraid that people will notice my shortcomings*) are rated on a 5-point scale (0 – 4) indicating the self-reported applicability of the items. The scores range between 0 and 48, with 48 indicating extreme fear of negative evaluation. The BFNE discriminates between social anxiety disorder and panic disorder and also has good concurrent validity (Collins, Westra, Dozois, & Stewart, 2005). Internal consistency in the present sample was high at mass-screening (Cronbach's alpha = .97, n = 52), as well as during the experiment (Cronbach's alpha = .94, n = 52).

Procedure

Experimenters were blind to the participants' fear of negative evaluation pre-test scores. The participants were tested in small groups (one to six participants). Participants were asked to start the computer programme. They were instructed to judge the validity of the syllogisms as quickly as possible by pressing a red 'NO' key on the left side of the keyboard or a green 'YES' key on the right. Participants were given four practice items with feedback on the correctness of their answers. Further explanation of the validity of the conclusion was given for the first and second practice items. The instructions were repeated at the start of each block. Each stimulus was preceded by a blank screen (500 ms) and a screen reading 'pay attention!' (1500 ms). Each stimulus disappeared as soon as a response was given, with a maximum of 20 s. If no response was given within this interval, it was treated as an incorrect response. After participants had completed the syllogistic reasoning task, they completed the belief check, after which they filled out a hardcopy version of the BFNE and were debriefed.

Data analysis

The outcome measures of the syllogistic reasoning task were computed by averaging the median RTs of the four blocks. For errors, the sum of errors over the blocks was computed. As reaction times have a fixed cut-off point (0 s or close to 0 s, depending upon the task that needs to be performed) possible skewness of the RT data was anticipated. It was therefore planned to use square rooted RT as outcome measure.

Although the study was initially designed to compare a high and a low anxious group, the participants showed a continuous rather than dichotomous distribution of BFNE scores (see participants section). To retain optimal power, the full range of scores was used, treating BFNE as a continuous measure of social anxiety. As such, our hypotheses had to be translated to fit the current design: More belief bias for social anxiety congruent materials with increasing BFNE scores is expected. In addition, it was explored whether belief bias for neutral common knowledge materials increases with BFNE scores. Accordingly, the RT/error data were subjected to a multi-level regression analysis using the MLwiN programme (see http://www.cmm.bristol.ac.uk/MLwiN/index.shtml; Rasbash, Browne, Healy, Cameron, & Charlton, 2004).

All multilevel models were fitted with 'measures per subject' as level one, and 'subject' as level two. The within-subject variables were dummy coded: SAcongruency 0 (SA non-congruent) and 1 (SA congruent); reality 0 (untrue) and 1 (true); validity 0 (invalid) and 1 (valid). BFNE*within-subject effects were also computed. For each category, two multilevel models were compared by means of a χ^2 likelihood ratio test; the basic model which appreciates the experimental within-subject structure but ignores the potential influence of BFNE (see Table 5.3, equations 1 and 3 for the basic model of the social anxiety convictions and the neutral common knowledge category respectively), and the hypothesized BFNE-interaction model including both the experimental within-subject structure and its potential interaction with the BFNE (see Table 5.3, equations 2 and 4 for the BFNE-interaction model of the social anxiety convictions and the neutral common knowledge category, respectively). For each category, it was evaluated which model fitted the data best. Within the best fitting model, the predictors were examined by means of t-tests. For the social anxiety conviction syllogisms, our hypothesis refers to a better fit of the BFNE-interaction model, and within this model, a significant contribution of the BFNE*SAcongruency*validity interaction to the prediction. For the neutral common knowledge syllogisms it was explored whether the fit improves when including the BFNE-interaction and, if so, whether the BFNE*reality*validity interaction significantly contributes to the prediction. For all tests, a critical value of α = .05 was adopted, one-sided for χ^2-tests and t-tests.

Table 5.3

The basic model and the BFNE-interaction model for the common knowledge and the convictions domain used in the multilevel analyses.

	Basic model	BFNE-interaction model
Social anxiety convictions category	Square-root Reaction time (ms)$_{ij}$ = β_{0ij}constant + β_1SAcongruency$_{ij}$ + $\beta_2$validity$_{ij}$+ β_3SAcongruency*validity$_{ij}$ + u_{0j} + ε_{ij} (1)	Square-root Reaction time (ms)$_{ij}$ = β_{0ij}constant + β_1SAcongruency$_{ij}$ + $\beta_2$validity$_{ij}$+ β_3SAcongruency*validity$_{ij}$ + β_4BFNE$_j$ + β_5BFNE*SAcongruency$_{ij}$ + β_6BFNE*validity$_{ij}$ + β_7BFNE* SAcongruency*validity$_{ij}$ + u_{0j} + ε_{ij} (2)
Neutral common knowledge category	Square-root Reaction time (ms)$_{ij}$ = β_{0ij}constant + $\beta_1$reality$_{ij}$ + $\beta_2$validity$_{ij}$+ $\beta_3$reality*validity$_{ij}$ + u_{0j} + ε_{ij} (3)	Square-root Reaction time (ms)$_{ij}$ = β_{0ij}constant + $\beta_1$reality$_{ij}$ + $\beta_2$validity$_{ij}$+ $\beta_3$reality*validity$_{ij}$ + β_4BFNE$_j$ + β_5BFNE*reality$_{ij}$ + β_6BFNE*validity$_{ij}$ + β_7BFNE* reality*validity$_{ij}$ + u_{0j} + ε_{ij} (4)

Results

Belief check

The believability scores of the social anxiety themes were calculated by subtracting the believability rating of the congruent conclusion from the non-congruent conclusion per theme, so that negative scores reflected negative, social anxiety congruent, views. For each theme, the believability scores for the public self-referent and the private self-referent perspective were averaged, resulting in eight believability scores. Also, an overall believability score was calculated by averaging all believability scores.

Cronbach's alpha was computed to determine the internal consistency of the eight themes, which proved to be good (α = .86). Supporting the validity of the present stimulus materials, the overall believability score correlated significantly with the BFNE scores (r = -.39, p = .004).

Syllogistic reasoning task

As expected, the RT data showed both significant skewness and kurtosis for some cells of the design. Normality was improved by square-root transformation of the RT data, but there were still some mild violations of kurtosis and skewness (the highest kurtosis was reduced from $z_{kurtosis} = 7.6$ to $z_{kurtosis} = 4.9$, and the highest skewness from $z_{skewness} = 5.6$ to $z_{skewness} = 3.5$). Details about the distributions can be obtained from the first author on request.

The error rate was too low to be meaningfully subjected to statistical analysis (cf. de Jong, Weertman et al., 1997). Hence statistical analysis was restricted to the RT data.

Social anxiety convictions syllogisms

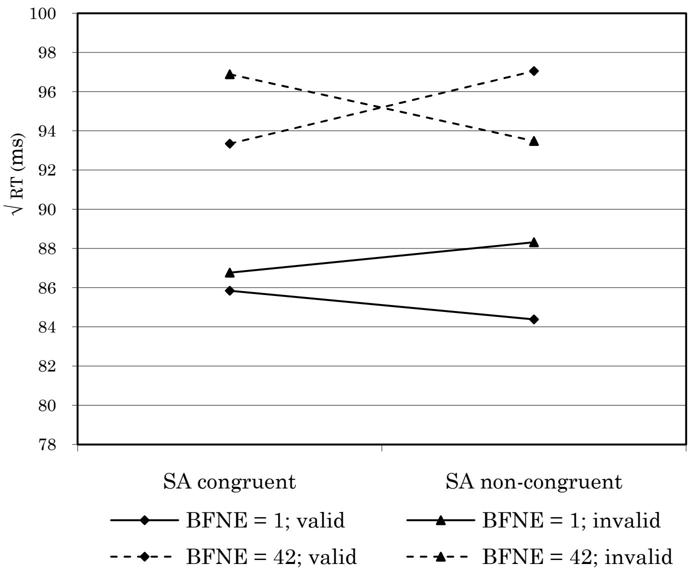
The BFNE-interaction model produced a significantly better fit over the basic model: χ^2difference (4) = 10.03, p = .040. The BFNE-interaction model best represents the data and looks as follows:

$$\begin{aligned}
&\text{Square-root Reaction time (ms)}_{ij} = \\
&88.190(3.297)_{ij}\text{constant} + \\
&-1.675(1.826)\text{SAconcruency}_{ij} + -4.116(1.826)\text{validity}_{ij} + \\
&3.257(2.583)\text{SAconcruency*validity}_{ij} + 0.126(0.130)\text{BFNE}_{j} + \\
&0.121(0.072)\text{BFNE*SAcongruency}_{ij} + 0.183(0.072)\text{BFNE*validity}_{ij} + \\
&-0.247(0.102)\text{BFNE*SAcongruency*validity}_{ij} + u_{0j} + \varepsilon_{ij}. \qquad (5)
\end{aligned}$$

Most importantly, the BFNE*SAcongruency*validity interaction dummy contributes significantly to the prediction (t [200] = -2.42, p = .008). The main effect of BFNE is not significant, but the BFNE*validity interaction dummy and the BFNE*SAcongruency interaction dummy are (t [200] = 2.54, p = .006 and t

[200] = 1.68, p = .047, respectively). Furthermore, the dummy for validity is also significant (t [200] = -2.28, p = *.012*), with SA non-congruent-valid syllogisms being solved slightly faster than SA non-congruent-invalid syllogisms, while the SAcongruency*validity interaction dummy and the SAcongruency dummy are not significant. To be able to interpret the direction of the BFNE-interaction effects, the equation was solved for our lowest and highest scoring participant (BFNE = 1 and BFNE = 42 respectively). The resulting patterns can be seen in Figure 5.1. There is a clear belief bias effect for high scorers (faster responses when there is a match between the conclusions' congruency with social anxiety-relevant convictions and the conclusions' logical validity), and no belief bias effect for low scorers.[18]

Figure 5.1. Square-rooted RTs (ms) on the four conditions of the social anxiety convictions domain for the lowest (BFNE = 1) and the highest (BFNE = 42) socially fearful participants, illustrating the SAcongruency*validity*BFNE interaction.



[18] When taking the two perspectives (public and private self-referent) apart, treating them as a third within-subject factor, multilevel analysis shows no significant BFNE*SAcongruency* *validity*perspective interaction (t [192] = 0.24, p = .405), indicating that the two perspectives show a similar pattern of belief bias dependent on BFNE.

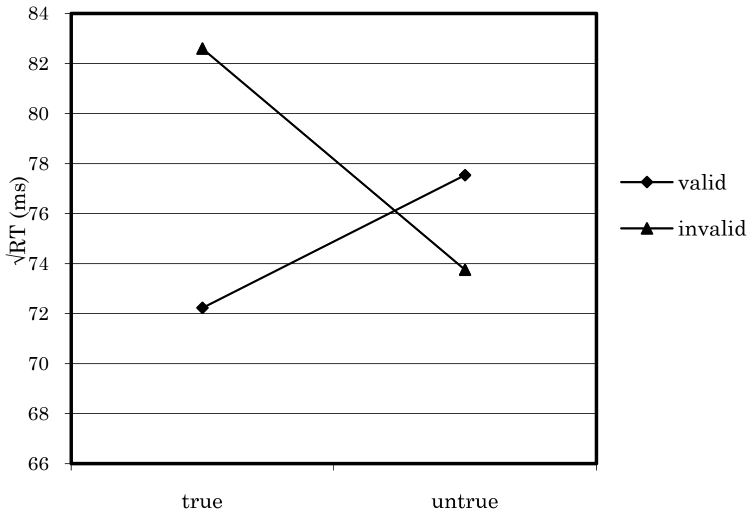
Neutral common knowledge syllogisms

The BFNE-interaction model did not produce a significantly better fit over the basic model: χ^2difference (4) = 3.77, p = .437. The basic model best represents the data and looks as follows:

$$\text{Square-root Reaction time (ms)}_{ij} = 73.750(1.474)_{ij}\text{constant} + 8.846(1.086)\text{reality}_{ij} + 3.788(1.086)\text{validity}_{ij} + -14.154(1.536)\ \text{reality*validity}_{ij} + u_{0j} + \varepsilon_{ij}. \quad (6)$$

There is a significant reality*validity interaction dummy (t [204] = -9.25, p < .001), and solving the equation shows that this interaction-effect is indeed the hypothesized belief bias effect, see Figure 5.2. This interaction was not influenced by the BFNE scores. Thus, there was no evidence supporting the idea that highly socially anxious participants display an increased general belief bias. The dummy for reality was significant, t (204) = 8.15, p < .001. On trials representing syllogisms that are invalid, true syllogisms (mismatched syllogisms, true-invalid) took longer to be solved than untrue syllogisms (matched syllogisms, untrue-invalid). The dummy for validity was also significant, t (204) = 3.49, p < .001. For trials representing syllogisms that are untrue, valid syllogisms (mismatched syllogisms, untrue-valid) take longer to solve than invalid syllogisms (matched syllogisms, untrue-invalid).

Figure 5.2. Square-rooted mean median RTs (ms) on the four conditions of the neutral syllogisms.



Additional analysis

During the debriefing procedure, some participants indicated that they found the syllogistic reasoning task was too long. In light of future use of this task, the data were therefore re-analysed using only the first half of the task (given the counterbalanced presentation of syllogisms over the blocks, this does not result in a different or unbalanced design). The results were similar to those obtained using all stimuli: the BFNE-interaction model was superior to the basic model for the social anxiety convictions category (χ^2difference [4] = 10.91, p = .028), and the BFNE*SAcongruency*validity interaction dummy in this model proved significant (parameter-estimate: -0.250, t [200] = -1.85, p = *.033*). The BFNE-interaction model was not superior to the basic model for the neutral common knowledge category (χ^2difference [4] = 13.43, p = .009), and therefore there was no BFNE*reality*validity interaction.

Discussion

This study investigated the relationship between belief bias and social anxiety. Although the study was initially designed to compare a high and low anxiety group, a shift in design had to be made due to the change in BFNE scores after preselection. Instead of making group comparisons, it was tested whether belief bias increased with increasing BFNE scores. Furthermore, the analyses were restricted to the RT data, as the error rates and the dispersion were too low to be analysed. The low error rates indicate that participants were committed to following the task instructions and did not show response biases. The main results can be summarized as follows. First, for the social anxiety relevant materials, results indicated that the higher participants' fear of negative evaluation, the stronger the belief bias effect. Second, for the neutral common knowledge syllogisms, there was an overall belief bias effect that was independent of participants' fear of negative evaluation.

According to contemporary cognitive models of anxiety disorders, persistent dysfunctional cognitions (such as 'If I make a mistake, people will make fun of me') play a vital role in the maintenance of symptoms (e.g., Beck et al., 1985; Clark & Wells, 1995; Rapee & Heimberg, 1997). One obvious explanation for the refractoriness of this type of anxiogenic convictions is that socially anxious individuals are actually evaluated less positively than non-anxious individuals, for example because they behave less skilful in social situations. In line with this, there are indications that in some situations people suffering from social anxiety may indeed perform less well than non-anxious controls (e.g., Stopa & Clark, 1993; Voncken & Bögels, 2008). This does not however imply that the convictions of social anxiety patients are necessarily true, as these oftentimes concern blunt negative appraisal or rejection by others. Another mechanism that may play a fairly direct role in the persistence of these anxiogenic convictions concerns the difficulty to correct dysfunctional convictions when confronted with disconfirming evidence. Correcting erroneous convictions requires the ability to accurately deduce the logical implications of empirical evidence for certain convictions. For instance, not being made fun of after having made a public mistake should lead to correction of the dysfunctional belief 'If I make a mistake, people will make fun of me', since it proves that the cognition is invalid. In support of the hypothesis that belief bias may be involved in social anxiety, the results for the RT data showed that individuals high in fear of negative evaluation have relative difficulty in judging anxiogenic (i.e., social anxiety congruent) information as false and reassuring non-congruent information as true. Such a belief bias effect for social anxiety convictions logically prevents dysfunctional cognitions from being corrected, thereby sustaining phobic fear.

