Behavioural and Cognitive Psychotherapy, 2014, 42, 479–490
First published online 17 May 2013 doi:10.1017/S1352465813000398

Time-Course of Attentional Bias for Positive Social Words in Individuals with High and Low Social Anxiety

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Background: Although accumulating research demonstrates the association between attentional bias and social anxiety, the bias for positive stimuli has so far not been adequately studied. **Aims:** The aim is to investigate the time-course of attentional bias for positive social words in participants with high and low social anxiety. **Method:** In a modified dot-probe task, word-pairs of neutral and positive social words were randomly presented for 100, 500, and 1250 milliseconds in a nonclinical sample of students to test their attentional bias. **Results:** Non-significant interaction of Group $\times$ Exposure Duration was found. However, there was a significant main effect of group, with significantly different response latencies between the high social anxiety (HSA) and low social anxiety (LSA) groups in the 100 ms condition, without for 500 or 1250 ms. With respect to attentional bias, the LSA group showed enhanced preferential attention for positive social words to which the HSA group showed avoidance in the 100 ms condition. In the 500 ms condition, preferential attention to positive social words was at trend in the LSA group, relative to the HSA group. Neither group showed attentional bias in the 1250 ms condition. **Conclusions:** These findings extend recent research about the attention training program and add to the empirical literature suggesting that the initial avoidance of positive stimuli may contribute to maintaining social anxiety.

Keywords: Attentional bias, positive social words, social anxiety, dot-probe paradigm.

Introduction

Individuals with social anxiety disorder have significant and persistent fear in one or more social conditions (American Psychiatric Association, 2000). According to the cognitive-behavioural therapy models (e.g. Clark and Wells, 1995), fear of negative evaluation (FNE) is a core feature of social anxiety. Clark and Wells (1995) posit that people with social anxiety have some attentional processing bias, which prevents them from collecting evidence that they do much better than they imagine, and maintains the cycle.

Considerable evidence shows that social anxiety is maintained in part by the decreased processing of positive social stimuli. For example, using an eye movement-based method, Chen, Clarke, MacLeod and Guastella (2012) found that socially anxious individuals show faster attentional disengagement from positive stimuli, and their lower total fixation times

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to positive stimuli are associated with higher levels of state anxiety. Using a dot-probe paradigm, Taylor, Bomyea and Amir (2010, 2011) found that socially anxious participants show diminished attentional allocation for positive social words compared with neutral words at 500 milliseconds, after a speech task. In line with this notion, Silvia, Allan, Beauchamp, Maschauer and Workman (2006) also reported that participants with social anxiety take longer to recognize happy faces. Socially anxious participants also selectively neglect positive responses from audiences (Perowne and Mansell, 2002). Vassilopoulos and Banerjee (2010) also found that participants with social anxiety might disqualify positive social events, which leads to the experience of low positive affect.

Although the available literature supports the association between social anxiety and the avoidance of positive stimuli, it remains unknown whether the avoidance is a result of initial allocation of spatial attention or a result of controlled strategies for sustained attention. Various possibilities for socially anxious individuals' avoidance of positive stimuli have been debated. Some researchers support the idea of strategic processing. Researchers found that high socially anxious individuals worry about the initial positive appraisal, which may lead to future negative appraisal, so they choose to perceive others' friendliness in a negative way (Alden, Taylor, Mellings and Laposa, 2008; Weeks, Rodebaugh, Heimberg, Norton and Jakatdar, 2009). However, others support the initial allocation of spatial attention hypothesis. They suggested that social anxiety is maintained by a deficit in the attentional processing of positive information. Participants with social anxiety ignore others' positive social signals and direct their attention to negative ones (Veljaca and Rapee, 1998; Cooper and Langton, 2006).

To test which possibility is more reasonable, we should clarify when the avoidance of positive stimuli happens. For decades, several studies explored the time-course of attentional bias for negative stimuli in social anxiety by using a dot-probe paradigm (Bradley, Mogg, Falla and Hamilton, 1998; Mogg, Philippot and Bradley, 2004). In the present study, we manipulated the stimuli presentation times in the probe task to compare the attentional differences for positive social words. Three presentation times were widely used in previous studies: initial attentional biases in dot probe tasks to threat faces with presentation times below 200 ms might reflect the initial covert target selection (Stevens, Rist and Gerlach, 2011). Therefore, 100 ms, which is too short to shift the attention, is likely to reflect automatic initial shifts in attention, rather than controlled strategies involved in sustained attention (Cooper and Langton, 2006; Koster, Verschuere, Crombez and Damme, 2005); 500 ms, which allows one or more attention shifts between the locations, may not be optimal to indicate the initial allocation of attention (Cooper and Langton, 2006); 1250 ms, which allows interpretation and judgment to influence participant responses (Staugaard, 2010), is usually used to determine whether attentional biases are sustained over this longer time interval (Bradley et al., 1998; Mogg et al., 2004).

