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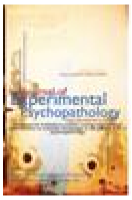

You See What You Fear: Spiders Gain Preferential Access to Conscious Perception in Spider-Phobic Patients

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Abstract

In phobic individuals, behavioral responses to phobia-related cues are facilitated and brain responses are augmented. It has rarely been investigated whether this preferential processing is accompanied by an altered conscious perception of phobia-related cues. We used binocular rivalry to investigate conscious perception of phobia-related cues in phobic individuals. 21 spider-phobic patients and 20 non-anxious control participants viewed pictures of spiders or flowers, each paired with a neutral pattern under conditions of binocular rivalry. Spider-phobic patients more often reported that they saw spider pictures as the first percept, and the total duration of seeing spider percepts was significantly longer in patients than in non-anxious participants. A second experiment was conducted to rule out that these differences were caused by different response criteria. Results support the validity of self-report in Experiment 1. In sum, predominance of phobia-related cues in binocular rivalry provides evidence that phobia-related cues gain preferential access to visual awareness in phobic individuals.

Keywords: Spider Phobia, Binocular Rivalry, Phobia-related Pictures, Multistable Visual Perception

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Introduction

It is important for survival to detect threat cues among the multitude of visual stimuli which surround us. Thus, a preferential processing of emotionally relevant cues may help to prepare an individual for adequate fight or flight responses. Evidence for rapid detection of threatening cues (e.g., angry faces) in healthy participants comes from several studies which used visual search or dot probe deployment paradigms (e.g. Mogg & Bradley, 1998; Öhman, Lundqvist, & Esteves, 2001). Thus, the significance of a stimulus is automatically evaluated at a preattentive perceptual stage and tunes sensitivities of sensory systems (Lang & Bradley, 2010; Öhman & Mineka, 2001).

In turn, this system is thought to be particularly (hyper-) sensitive to phobia-related cues such as a spider in spider-phobic individuals (see Hofmann, Alpers, & Pauli, 2008). Indeed, several studies support this assumption by showing that fearful individuals detect fear-related cues (spiders or snakes) faster, draw enhanced attention towards or have difficulties to disengage attention from threatening cues (Gerdes, Alpers, & Pauli, 2008; Gerdes, Pauli, & Alpers, 2009; Mogg & Bradley, 2006; Weymar, Gerdes, Löw, Alpers, & Hamm, 2013). Furthermore, fear-specific neural activation in the amygdala but also in sensory cortex areas has also been documented (Alpers et al., 2009; Carlsson et al., 2004; Kolassa, Musial, Mohr, Trippe, & Miltner, 2005; Larson et al., 2006; Straube, Mentzel, & Miltner, 2006). Taken together, these studies show that phobia-related cues can modulate visual processing at different levels, indicating that individual differences can variously influence the way we perceive our surrounding.

However, most of the existing studies concentrated on the influence of fear on the intensity or the efficiency of visual processing. Although verbal reports of spider-phobic patients suggest that they actually *perceive* spiders more vividly, only few studies have investigated whether the conscious perception of threat cues is indeed altered. The fact that emotional cues or affective states can influence visual awareness has been demonstrated impressively in several studies using a paradigm called binocular rivalry. Binocular rivalry occurs when different pictures are presented to one eye each and when they cannot be merged into a coherent percept. While one picture temporarily predominates, the other picture is suppressed and not accessible to consciousness. The perceptual reversals are mostly independent from intentional control (Leopold & Logothetis, 1999; Meng & Tong, 2004) or distraction (Leopold, Fitzgibbons, & Logothetis, 1995), but there are also some examples for top-down modulation by attention and influences of higher-level processes (Carter et al., 2005; Chong & Blake, 2006; Mitchell, Stoner, & Reynolds, 2004). Thus, binocular rivalry is a useful tool to investigate how visual information gains access to conscious perception (for detailed overviews see Blake, 2001; Blake & Logothetis, 2002; Tong, Meng, & Blake, 2006). During the last decade, several binocular rivalry studies have shown that the (emotional) content of a stimulus affects the extent to which it predominates in awareness (Alpers & Pauli, 2006; Sheth & Pham, 2008). More precisely, aversively conditioned cues (Alpers, Ruhleder, Walz, Mühlberger, & Pauli, 2005), emotional scenes (Alpers & Pauli, 2006), emotional facial expressions (Alpers & Gerdes, 2007; Bannerman, Milders, de Gelder, & Sahraie, 2008; Yoon, Hong, Joormann, & Kang, 2009), as well as faces associated with affective social information (Anderson, Siegel, Bliss-Moreau, & Barrett, 2011) predominate in conscious awareness over neutral information.