It should be acknowledged that belief bias theory concerns errors in reasoning. In the present study we used linear syllogisms that are known to be relatively easy and to produce little errors (Huttenlocher, 1968). Indeed, in line with previous research using this type of syllogisms (e.g., de Jong, Weertman et al., 1997), participants in this study made only few errors. This implies that the participants actually reasoned analytically when performing the task. In this study, a belief bias effect for RTs was found in a single-task situation where all resources could be employed to the task. With all resources available, the participants needed more time to answer the mismatched syllogisms, indicating that it took more effort and/or resources to answer these syllogisms. It seems safe to assume that when reasoning takes more effort in a lab, it will result in faulty reasoning when sufficient cognitive resources and/or the motivation to reflect on the validity of their initial convictions are lacking, which is likely to be the case in most real life situations (e.g., Beevers, 2005; Evans & Curtis-Holmes, 2005). Obviously, further research manipulating the availability of cognitive resources is necessary to arrive at more final conclusions in this respect.

The absence of a relationship between belief bias for neutral common knowledge and fear of negative evaluation indicates that anxious individuals are not characterized by a reasoning abnormality and that the belief bias for social anxiety convictions that was found in the present study reflects a normal tendency to reason in a belief biased manner with respect to strongly held convictions.[19] This belief bias for social anxiety convictions is merely problematic because it logically acts to maintain convictions that are *dysfunctional*.

The finding of complaint-related belief bias for individuals who are fearful of negative evaluation is an important first step in determining whether belief bias may indeed be involved in the maintenance of social anxiety disorder. Meanwhile, it should be acknowledged that on the basis of the present study it cannot be ruled out that this belief bias for social anxiety convictions is a mere symptom of social anxiety rather than a mechanism that reciprocally strengthens the dysfunctional convictions. While causality problems of the present type are hard to solve, they are theoretically important. As a next step it would be worthwhile investigating whether post-treatment belief bias is predictive of relapse after successful treatment (cf. de Jong, van den Hout, & Merckelbach, 1995). If not, causality seems highly unlikely. A more direct and rigorous way to test the causal properties of belief bias would be to specifically reduce belief bias and to test whether this results in a reduction of dysfunctional beliefs and symptoms of social anxiety (cf. MacLeod, Rutherford, & Campbell, 2002). Perhaps most relevant to the clinical context is the question whether enhanced belief bias present after successful treatment of the social anxiety disorder can predict relapse. If the symptoms have disappeared, but social anxiety related belief bias is still present, this belief bias potentially indicates that the patient still holds social anxiety related convictions. As such, the belief bias task may serve as an implicit measure to detect such (potentially unreported) remaining beliefs. Of course, further research is required to actually test these notions.

It is a well-established fact that the belief bias theory holds for common knowledge and commonly shared prejudices (e.g., Evans, Newstead, et al., 1993). The current study illustrates that belief bias effects can also be found for irrational convictions for which disconfirming evidence is widely available. The finding that correct information does not necessarily result in disconfirmation of irrational convictions emphasizes the difficulty for people to reason following logical rules. This underscores the importance of explicitly discussing the arguments for and against dysfunctional convictions in the context of behavioural experiments as a way to help patients to detect the relevant premises or arguments for their dysfunctional conclusion.

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[19] Based on the current design, it cannot be ruled out that high socially anxious people display a stronger belief bias for all sorts of convictions (e.g., prejudices) than low anxious people. This would however not alter the interpretation of the current findings.

Limitations

Although the correlation between the believability check and the BFNE was significant and supports the validity of the stimulus materials that were used, the modest strength of the association suggests that there is also still room to further improve the validity of the stimulus material and thereby the sensitivity of the present belief bias task. It should be acknowledged that global social anxiety themes were used. The validity of the task may be enhanced by adjusting the syllogisms to individuals' core beliefs. In addition, the construction of linear syllogisms required the inclusion of abstract contrasts (e.g., I am less socially skilled *than person A* and *person A* is less socially skilled *than person 1*) which may have resulted in a sub optimal reflection of the individual's actual convictions. Future research may need to search for different paradigms to measure belief bias which allow for a better match of the materials with the actual convictions.

There was a discrepancy between the BFNE scores during the mass-screening and during the experiment proper. This could raise some doubts concerning the reliability and validity of our screening instrument. Yet, the reliability scores of both test administrations were high. Hence, there is reason to suspect that the changes in scores reflect real changes in social anxiety rather than a statistical artefact (cf. Dijk & de Jong, 2009) or unreliability of the BFNE. Ample new social experiences associated with starting a new life as a student could potentially explain the unexpected deviance in BFNE scores between the mass-screening and the actual experiment. These change in BFNE scores interfered with our planned factorial approach. Fortunately, the range and distribution of BFNE scores during the actual experiment allowed us to test our hypotheses while maintaining the continuity of our data, resulting in a relatively powerful design.

Another point of attention lies in the use of the BFNE as a measure of social anxiety. There have been some concerns with the use of BFNE as a measure of social anxiety, given that it only measures beliefs and not behaviours (Wilson & Rapee, 2005). On the other hand, Collins et al. (2005) and Weeks et al. (2005) have found that the BFNE is a valid measure for clinical social anxiety groups. In addition, Stopa and Clark (2001) showed that for psychological process studies, an analogue design based on BFNE-scores produces findings that are essentially the same as those found in studies using social anxiety disordered patients and non-clinical controls. The results of the current study can be potentially relevant to other patient groups as well: Studies using different analogue or patient groups such as eating disorders have found correlations between the BFNE and self-reported eating disorder and depressive symptoms (e.g., Gilbert & Meyer, 2003; Hinrichsen, Wright, Waller, & Meyer, 2003). On the other hand, both eating disorder and depression self-report questionnaires are known to correlate with other measures of social anxiety symptoms as well (e.g., Gibb, Coles, & Heimberg, 2005; Hinrichsen, Waller, & van Gerko, 2004), and both disorders are found to have high comorbidity with social anxiety disorder (e.g., Kessler, 1995; Pallister & Waller, 2008). Whether the results of the current study can be generalized to disorders such as depression and eating disorder remains to be seen.

The order of the BFNE and the syllogistic reasoning task was not counterbalanced over participants. The BFNE was always administered after completion of the reasoning task. This was done to avoid potential priming effects of the BFNE on the reasoning task (cf. Bosson, Swann, & Pennebaker, 2000), however this procedure may have enhanced existing individual differences in BFNE scores.

A final remark concerns the generalisation of the current findings. It remains to be seen whether similar findings will be obtained in a more male/female balanced group, as well as in less highly educated groups. In addition, the present study relied on an analogue sample, and it remains therefore to be seen whether similar findings will be obtained in treatment seeking individuals suffering from a clinically diagnosed social anxiety disorder.

Conclusion

The present study supports the potential importance of belief bias in the maintenance of social anxiety disorder. Future studies are necessary to investigate whether the present effects can be replicated with patients suffering from social anxiety disorder or other forms of psychopathology in which dysfunctional cognitions are assumed to play a critical role, such as depression, and to test the alleged causality of this bias in maintaining and developing psychopathological symptoms.

Appendix

Linear syllogisms; social anxiety convictions category

Syllogism content	Conclusion
I < person A < person 1 (less capable)	I am less capable than person 1 Others find me less capable than person 1
I < person A < person 1 (less skilled socially)	I am less skilled socially than person 1 Others find me less skilled socially than person 1
person A > person 1 > me (more spontaneous)	Person A is more spontaneous than me Others find person A more spontaneous than me
I > person A > person 1 (ridiculed)	I feel ridiculed more quickly than person 1 Others ridicule me more quickly than person 1
I > person A > person 1 (rejected)	I feel rejected more quickly than person 1 Others reject me more quickly than person 1
person A > person 1 > me (more interesting)	Person A is more interesting than me Others find person A more interesting than me
person A > person 1 > me (taken seriously)	Person A feels taken seriously more often than me Others take person A seriously more often than me
I > person 1 > person A (looked at)	I feel looked at more quickly than person A Others look at me more quickly than at person A

Note. The syllogisms were varied in congruency and validity. Only the congruent with SA and valid syllogisms are presented in the table.

Linear syllogisms; neutral category

Syllogism content	Conclusion
elephant > dog > fly (bigger)	An elephant is bigger than a fly
scooter < car < airplane (smaller)	A scooter is smaller than an airplane
house > bicycle > apple (expensive)	A house is more expensive than an apple
leopard > human being > snail (faster)	A leopard is faster than a snail
lamppost > broom > pen (bigger)	A lamppost is bigger than a pen
car > moped > bicycle (faster)	A car is faster than a bicycle
Sahara > Spain > Iceland (warmer)	The Sahara is warmer than Iceland
white < grey < black (lighter)	White is lighter than black

Note. The syllogisms were varied in reality value and validity. Only the true and valid syllogisms are presented in the table.

Chapter 6

Belief-confirming reasoning bias in social anxiety disorder: A preliminary report

Abstract

Previous work showed that high socially anxious students display a fear-confirming belief biased reasoning pattern whereas low socially anxious students do not. This belief bias logically serves to confirm dysfunctional beliefs. The present study was designed to corroborate and extend these earlier findings by testing whether (i) enhanced belief bias can be found in a clinical group of treatment seeking individuals diagnosed with social anxiety disorder (SAD), (ii) this social anxiety convictions-sustaining belief bias is specific for SAD or can also be found in other clinical groups such as panic disorder (PD), (iii) enhanced belief bias in SAD is restricted to the domain of concerns or reflects a generally enhanced belief bias. Therefore, SAD patients (n = 45), a clinical control group of PD patients (n = 24), and non-clinical controls (NCCs, n = 16) completed a belief bias task reflecting social anxiety relevant and neutral content. Results showed that indeed SAD patients displayed a belief bias for social anxiety related materials. Yet this enhanced belief bias was not specific for SAD as the PD group showed a similar social anxiety related belief bias. Finally, the results indicated that SAD patients are not characterized by a generally enhanced belief-confirming reasoning style when compared to non-clinical controls. These findings indicate that although SAD patients are not characterized by an abnormal reasoning pattern in itself, they do apply a normal strategy to dysfunctional beliefs which logically acts in a way to confirm their dysfunctional convictions.

Introduction

Cognitive theories propose that dysfunctional beliefs such as ’if I blush people will think that I am incompetent’ play an important role in the aetiology and maintenance of anxiety disorders. Although each anxiety disorder has its own set of disorder-specific dysfunctional beliefs, these anxiogenic beliefs are generally perceived as highly believable by the patient and tend to be highly persistent even though these beliefs are typically unrealistic and invalid (e.g., Beck, 1976; Clark, 1986; Clark & Wells, 1995). In line with the importance that is attributed to dysfunctional beliefs in the maintenance of disorders, the major focus of current treatment strategies is to somehow challenge these convictions in an attempt to replace dysfunctional beliefs by more rational ones (e.g., CPA, 2006; McKay, Taylor, & Abramowitz, 2010; Trimbos-instituut, 2003). The alleged crucial role of irrational beliefs in the persistence of symptoms points to the vital importance of individuals’ ability to draw adequate conclusions on the basis of the available evidence. The inability to draw appropriate conclusions on the basis of available evidence seems a particularly direct way to impede the adjustment of irrational, anxiogenic beliefs. Such inability may thus help explain the origin and persistence of anxiety disorders.

Basic research has shown that people in general have difficulty to distinguish the believability of information from its logical value when they reason with highly believable materials (an effect known as the belief bias effect; e.g., Evans, Newstead, & Byrne, 1993). People are generally slower in responding and make more mistakes when they have to reason with information that is logically valid but unbelievable or with information that is logically invalid but believable. Belief bias is often investigated using syllogisms. A syllogism consists of premises that one needs to accept as being true, and a conclusion that does or does not logically follow from the premises. An example of a syllogism is presented below:

Premise 1	A is larger than B
Premise 2	B is larger than C
Conclusion	**Therefore A is larger than C**

When measuring belief bias, the syllogism is not abstract such as the syllogism presented above, but is filled with real life situations, such as ‘an airplane is faster than a car, a car is faster than a bicycle, therefore an airplane is faster than a bicycle’. Participants are presented with a series of syllogisms and are asked to judge whether or not each conclusion logically follows from the premises, while both the logical validity and the believability of the conclusions are varied. Belief bias is measured in more errors and/or slower latencies when the logical validity and the believability do not match (as opposed to when they do match).

In everyday life, some degree of belief bias can be considered functional. It facilitates the maintenance of a relatively stable belief system from which the world and experiences can be interpreted without great effort, leaving the attentional capacities for more urgent and complex tasks. Also, in dangerous situations, it may well be wise to rely on plausible conclusions (and to respond quickly) rather than to consider whether those conclusions meet the standards of formal logic (Evans, Over, & Manktelow, 1993). However, when belief bias is applied to dysfunctional beliefs, it may become counterproductive, as it then facilitates the maintenance of these problematic convictions.

In a first attempt to examine whether indeed belief bias is involved in anxiety disorders, women with spider phobia and a no-fear control group were presented with a series of linear syllogisms involving spider phobia relevant as well as neutral materials (de Jong, Weertman, Horselenberg, & van den Hout, 1997). This study failed to find a convincing difference between the phobic and the non-phobic group regarding the spider syllogisms. This may well have been due to methodological problems. Spider phobia relevant beliefs are hard to translate into linear syllogisms. Linear syllogisms are based on comparison ('A is *larger than* B, B is *larger than* C, therefore A is *larger than* C') and the inclusion of comparison categories in spider phobic beliefs may have substantially decreased the resemblance between these spider phobic beliefs (e.g., 'a spider is creepy') and the spider phobia related syllogisms (e.g., 'a spider is creepier than a fish, a fish is creepier than a pigeon, therefore a spider is creepier than a pigeon'). Also, this may have increased general believability: Even though most non-anxious people will probably not think of a spider as being creepy, they will believe that indeed a spider is creepier than a pigeon. These two factors may well have decreased the sensitivity of the reasoning task. Similar problems were evident in a subsequent study testing enhanced belief bias in panic disorder. Here, linear syllogisms were constructed based on panic disorder beliefs. The syllogisms conclusions (e.g., 'palpitations are more dangerous than a mosquito bite') were rated on believability. Both panic disorder patients and OCD patients as well as non-anxious control participants rated the conclusions of the panic disorder related syllogisms as highly believable. This seems to indicate that the panic disorder related dysfunctional beliefs were not successfully translated into panic disorder related syllogisms (Vroling, Smeets, & de Jong, 2010).