Moreover, one potential limitation of prior research is the choice of positive, neutral and negative stimuli. Dimberg and Christmanson (1991) mentioned that participants with low speaking fear showed differential EMG for different emotional faces (i.e. smiling when viewing happy faces and frowning when viewing angry faces). When focused only on the attentional bias for positive stimuli, the adding of negative stimuli may arouse unrelated emotion, which results in interference with the outcome of trials. Therefore, our study compared only positive and neutral words, excluding unnecessary interference. We chose words (rather than faces) for two reasons: first, although facial stimuli may have better ecological validity, their meaning can be more complex and lead to explanatory confusion

Table 1. Anxiety level of sample (standard deviations in parentheses)

Variable	HSA	LSA	Max	Min	*t*
Fear of Negative Evaluation Scale	91.72 (6.33)	52.41 (8.09)	107.00	30.00	16.06***
Social Interaction Anxiety Scale	38.11 (9.12)	17.24 (8.13)	56.00	7.00	7.13***
Social Phobia Scale	24.83 (11.58)	12.00 (7.78)	42.00	0.00	3.83***

Notes: HSA = high social anxiety; LSA = low social anxiety
*** $p < .001$ (two tailed)

(Yoon and Zinbarg, 2007); second, words can express a wider range of positive emotional states than faces (Pishyar, Harris and Menzies, 2004).

The primary goal of the present study was to investigate the time course of attentional bias for positive social words, and to try to clarify whether previous evidence of avoidance of positive social stimuli is an initial allocation of spatial attention (i.e. is present at 100 ms), or the consequence of controlled strategies for sustained attention (i.e. exists beyond 100 ms), during which time positive social words may be interpreted as threatening stimuli. Given their social-evaluative concerns, we hypothesized that individuals with high social anxiety would show avoidance beyond 100 ms and sustain this over some time. As positive stimuli can enhance positive affect and decrease anxiety, we also predicted that people without social anxiety would show preference for positive social words at the three presentation times.

Method

Participants

Sixty-two students from Peking University completed the Fear of Negative Evaluation Scale (FNE: Watson and Friend, 1969, revised by Ye, Qian, Liu and Chen, 2007). We invited those who scored $\leqslant$63 (bottom 27%) or $\geqslant$86 (top 27%) to participate in the study. They were assigned to LSA and HSA groups based on the FNE scores. The HSA group consisted of 18 participants (11 male, 7 female), ranging from 18 to 24 years old, and the LSA group consisted of 17 participants (9 male, 8 female), ranging from 18 to 26 years old. The two groups were matched for gender, χ^2 (1, N = 35) = 0.24, p = .63, d = .08, but differed significantly in age, t (33) = −2.32, p = .03, d = .78, with the HSA group being younger than the LSA group. HSA participants scored significantly higher on three social anxiety-related scales (FNE, Watson and Friend, 1969; Social Interaction Anxiety Scale, SIAS, and Social Phobia Scale, SPS, Mattick and Clark, 1998) than the LSA group (see Table 1).

Materials

The stimuli consisted of 32 word-pairs. We first created a list of 112 Chinese words that seemed positive and highly relevant to social situations (e.g. like, appreciate). In the second step, we paired these words with neutral words according to their length and frequency based on the *Dictionary of Modern Chinese Language High Frequency Words* (Liu, 1990). Third, five clinical psychology graduates were asked to rate each word on 5-point Likert-type scales according to its positive sociality (0 = not at all fit; 4 = very fit) and emotionality (0 = very negative; 4 = very positive), which resulted in 32 most representative word pairs, with mean positive sociality 3.40 and emotionality 3.65 for positive social words, and mean positive sociality 0.06 and emotionality 0 for neutral words.

Measures

Fear of Negative Evaluation Scale (FNE; Watson and Friend, 1969). This scale is a 30-item self-report measure of fear and distress related to negative evaluation from others, which is one of the hallmark criteria for the diagnosis of social phobia. Items are rated on "yes or no" in the original scale, but a 5-point Likert-type scale in the Chinese version, ranging from 0 (not at all characteristic of me) to 4 (extremely characteristic of me). The Chinese version was revised by Ye et al. (2007), with Cronbach α coefficient .90 and retest reliability .90. The Cronbach's alpha in the current sample was .91.

