Belief biased reasoning in anxiety disorders
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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.
Belief-confirming reasoning bias in social anxiety disorder

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:

<table>
<thead>
<tr>
<th>Premise 1</th>
<th>A is larger than B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premise 2</td>
<td>B is larger than C</td>
</tr>
<tr>
<td><strong>Conclusion</strong></td>
<td><strong>Therefore A is larger than C</strong></td>
</tr>
</tbody>
</table>

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 Vrolijk 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.*  

<table>
<thead>
<tr>
<th>Believable conclusion</th>
<th>Unbelievable conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>valid</td>
<td>invalid</td>
</tr>
<tr>
<td>An elephant is bigger than a dog</td>
<td>A mouse is bigger than a dog</td>
</tr>
<tr>
<td>A dog is bigger than a mouse</td>
<td>A dog is bigger than an elephant</td>
</tr>
<tr>
<td><strong>An elephant is bigger than a mouse</strong></td>
<td><strong>A mouse is bigger than an elephant</strong></td>
</tr>
<tr>
<td>A mouse is bigger than a dog</td>
<td>An elephant is bigger than a dog</td>
</tr>
<tr>
<td>A dog is bigger than an elephant</td>
<td>A dog is bigger than a mouse</td>
</tr>
<tr>
<td><strong>An elephant is bigger than a mouse</strong></td>
<td><strong>A mouse is bigger than an elephant</strong></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>SA congruent conclusion</th>
<th>SA non-congruent conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>valid</td>
<td>invalid</td>
</tr>
<tr>
<td>Others find me less capable than person A</td>
<td>Others find person 1 less capable than person A</td>
</tr>
<tr>
<td>Others find person A less capable than person 1</td>
<td>Others find person A less capable than me</td>
</tr>
<tr>
<td><strong>Others find me less capable than person 1</strong></td>
<td><strong>Others find person 1 less capable than me</strong></td>
</tr>
<tr>
<td>invalid</td>
<td></td>
</tr>
<tr>
<td>Others find person 1 less capable than person A</td>
<td>Others find me less capable than person A</td>
</tr>
<tr>
<td>Others find person A less capable than me</td>
<td>Others find person A less capable than person 1</td>
</tr>
<tr>
<td><strong>Others find me less capable than person 1</strong></td>
<td><strong>Others find person 1 less capable than me</strong></td>
</tr>
</tbody>
</table>
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. 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.

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20 While the
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 \( \alpha \) 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
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*SA congruency*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 disconfirming belief bias pattern.

Continuing on the relevant group*SA congruency*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*SA congruency*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*SA congruency*validity interaction ($F(2,82) = 0.02$, $p = .98$). The two-way SA congruency*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, $F(1,82) = 16.85$, $p < .01$, $\eta^2 = .17$).
Belief-confirming reasoning bias in social anxiety disorder

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

<table>
<thead>
<tr>
<th></th>
<th>SAD</th>
<th>PD</th>
<th>NCC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SA congruent</td>
<td>SA non-congruent</td>
<td>SA congruent</td>
</tr>
<tr>
<td>valid</td>
<td>1.40 (1.38)</td>
<td>1.65 (1.45)</td>
<td>1.48 (1.12)</td>
</tr>
<tr>
<td>invalid</td>
<td>2.37 (1.69)</td>
<td>2.19 (1.62)</td>
<td>3.24 (1.18)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>SAD</th>
<th>PD</th>
<th>NCC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>believable</td>
<td>unbelievable</td>
<td>believable</td>
</tr>
<tr>
<td>valid</td>
<td>6.64 (2.13)</td>
<td>7.94 (2.34)</td>
<td>8.12 (2.32)</td>
</tr>
<tr>
<td>invalid</td>
<td>8.40 (2.76)</td>
<td>7.15 (2.31)</td>
<td>9.02 (1.97)</td>
</tr>
</tbody>
</table>

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\textsuperscript{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

\textsuperscript{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.