Therefore, a study following up on this notion focused on social anxiety to test further the potential role of belief bias in anxiety disorders (Vroling & de Jong, 2009). Social anxiety beliefs often imply social comparison, making social anxiety convictions more suitable for translation into linear syllogisms (e.g., 'I am not likeable' translates into 'I am less likeable than others' or into a linear syllogism such as 'I am less likeable than Jane and Jane is less likeable than John, therefore I am less likeable than John'). Also, belief bias likely plays an important role in social anxiety disorder, as social anxiety disorder patients hold on to their dysfunctional beliefs even though they will have been involved in many social situations that contradicted their fearful convictions (since feared social situations cannot be so easily avoided as for instance panic related or spider related situations). In support of the notion that belief bias may indeed be involved in social anxiety, it was found that a group of students with varying levels of fear of negative evaluation showed a linear relationship between the strength of their social fear and the strength of their belief bias (Vroling & de Jong, 2009).

An important next step would be to see whether a similar belief bias effect can also be traced in a treatment seeking sample of people with a formal diagnosis of social anxiety disorder. In addition, it would be important to establish whether the enhanced belief bias concerning social anxiety relevant themes is specific for people suffering from social anxiety disorder or can be found in other anxiety disorders as well. If indeed a social anxiety-related belief bias can also be found in other anxiety disorder patient groups, this would be indicative of the influence of an anxious state (or an anxiety disorder state) on reasoning performance instead of the influence of beliefs per se. Finally, it would be important to examine whether or not the belief bias in clinical groups is restricted to the domain of concerns, or whether it represents a more general stronger-than-normal reliance on beliefs in logical reasoning performance: A recent study showed that participants with a generally enhanced belief bias showed delayed extinction in a differential aversive conditioning experiment (Vroling & de Jong, 2010a). These findings are consistent with the hypothesis that a generally enhanced belief bias may act in a way to immunize against refutation of somehow acquired (anxiogenic) beliefs (e.g., de Jong, Weertman et al., 1997), and may thus set people at risk for developing psychopathology.

In the present study, we test whether patients suffering from social anxiety disorder display a domain-specific belief bias, and compare their belief bias to those of a clinical control group consisting of panic disorder patients (who hold a different set of dysfunctional beliefs; e.g., Clark, 1986; Rapee & Heimberg, 1997). To test whether disorder related belief bias is specific for disorder related convictions or represents a more general characteristic, we also included neutral reasoning materials and a non-clinical control group.

Method

Participants

Patients with social anxiety disorder (SAD) as primary diagnosis (*n* = 45; 17 women) and patients with panic disorder (PD) as primary diagnosis and no SAD as comorbid disorder (*n* = 24; 11 women) were recruited among individuals seeking treatment in various ambulant community health care centres in The Netherlands. The mean age in the SAD group was 31.47 (*SD* = 10.57) and in the PD group was 37.46 (*SD* = 14.03). Mean (and median) educational level was intermediate vocational education for both the SAD group and the PD group.

All patients met DSM-IV criteria for SAD or PD respectively as measured with Mini-International Neuropsychiatric Interview-Plus (M.I.N.I.-Plus, van Vliet, Leroy, & van Megen, 2000). In the SAD group 33 patients (73 %) suffered one or more comorbid disorders, among which were depression or dysthymia (32 %), panic disorder (13 %) and generalised anxiety disorder (21 %). In the PD group 11 patients (46 %) suffered one or more comorbid disorders, among which were depression or dysthymia (50 %) and generalised anxiety disorder (22 %).

Healthy control participants (*n* = 16; 8 women) were recruited through acquaintances and local advertisements. The non-clinical controls (NCC) were included after screening on the presence of any DSM-IV axis-I disorder as measured by the M.I.N.I.-Plus. Mean age was 26.75 years (*SD* = 10.43) and mean (and median) educational level was intermediate vocational education.

All participants included in the study had an estimated IQ of 90 or higher, good comprehension of the Dutch language, showed no signs of current psychosis and did not suffer from dyslexia.

Materials

Reasoning task

Belief bias is commonly measured using a syllogistic reasoning task, in which the believability of the conclusions and the logical validity of the syllogisms are systematically varied. An example of the four possible variations is given in Table 6.1. People generally have more difficulty (they respond slower and make more mistakes) responding to syllogisms for which the believability and logical validity do not match (viz., believable yet invalid or unbelievable yet valid), than when they do match (viz. believable and valid or unbelievable and invalid).

The task was based on the task used by Vroling and de Jong (2009). Again, we used linear syllogisms in the form 'a > b, b > c, therefore a > c', covering both the social anxiety (SA) convictions domain and the factual common knowledge domain (with neutral valence). Seven of the eight original themes (being capable, being less socially skilled, being spontaneous, being ridiculed, being rejected, being found more interesting, and being taken serious) were selected to be used in the present study: The syllogisms concerning ‘feeling looked at’ were deleted from the task because the data from Vroling and de Jong (2009) suggested that this theme was ambiguous. Also, to reduce the length of the task, we only used the public self-referent syllogisms. The syllogisms from the common knowledge domain were identical to those used by Vroling and de Jong (2009).

In line with Vroling and de Jong (2009), we use the terms SA congruency with the levels SA congruent and SA non-congruent to refer to the ‘believability’ of the SA related syllogisms, since the believability of these conclusions probably differs as a function of social anxiety (SAD participants are likely to find the SA congruent conclusions believable whereas the NCCs will find these unbelievable).

Each theme in the SA convictions domain was presented in a SA congruent-valid, a SA congruent-invalid, a SA non-congruent-valid, and a SA non-congruent-invalid manner. An example of these four presentations is given in Table 6.2. Each theme in the neutral common knowledge domain was presented in a believable-valid, a believable-invalid, a unbelievable-valid, and a unbelievable-invalid manner. In total, 7 * 4 SA congruency syllogisms and 8 * 4 neutral common knowledge syllogisms were presented. For these 60 syllogisms, the order in which the premises were presented (‘a > b, b > c, therefore a > c’ or ‘b > c, a > b, therefore a > c’) was randomly determined (to reduce the length of the task; contrary to Vroling and de Jong [2009] in which all syllogisms were presented in both orders). Randomly changing the premise order will counter the use of reading strategies that could undermine the task’s sensitivity as a measure of reasoning bias (cf., Smeets & de Jong, 2005).

Both categories of syllogisms were presented intermixed in two blocks of trials, separated by a fixed 30-second break. Each block started with six filler syllogisms to ensure that participants were focused on the task when answering the experimental syllogisms, and to be able to counterbalance syllogisms type (e.g., believable-invalid). All syllogisms were presented in a fixed random order with the following restrictions: Topic should differ between all consecutive stimulus presentations, a particular syllogism type could not occur more than twice in a row and premise order should differ at every fourth stimulus presentation at least. The outcome measures are reaction time (RT) and number of errors.

Table 6.1
*Example of the four possible believability * logical validity variations of a neutral syllogism.*

	Believable conclusion	Unbelievable conclusion
valid	An elephant is bigger than a dog A dog is bigger than a mouse **An elephant is bigger than a mouse**	A mouse is bigger than a dog A dog is bigger than an elephant **A mouse is bigger than an elephant**
invalid	A mouse is bigger than a dog A dog is bigger than an elephant **An elephant is bigger than a mouse**	An elephant is bigger than a dog A dog is bigger than a mouse **A mouse is bigger than an elephant**

Table 6.2
*Example of the four possible social-anxiety congruency * logical validity variations of a social anxiety-related syllogism.*

	SA congruent conclusion	SA non-congruent conclusion
valid	Others find me less capable than person A Others find person A less capable than person 1 **Others find me less capable than person 1**	Others find person 1 less capable than person A Others find person A less capable than me **Others find person 1 less capable than me**
invalid	Others find person 1 less capable than person A Others find person A less capable than me **Others find me less capable than person 1**	Others find me less capable than person A Others find person A less capable than person 1 **Others find person 1 less capable than me**

Believability check

To confirm that the SA congruency syllogisms were indeed congruent with social anxiety concerns, participants were asked to rate the believability of the conclusions of the social anxiety related syllogisms. Both the SA congruent and the SA non-congruent conclusions were presented. The task was similar to the one used by Vroling and de Jong (2009). The conclusions were presented four at a time on the computer screen. For each conclusion the believability was rated on a Visual Analogue Scale (VAS) ranging from 'unbelievable' to 'believable'. The VAS presented on screen was 17 cm wide, and all scores were rescaled into a 0-100 range.

M.I.N.I.

The Mini-International Neuropsychiatric Interview (M.I.N.I., see Sheehan et al., 1998) is a brief structured interview used to diagnose axis-I psychopathology according to the DSM-IV. The Dutch version of the M.I.N.I.-Plus (van Vliet et al., 2000), an extended version of the M.I.N.I., was used to screen and diagnose all participants.

Social anxiety measure

To measure the level of social anxiety, a Dutch translation of the Social Phobia and Anxiety Inventory (SPAI: Turner, Beidel, Dancu, & Stanley, 1989; Dutch SPAI: Scholing, Bögels, & van Velzen, 1995) was used. The SPAI consists of 45 self-statements on experienced tension/anxiety in various social and non-social situations, which can be scored on a scale of 0 (never) to 7 (always). A total score was computed by subtracting the subscore for agoraphobia from the subscore for social anxiety. Psychometric properties for the Dutch SPAI are good. A cut-off score of 88 is recommended for the diagnosis of SAD (Bögels & Reith, 1999).

Procedure

For the computerized syllogistic reasoning task, the participants were instructed to decide as quickly as possible whether or not the conclusion was correct (i.e., logically valid) given the two premises. It was emphasized that the reality basis (i.e., believability / SA congruency) neither of the premises nor of the conclusions should be taken into account. To get familiarized with the reasoning task, participants received four examples. After the first two examples, the participants received feedback about the correctness of their decision, along with a standard explanation about the validity of the conclusion concerned. After the third and fourth example, the participants received feedback about the correctness of their decision without explanation.[20] While the

[20] Providing feedback on the accuracy of reasoning performance on a belief bias task can theoretically result in a decrease of belief bias effects. Yet, decreases in belief bias effects are hard to create (e.g., one needs to motivate the reasoner to actively "think about their evaluation

feedback and explanation were presented, the particular syllogism remained on screen. After the example syllogisms, the instructions for the reasoning task were summarized. The participant could start the actual reasoning task by pushing the space bar whenever he or she was ready.

Preceding every single stimulus presentation, the sentence "*pay attention!*" appeared on the screen to alert the participant for the next syllogism. The participant indicated whether he or she considered the syllogism valid or not by pushing either the 'valid' or the 'not valid' button of an E-prime response box. The syllogism disappeared from the screen immediately after the participant had pushed one of the two buttons. The program recorded the participants' decisions (valid or invalid) as well as their response latencies (in milliseconds) on a trial by trial basis. If participants took more than 20 s to respond, the response was coded wrong and the next syllogisms would be presented. During the experiment, the participants received no feedback about their performance.

The participants continued with the computerized believability check, after which they completed the paper-and-pencil version of the SPAI. They were then debriefed and received a €15,- coupon for their help. This report is part of a larger study into the role of cognitive processes in (the treatment of) social anxiety disorder.

Data reduction and analysis

The SA non-congruent believability ratings were averaged and subtracted from the averaged SA congruent believability ratings to create a single believability score.

For each type of syllogism within each domain, all errors were summed, resulting in 8 (2 domains * 4 types) error scores per subject. Reaction times scores were calculated by averaging the reaction times of the correct responses, again per type of syllogisms within each domain. The differences in belief bias between the groups will be explored by means of repeated measures ANOVAs. A level of $\alpha = .05$ will be adopted for these tests. If belief bias is found to differ between groups, this interaction will be further explored by three separate repeated measures ANOVA (which will be restricted to the relevant three-way interaction), comparing SAD with PD, SAD with NCC and PD with NCC. For these analyses, a critical p-value of .033 will be adopted: We test one-tailed, in line with our hypothesis, and use a Bonferroni-corrected α of .05 / 3 = .017 for these three tests, resulting in a one-tailed critical p-value of .033 (= 2 * .017).

Belief bias can be evident on either RT or errors. In the present design, where participants are asked to respond as quickly and accurately as possible, a

of arguments", p59, Neilens, Handley, & Newstead, 2009). It is therefore unlikely that our feedback on only four syllogisms may have caused a decrease in belief bias effects.

speed-accuracy trade-off will likely occur. Belief-based delays (belief bias measured in RT) will probably result in belief-based reasoning errors in daily-life, since real-life events do not provide single-task 20 s time frames to decide on whether or not a conclusion is valid, and demand quick (and thus oftentimes dirty) responses. Therefore, both measures of belief bias (RT and errors) will be considered equally relevant.

Results

Groups and psychopathology

The groups were compared on level of social anxiety by means of an ANOVA with group (SAD / PD / NCC) as between subject factor and SPAI as outcome measures, with repeated contrasts to compare the SAD versus the PD group and versus the NCC group. The social anxiety levels are highest for the SAD group (M = 97.24, SD = 26.56), lower for the PD group (M = 43.93, SD = 34.18) and lowest for the NCC group (M = 31.25, SD = 19.09). As expected, there was a significant difference between the groups on the level of social anxiety, $F(2,80) = 45.90$, $p < .01$. The contrasts show that the SAD and the NCC group differed in social anxiety ($p < .01$) as well as the SAD and the PD group ($p < .01$).

Believability check

The SAD group showed an on average positive believability rating (M = 20.52), which is consistent with the idea that the SAD group found the SA congruent themes more believable than the SA non-congruent themes. The PD group and the NCC group showed an on average negative believability rating (M = -11.99 and M = -14.52 respectively), which is consistent with the idea that for these groups of participants the SA non-congruent themes are more believable than the SA congruent themes. The groups were compared on believability ratings by means of an ANOVA with group (SAD / PD / NCC) as between subject factor and believability check as outcome measure, with simple contrasts to compare the SAD versus the PD group and the SAD versus the NCC group. The groups differed on their believability ratings, $F(1,80) = 20.04$, $p < .01$, $\eta^2 = .33$. The contrasts indicated that the SAD group scored higher than the PD group ($p < .01$) and higher than the NCC group ($p < .01$).

Group differences in belief bias

Domain-specific belief bias

We analyzed the RT data by means of a repeated measures ANOVA with SA congruency (SA congruent / SA non-congruent) and validity (valid / invalid) as within subject factors and group (SAD / PD / NCC) as between subject factor.

Most pertinent to our hypothesis, we found a significant group*SAcongruency*validity interaction: $F(2,76) = 3.66$, $p = .03$, $\eta^2 = .09$. The groups differed in RT based belief bias for domain-specific syllogisms. Furthermore, we found a significant main effect for validity ($F[1,76] = 5.01$, $p = .03$, $\eta^2 = .06$), with valid syllogisms being solved faster than invalid syllogisms ($M = 10.26$ s and $M = 10.74$ s respectively). The group*belief bias interaction is presented in Figure 6.1. As can be seen in the figure, the SAD group displays a SA convictions-confirming belief bias pattern, the PD group displays no belief bias effect, and the NCC group displays a SA convictions *dis*confirming belief bias pattern.