Social Interaction Anxiety Scale (SIAS; Mattick and Clark, 1998). This scale measures anxiety when meeting and talking with others. It consists of 20 items, scored on a 5-point Likert-type scale, ranging from 0 (not at all characteristic or true of me) to 4 (extremely characteristic or true of me). The Chinese version was revised by Ye et al. (2007), with Cronbach α coefficient .87 and retest reliability .86. The Cronbach's alpha in the current sample was .88.

Social Phobia Scale (SPS; Mattick and Clark, 1998). This scale measures anxiety when being observed by others. It consists of 20 items, scored on a 5-point Likert-type scale, ranging from 0 (not at all characteristic or true of me) to 4 (extremely characteristic or true of me). The Chinese version was revised by Ye et al. (2007), with Cronbach α coefficient .90 and retest reliability .85. The Cronbach's alpha in the current sample was .94.

Procedure

The experiment was conducted in three steps. On arrival, the subjects were asked to complete the FNE, SIAS and SPS measures. Next was preparation for a speech to be given later, to evoke anxiety and obtain a better effect (Garner, Mogg and Bradley, 2006). Then, the dot-probe task was executed.

Anxiety-evoking task. The following instructions were given: "Thanks for taking part in our experiment which assesses your social skills and public speaking ability. After the computerized task, you will be asked to make a 3-minute speech on a given topic. Experimenters will stay here to watch your speech and give you a rating. This video camera will record your speech so that more experts can watch it later in order to give you a more comprehensive assessment of your performance and your social skill. You have 30 seconds to prepare before the camera begins to record."

Dot-probe task. The dot-probe task was a modified version of the original task (MacLeod, Mathews and Tata, 1986), to detect any attention bias in participants. Participants were seated with their eyes approximately 60 cm from the computer screen. At the beginning of each trial, a black cross (2 $\times$ 2 cm) was presented in the centre of the screen for 1000 ms. Then a word-pair appeared (1 $\times$ 1 cm; 3 cm apart, within 1.0° visual angle for each word and 4.0° visual angle for the centre-to-centre distance of the two words) with one word above and the other below the centre of the screen. One word of the pair was socially positive, and the other was a matched neutral word. The word pair presentation time varied randomly among 100, 500 and 1250 ms. Participants were told that a probe would randomly replace either of the displayed words. The probe could be either an "E" or an "F". Participants were instructed to press the left mouse button when seeing "E", and the right button when seeing "F". Participants were also asked to respond as quickly and accurately as possible. After their response, the probe disappeared and the next trial began. The inter-trial interval was 500 ms. There were 32 word-pairs and each pair was shown six times (i.e. a total of 192 trials), to counterbalance the location of the probe (upper or lower), the location of either word (upper or lower), and the presentation time (100, 500, 1250 ms). Participants had 10 trials for practice. Each trial took 3 s and all of the tasks took 10 min without a break.

After finishing the last dot-probe task, the rationale for the deception was explained and participants were asked whether they had believed that they had to give a speech. They then received 30 RMB as compensation for their time.

Results

Manipulation check

Eighty-nine percent of the participants believed the speech requirement and reported their anxiety, which showed the success of the anxiety-evoking task. There was no difference between the two groups in believing or disbelieving the speech requirement, $t\ (33) = 0.29$, $p = .77$, $d = .10$; but the two groups reported a significant difference in anxiety level, $t\ (33) = 2.38$, $p < .05$, $d = .80$.

Data reduction

Trials with errors, participants' response latencies less than 100 ms or greater than 2000 ms, and an average reaction time more than three standard deviations below or above the mean latencies were excluded from the analyses. Each participant had a low error rate (< 1%) and the data were normally distributed. Mean reaction times on the presentation time (100/500 /1250 ms), word position (upper/lower), and location of the probe (upper/lower) for the HSA and LSA group were presented in Table 2.

Dot-probe task

The data were entered into a $3 \times 2 \times 2 \times 2$ repeated measures ANOVA, with presentation time (100/500 /1250 ms), word position (upper/lower), and location of the probe (upper/lower) as within-subjects variables, and group (LSA/HSA) as between-subject variable. This revealed a significant effect of presentation time, $F\ (2, 66) = 3.28$, $p = .04$, $\eta^2 = .09$, and a significant three-way interaction of word position × location of the probe × group, $F\ (1, 33) = 10.67$, $p = .003$, $\eta^2 = .24$. All other effects were not significant ($p > .05$). To simplify the three-way interaction, a bias score (*d*) was calculated by subtracting the reaction time for probes following the positive words from the reaction time for probes following the neutral words (Koster et al., 2005). Thus, negative bias scores indicated that attention was directed away from positive words (i.e. towards neutral words), whereas positive bias scores indicated attention to positive words (i.e. away from neutral words).