Moreover, not only characteristics of the stimuli, but also characteristics of the observer determine which information gets prioritized access to conscious perception. Recently, it was shown that states of pleasant affect lead to a dominant perception of smiling faces, whereas unpleasant affect leads to a dominant perception of scowling faces (Anderson, Siegel, & Feldmann Barrett, 2011). Trait anxiety was also shown to influence the initial selection of emotional faces (Gray, Adams, & Garner, 2009) and a recent study could demonstrate (with a variant of binocular rivalry) that mood-congruent stimuli such as sad faces gain preferential access to awareness in depressive patients (Sterzer, Hilgenfeldt, Freudenberg, Bermpohl, & Adli, 2011).

In sum, existing studies on specific phobia unequivocally suggest that phobia-related cues are preferentially processed in the brain, thus phobia-related cues should also gain preferential access to visual awareness in spider-phobic patients compared to non-anxious participants. Therefore, we conducted a binocular rivalry experiment in which phobia-related and neutral pictures were presented to spider-phobic patients and non-anxious control participants. Based on previous studies, we expected that phobic fear would influence the initial selection which is thought to be relatively uncontaminated by attentional effects (Gray et al., 2009; Ooi & He, 1999), as well as increase the overall dominance of phobia-related material in spider-phobic patients. Theoretically, a dominance of phobia-related cues in binocular rivalry would suggest that phobic fear alters processing already at basic stages of vision and influences the way in which spider-phobic patients perceive spiders.

Although self-report of perception in binocular rivalry has been validated well in healthy controls (Alpers et al., 2005), it was important to control for possible response biases in phobic patients (see Becker & Rinck, 2004). We therefore conducted a second experiment with spider-fearful participants where different percepts occurring in binocular rivalry were simulated to objectively register their responses to the different percepts.

Experiment 1: Binocular Rivalry

Method

Participants.

Twenty-one spider-phobic (19, i.e., 90.5 % were female) and 20 non-anxious control participants (11, i.e., 55% female) were recruited by advertisements in local newspapers. Potential candidates were invited when they passed a phone-screening with the fear of spiders screening questionnaire (SAS, Rinck et al., 2002). They were then interviewed by trained research assistants using a structured clinical interview (SCID, Wittchen, Gruschwitz, Wunderlich, & Zaudig, 1997). Spider-phobic patients were required to meet all DSM-IV criteria for specific phobia, animal type (spiders) (American Psychiatric Association, 1994). The non-anxious control participants were required not to meet any criteria. Exclusion criteria for both groups were lifetime psychotic disorders, other current mental disorders as well as concurrent medical or neurological treatment.

All participants had normal vision or used contact lenses (7 participants of the non-anxious control group and 15 of the patient group). Mean age was M = 34.8 years (SD = 12.02, range: 22-66) in patients and M = 28.8 years (SD = 6.73 range: 18-45) in control participants, which did not differ significantly, $t(35) = 1.65$, $p = .11$.

Material and apparatus.

Instructions and stimuli presentation were controlled by Presentation® (Version 10.0, www.neurobs.com) which also registered the participants' responses. The stimulus material consisted of 20 different spider and 20 different flower pictures (see Kolassa et al., 2005) displayed in gray-scale. All pictures were similar in size, contrast, and complexity (see Figure 1). Pictures were presented through a mirror stereoscope paired with a gray-scaled standard pattern of similar size, resulting in binocular rivalry between the picture and the pattern. Stimuli were presented in a circular black frame (radius = 4.3 cm) which supports the spatial alignment of the two pictures during stereoscopic viewing.

Figure 1: Example of stimuli: the standard pattern which was either paired with a neutral flower picture or a spider picture.

Each trial consisted of one spider or flower picture presented to one eye and the standard pattern presented to the other eye. Each picture was projected once to the left and once to the right eye. In sum, 80 trials with rivaling pairs of pictures (spider – pattern pairs or flower – pattern pairs) were presented in random order. Trials lasted for 8 s with an inter trial interval of 3 s.

Participants viewed the picture pairs through a mirror stereoscope (ScreenScope SA200, www.stereoaids.com), with a chin-rest 20 cm in front of the screen, so that the left picture was visible to the left eye only, and the right picture was visible to the right eye only. Two integrated optical lenses reduced the pictures size by a factor of three, resulting in a visual angle of 4 degrees. This is still large enough for discrimination but also small enough to limit the probability of piecemeal rivalry (Blake, O'Shea, & Mueller, 1992).