Continuing on the relevant group*SAcongruency*validity interaction, the planned group-comparisons (repeated measures ANOVAs with SA congruency and validity as within subject factors and group [SAD / PD; SAD / NCC; PD / NCC respectively] as between subject factor, only testing the group*SAcongruency*validity interaction) showed that the difference between the SAD and PD groups with respect to their RT based SA congruency belief bias did not reach the conventional level of significance ($F[1,62] = 2.15$, $p = .15$). As expected, the SAD group did differ from the NCC group: $F(1,56) = 7.95$, $p = .01$, $\eta^2 = .12$. The SAD group displayed a clear belief bias effect in the expected direction (most rapid responses for SA congruent – valid syllogisms and most delay for SA congruent – invalid syllogisms), while the NCC group displayed a lesser and more importantly reversed belief bias effect (the NCC group showed delays in response for the SA non-congruent – invalid syllogisms). The PD group did not significantly differ from the NCC group, $F(1,34) = 1.07$, $p = .31$.

We analyzed the error data (see Table 6.3) by means of a repeated measures ANOVA with SA congruency (SA congruent / SA non-congruent) and validity (valid / invalid) as within subject factors and group (SAD / PD / NCC) as between subject factor. Contrary to our expectations, there was no significant group*SAcongruency*validity interaction ($F[2,82] = 0.02$, $p = .98$). The two-way SAcongruency*validity interaction was also not significant ($F[1,82] = 1.55$, $p = .22$), indicating that there was overall no belief bias effect. We did find a significant group*validity interaction ($F[2,82] = 3.03$, $p = .03$, $\eta^2 = .08$), with the SAD and the PD making fewer errors on valid ($M = 1.62$ and $M = 1.85$ respectively) than on invalid ($M = 2.39$ and $M = 2.96$ respectively) trials and the NCC group showing equal errors on valid ($M = 2.34$) and invalid ($M = 2.34$) trials. Overall, fewer errors were made on valid trials than on invalid trials ($M = 1.94$ and $M = 2.56$ respectively, as indicated by the validity main effect, $F[1,82] = 16.85$, $p < .01$, $\eta^2 = .17$).

Table 6.3
Average errors (and SD) per social anxiety-related syllogism condition for the various groups.

	SAD		PD		NCC	
	SA congruent	SA non-congruent	SA congruent	SA non-congruent	SA congruent	SA non-congruent
valid	1.40 (1.38)	1.65 (1.45)	1.48 (1.12)	1.95 (1.47)	1.93 (1.91)	2.20 (1.37)
invalid	2.37 (1.69)	2.19 (1.62)	3.24 (1.18)	2.24 (1.61)	2.33 (1.35)	2.33 (1.29)

Table 6.4
Mean RT (and SD) in s per neutral syllogism condition for the various groups.

	SAD		PD		NCC	
	believable	unbelievable	believable	unbelievable	believable	unbelievable
valid	6.64 (2.13)	7.94 (2.34)	8.12 (2.32)	8.73 (2.75)	7.76 (2.33)	8.91 (2.62)
invalid	8.40 (2.76)	7.15 (2.31)	9.02 (1.97)	8.44 (2.13)	8.84 (2.27)	8.56 (2.06)

General belief bias

We analyzed the RT data by means of a repeated measures ANOVA with believability (believable / unbelievable) and validity (valid / invalid) as within subject factors and group (SAD / PD / NCC) as between subject factor. As expected, there was a significant believability*validity interaction effect (F[1,76] = 15.67, $p < .01$, $\eta^2 = .17$). This pattern was consistent with a general belief bias effect, and it did not differ between groups (group*believability*validity F[2,76] = 1.26, $p = .29$). The means and standard deviations for the various groups are given in Table 6.4. Also, there was a main effect for validity, with valid syllogisms ($M = 8.01$ s) being solved faster than invalid syllogisms ($M = 8.40$ s), $F(1,76) = 4.29$, $p = .04$, $\eta^2 = .05$.

We analyzed the error data by means of a repeated measures ANOVA with believability (believable / unbelievable) and validity (valid / invalid) as within subject factors and group (SAD / PD / NCC) as between subject factor. We found a significant group*believability*validity effect (F[2,82] = 3.21, $p < .05$, $\eta^2 = .07$), as well as an overall believability*validity effect (F[1,82] = 19.92, $p < .01$, $\eta^2 = .19$). As can be seen in Figure 6.2, the groups differed in the strength of their belief bias effects. Furthermore, we found a significant main effect for believability (F[1, 82] = 7.61, $p = .01$, $\eta^2 = .09$), with fewer errors on believable trials ($M = 1.31$) than on unbelievable trials ($M = 1.67$).

Continuing on the relevant group*believability*validity interaction, the planned group-comparisons (repeated measures ANOVAs with believability and

Figure 6.1. Social anxiety-related belief bias effects (measured in s) for the various groups.

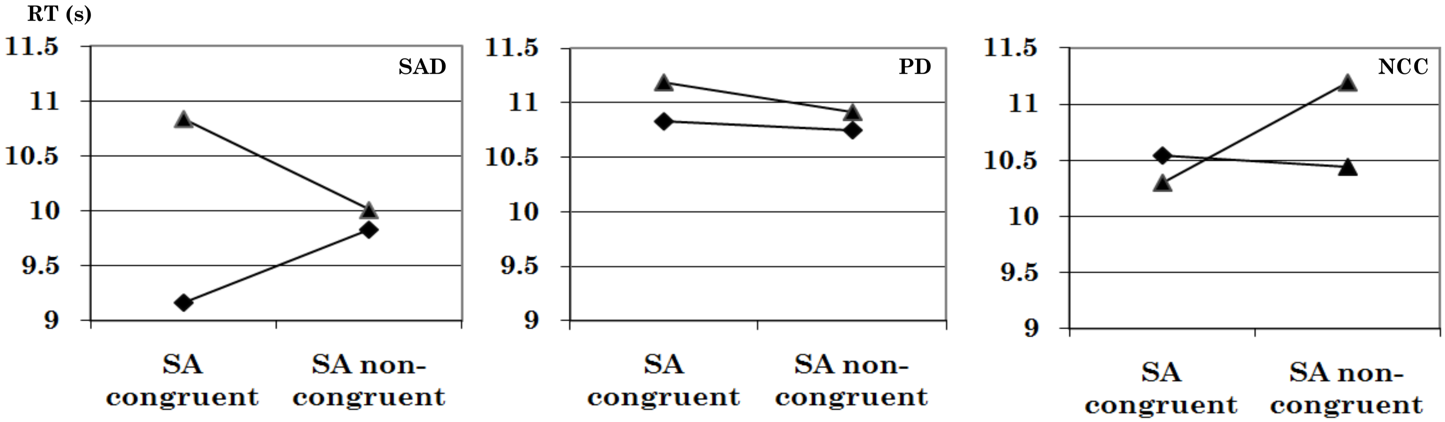
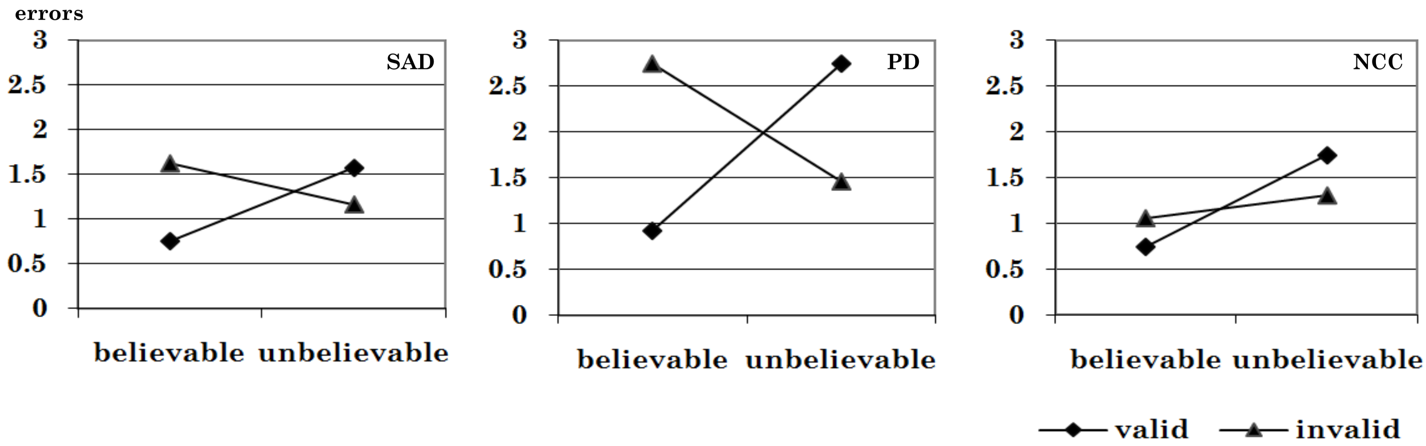


Figure 6.2. Neutral belief bias effects (measured in errors) for the various groups.



validity as within subject factors and group [SAD / PD ; SAD / NCC ; PD / NCC respectively] as within subject factor, only testing the group*believability*validity interaction) showed that none of the groups in particular showed a significantly deviating belief bias pattern[21] (SAD vs. PD $F[1,67] = 4.22$, $p = .04$, $\eta^2 = .06$; SAD vs. NCC $F[1,59] = 0.46$, $p = .50$; PD vs. NCC $F[1,38] = 3.89$, $p = .056$, $\eta^2 = .09$), even though the pattern of the PD group seems elevated compared to the other groups.

Discussion

This study investigated social anxiety related as well as generally enhanced belief bias in social anxiety disorder patients. The main results can be summarized as follows: (i) Self reports indicated that specifically the SAD group considered the SA congruent syllogisms to be believable; (ii) the SAD group displayed a conviction-confirming belief bias for SA-relevant syllogisms, where the NCC group did not; (iii) the SA-related belief bias effect was most pronounced for the SAD group although the difference with the PD group did not reach significance (iv) all groups showed a clear belief bias effect for the neutral themes; (v) the groups differed in the strength of neutral belief bias: There was a trend for the PD group to show a relatively strong belief bias concerning neutral syllogisms.

The first goal of the present study was to examine whether disorder-relevant belief bias could be traced in a clinical group. Supporting the view that belief bias is involved in psychopathology, we found that social anxiety patients displayed a social anxiety related belief bias whereas the non-clinical controls did not. This domain-specific belief bias in SAD patients may serve to maintain dysfunctional beliefs and thereby contribute to the maintenance of SAD. Our second goal was to determine whether the SAD-relevant belief bias is specifically related to SAD patients, or would also be evident in other clinical groups. Although the pattern showed that the SA-related belief bias was most pronounced for the SAD group, with the PD group scoring between the SAD and the NCC group, the difference between the SAD and the PD group did not reach significance. Thus the present pattern of findings do not sustain the strong conclusion that the SAD-relevant belief bias is restricted to SAD. This may indicate that the domain-specific belief bias is in fact not in content related to the disorder but is anxiety or anxiety disorder related. One interpretation is

[21] Note that a critical p-value of .033 was adopted for these tests, using Bonferroni corrections as well as one-sided testing; see data reduction and analysis paragraph of the Method section.

that the ‘domain-specific’ belief bias is a general tendency for anxiety patients to engage in fear-confirming reasoning when presented with anxiety related materials. Perhaps the social anxiety related materials presented to the participants are anxiety provoking for anxiety patients in general and as such limit attentional capacities. When working memory is impaired (as is the case when a person is anxious), reliance on heuristic processing (System 1 reasoning, cf. Evans, 2003) increases and therefore belief bias increases (e.g., Kienan, 1987; Tohill & Holyoak, 2000). Yet, most likely, such anxiety effects would have spilled over to the neutral syllogisms as well. At least for the SAD group this effect was clearly absent, making this explanation less likely. This interpretation however does need further testing by for instance inducing anxiety prior to testing for belief bias. An alternative interpretation is that the reasoning task and/or the study lacked sufficient power to differentiate between the SAD and the PD group. Indeed, the pattern of the belief bias effect for the PD group suggests that this group does not show belief bias whereas the pattern for the SAD group clearly shows a belief bias effect.

The third goal of the present study was to put in perspective an earlier finding of a generally enhanced belief bias for spider phobic patients (de Jong, Weertman et al., 1997) which has not been found in the non-clinical range (e.g., Smeets & de Jong, 2005; Vroling & de Jong, 2009) or in different patient groups (Vroling, Smeets et al., 2010). Although we did find a significant belief bias*group interaction effect, this effect could not be attributed to one particular group. Perhaps most important for the present context we found no evidence for a generally enhanced belief bias in SAD patients. Thus the enhanced belief bias of the SAD patients for the SA-relevant syllogisms cannot be attributed to a generally enhanced belief bias. As such, the present results do not support the hypothesis that a generally enhanced belief bias sets people at risk for developing SAD. Meanwhile the data do provide some tentative indication that the PD group showed larger belief bias than the NCC group. Yet, given that we have only tentative support, it remains to be seen whether the present findings represent a replicable phenomenon.

Some remarks concerning the study’s limitations are in order. Although we managed to create syllogisms that resemble the dysfunctional convictions more than in earlier studies (de Jong, Weertman et al., 1997; Vroling, Smeets et al., 2010), the believability check indicated that there is still room for improvement. Indeed, a believability rating of 21 (out of a 100) is still low for what are assumed to be strongly held beliefs. Limited resemblance of the syllogisms to the dysfunctional social anxiety convictions (as seems to be in order here given the relatively low believability ratings by the SAD patients) limits the sensitivity of the reasoning task. Earlier studies already had difficulty to create syllogisms that were well-matched to dysfunctional beliefs, and the presently targeted SAD was supposed to be the most ideal candidate for successfully translating dysfunctional convictions into linear syllogisms. The results of the present study therefore lead to the conclusion that linear syllogisms apparently provide a sub optimal medium to test belief bias with respect to psychopathologic content. Future research should look into possibilities to measure belief bias using a different deductive reasoning task. Another interpretation is that SAD patients do not report high believability of social anxiety related dysfunctional convictions when not in a (dooming or present) socially threatening situation (e.g., Clark & Wells, 1995). As such, it would be worth testing whether activation of the convictions would increase belief bias for the SA themes.

A second remark concerns limited power of the present study: The combination of a relatively small PD group (the sample size was based on power estimations expecting medium effects) and a moderately sensitive reasoning task may have limited the power of the present study with respect to the SA congruency reasoning for the PD group. The same yields for the NCC group.

In conclusion, the present study showed that social anxiety disorder patients display belief bias when reasoning with social anxiety related materials. Panic disorder patients also showed levels of social anxiety related belief bias, which is likely due to limitations in the translation of social anxiety related dysfunctional beliefs into social anxiety related linear syllogisms. This finding does however leave open the possibility that anxiety disorder patients in general show an anxiety-convictions confirming reasoning strategy, making them liable not only for the consolidation of their disorder-specific dysfunctional convictions but also to the consolidation of other anxiety-disorder related convictions. Belief based reasoning for neutral materials was not deviant for social anxiety disorder patients. Whether panic disorder patients are characterized by a more trait-like belief-based reasoning disturbance remains to be seen. Even though social anxiety disorder patients do not display a generally deviant belief-based reasoning strategy, the strength of their dysfunctional convictions does lead to belief based reasoning with respect to social anxiety related materials. As such, this normal belief biased reasoning process is believed to contribute to the consolidation of the dysfunctional convictions of social anxiety disorder patients, thereby acting in a way to maintain the socially anxious preoccupations.