Table 2. Mean reaction times on the presentation time (100/500 /1250 ms), word position (upper/lower), and location of the probe (upper/lower) for the HSA and LSA group

			HSA		LSA	
Presentation time	Word position	Location of the probe	*M*	*SD*	*M*	*SD*
100 ms	Up	Up	578.82	64.88	591.62	64.65
		Down	567.95	74.75	605.26	68.51
	Down	Up	569.29	77.66	605.98	80.36
		Down	575.04	80.84	597.06	67.46
500 ms	Up	Up	575.48	78.23	590.30	67.77
		Down	567.01	77.11	597.19	71.04
	Down	Up	568.17	79.07	595.70	79.67
		Down	563.87	78.41	582.00	73.97
1250 ms	Up	Up	568.38	78.26	582.19	76.32
		Down	566.63	74.61	583.92	72.47
	Down	Up	564.00	79.55	574.26	72.27
		Down	566.86	84.62	577.74	76.44

All the *d* scores were entered into a 2 × 3 mixed design analysis of repeated measures AVOVA with group type (HSA versus LSA) as a between-subject variable and exposure duration (100 vs 500 vs 1250 ms) as a within-subject variable. There was no significant interaction of Group × Exposure Duration, $F\ (1, 33) = 0.33$, $p = .57$, $\eta^2 = .01$, and no significant main effect of exposure duration, $F\ (1, 33) = 2.87$, $p = .10$, $\eta^2 = .08$, but a significant main effect of group, $F\ (1, 33) = 10.67$, $p < .01$, $\eta^2 = .24$. We also conducted repeated measures ANCOVA with age as the covariate. The group effect remained significant, $F\ (1, 32) = 8.48$, $p < .01$, $\eta^2 = .21$, indicating that the difference in attention between the groups was not due to the group difference in age. The non-significant interaction between Group and Exposure Duration meant that no evidence supported the difference of attentional bias between two groups varied at the different levels of Exposure Duration. However, the main aim of our study was to investigate the time-course of attentional bias for positive social words between the HSA and LSA groups. Therefore, an independent-samples *t*-test of *d* scores was carried out in each exposure condition. The two groups differed significantly in the 100 ms condition ($M = 8.31$, $SD = 17.82$; $M = -11.28$, $SD = 20.08$, respectively), $t\ (33) = 3.06$, $p < .01$, $d = 1.03$, whereas there were non-significant trends at 500 ms ($M = 2.09$, $SD = 22.61$; $M = -10.29$, $SD = 21.09$, respectively) and 1250 ms ($M = 2.30$, $SD = 17.50$; $M = 0.88$, $SD = 21.01$, respectively), $t(33) = 1.67$ and 0.22, $p = .10$ and $p = .83$, $d = .57$ and .07 respectively (see Figure 1).

To clarify whether attentional bias did exist at different exposure durations, one-sample *t*-test between the *d* scores and the value of zero were performed within each group in different conditions, and the *d* scores of the HSA group were significantly higher than zero in the 100 ms condition, $t\ (17) = 1.98$, $p = .06$, $d = .47$, indicating a tendency to avoid positive social words. In the 500 and 1250 ms conditions, no significant difference from zero was found, $t\ (17) = 0.39$, $p = .70$, $d = .09$, $t\ (17) = 0.56$, $p = .58$, $d = .13$. The *d* scores of the LSA group were significantly lower than zero at 100 ms, $t\ (16) = -2.32$, $p = .03$, $d = .56$, and at 500 ms,

https://doi.org/10.1017/S1352465813000398 Published online by Cambridge University Press