Questionnaires.

Fear of spiders was measured with the German versions of the Fear of Spiders Questionnaire (FSQ, Rinck et al., 2002). As a brief measure of positive and negative affect, the Positive Affect Negative Affect Schedule (PANAS, German version: Krohne, Egloff, Kohlmann, & Tausch, 1996) was used. Trait anxiety was measured with the State-Trait Anxiety Inventory (STAI-T, German version: Laux, Glanzmann, Schaffner, & Spielberger, 1981).

Procedure.

The procedure was reviewed and approved by the ethics committee of the German Psychological Association (DGPs). First, written informed consent was obtained and participants filled in the questionnaires. Participants were then instructed to look through the stereoscope. The experiment started with eight demonstration trials in which all picture categories as well as the pattern were introduced, and was followed by eight practice trials. Participants had to indicate continuously by holding a computer key whether the picture – spider or flower – or the pattern was exclusively visible or whether they perceived a mixture of both pictures (the coupling of picture or pattern with the *left* or *right cursor* key was counterbalanced, mixed percepts had to be indicated with *cursor down*). Whenever they perceived any kind of perceptual change, they had to respond promptly by pressing another key. Importantly, there was never any reference to the phobic material in the coding instructions. Participants were instructed to code exclusive percepts as a "picture" or as a "pattern".

Afterwards, participants were asked to rate all spider and flower pictures on valence (1 = "very negative" and 9 = "very positive") and on arousal (1 = "not at all intense" and 9 = "very intense") - pictures were viewed without the stereoscope and presented until a response occurred.

Data reduction.

Initial dominant percept and cumulative dominance duration were used as main outcome measures of predominance (see Mamassian & Goutcher, 2005). *Initial percept*: In order to calculate the rate at which the pictures gained access to visual awareness at the beginning of each trial, we calculated the mean number of trials on which the reported *initial* percept was either a (A) picture, (B) pattern, or (C) mixed percept. This was done separately for spider and flower trials.

Cumulative dominance duration.

As an index of the visual percept across an entire trial, we calculated the mean duration of each reported percept ((A) picture, (B) pattern, or (C) mixed), again, separately for spider and flower trials. The duration of a reported percept was identified as the time that one key is continuously pressed before switching to another key. For example, a 2 second duration of spider percept would result from pressing key A (indicating “picture” percept) and then pressing key B or C after 2 seconds (indicating a change of percept from spider to pattern or mixed, respectively). Note that during one trial several percept changes are possible (A-B-A-B) as well as reoccurring percepts (A-B-A-C).

Because the perception of picture, pattern, or mix are not statistically independent, we calculated a predominance ratio for the initial percept as well as for the cumulative duration: the number (respectively the cumulative duration) of picture percepts *minus* the number of exclusive pattern percepts *divided by* the sum of the number of picture and pattern percepts (see Levelt, 1965). This ratio ranges from −1 to 1, where “−1” indicates perfect dominance of the pattern, “0” implies balanced dominance of picture and pattern, and “1” indicates perfect dominance of the pictures. In addition, we calculated the *latency of the initial percept* separately for trials in which a picture, a pattern, or a mixed percept was reported as the initial percept.

Statistical analyses.

Picture ratings for valence and arousal were compared in separate ANOVAs with the between factor group and a within factor picture category (spider, flower) and follow-up *t*-tests (Bonferroni-corrected). The predominance ratios of cumulative duration and initial percepts were compared in separate ANOVAs with the between factors group and the within factor picture category (spider, flower) and follow-up *t*-tests (Bonferroni-corrected). Degrees of freedom for repeated measures effects were Greenhouse-Geisser corrected but the original degrees of freedom are listed. As a measure of effect size for the ANOVAs, partial eta squared (η_p^2) is reported.

Results Experiment 1

Descriptive questionnaire data.

The questionnaire scores and statistics are shown in Table 1. As expected, the spider-phobic patients scored significantly higher on all spider fear questionnaires compared to the non-anxious control participants. No group differences were found for the scores on the PANAS (Krohne et al., 1996) and on the STAI-T (Laux et al., 1981).

Table 1: Means, standard deviations and t-test results for the questionnaire scores of spider-phobic patients (n = 21) and non-anxious participants (n = 20).