Chapter 7

General discussion

Patients suffering from anxiety disorders seem to hold on to their anxiogenic dysfunctional convictions in the face of disconfirming evidence. This failure to correct anxiogenic dysfunctional convictions can be explained by looking at the patients´ reasoning style. Correcting erroneous convictions requires that people accurately deduce the logical implications of empirical evidence for their beliefs. It is well established that people in general have difficulty to reason according to the rules of logic when reasoning with materials they strongly believe in. This effect is known as the belief bias effect. Anxiety disorder patients believe strongly in their anxiogenic dysfunctional convictions. Therefore, belief bias can logically be assumed to be involved in sustaining anxiogenic dysfunctional convictions in anxiety disorders.

Previous research in the context of spider phobia (de Jong, Weertman, Horselenberg, & van den Hout, 1997) provided preliminary evidence to suggest that belief bias in anxiety disorders can take two forms: First, belief bias may be evident in the domain of disorder-related convictions. Such a *domain-specific belief bias* represents a reasoning process that is in itself not deviant, but becomes counterproductive because it helps to sustain convictions that are at the core of anxiety disorders. Second, a strong belief bias might (also) be a general cognitive characteristic of individuals suffering from anxiety disorders, exerting its influence on symptom-irrelevant domains as well. The presence of such a *generally enhanced belief bias* may be indicative of a trait-like information processing bias that acts as a diathesis in the development of anxiety disorders.

The present thesis set out to explore the potential role of belief bias in anxiety disorders. The examination followed two lines: The first line focussed on investigating whether a generally enhanced belief bias is involved in the development of anxiety disorders. The second line focussed on determining both the specificity of the domain-specific belief bias effect (viz. being indeed disorder bound) and the generality of this effect over various anxiety disorders. In the present chapter, a summary of the empirical studies (Chapters 2 to 6) will be given. These will then be discussed with respect to the two research lines. Limitations, future research and relevance will also be discussed.

Summary of the empirical chapters

Generally enhanced belief bias in a general sample

The finding of a generally enhanced belief bias in spider phobic patients (de Jong, Weertman et al., 1997) could either represent an epiphenomenon of anxiety disorders, or it could indicate that generally enhanced belief bias contributes to the development of an anxiety disorder such as spider phobia. If generally enhanced belief bias is indeed related to the development of anxiety disorders, a relationship between the strength of belief bias and level of anxiety symptoms can already be evident in a non-clinical sample. To test this notion, in the study reported in Chapter 2, a large sample of students was subjected to a belief bias task. In this task neutral syllogisms were presented (e.g., 'An elephant is bigger than a dog, a dog is bigger than a mouse, therefore an elephant is bigger than a mouse'), as well as general threat related syllogisms (e.g., 'Long cancer is more dangerous than pneumonia, pneumonia is more dangerous than the flu, therefore long cancer is more dangerous than the flu) and general safety related syllogisms (e.g., 'The Netherlands are safer than Russia, Russia is safer than Afghanistan, therefore the Netherlands are safer than Afghanistan'). General threat- and general safety-related syllogisms have not previously been studied in the context of anxiety. Since it was assumed that the relationship between belief bias and anxiety symptoms would be less pronounced in a general population, we hoped that adding threat and safety components to the reasoning materials would facilitate the detection of this relationship: It is likely that specifically participants who show enhanced confirmation of threatening information (as indexed by a threat related belief bias) or enhanced disconfirmation of safety-related information (as indexed by a reversed safety related belief bias effect) will be particularly at risk for the development of anxiety disorders, which may result in developing anxiety symptoms more easily. No relationship between belief bias as measured with general threat-related, general safety-related, or neutral syllogisms and anxiety symptoms was found. In this study however, no control had been exerted over the amount of anxiety-inducing learning experiences. Anxiety-inducing learning experiences may be a critical moderating factor in the relationship between belief bias and anxiety symptoms: A belief-confirming reasoning strategy can serve to consolidate anxiogenic beliefs only if people have experienced situations that could have lead to such anxiogenic convictions.

In Chapter 3, anxiety-related learning experiences were brought under experimental control in an attempt to show that indeed belief bias is related to the development of anxiety symptoms. It was assumed that a heightened belief bias would delay the extinction of shock expectancies. In the first of two experiments, participants (students) initially learned to expect an aversive shock following one of two abstract figures. In this acquisition phase, the shock always followed after one of the figures (CS^+) and never after the other figure (CS^-). After having learned this relationship, the shock was no longer administered after the presentation of the CS^+ (nor after the presentation of the CS^-). Participants had to indicate the probability that a shock would follow on each CS-presentation. General belief bias was measured prior to the fear conditioning procedure with the use of neutral syllogisms. As expected, in the acquisition phase shock expectancies increased for the CS^+ and decreased for the CS^-. In the extinction phase, shock expectancies for the CS^+ decreased, resulting in a decreased differential UCS expectancy between the CS^+ and the CS^-. We had expected to find that differences in UCS expectancies between the CS^+ and the CS^- in the extinction phase would be more pronounced for participants with stronger general belief bias. We did not find such positive correlations when belief bias was indexed by errors, and we even found negative correlations with belief bias when belief bias was indexed by RTs. We argued that this unexpected result could have been caused by a lack of intrinsic relatedness of the CS^+ to the shock: This lack may have led participants to form less strong beliefs about the CS^+ and the shock belonging together. Less strong beliefs do not facilitate belief biased reasoning. If anything, as the initial beliefs go against any relationship concerning the CS^+ and the shock, belief bias will work to confirm that indeed the CS^+ and the shock did not belong together. This may result in speeded extinction of UCS expectancies. The second experiment therefore used stimuli that were intrinsically related to the UCS (a cactus and a sunflower) to test the alleged relationship. For half of the participants the cactus served as CS^+ (high belongingness condition) and for half the sunflower served as CS^+ (low belongingness condition). Apart from these differences, the design was similar to that of Exp.1. In the high belongingness condition, the differences in UCS expectancies between the CS^+ and the CS^- in the extinction phase were indeed more pronounced for participants with stronger general belief bias (as indexed by errors). For the low belongingness condition, no correlations emerged. Based on these results, it was concluded that indeed belief bias may play a role in the delay of UCS expectancy extinction, and that this experiment functions as a model for how generally enhanced belief bias may indeed be involved in the development of anxiety disorders through the consolidation of fear expectancies.

Domain-specific and generally enhanced belief bias in patients and analogue samples

In Chapter 4, domain-specific as well as generally enhanced belief bias was tested in panic disorder (PD) patients. To be able to determine whether domain-specific belief bias was indeed specific for patients suffering from PD, a clinical control group consisting of obsessive-compulsive disorder (OCD) patients was included in the study. To be able to determine potential differences in general belief bias, a non-clinical control (NCC) group was also included. Participants were tested for domain-specific belief bias, which in the present study comprise PD-related belief bias, as well as generally enhanced belief bias. After they had completed the belief bias task, the participants were asked to rate the believability of the conclusion of every syllogism. With respect to the conclusions that were rated on believability, the PD related conclusions were rated as equally believable by all groups. This is remarkable given that these had been designed to match PD related convictions. With respect to the belief bias task, the error data could not be taken into consideration due to severe skewness. The analyses were therefore restricted to the RT data. For the domain-specific syllogisms, there was a marginally significant group difference. Remarkably, although the PD group indeed displayed domain-specific belief bias, so did the OCD group. The ‘domain-specific’ belief bias was even stronger in the OCD group than in the PD group. Together with the unexpectedly high believability ratings for the PD-related conclusions in the OCD and NCC groups, these findings raise the question of whether the domain-specific syllogisms were indeed specific to PD convictions. The conclusion with respect to the specificity of the domain-specific belief bias effect was therefore postponed.

The groups did not differ in their levels of general belief bias (as indexed by RTs). This finding does not support the notion of anxiety disorder patients being characterised by a generally enhanced belief bias.

The studies focussing on spider phobia (de Jong, Weertman et al., 1997) and PD (Chapter 4) made clear that spider phobic and PD convictions are hard to translate into linear syllogisms. In an attempt to improve the specificity of the reasoning task, we focused in Chapter 5 on an anxiety disorder for which beliefs are easier to translate into linear syllogisms: Social anxiety disorder (SAD) patients are overly concerned with how they perform in comparison to other people. This comparison component better suits the form of linear syllogisms, as linear syllogisms consist of a comparison between three components (and a comparison of two of these components in the conclusion). Thus, social anxiety convictions were targeted. Eight social anxiety related syllogisms were constructed (e.g., ‘Others find me less capable than person A, other find person A less capable than person 1, therefore others find me less capable than person 1’).

To test whether indeed these newly created social anxiety-related syllogisms match social anxiety symptoms, we tested for a relationship between social anxiety-related belief bias and social anxiety symptoms in a non-clinical sample: Participants were students with varying levels of social anxiety (ranging from very low to high on the Fear of Negative Evaluation scale). The participants completed a belief bias task comprising neutral and social anxiety related syllogisms. Due to skewness of the error data, only the RT data could be used in the analyses. As expected, domain-specific (viz. in the present study social anxiety related) belief bias was positively related to levels of social anxiety: Participants with higher levels of social anxiety also showed more domain-specific belief bias. This underlines the usefulness of the newly developed social anxiety-related syllogisms to measure domain-specific belief bias in SAD patients.

No relationship was found between general belief bias and social anxiety symptoms. Taken together, these findings support the notion that belief bias may be involved in the maintenance of SAD through the maintenance of anxiogenic dysfunctional convictions, but do not support the notion that SAD patients are characterised by a generally deviant reasoning strategy.

A believability check of the syllogisms' conclusions revealed that the perceived believability of the social anxiety related conclusions was indeed related to the level of social anxiety. The results from both the belief bias task and the believability check underline the successful translation of anxiogenic dysfunctional convictions into syllogisms, although the believability ratings show that there is still room for improvement.

After having successfully translated social anxiety convictions into syllogisms, this measure of domain-specific belief bias was put to the test in a SAD patient group: In Chapter 6, SAD patients were tested for the presence of domain-specific (viz. in the present study social anxiety related) belief bias. The specificity of this domain-specific belief bias was tested by comparing SAD patients with PD patients. Domain-specific belief bias was measured with the social anxiety-related syllogisms developed in Chapter 5. The believability of the social anxiety-related syllogisms was checked by having patients rate the believability of all social anxiety-related conclusions. General belief bias was also measured and performance of both patient groups was compared to the performance of a NCC group. The results presented in this chapter are preliminary, as the inclusion of participants in the NCC group is still ongoing (n = 16 at present). As expected, the SAD group displayed belief bias concerning social anxiety-related syllogisms. Contrary to expectations, the SAD and the PD group did not significantly differ in their level of 'domain-specific' belief bias as indexed by RTs, although the effects are in the expected direction: On average, the PD group displayed no belief bas whereas the SAD group did. No effects of domain-specific belief bias were found when indexed by errors. With respect to the believability of the social anxiety-related syllogisms, the SAD patients rated the social anxiety-related conclusions as more believable than the PD patients and the NCCs. The ratings by the SAD group showed only moderate believability, indicating that there is still much room for improvement. Together these results do not support the notion that domain-specific belief bias is in content disorder-unique, and give rise to the interpretation that the domain-specific belief bias is caused by the anxiety state of anxiety disorder patients. Yet, had the 'domain-specific' belief bias effect represented a general effect of anxiety, this would have likely spilled over to neutral syllogisms. This did not happen. An alternative interpretation that should be taken into consideration is that the only moderate believability of the domain-specific syllogisms for the SAD group may have limited the sensitivity of the task to detect differences between groups.

With respect to general belief bias, there were no group differences when comparing belief bias as indexed by RTs. The groups did differ significantly for general belief bias as indexed by errors: The results seem to indicate that the PD patients display more general belief bias than the SAD patients and the NCCs. These differences did however not meet the required level of significance when correcting for type I error. Differences between the PD and the NCC group may emerge when the inclusion of NCC participants is completed.

In Table 7.1, an overview is given of the most relevant findings of the present series of studies. In the following part, the results of these studies will be combined to answer the research questions of this thesis. First, the question regarding the involvement of belief bias in the development of anxiety disorders will be discussed. We will continue with discussing the specificity and the generality of the domain-specific belief bias.

Involvement of belief bias in the development of anxiety disorders

In a first study investigating the relationship between belief bias and psychopathology, de Jong, Weertman et al. (1997) found that spider phobic patients show an enhanced belief bias for neutral materials compared to non-anxious controls. It was argued that this generally enhanced belief bias may be a trait-like reasoning bias contributing to the development of the spider phobia. It was assumed that particular learning experiences may lead to the formation of dysfunctional convictions and that a generally enhanced belief bias would prevent the refutation of these convictions, and would even strengthen them, thereby fuelling the development of an anxiety disorder. In this thesis the extent to which this interpretation holds true was studied.

We were unable to relate neutral belief bias to anxiety symptoms in a general student sample in Chapter 2, which is in line with earlier findings from a non-clinical sample in which only neutral syllogisms were used (Smeets & de Jong, 2005). We had expected that introducing themes regarding threat and safety into the syllogisms would facilitate the detection of a relationship between belief bias and anxiety symptoms in a non-clinical sample. However, no correlations were found between general threat- and general safety-related belief bias and anxiety symptoms. When using a different approach, by bringing learning experiences under control in a differential fear conditioning paradigm in

Chapter 3, we found evidence that belief bias is related to the rate of extinction of UCS expectancies in a normal student sample. The fear conditioning task in our study modelled the development of an anxiety disorder; the finding that larger belief bias effects are related to delayed extinction supports the notion that belief bias may be involved in the development of anxiety disorders. The lack of correlations between belief bias and the acquisition of differential UCS expectancies suggests that belief bias may not be involved in the initial development of an anxious expectation. However, a lack of extinction of such an anxious expectation may turn this expectation into an anxiogenic conviction. Such anxiogenic (dysfunctional) convictions are at the core of anxiety disorders.
The support for the notion that belief bias is involved in the development of anxiety disorders would have been stronger, had we also found correlations between belief bias and speeded acquisition. One way to enhance the sensitivity for individual differences in acquisition learning (as well as in extinction learning) would be to include multiple stimuli in the design and to reduce the CS^+/UCS contingency. This may help detect correlations between belief bias and acquisition of initial anxious expectations.

Table 7.1
Overview of the most relevant findings in the present thesis

			Generally enhanced belief bias	
			indexed by errors	indexed by RTs
Chapter 2	student sample		No correlations with anxiety symptoms	No correlations with anxiety symptoms
Chapter 3[a] Exp2, High bel. cond.	student sample	Acquisition phase	No correlations with differential acquisition	No correlations with differential acquisition
		Extinction phase	Positive correlations between belief bias and differential extinction	No correlations with differential acquisition
Chapter 4	PD pt's OCD pt's NCCs		[c]	PD = OCD = NCC
Chapter 5	student sample		[c]	No correlations with FNE
Chapter 6	SAD pt's PD pt's NCCs		Groups differ in belief bias SAD = NCC PD > NCC[d]	SAD = PD = NCC

[a] Only the high belongingness condition of Exp.2 is discussed [b] not included in the design

The results from the studies reported in Chapter 3 may help explain why the relationship between belief bias and anxiety symptoms was not evident in Chapter 2, nor in the previous study by Smeets and de Jong (2005): The series of studies in Chapter 3 showed that it was indeed helpful to bring learning experiences under control to enhance the sensitivity for the assumed relationship. The findings from the studies in Chapters 2 and 3 suggest that belief bias itself does not contribute to the development of anxiety disorders, but that belief bias combined with certain anxiety-inducing learning experiences can. It should be noted that we only found limited evidence for the presence of a generally enhanced belief bias in our patient groups. This finding indicates that even if belief bias (combined with anxiety-inducing learning experiences) is involved in the development of anxiety disorders, it is likely only one of many factors that contributes to the development of anxiety disorders. Also, the absence of consistent and strong findings regarding generally enhanced belief bias in our patient groups indicate that belief bias is by no means a prerequisite for developing an anxiety disorder.