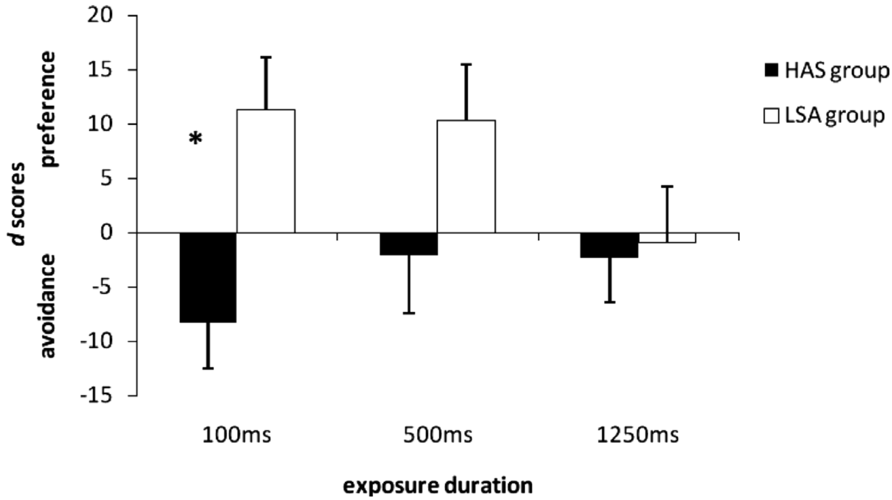

Figure 1. The *d* scores for the two groups at three presentation times. Attentional bias scores for word-pairs involving positive social words and neutral words. A negative bias score denotes avoidance attentional bias for positive social words. Scores above 0 indicate preferential attentional bias for positive social words.
$p < .05$ (two tailed)

$t\,(16) = -2.01$, $p = .06$, $d = .49$, indicating preferential attention to positive social words, but no evidence of a bias in the 1250 ms condition was found, $t\,(16) = 0.17$, $p = .87$, $d = .04$.

Discussion

Empirical findings indicate that people with social anxiety show less preference for positive information than normal people in social situations (Hirsch and Mathews, 2000; Kashdan, Weeks and Savostyanova, 2011). The present study extended this research by using three different presentation times to detect the difference. We found that participants with high social anxiety appeared to exhibit initial avoidance from positive words (i.e. at 100 ms), but the inverse was found in the LSA group. These findings added another explanation for the association between attentional bias for positive stimuli and social anxiety.

The initial avoidance and absence of attentional bias at a longer exposure (i.e. 500 ms) are in line with Cooper and Langton's (2006) research, in which attention away from the happy face in neutral/happy pairs at 100 ms (but not longer) was also detected in a high-anxiety group. However, our results are inconsistent with those of Taylor et al. (2010). The real speech task versus the pretended speech task may contribute to the difference. No matter when the avoidance happens, it may inhibit fear and anxiety in the short-term (Koster et al., 2005), and this safety behaviour may contribute to maintaining the negative belief system and enhance the social anxiety (Clark and Wells, 1995).

Similarly, our results are congruent with the report of Rossignol et al. (2012), which examined P1, N170 and P3b to consider different stages of cognitive processing using ERPs. Interestingly, in contrast to the well-known hypothesis of impairment in the ability to disengage attention from threat (Buckner, Maner and Schmidt, 2010), socially anxious individuals produce enhanced P1in response to all emotional faces (regardless of anger, fear, disgust or happiness) as compared to neutral ones, but N170, P3b and behavioural responses are not modulated by social anxiety. Individuals with social anxiety tend to exhibit increased pre-attentive detection mechanism for emotional cues in general, and not only for threat.

Alden et al. (2008) proposed that individuals may experience anxiety and avoid positive stimuli because of their concern that initial positive appraisal may lead to future negative appraisal, which means that the attentional bias may be a result of cognitive avoidance. However, in our study, we found that the HSA group already avoided positive social words at 100 ms, which suggested that this may exist well before complex cognitive processing (e.g. predicting the negative evaluation). Therefore, the avoidance of positive social words is more like automatic processing than conscious avoidance after recognizing the future risk. Wallace and Alden's (1995, 1997) proposal (i.e. fear of ultimate negative evaluation) cannot explain the current results, suggesting alternative mechanisms for the fear and avoidance of positive social stimuli other than complex processing. Participants never focused their attention on positive stimuli, because they automatically neglected them.

Enhanced preferential attention for positive social words at 100 and 500 ms (but not at 1250 ms) in the LSA group was partly in line with our hypothesis. Positive stimuli as safe signals easily attract the attention of normal people at the early stage (Wieser, Pauli, Weyers, Alpers and Mühlberger, 2009), but the attraction may later be gradually lost. The process can help them receive positive feedback and increase positive experience. In real life, this preferential tendency may make a person seem more warm and friendly. Unlike the LSA group, the HSA group relatively lacked initial attention to and processing of positive social words. Unable to figure out the fact might contribute to the maintenance of pathological social fear in social anxiety (Taylor et al., 2010). Their experience of frequent social failure, low positive affect and high anxiety ultimately support their negative hypothesis, which in turn influences the development of bias in the processing of positive information, and leads to automatic responses to positive social stimuli gradually. A circle forms and is self-maintaining.

The findings are consistent with recent cognitive models of social phobia that emphasize the role of reducing processing of external social cues in maintaining social anxiety (e.g. Clark and Wells, 1995). If patients can choose to attend to social cues or not, they show biased attention away from faces, which may avoid interaction with others (Chen, Ehlers, Clark and Mansell, 2002). Existing models specify that selective attention to threatening social information heightens anxiety (e.g. Rapee and Heimberg, 1997). However, these models focus less on the processing of positive cues and their fundamental role of maintaining pathology. Our study adds an empirical literature to supplement current cognitive models of social anxiety. The current findings demonstrate initial avoiding to positive social cues may prevent patients from seeing that they are more positive than they thought, which maintains their negative belief system.

Further, our results also extend in several ways recent research that focuses on positive social information processes and uses positive stimuli to develop attention training programs (Li, Tan, Qian and Liu, 2008; Wiener, Perloe, Whitton and Pincus, 2012). First, Heeren, Reese, McNally and Philippot (2012) found that increasing vigilance for slightly positive faces (relative to angry faces) via attention training can reduce self-reported, behavioural, and physiological responses to social stressor, which suggested that attending to non-threatening cues can reduce the disengaging attention from threat. Conversely, Li et al. (2008) used a

7-day of attention training toward positive faces (relative to negative faces), and their results showed that the socially anxious participants focus more on positive faces and reduce self-reported fear of social interaction. In accordance with our results, one alternative explanation for this effectiveness would be that such training also reduces the avoidance of positive cues (not merely vigilance for threat). Second, recent research demonstrated that manipulation of attention away from negative social stimuli reduces the symptoms of social anxiety (Amir et al., 2009). However, attentional bias away from positive social cues may contribute to the maintenance of social fear (Taylor et al., 2010). Taken together with our results, directing patient's attention to positive social cues as well as away from negative social ones may obtain a better effect than using only one strategy. Third, detecting the differences in attentional bias at different presentation times supplements the theory and has implications for the potential refinement of existing interventions for people with social anxiety. The results of our study suggested that 100 ms, at which time participants with high social anxiety avoided positive words, cannot be used to train attention to positive stimuli, and the absence of any difference between 500 ms and 1250 ms suggested that a presentation time more than 500 ms is not useful. In addition, the different levels of anxiety aroused by the anxiety-evoking task meant that the high anxious group felt anxiety more easily, and were under greater social stress than low anxiety group, which suggested that interventions using attention training should not only focus on the exposure time, but also be implemented before the exposure in order to decrease the anxiety.

Several limitations of the current study need to be addressed. First, the failure to detect attentional bias at 500 and 1250 ms might be due to the long exposure duration, where multiple attentional shifts between the words in each pair could take place (Mogg et al., 2004). It is important to extend the study by using eye tracking to investigate the precise time of the attention shift. Second, the present data were obtained in participants with high social anxiety rather than clinical patients. Further research should investigate the attentional bias for positive social words in patients with social phobia. Third, we did not use the negative words for the strict manipulation, so the interpretability of the findings may be limited by the lack of an "emotional/negative" comparison condition. It seems appropriate to take this into account in future research. Finally, the materials used in the dot-probe task were "positive social to neutral non-social" word-pairs. It is difficult to determine whether the attentional bias in the HSA group was a response to the emotional valence (i.e. positive vs neutral) or to the social-related characteristic (i.e. social vs non-social). It may be helpful to compare the "positive social word vs positive nonsocial word" and "positive social word vs neutral social word" to determine which factor contributes more to the attentional bias detected in the present study.

To summarize, in the HSA group, the avoidance of positive social words was detected at an early stage (100 ms), suggesting that this involves initial allocation of spatial attention rather than controlled strategies for sustained attention (i.e. interpreting the positive social information negatively or discounting positive social events). Compared with the LSA group, participants with social anxiety lacked initial attention and processing of positive social words.

Acknowledgments

The authors thank Dr I. C. Bruce and the anonymous reviewers for their helpful comments on an earlier version of this manuscript. This work was supported by National Science Foundation of China (Project 31170991).

References

Alden, L. E., Taylor, C. T., Mellings, T. M. J. B. and Laposa, J. M. (2008). Social anxiety and the interpretation of positive social events. *Journal of Anxiety Disorders*, *22*, 577–590. doi: 10.1016/j.janxdis.2007.05.007

American Psychiatric Association (2000). *Diagnostic and Statistical Manual of Mental Disorders, DSM-IV (4th ed) (Text Revision)*. Washington, DC: Author.