Table 7.1
continued

		Domain-specific belief bias		
		indexed by errors	indexed by RTs	Believability domain-specific conclusion
Chapter 2	...	[b]	[b]	[b]
Chapter 3[a] Exp2, High bel. cond.	...	[b] [b]	[b] [b]	[b] [b]
Chapter 4	...	[c]	PD = OCD No belief bias for NCC	PD-related conclusions are very believable to all groups PD = OCD = NCC
Chapter 5	...	[c]	Positive correlations with FNE	Believability of SAD-related conclusions is positively correlated with FNE
Chapter 6	...	No group differences	SAD display belief bias SAD = PD > NCC, but tendency SAD > PD > NCC	SAD-related conclusions are somewhat believable to SAD patients SAD > PD = NCC

[c] This index could not be analysed [d] This effect was marginally significant (with n = 16 for NCC)

The relationship between belief bias and rate of extinction of UCS expectancies in Chapter 3 was only evident for belief bias as indexed by errors. When belief bias expresses itself in RTs, this indicates that participants have successfully completed the reasoning process: Participants have correctly noticed and corrected their initial tendency to rely on the believability instead of the logical validity of the information. On the other hand, when belief bias is expressed by errors, this indicates that the participant has relied on heuristic processing (System 1 processing) and erroneously relied on the believability to determine logical validity. This means that System 2 (analytical reasoning) was less (or not) involved (cf. e.g., Evans, 2003). It should be noted that participants can draw the wrong conclusion even when they do engage in System 2 reasoning and let this reasoning prevail. System 2 reasoning guarantees analytical reasoning, but it does not guarantee correct outcome (Evans, 2003).

While we found indications for a generally enhanced belief bias to be related to delayed extinction of UCS expectancies (Chapter 3), we did not find evidence for the presence of a generally enhanced belief bias in PD or OCD patients (Chapter 4). It should be noted that we only found enhanced belief bias as indexed by *errors* to be related to delayed extinction of UCS expectancies. If indeed the relationship between generally enhanced belief bias and anxiety disorders is only evident for belief bias as indexed by errors, this may well explain why no evidence for a generally enhanced belief bias was found in PD or OCD patients in Chapter 4: In the study reported in Chapter 4, the distribution of the error data did not meet requirements for general linear modelling (nor could the data be analysed non-parametrically, due to the complexity of the design). The error data could therefore not be analysed. In the other patient study of the present thesis (Chapter 6), the distribution of the error data did allow us to analyse belief bias as indexed by errors, and here indeed we did find evidence for a generally enhanced belief bias to be related to anxiety disorders. Although the group differences in belief bias cannot yet be attributed to any particular group (likely due to current sample sizes), there are some indications that PD patients but not SAD patients display a generally enhanced belief bias as indexed by errors. In this study too, no relationship between generally enhanced belief bias and anxiety disorders was found when belief bias was indexed by RTs.

In apparent contrast with this, the initial finding of a generally enhanced belief bias in spider phobic patients (de Jong, Weertman et al., 1997) *was* evident in RTs. The error data could not be analysed in this spider phobia study due to a lack of variation, so it remains unclear whether the spider phobic patients differed from the non-phobic controls in general belief bias as indexed by errors. De Jong, Weertman et al. (1997) were the only ones to find effects for generally enhanced belief bias when belief bias was indexed by RTs. This may be due to a difference in task design between the initial spider phobia study of de Jong, Weertman et al. (1997) and the studies reported in the present thesis: In the spider phobia study, considerably more time was left between the presentation of the syllogisms than in the present series of studies, which may have resulted in a lesser sense of urgency for participants in the spider phobia study. A sense of urgency will decrease System 2 reasoning. Thus, compared to the participants in the spider phobia study, participants in the studies reported in this thesis will have relied more on System 1 processing. Hence, these participants will have made more belief biased reasoning errors (as compared to the participants in the spider phobia study, who probably could make better use of System 2 reasoning and were thus better able to correct their initial belief bias tendencies). This may explain why a generally enhanced belief bias in the initial spider phobia study was evident when belief bias was indexed in RTs. Of course, this post hoc explanation needs further testing in order to be validated. The differences in meaning of belief bias indexed by RTs and indexed by errors will be discussed later on in this chapter.

The results from the studies reported in the present thesis indicate that a generally enhanced belief bias is present in some but not all anxiety disorders. At present, the findings indicate that spider phobic patients as well as PD patients can be characterised by a generally enhanced belief bias, whereas SAD patients cannot. Assuming that, in the studies reported in this thesis, a generally enhanced belief bias will only become evident when indexed in errors, we can make no assumptions about the role of generally enhanced belief bias in OCD patients (since errors could not be analysed in Chapter 4). This interpretation should however be taken with caution: That a relationship between generally enhanced belief bias and (the development of) anxiety disorders will only express itself when belief bias is indexed by errors in the present series of studies is merely a post hoc explanation. Future studies need to confirm whether indeed the present set-up and instructions of the belief bias task results in the detection of this relationship only when belief bias is indexed by errors.

The finding of differences in general belief biased reasoning performance over various anxiety disorders points to the possibility of generally enhanced belief bias being differentially involved in various anxiety disorders. The finding that generally enhanced belief bias was related to extinction of UCS expectancy points to the relevance of belief bias in the development of specific phobia, since we induced fear for a single stimulus in this study. Given the potentially differential contribution of generally enhanced belief bias to various anxiety disorders, we cannot confidently conclude from this that the same holds for the development of other anxiety disorders such as PD. Therefore, it would be advisable to design disorder specific lab models to test for the contribution of belief bias to the development of each of the anxiety disorders. For instance, as a laboratory model for the development of PD, a fear conditioning paradigm could be used in which false heart rate feedback is paired with air puffs containing high CO_2 concentrations (cf. Stegen, De Bruyne, Rasschaert, Van de Woestijne, & Van den Bergh, 1999).

Specificity and generality of the domain-specific belief bias effect

Translation of anxiogenic dysfunctional convictions into domain-specific syllogisms

The results from the present series of studies indicate that the translation of anxiogenic dysfunctional convictions into domain-specific syllogisms has been problematic and may have hampered a proper interpretation of the results. Before answering the question regarding the specificity and the generality of the domain-specific belief bias effect, we therefore first address the problem concerning the translation of anxiogenic dysfunctional convictions into syllogisms.

Similar to the spider phobia study (de Jong, Weertman et al., 1997), Chapter 4 reports on the difficulties in creating linear syllogisms that match anxiogenic dysfunctional convictions of PD patients. In the study reported in Chapter 4, we measured the believability of the syllogisms' conclusions. If the domain-specific syllogisms are indeed specifically designed to match the anxiogenic dysfunctional convictions of the patient group that was targeted, believability of the conclusions should be high for the targeted patient group but not for other participants. Thus, with respect to the study reported in Chapter 4, if the PD-related syllogisms were specifically designed to match PD-related dysfunctional convictions, PD patients but not NCCs or OCD patients should rate the conclusions of these syllogisms as highly believable. In this study it was however found that all three groups rated the PD-related conclusions as very believable. Indeed, conclusions of syllogisms such as 'A spider is creepier than a fish, a fish is creepier than a pigeon, *therefore a spider is creepier than a pigeon*' (de Jong, Weertman et al., 1997) or 'Gasping is scarier than a dark cellar, a dark cellar is scarier than a romantic movie, *therefore gasping is scarier than a romantic movie*' (Chapter 4) seem generally believable. In an attempt to better match anxiogenic dysfunctional convictions and syllogisms, we successfully turned our attention to social anxiety (Chapter 5). The better match between anxiogenic dysfunctional convictions and domain-specific syllogisms was supported by the findings presented in Chapter 6, showing that NCCs did not display belief bias for social anxiety-related syllogisms. Believability ratings confirmed that NCCs and also PD patients considered the social anxiety related conclusions mildly unbelievable, and that the SAD patients considered the conclusions mildly believable (scoring on average 20.5 on a scale of –100 to 100, whereas the PD group scored – 12 for believability and the NCC group –14.5). These believability ratings indicate that although the translation was successful, there is still much room for improvement. Also, the lack of a group difference for domain-specific belief bias between the SAD and the PD group can be interpreted as a lack of fit between the social anxiety convictions and the syllogisms. Thus, linear syllogisms are likely not ideally suited to convey disorder related convictions. Other options should therefore be explored.

Belief bias has typically been studied in student groups by means of categorical syllogisms such as 'No addictive substances are cheap, some cigarettes are cheap, therefore some cigarettes are no addictive substances' (Evans, Newstead et al., 1993). As de Jong, Weertman et al. (1997) argued, categorical syllogisms are hard to solve, even for students, making them less suitable to measure belief bias in the general population. It is therefore wise to look for alternative ways to measure belief bias. Anxiogenic dysfunctional convictions often hold an 'if …, then…' form: 'If I feel palpitations, I will have a heart attack', 'If I blush, people will ridicule me', 'If I don't wash my hand, my mother will die'. Causal conditional reasoning ('if P, then Q', see e.g., Evans, Newstead et al., 1993) might therefore provide a more optimal means to measure belief bias.

In a study which is not reported in the present thesis, we made a first attempt to measure belief bias with causal conditionals. In this study, we relied on the definition and consequences of belief bias instead of the original design of belief bias tasks: Belief bias refers to holding on to ones conviction when presented with disconfirming information. We therefore presented participants (students) with believable causal inferences (e.g., 'Conditional: If the brake is being pushed, the car slows down; Fact: The brake is being pushed; Conclusion: The car slows down'), of which the participants rated the credibility of the conclusions given the conditionals and facts on a visual analogue scale (0-100). After a break, the participants were presented with exactly the same conditionals, yet this time new information was added to the fact, which may prompt people to think of alternative interpretations (e.g., 'Conditional: If the brake is being pushed, the car slows down; Fact: The brake is being pushed *and the brakes are not broken*; Conclusion: The car slows down'). Again, the participants had to rate the credibility of the conclusions. Logically speaking, the inclusion of the new information should not change the credibility of the conclusion, but people are known to change their evaluation of the conclusion in light of this new information. Indeed, it was found that participants changed their credibility ratings, either towards becoming more convinced (as we had eliminated one of the possible alternative interpretations or disabling situations;

cf. Cummins, Lubart, Alksnis, & Rist, 1991) or towards becoming less convinced (as we had seduced people to consider additional information with respect to the conditionals; cf. De Neys, Schaeken, & D'Ydewalle, 2003). It was expected that participants who show high levels of belief bias as measured with syllogisms would show a relative lack of change in credibility on the present conditional reasoning task (when comparing the credibility of the regular conditionals with the credibility of the conditionals in which additional information was presented). We correlated the amount of change in credibility with an original measure of belief bias to be able to determine whether indeed the newly developed conditional reasoning task measures belief bias. No correlations between the amount of change on the new reasoning task and the original belief bias measure were found in this initial exploratory study, indicating that, in its present form, this design does not provide a valid measure for belief bias (Abbink, 2007). Future studies should seek to increase the sensitivity of this newly developed task. Perhaps inspiration for the increase of sensitivity can be gained from a recent study in which causal conditionals were successfully used to create an interaction between believability and logical validity (Evans, Handley, Neilens, & Over, 2010).

Specificity and generality of the domain-specific belief bias effect

The patient studies described in Chapters 4 and 6 show that the effect of a disorder-related belief bias is not only evident in spider phobic patients, but also in PD patients and patients suffering from SAD. Theoretically, a disorder-related belief bias is expected to be evident in all disorders for which anxiogenic dysfunctional convictions play an important role. The present findings lend support to the idea that disorder-related belief bias can indeed be found in various anxiety disorders. We could conclude from this that generality of the effect is indeed in order. However, it still remains to be seen whether disorder-relevant belief bias is indeed restricted to the relevant disorder.

The finding that, in the present series of studies, not only the PD group but also the OCD group displayed PD-related 'domain-specific' belief bias, and that not only the SAD group but also the PD group displayed social anxiety related 'domain-specific' belief bias, leads to questioning either the domain-specificity of the *syllogisms* (as was discussed above) or the domain-specificity of the *belief bias effect*, or both. Co-morbidity can be ruled out as potential explanation as we had defined the presence of the primarily targeted disorder (viz. PD in Chapter 4 and SAD in Chapter 6) as an exclusion criterion for the clinical control groups (viz. OCD in Chapter 4 and PD in Chapter 6). If the domain-specific belief bias is not restricted to the relevant disorders, but to suffering from an anxiety disorder in general, the domain-specific belief bias effects might have been caused by anxiety itself. One can imagine that reasoning with anxiety-related materials (e.g., social rejection or spiders being scary) may have an enhanced content-effect for those participants who initially experienced higher levels of anxiety (viz. the patient groups). Most likely, if indeed the emotionality of the content would have induced a heightened level of anxiety in our patients, such detrimental effect of anxiety[22] would have spilled-over to the neutral syllogisms as well. Yet, we did not find similar effects on the neutral syllogisms. Note that we did find some differences between groups in general belief bias, but that these differences are not similar to the differences in domain-specific belief bias effects. It seems therefore most parsimonious to assume that, once an adequate domain-specific belief bias measure has been developed, the domain-specific belief bias will prove to be domain- (or disorder-) specific indeed. It is expected that this effect will be evident in all anxiety disorders (although strength may vary over the various anxiety disorders, depending on the role of anxiogenic dysfunctional convictions within each disorder). Most likely, the domain-specific belief bias will prove to consist of a normal process that backfires because of its deviant input (namely the anxiogenic dysfunctional beliefs).

Reaction times vs. errors in belief bias

In the present series of studies, belief bias was indexed by both errors and RTs. Originally, studies investigating belief bias have only focussed on the distribution of errors between matches and mismatches in categorical syllogistic reasoning tasks. As categorical syllogisms are hard to solve even for students (cf. de Jong, Weertman et al., 1997), we have used linear syllogisms to be able to measure belief bias in a general population. By doing so, we chose to include RTs as an index for belief bias: Linear syllogisms generally elicit only few errors when evaluated for logical validity when there are few time constraints (e.g., Huttenlocher, 1968), making errors a less reliable outcome measure for belief bias (in which the differences in errors between cells needs to be evaluated). With the inclusion of RTs to index belief bias, we were able to detect belief bias even when people made no mistakes: When people have relatively more

[22] It should be noted that Mancini and colleagues oppose this view of a detrimental effect of anxiety. They argue that patients perform more adequate reasoning compared to controls when reasoning with disorder-relevant materials. They base this interpretation on results of a study in which syllogisms were presented that were either valid or invalid, but that were always believable. This design does not allow to differentiate between better reasoning performance and belief biased reasoning: If their interpretation is correct, patients would also perform better on valid-*unbelievable* syllogisms. These syllogisms were not included in the reasoning task (Mancini, Gangemi, & Johnson-Laird, 2008, July). The data of the present thesis consistently contradict the notion that patients would have performed better on valid-*unbelievable* syllogisms.

difficulty to solve mismatched syllogisms but do so accurately anyway, they will likely show a delayed response on these more difficult syllogisms (Evans, 2003).