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

Bradley, B. P., Mogg, K., Falla, J. S. and Hamilton, L. R. (1998). Attentional bias for threatening facial expressions in anxiety: manipulation of stimulus duration. *Cognition & Emotion*, *12*, 737–753. doi: 10.1080/026999398379411

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

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

Chen, Y. P., Ehlers, A., Clark, D. M. and Mansell, W. (2002). Patients with generalized social phobia direct their attention away from faces. *Behaviour Research and Therapy*, *40*, 677–687. doi: S0005-7967(01)00086-9

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

Cooper, R. M. and Langton, S. R. H. (2006). Attentional bias to angry faces using the dot-probe task? It depends when you look for it. *Behaviour Research and Therapy*, *44*, 1321–1329. doi: 10.1016/j.brat.2005.10.004

Dimberg, U. and Christmanson, L. (1991). Facial reactions to facial expressions in subjects high and low in public speaking fear. *Scandinavian Journal of Psychology*, *32*, 246–253.

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

Heeren, A., Reese, H. E., McNally, R. J. and Philippot, P. (2012). Attention training toward and away from threat in social phobia: effects on subjective, behavioral, and physiological measures of anxiety. *Behaviour Research and Therapy*, *50*, 30–39. doi: 10.1016/j.brat.2011.10.005

Hirsch, C. R. and Mathews, A. (2000). Impaired positive inferential bias in social phobia. *Journal of Abnormal Psychology*, *109*, 705–712. doi: 10.1037/0021-843X.109.4.705

Kashdan, T. B., Weeks, J. W. and Savostyanova, A. A. (2011). Whether, how, and when social anxiety shapes positive experiences and events: a self-regulatory framework and treatment implications. *Clinical Psychology Review*, *31*, 786–799. doi: 10.1016/j.cpr.2011.03.012

Koster, E. H. W., Verschuere, B., Crombez, G. and Damme, S. V. (2005). Time-course of attention for threatening pictures in high and low trait anxiety. *Behavior Research and Therapy*, *43*, 1087–1098. doi: 10.1016/j.brat.2004.08.004

Li, S., Tan, J., Qian, M. and Liu, X. (2008). Continual training of attentional bias in social anxiety. *Behaviour Research and Therapy*, *46*, 905–912. doi: 10.1016/j.brat.2008.04.005

Liu, Y. (1990). *The Dictionary of Modern Chinese Language High Frequency Words*. Beijing: China Astronautic Publishing House.

MacLeod, C., Mathews, A. and Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, *95*, 15–20. doi: 10.1037/0021-843X.95.1.15

Mattick, R. P. and Clark, J. C. (1998). Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. *Behaviour Research and Therapy*, *36*, 455–470. doi: 10.1016/S0005-7967(97)10031-6

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

Perowne, S. and Mansell, W. (2002). Social anxiety, self-focused attention, and the discrimination of negative, neutral and positive audience members by their non-verbal behaviours. *Behavioural and Cognitive Psychotherapy*, *30*, 11–23. doi: 10.1017/S1352465802001030

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

Rapee, R. M. and Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy*, *35*, 741–756. doi: 10.1016/S0005-7976(97)00022-3

Rossignol, M., Campanella, S., Maurage, P., Heeren, A., Falbo, L. and Philippot, P. (2012). Enhanced perceptual responses during visual processing of facial stimuli in young socially anxious individuals. *Neuroscience Letters*, *526*, 68–73. doi: 10.1016/j.neulet.2012.07.045

Silvia, P. J., Allan, W. D., Beauchamp, D. L., Maschauer, E. L. and Workman, J. O. (2006). Biased recognition of happy facial expressions in social anxiety. *Journal of Social and Clinical Psychology*, *25*, 585–602. doi: 10.1521/jscp.2006.25.6.585

Staugaard, S. R. (2010). Threatening faces and social anxiety: a literature review. *Clinical Psychology Review*, *30*, 669–690. doi: 10.1016/j.cpr.2010.05.001

Stevens, S., Rist, F. and Gerlach, A. L. (2011). Eye movement assessment in individuals with social phobia: differential usefulness for varying presentation times? *Journal of Behavior Therapy and Experimental Psychiatry*, *42*, 219–224. doi:10.1016/j.jbtep.2010.11.001

Taylor, C. T., Bomyea, J. and Amir, N. (2010). Attentional bias away from positive social information mediates the link between social anxiety and anxiety vulnerability to a social stressor. *Journal of Anxiety Disorders*, *24*, 403–408. doi: 10.1016/j.janxdis.2010.02.004

Taylor, C. T., Bomyea, J. and Amir, N. (2011). Malleability of attentional bias for positive emotional information and anxiety vulnerability. *Emotion*, *1*, 127–138. doi: 10.1037/a0021301

Vassilopoulos, S. P. and Banerjee, R. (2010). Social interaction anxiety and discounting of positive interpersonal events. *Behavioural and Cognitive Psychotherapy*, *38*, 597–609. doi: 10.1017/S1352465810000433

Veljaca, K. A. and Rapee, R. M. (1998). Detection of negative and positive audience behaviours by socially anxious subjects. *Behaviour Research and Therapy*, *36*, 311–321. doi: 10.1016/S0005-7967(98)00016-3

Watson, D. and Friend, R. (1969). Measurement of social-evaluative anxiety. *Journal of Consulting and Clinical Psychology*, *33*, 448–457. doi: 10.1037/h0027806

Wallace, S. T. and Alden, L. E. (1995). Social anxiety and standard setting following social success or failure. *Cognitive Therapy and Research*, *19*, 613–631. doi: 10.1007/BF02227857

Wallace, S. T. and Alden, L. E. (1997). Social phobia and positive social events: the price of success. *Journal of Abnormal Psychology*, *106*, 416–424. doi: 10.1037/0021-843X.106.3.416

Weeks, J. W., Rodebaugh, T. L., Heimberg, R. G., Norton, P. J. and Jakatdar, T. A. (2009). "To avoid evaluation, withdraw": fears of evaluation and depressive cognitions lead to social anxiety and submissive withdrawal. *Cognitive Therapy and Research*, *33*, 375–389. doi: 10.1007/s10608-008-9203-0

Wieser, M. J., Pauli, P., Weyers, P., Alpers, G. W. and Mühlberger, A. (2009). Fear of negative evaluation and the hypervigilance-avoidance hypothesis: an eye-tracking study. *Journal of Neural Transmission*, *116*, 717–723. doi: 10.1007/s00702-008-0101-0

Wiener, C., Perloe, A., Whitton, S. and Pincus, D. (2012). Attentional bias in adolescents with panic disorder: changes over an 8-day intensive treatment program. *Behavioural and Cognitive Psychotherapy*, *40*, 193–204. doi: 10.1017/S1352465811000580

Ye, D., Qian, M., Liu, X. and Chen, X. (2007). The revision of Social Interaction Anxiety Scale and Social Phobia Scale. *Chinese Journal of Clinical Psychology*, *15*, 115–117. doi: 1005-3611(2007)02-0115-03

Yoon, L. K. and Zinbarg, R. E. (2007). Threat is in the eye of the beholder: social anxiety and the interpretation of ambiguous facial expressions. *Behavior Research and Therapy*, *45*, 839–847. doi: 10.1016/j.brat.2006.05.004

Appendix: Material of word-pairs

We used the Chinese version in the study. Because of the cultural differences, there may be different meanings for some words in British culture.

	Positive		Neutral	
Word-pairs	Positive social words	frequency (Chinese)	Neutral words	frequency (Chinese)
1	支持 (support)	2471	创造 (create)	2872
2	团结 (unite)	2283	制定 (establish)	2105
3	欢迎 (welcome)	1216	相应 (parallel)	1261
4	友好 (friendly)	1155	动物 (animal)	1184
5	热情 (passion)	898	棉花 (cotton)	932
6	喜欢 (like)	799	排列 (array)	803
7	肯定 (affirmative)	758	摩擦 (friction)	782
8	关心 (care)	715	销售 (market)	731
9	尊重 (respect)	503	锻炼 (exercise)	596
10	鼓励 (encourage)	490	调制 (modulate)	463
11	鼓舞 (inspire)	471	施用 (use)	424
12	亲切 (kind)	428	花生 (peanut)	433
13	微笑 (smile)	284	桌子 (desk)	274
14	欣赏 (appreciate)	207	驾驶 (drive)	231
15	表扬 (praise)	202	描绘 (portray)	227
16	称赞 (acclaim)	188	雕刻 (engrave)	177
17	赞美 (admire)	115	跳远 (broad-jump)	110
18	真诚 (sincere)	91	手表 (watch)	101
19	倾听 (listen)	89	奔跑 (run)	75
20	赞赏 (applaud)	88	酿造 (brew)	81
21	诚恳 (hearty)	81	被子 (quilt)	80
22	褒奖 (commendation)	80	搬运 (transport)	80
23	友爱 (love)	60	板凳 (bench)	61
24	认可 (approve)	48	散步 (walk)	44
25	开朗 (cheerful)	37	茶壶 (teapot)	37
26	赞许 (favour)	36	挪动 (move)	39
27	风趣 (witty)	36	泥水 (muddy)	33
28	幽默 (humorous)	30	花瓶 (vase)	30
29	接纳 (accept)	25	梳妆 (dress)	25
30	体谅 (sympathy)	20	查阅 (consult)	26
31	随和 (easy-going)	10	农畜 (cattle)	12
32	友善 (nice)	7	牌照 (license)	8