In an attempt to force people to show their belief bias on the easier-to-solve linear syllogisms, instructions were used that stressed both the need for accuracy (to ensure that people actually engaged in logical reasoning performance) and the need for rapid response (to enhance differences in RTs between the easier and the more difficult syllogisms). In doing so, we have created ambiguous instructions: People need to choose between being accurate and being fast. Wanting to be accurate will induce System 2 processing, in which belief bias is more likely to be overcome with respect to correct outcome of the reasoning process (e.g., Dickstein, 1975), whereas wanting to be quick will induce System 1 processing, in which beliefs will be an important guide for the evaluation of the syllogisms (e.g., Evans & Curtis-Holmes, 2005). We cannot be certain how people handled this discrepancy. Most likely, they have tried to find some middle ground. We know that participants did not solely rely on being quick, given that the average reaction times often lie around 7 seconds or more and that, generally, more syllogisms were solved correctly than incorrectly in each cell of the design. This contradicts the notion that participants did not engage in a reasoning process. Yet, the exact balance people found in this speed-accuracy trade-off remains unclear. Also, this balance may have varied between participants as well as within participants (for instance after participants were reminded of the instructions after a break in the reasoning task, or due to increasing fatigue over the course of the reasoning task).

The speed-accuracy trade-off does not appear to be stable over the various studies: For instance, in one of our studies, belief bias error scores correlated with belief bias error scores between domains, indicating a stable speed-accuracy trade-off for all types of syllogisms. In another study, all belief bias scores (both error-based and RT-based for neutral, threat and safety domain) correlated with each other, indicating an overall stable approach. In yet another study, no correlations between belief bias scores as indexed by errors or by RTs and the various domains were found (which could be taken as a sign of varying speed-accuracy trade-off). Even though the exact nature of the speed-accuracy trade-off in the present series of experiments remains unclear and hinders the interpretation of the differences between results found for belief bias as indexed by either errors or RTs, this need not lead to mistrusting our findings: RTs were relatively high, even for matched syllogisms, and error rates were on average low, even for mismatched syllogisms. These findings indicate that people overall did not consequently rely solely on System 1 processing. Also, in all studies we found clear interaction effects between believability and validity, albeit that we sometimes found it for both errors and RTs and sometimes for only RTs or errors. This shows that although there is indeed a trade-off, the tasks were sensitive enough to measure belief bias effects.

Belief bias as indexed by errors is clearly the most overt threat to the disconfirmation of beliefs: Participants who engage in faulty, belief-confirming, reasoning under relatively ideal conditions (e.g., although we did include time pressure, the maximum response time was 20 seconds, and reasoning took place in a single-task setting) will likely show at least the same level of belief bias in everyday situations. In future research, if one wants to detect those people most at risk for confirmation of (anxiogenic dysfunctional) beliefs, then instructions need to induce participants to make great effort to come up with the correct answer. Therefore, instructions would need to stress accuracy. By doing so the sensitivity of the belief bias task will diminish. Therefore, if one wants to be able to detect even small levels of belief biased reasoning, then belief bias should be facilitated by stressing rapid responding in the instructions. However, by doing so, one risks that participants will only rely on believability and will not commit to any effort of reasoning.

Future research

The series of studies in the present thesis of course give rise to suggestions on improvement of previously conducted studies and to new research questions. These will be discussed here. First, as discussed earlier, it is important to find better ways to measure domain-specific belief bias in order to be able to successfully continue the research into the specificity and generality of domain-specific belief bias in anxiety disorders. Hopefully causal conditional reasoning will prove useful in this context. Second, it would be wise to use unambiguous task instructions to avoid confusion in the meaning of belief bias as indexed on errors versus as indexed on RTs.

Until now, the role of domain-specific belief bias as a maintaining factor for anxiety disorders has only been logically derived. Future studies should set out to empirically test the alleged causal influence of disorder-relevant belief bias in the maintenance of symptoms. In order to do so, domain-specific belief bias in one group of patients should be experimentally reduced while a second group of patients receives no manipulation of belief bias (cf. Amir, Weber, Beard, Bomyea, & Taylor, 2008 for a similar approach in the context of attentional bias). How a reduction of belief bias can be achieved will be discussed later on in this paragraph.

In a similar vein, it would be important to test further the alleged causal influence of generally enhanced belief bias on the development of anxiety disorders. Reactions to a fear conditioning paradigm such as in Chapter 3 (Exp. 2) should be compared between groups of participants with experimentally enhanced belief bias and experimentally reduced belief bias. As noted earlier, we would recommend to set up fear conditioning studies related to each anxiety disorder, separately. If belief bias is experimentally enhanced, delayed extinction would be expected, whereas experimentally reducing belief bias would result in relatively speeded extinction. Preferably, both enhancement of belief bias and reduction of belief bias should be compared to no manipulation of belief bias. Special attention needs to be paid to the generalisability of these retraining effects beyond the task in which belief bias was retrained (cf. Salemink, van den Hout, & Kindt, 2010), as we need to create an enhanced or reduced bias in reasoning that can be transferred to the fear conditioning task.

At present, we have only limited leads on how to sustainably manipulate belief bias. We need to gain this knowledge to be able to experimentally test the role of belief bias in the development of anxiety disorders, as well as to be able to investigate the therapeutic use of a (still to be developed) belief bias modification training. Several factors, known to influence belief bias, regrettably are difficult (if not impossible) to bring under experimental control, such as intelligence, working memory, age. Relevant factors that may be more easily influenced are cognitive load, time constraint, instruction and training. Decreasing working memory capacity by increasing cognitive load will likely result in increased belief biased reasoning, yet this does not influence the default mode by which participants engage in reasoning processing. A similar line of reasoning holds for introducing time constraints. Cognitive load and time constraints only temporarily hinder participants from engaging in more thorough System 2 processing. More promising factors for influencing belief bias are instruction and training in logical reasoning. Yet, the effects of instruction and training are small and not easy to induce (cf. Neilens, Handley, & Newstead, 2009). Factors that have not been studied in the context of belief bias, but that may prove helpful in modifying belief bias are feedback and allocation of attention. In order to create enhanced belief bias, participants can receive positive feedback (e.g., a smiling face) directly after all trials that have been answered in line with the believability of the syllogisms conclusions. This would mean that one would receive positive feedback after accepting believable-valid and believable-invalid trials and after rejecting unbelievable-valid and unbelievable-invalid trials. In order to create a reduction in belief biased reasoning, positive feedback should be related to accurate evaluation of the logical validity. In addition, when trying to induce an enhanced belief bias, a relatively high percentage of believable-valid and unbelievable-invalid syllogisms could be presented, whereas a relatively high percentage of believable-invalid and unbelievable-valid syllogisms could be presented in order to reduce belief bias. Furthermore, allocating attention to the believability- or validity-relevant aspects of the syllogisms could potentially help people to focus their reasoning process. When trying to enhance belief bias, participants should allocate less attention to the premises and more attention to the (believability of the) conclusion. By visually drawing attention to the conclusion and reducing attention to the premises, participants can be aided in this process. In order to reduce belief bias, attention has to be drawn away from the believability of the conclusion and be focused on the logical construction of the syllogisms. In order to do this, attention needs to be directed to the premises as well as the conclusion. Through this, relative to the enhanced belief bias manipulation, this may induce a careful consideration of all pieces of information. Such carefulness may generalise to daily-life. Allocation of attention can for instance be achieved by using a prior-to-presentation fixation cross. Additional ways to manipulate belief bias should be explored. It will probably take multiple training sessions to create modified belief bias effects that can be generalised to different tasks.

The present thesis is a first step in determining the involvement of belief bias in the development and maintenance of anxiety disorders. With the aforementioned suggestions, the causal status of belief bias in the development and maintenance should become more clear. Another interesting line of research lies in the relevance of domain-specific and/or generally enhanced belief bias in the *treatment* of anxiety disorders. Belief bias can be hypothesised to hinder effective treatment, as it leaves patients less open minded for change. On the other hand, a domain-specific belief bias can potentially be of use to the therapist: If belief bias is an important component through which anxiogenic dysfunctional convictions are sustained, then patients with (high levels of) domain-specific belief bias should benefit substantially from cognitive therapy (in which reasoning errors are targeted). Also, it should be explored whether post-treatment belief bias can serve as a predictor for relapse. As a first step to shed light on these questions regarding relevance of belief bias for treatment, we are currently conducting a study in which SAD and PD patients are tested for domain-specific and generally enhanced belief bias as well as anxiety symptoms, prior to treatment, post-treatment and at follow-up. We expect that this study will shed light on how initial levels of belief bias relate to symptom reduction during treatment, and whether post-treatment levels of belief bias can predict symptom relapse (Vroling & de Jong, 2010, June).

Concluding remarks

The present thesis provides an indication for the involvement of generally enhanced belief bias in the development of anxiety disorders. Learning experiences are a necessary moderator for this relationship. It seems that the role of generally enhanced belief bias in the development of anxiety disorders is relatively minor: Had belief bias been a highly important contributor, we would already have found this relationship in general samples. Also, we would likely have found more pronounced discrepancies between patients and NCCs, with patients showing more generally enhanced belief bias.

The domain-specific belief bias effect needs further testing with better matched reasoning materials. It is likely that domain-specific belies bias will indeed prove to exist, and will prove to be related to the strength of anxiogenic dysfunctional cognitions or to the strength of implicit anxiogenic associations. Whether domain-specific belief bias is indeed causally involved in the maintenance of anxiety disorders also needs further testing. A first step would be to observe whether domain-specific belief bias is reduced after successful treatment. A second and more crucial step would be to experimentally reduce domain-specific belief bias to see whether this leads to a reduction of anxiety symptoms.

With respect to clinical relevance, it is important to note that belief bias may affect treatment results: The study reported in Chapter 6 contains only the first part of a larger study in which patients are followed over the course of treatment. Preliminary data from this study suggest that indeed both domain-specific as well as neutral belief bias can be found to be related to treatment outcome (Vroling & de Jong, 2010, June).

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Samenvatting

Ongeveer negentien procent van de Nederlandse bevolking krijgt in zijn leven een angststoornis. Mensen die lijden aan een angststoornis ervaren intense angsten die van invloed zijn op het dagelijks leven. De meest voorkomende angststoornissen zijn: paniekstoornis met/zonder agorafobie (angst voor en het vóórkomen van paniekaanvallen), specifieke fobie (angst voor een bepaald object, dier of situatie zoals bijvoorbeeld spinnen of hoogten), sociale angst stoornis (angst voor afwijzing in sociale- of beoordelingssituaties), obsessief compulsieve stoornis (terugkerende dwangmatige gedachten en handelingen), posttraumatische stress stoornis (na blootstelling aan een traumatische gebeurtenis: langdurige klachten van herbeleven van de traumatische gebeurtenis, vermijding en alertheid), acute stress stoornis (ontwikkeling van angst of andere symptomen binnen een maand na blootstelling aan een traumatische gebeurtenis), en gegeneraliseerde angststoornis (overmatige angst en zorgen over verschillende onderwerpen/gebeurtenissen).

Volgens de cognitieve theorie liggen disfunctionele overtuigingen ten de grondslag aan alle angststoornissen. Het gaat dan om overtuigingen zoals ‘hartkloppingen zijn een teken van een aankomende hartaanval’ of ‘als ik bloos dan zullen mensen mij uitlachen’. Opvallend aan disfunctionele overtuigingen is dat deze meestal niet waar zijn en dat mensen met een angststoornis er toch sterk in blijven geloven. Dit doet vermoeden dat mensen met een angststoornis niet goed zijn in het trekken van conclusies op basis van ervaringen (bijvoorbeeld het concluderen dat de overtuiging ‘blozen leidt tot uitgelachen worden’ niet klopt wanneer je een keer niet uitgelachen werd terwijl je wel bloosde).

Onderzoek laat zien dat mensen wisselen in de mate waarin ze logisch correcte conclusies kunnen trekken. De geloofwaardigheid van informatie kan sterk van invloed zijn op de beoordeling van de logische geldigheid. Deze interferentie van geloofwaardigheid op logische correct redeneren wordt belief bias genoemd. Belief bias wordt gemeten met behulp van syllogismen. Syllogismen bestaan uit twee premissen en een conclusie. De premissen zijn de stellingen die voor waar moeten worden aangenomen. Van de conclusie moet bepaald worden of deze geldig is, dus of deze logisch volgt uit de premissen. Naast het wel of niet logisch geldig zijn van een conclusie, kan ook de geloofwaardigheid van een conclusie worden gevarieerd. Wanneer mensen zich laten leiden door geloofwaardigheid in het beoordelen van de logische geldigheid is er sprake van belief bias. Meer concreet is belief bias te zien aan langere reactietijden en meer fouten bij de beoordeling van syllogismen die logisch geldig maar ongeloofwaardig of logisch ongeldig maar geloofwaardig zijn, in vergelijking met syllogismen die logisch geldig en geloofwaardig of logisch ongeldig en ongeloofwaardig zijn. Een voorbeeld van de vier mogelijke combinaties van logische geldigheid en geloofwaardigheid is te zien in Tabel 8.1.

Tabel 8.1

	Geloofwaardig	Ongeloofwaardig
	Een olifant is groter dan een koe	Een muis is groter dan een koe
logisch	Een koe is groter dan een muis	Een koe is groter dan een olifant
geldig	**Een olifant is groter dan een muis**	**Een muis is groter dan een olifant**
logisch	Een muis is groter dan een koe	Een olifant is groter dan een koe
ongeldig	Een koe is groter dan een olifant	Een koe is groter dan een muis
	Een olifant is groter dan een muis	**Een muis is groter dan een olifant**

Belief bias is een normaal fenomeen: Mensen zijn geneigd om bij sterke overtuigingen de vuistregel te hanteren dat wat geloofwaardig is, ook waar is. Met deze strategie ervaar je steeds 'bewijs' voor je eigen overtuiging, en wordt bewijs dat indruist tegen je eigen overtuiging als onwaar bestempeld. Op deze manier blijft de sterke overtuiging intact. Mensen met een angststoornis hebben sterke disfunctionele overtuigingen. Het is dus waarschijnlijk dat zij belief bias toepassen op overtuigingen die in hun angststoornis centraal staan. Gevolg is dat deze overtuigingen als het ware beschermd worden tegen ontkrachting. Hiermee zou de angststoornis dus in stand worden gehouden. Wanneer belief bias voor disfunctionele overtuigingen naar voren komt bij angststoornis patiënten wordt dit domeinspecifieke belief bias genoemd.

In een eerste studie naar belief bias onder patiënten die lijden aan een spinnenfobie vonden de Jong en collega's (1997) dat de patiënten zich voor spingerelateerde onderwerpen inderdaad lieten afleiden door de geloofwaardigheid in het beoordelen van de logische geldigheid. Er is hier dus sprake van een domeinspecifieke belief bias. Opvallend was echter dat de patiënten met een spinnenfobie zich in het algemeen sterker lieten leiden door geloofwaardigheid dan niet-angstige controleproefpersonen, dus ook bij thema's die voor iedereen vergelijkbaar geloofwaardig zouden moeten zijn. Op basis hiervan werd geconcludeerd dat mensen met een spinfobie, of misschien zelfs alle mensen met een angststoornis, mogelijk over het algemeen meer belief bias vertonen , dus slechter zijn in logisch redeneren dan niet-angstige mensen. Mogelijk is een hogere belief bias een karaktertrek van mensen met een angststoornis. En als dat het geval is, dan speelt deze belief bias wellicht een rol in het ontwikkelen van een angststoornis. Immers, als je een sterke neiging hebt om vast te houden aan dat wat je gelooft, of zelfs om steeds sterker te bevestigen wat je al gelooft, dan worden ideeën, en dus ook angstopwekkende ideeën, sneller omgevormd tot vaststaande overtuigingen. Zulke vaststaande angstopwekkende overtuigingen kunnen de basis vormen voor een angststoornis.

In de huidige these worden twee onderzoekslijnen gevolgd. Allereerst wordt de mogelijkheid onderzocht dat belief bias inderdaad betrokken zou zijn bij de ontwikkeling van angststoornissen. Dit wordt uitgewerkt in de hoofdstukken 2 en 3. Daarnaast wordt gekeken naar de generaliseerbaarheid en specificiteit van domeinspecifieke belief bias bij angststoornissen. Dat wil zeggen, dat onderzocht wordt of domeinspecifieke belief bias ook gevonden kan worden bij andere angststoornissen dan spinnenfobie, en of de domeinspecifieke belief bias voor bijvoorbeeld paniekstoornis inderdaad specifiek is voor paniekstoornispatiënten en niet ook gevonden kan worden bij patiënten met een andere angststoornis. Deze vragen worden uitgewerkt in de hoofdstukken 4, 5 en 6.

In hoofdstuk 2 worden aanwijzingen gezocht voor een relatie tussen een verhoogde algemene belief bias en de ontwikkeling van angststoornissen. Wanneer een verhoogde algemene belief bias betrokken is bij het tot stand komen van angststoornissen zal de relatie tussen belief bias en angstklachten naar waarschijnlijkheid al zichtbaar moeten zijn voordat de angststoornis zich ontwikkelt. Deze relatie werd daarom onderzocht in een aselecte groep studenten. De relatie tussen belief bias en angstklachten is in een normale populatie minder sterk dan in een patiëntenpopulatie en daarom moeilijker te meten. Door gebruik te maken van voor iedereen geldende dreiginggerelateerde thema's, die dichter bij angst liggen dan neutrale thema's, verwachtten we de veronderstelde relatie sensitiever te kunnen meten. Naast dreiginggerelateerde thema's werden ook veiligheidgerelateerde thema's en algemene neutrale thema's gebruikt om belief bias te meten. De belief bias scores voor de drie thema's werden gecorreleerd met de mate van angstklachten. Verwacht werd dat er een positieve relatie tussen belief bias en angst zou zijn. Er werden geen significante correlaties gevonden. Dit onderzoek levert daarmee geen bewijs voor het bestaan van een relatie tussen belief bias en de ontwikkeling van angststoornissen. Mogelijk echter komt de relatie tussen belief bias en de ontwikkeling van angststoornissen pas naar voren wanneer ook angstige ervaringen in het onderzoek betrokken worden. Immers, zonder angstige ervaringen zullen er naar alle waarschijnlijkheid geen angstopwekkende ideeën worden gevormd. Deze angstopwekkende ideeën zijn een noodzakelijke voorwaarde voor het tot uiting komen van belief bias en dus ook voor het tot uiting komen van de veronderstelde relatie.

Hoofdstuk 3 bouwt voort op de suggesties van hoofdstuk 2. In een nieuwe aselecte groep studenten werden angstopwekkende leerervaringen onder experimentele controle gebracht met behulp van een angstconditionering paradigma. Onderzocht werd of er een samenhang is tussen belief bias en het uitdoven van aangeleerde angst. Het angstconditionering paradigma zag er als volgt uit: De proefpersonen kregen bij sommige plaatjes een elektrische schok toegediend en bij andere plaatjes geen schok. De proefpersonen gaven bij elk plaatje aan in hoeverre ze een schok verwachtten (dit wordt USC verwachting genoemd). In de aanleerfase volgde de schok steeds op hetzelfde plaatje (dit wordt de CS^+ genoemd). Door een aantal keer aanbieden van de CS^+ en een plaatje waar geen schok op volgt leren mensen wanneer de schok verwacht kan worden. Vervolgens werden in de uitdovingfase geen schokken meer aangeboden. Bij de meeste mensen zal de aangeleerde angst voor het plaatje waaraan de schok gekoppeld was dan dalen. Een dergelijk conditioneringsparadigma doet dienst als een model voor de ontwikkeling van een angststoornis: Mensen worden in de aanleerfase bang gemaakt voor een plaatje en krijgen vervolgens ontkrachtende informatie aangeboden in de uitdovingfase (immers, in deze fase krijgen ze geen schokken meer aangeboden bij de CS^+). De verwachting was dat mensen die een hogere algemene belief bias laten zien een vertraging laten zien in de uitdoving van UCS verwachtingen. Dit staat model voor de uitdoving van angst.

In het eerste experiment werden twee neutrale plaatjes gebruikt voor de conditionering. Hiermee vonden we geen relatie tussen belief bias en vertraagde uitdoving van UCS verwachting. De resultaten van dit eerste experiment gaven aanleiding te veronderstellen dat plaatjes gebruikt moeten worden die een initiële verwachting oproepen over het al-dan-niet plaatsvinden van een schok, om de relatie tot uiting te brengen. In het tweede experiment werden daarom een zonnebloem en een cactus gebruikt als conditioneringsplaatjes. Wanneer de cactus als CS^+ diende lieten mensen met een hogere mate van belief bias inderdaad een vertraagde uitdoving van UCS verwachting zien. Dit gold niet wanneer de zonnebloem als CS^+ diende. Hieruit concluderen we dat een algemeen verhoogde belief bias dus inderdaad kan bijdragen aan het ontwikkelen van een angststoornis. De resultaten van deze twee experimenten laten evenwel ook zien dat deze relatie niet bijzonder sterk is.

In hoofdstuk 4 werd onderzocht of, naast spinfobie patiënten (uit de studie van de Jong en collega's uit 1997), ook paniekstoornis patiënten een algemeen verhoogde belief bias laten zien. Bovendien werden de generaliseerbaarheid en de specificiteit van de domeinspecifieke belief bias nader onderzocht. Paniekstoornispatiënten en niet-angstige controleproefpersonen kregen een belief bias taak voorgelegd die bestond uit zowel algemene als paniekgerelateerde syllogismen. Opvallend genoeg lieten de paniekstoornispatiënten geen verhoogde algemene belief bias zien in vergelijking met de niet-angstige controlegroep. Wel lieten zij, zoals verwacht, een paniekgerelateerde, dat wil zeggen domeinspecifieke, belief bias zien. Om de specificiteit van dit domeinspecifieke effect te onderzoeken werden dezelfde syllogismen ook aan een groep obsessief compulsieve patiënten voorgelegd. Ook de obsessief compulsieve patiënten lieten een paniekgerelateerde belief bias zien, en net als de groep paniekpatiënten geen algemeen verhoogde belief bias. Deze bevinding zet vraagtekens bij het stoornisgebonden zijn van de domeinspecifieke belief bias. Mogelijk dat deze belief bias niet veroorzaakt wordt door de stoornisspecifieke disfunctionele overtuigingen, maar door de algemene angstigheid van angststoornis patiënten. Als dit het geval zou zijn, dan hadden we echter ook vertekeningen moeten zien op de algemene syllogismen, wat niet het geval was. Een andere verklaring ligt in de geloofwaardigheid van aan de paniekgerelateerde syllogismen: De paniekstoornis patiënten vonden deze door ons geconstrueerde syllogismen behoorlijk geloofwaardig. Echter, de obsessief compulsieve patiënten en de niet-angstige controleproefpersonen vonden deze syllogismen eveneens behoorlijk geloofwaardig. Waarschijnlijk zijn de paniekgerelateerde syllogismen dus te algemeen geloofwaardig geweest. Blijkbaar laten paniekstoornis overtuigingen zich niet eenvoudig vertalen in paniekgerelateerde syllogismen.

Hoofdstuk 5 richt zich daarom op het verbeteren van de vertaling van disfunctionele overtuigingen naar domeinspecifieke syllogismen. We veronderstelden dat sociaal angstige overtuigingen zich beter lenen voor een dergelijke vertaling. Sociaal angstige overtuigingen hebben namelijk betrekking op vergelijkingen met andere mensen en syllogismen dragen altijd vergelijkingen in zich. Een groep studenten met variërende scores op een vragenlijst voor sociale angst maakten een belief bias taak die bestond uit zowel algemene als aan sociale angst gerelateerde syllogismen. Tevens vroegen we alle proefpersonen de geloofwaardigheid van de aan sociale angst gerelateerde syllogismen te beoordelen. Het bleek dat mensen die hoger scoorden op de vragenlijst voor sociale angst de syllogismen die betrekking hadden op sociale angst als geloofwaardiger beoordeelden dan mensen die laag op deze vragenlijst scoorden. En inderdaad lieten mensen die hoger scoorden op de vragenlijst voor sociale angst ook meer domeinspecifieke belief bias zien. Deze bevindingen laten zien dat de vertaling van de overtuigingen naar de syllogismen succesvol was. Overigens vonden we weer geen aanwijzingen dat mensen die een sterkere mate van sociale angst hebben ook een sterkere algemene belief bias zouden laten zien.

In hoofdstuk 6 worden de syllogismen uit hoofdstuk 5 getoetst in een groep sociaal angstige patiënten. De opzet van de studie was gelijk aan de opzet van de studie uit hoofdstuk 4, waarbij de klinische controlegroep ditmaal bestond uit paniekstoornis patiënten. De beoordeling van de geloofwaardigheid van de syllogismen die betrekking hebben op sociale angst door de verschillende groepen liet zien dat de vertaling van de disfunctionele overtuigingen naar syllogismen ditmaal beter gelukt was. Er bleek echter zeker nog ruimte voor verbetering.

Zoals verwacht vonden we een domeinspecifieke belief bias voor de sociaal angstige patiënten, en niet voor de niet-angstige controlegroep. Op het eerste gezicht liet de groep paniekstoornispatiënten (de klinische controlegroep) ditmaal geen domeinspecifieke belief bias zien. Statistisch gezien verschilde de domeinspecifieke belief bias van de sociaal angstige groep echter niet van die van de paniekstoornis groep. We concluderen, in lijn met de argumentatie uit hoofdstuk 4, dat het onwaarschijnlijk is dat de domeinspecifieke belief bias veroorzaakt wordt door algemene angstigheid, en dat het waarschijnlijk is dat er een nog betere vertaling moet komen van de disfunctionele overtuigingen in sociaal angstige syllogismen.

Verder vonden we in dit onderzoek geen aanwijzingen voor een algemeen verhoogde belief bias bij de sociaal angstige patiënten. Het lijkt erop dat paniekstoornis patiënten wel een verhoogde belief bias hebben. Dit kan echter nog niet met zekerheid gezegd worden omdat er nog te weinig proefpersonen meedoen aan het onderzoek om hierover statistisch solide conclusies te kunnen trekken.

Al met al zijn de resultaten van de verschillende onderzoeken niet eenduidig. We vinden bij de meeste patiëntengroepen geen algemeen verhoogde belief bias, terwijl dat in eerder onderzoek bij patiënten die lijden aan spinnenfobie wel gevonden werd (de Jong en collega's, 1997) en we ook enige aanwijzingen hebben dat dit bij paniekstoornispatiënten het geval zou kunnen zijn. Ook vinden we geen relatie tussen belief bias en angstklachten in een algemene studentenpopulatie. Echter, wanneer we angstige leerervaringen onder experimentele controle brengen vinden we wel een relatie. Waarschijnlijk kan een deel van de wisselende resultaten verklaard worden doordat we belief bias soms alleen gemeten hebben met reactietijden, en soms ook met fouten[23]. Gezien het feit dat er in sommige studies wel degelijk een relatie tussen algemeen verhoogde belief bias en (de ontwikkeling van) angststoornissen gevonden is, concluderen we dat belief bias waarschijnlijk betrokken zal zijn bij de ontwikkeling van angststoornissen. Vermoedelijk is deze relatie echter niet bijzonder sterk, aangezien zij niet in alle studies tot uiting komt. Bovendien zou de bijdrage van belief bias aan de ontwikkeling van angststoornissen

[23] In alle studies is belief bias zowel met reactietijden als met fouten gemeten. In sommige studies waren met name de fouten dusdanig scheef verdeeld dat er geen statistische analyses op konden worden uitgevoerd. In deze studies zijn de analyses dus beperkt tot belief bias gemeten in reactietijden.

verschillend kunnen zijn voor verschillende angststoornissen. Het angstconditionering paradigma modelleert vooral de specifieke fobie, en juist voor de specifieke fobie werd in eerder onderzoek wel een relatie met algemeen verhoogde belief bias gevonden (namelijk in de studie van de Jong en collega's, 1997). Voor andere angststoornissen blijft dit vooralsnog onduidelijker.

De domeinspecifieke belief bias bleek zich niet zo eenvoudig te laten meten als vooraf werd gedacht. Het vertalen van disfunctionele overtuigingen in syllogismen maakte dat de geloofwaardigheid van de stoornisspecifieke syllogismen voor de patiëntendoelgroep afnam, en dat deze juist groter werd voor de niet-patiënten. Syllogismen lijken dus niet de juiste manier om domeinspecifieke belief bias te meten. Op welke manier dit wel gemeten kan worden is nog onduidelijk. De verwachting is dat, indien een goede manier van meten wordt gevonden, wel aangetoond kan worden dat de domeinspecifieke belief bias inderdaad specifiek is voor de betreffende stoornis. Dit zal naar alle waarschijnlijkheid gelden voor alle angststoornissen, hoewel de sterkte van deze domeinspecifieke belief bias wel per angststoornis kan verschillen.

Hoewel er nog onduidelijkheden bestaan over de exacte aard van de relatie tussen belief bias en angststoornissen, geven de eerste resultaten van lopende vervolgonderzoeken verder gewicht aan de veronderstelling dat belief bias bij angststoornissen een rol speelt. Zowel algemeen verhoogde als domeinspecifieke belief bias lijken[24] voorspellend te zijn voor therapieverloop en voor klachtenverloop na afronding van de therapie.

[24] Dit zijn tussentijdse resultaten uit een lopende studie, de uiteindelijk resultaten laten nog op zich wachten.

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Curriculum Vitae

Maartje Sophie Vroling werd geboren op 7 januari 1981 in ’s-Gravenhage. Zij behaalde in 2000 haar VWO diploma, waarna zij de studie Psychologie aan de Radboud Universiteit Nijmegen begon. Gedurende haar studie was zij als student-assistent betrokken bij het verzorgen van onderwijs in statistiek en methoden van onderzoek, en werkte ze in 2005 als junior onderzoeker voor Spatie, Centrum voor Geestelijke Gezondheid te Apeldoorn. Na haar afstuderen in de richting Klinische Psychologie, startte zij in 2005 een promotietraject aan de Rijksuniversiteit Groningen onder begeleiding van Peter J. de Jong. Het thans voorliggende proefschrift is hiervan het eindproduct. Sinds 2010 is zij werkzaam bij de Gelderse Roos (tegenwoordig onderdeel van Pro Persona) te Tiel, als senior wetenschappelijk medewerker en basispsycholoog. Daarnaast heeft zij een parttime aanstelling als docent Klinische Psychologie aan de Radboud Universiteit Nijmegen.

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