Questionnaire	**Phobic patients**	**Non-anxious participants**	***t*-tests**		
	M (SD)	***M (SD)***	***t*-value**	**df**	***p***
FSQ	61.10 (23.25)	1.30 (2.47)	11.43	39	.001
STAI-T	41.47 (7.93)	37.35 (5.18)	1.93	39	.061
PA	27.65.15 (3.90)	27.70 (5.08)	.037	38	.651
NA	10.30 (2.47)	9.15 (1.95)	1.63	48	.11

Note. FSQ = German version of the Fear of Spider Questionnaire (Rinck et al., 2002); STAI-T: State–Trait Anxiety Inventory – Trait form (German version, Laux et al., 1981); PA: positive affect scale NA: negative affect scale; (German version of PANAS, Krohne et al., 1996).

Stimulus ratings.

The stimulus material effectively evoked emotional responses in spider-phobic patients. For the valence ratings of spider and flower pictures, there was a main effect of picture category, $F(1, 39) = 66.56$, $p < .001$, $\eta_p^2 = 0.63$, and group, $F(1, 39) = 25.59$, $p < .001$, $\eta_p^2 = 0.40$, as well as a significant picture category by group interaction, $F(1, 39) = 33.78$, $p < .001$, $\eta_p^2 = 0.46$. Follow-up *t*-tests showed, that the spider-phobic patients rated spider pictures ($M = 2.29$, $SD = 1.39$) as significantly more negative than non-anxious participants ($M = 5.27$, $SD = 1.15$), $t(39) = 7.47$, $p < .001$, but there were no group differences in the valence ratings of flower pictures (phobic patients: $M = 6.47$, $SD = 1.46$; non-anxious participants: $M = 5.96$, $SD = 0.84$).

Arousal ratings also differed according to a priori expectations: There were main effects of picture category, $F(1, 39) = 41.86$, $p = .001$, $\eta_p^2 = 0.52$, and group, $F(1, 39) = 26.55$, $p < .001$, $\eta_p^2 = 0.41$, as well as a significant picture category by group interaction, $F(1, 39) = 47.10$, $p < .001$, $\eta_p^2 = 0.55$. Spider-phobic patients rated spider pictures as significantly more arousing ($M = 7.19$, $SD = 1.52$) than non-anxious participants ($M = 2.68$, SD = 1.70), $t(39) = 8.978$, $p < .001$, but there were no significant differences in the arousal ratings for flower pictures (phobic patients: $M = 3.20$, $SD = 2.01$; non-anxious participants: $M = 2.80$, $SD = 1.94$).

Initial percept during rivalry.

The mean numbers of initial percepts are shown in Figure 2. In spider-phobic patients, the spider picture appeared more often as the initial percept (relative to the pattern) than in non-anxious participants. The ANOVA for the initial percept predominance ratios of spider and flower trials revealed a significant interaction of picture category by group, $F(1, 39) = 7.51$, $p = .009$, $\eta_p^2 = 0.16$. Follow-up *t*-tests showed, that the predominance ratio of spider trials differed significantly between groups (phobic patients: $M = .51$, $SD = .38$; non-anxious participants: $M = .17$, $SD = .38$; $t(39) = 2.83$, $p = .007$), whereas the predominance ratio of flower trials did not differ between groups (phobic patients: $M = .23$, $SD = .40$; non-anxious participants: $M = .23$, $SD = .38$). Within the groups, spider-phobic patients' predominance ratio during spider trials was significantly higher than the predominance ratio during flower trials, $t(20) = 3.04$, $p = .006$, whereas the predominance ratio of spider and flower trials did not differ significantly in non-anxious participants.

Cumulative duration of percepts during rivalry.

The cumulative duration of each percept is shown in Figure 3. In spider-phobic patients the spider picture predominated over the pattern longer than in non-anxious participants. The ANOVA for the predominance ratios of spider and flower trials revealed a significant main effect for picture category, $F(1, 39) = 11.32$, $p = .002$, $\eta_p^2 = 0.23$, and group, $F(1, 39) = 4.89$, $p = .033$, $\eta_p^2 = 0.11$, as well as a significant interaction of picture category and group, $F(1, 39) = 7.42$ $p = .009$, $\eta_p^2 = 0.16$. The follow-up *t*-tests showed significant differences between groups for the predominance ratio of spider trials (phobic patients: $M = .49$, $SD = .36$; non-anxious participants: $M = .17$, $SD = .30$; $t(39) = 3.13$, $p = .003$), whereas the predominance ratio of flower trials did not significantly differ between the groups (phobic patients: $M = .25$, $SD = .38$; non-anxious participants: $M = .14$, $SD = .29$).

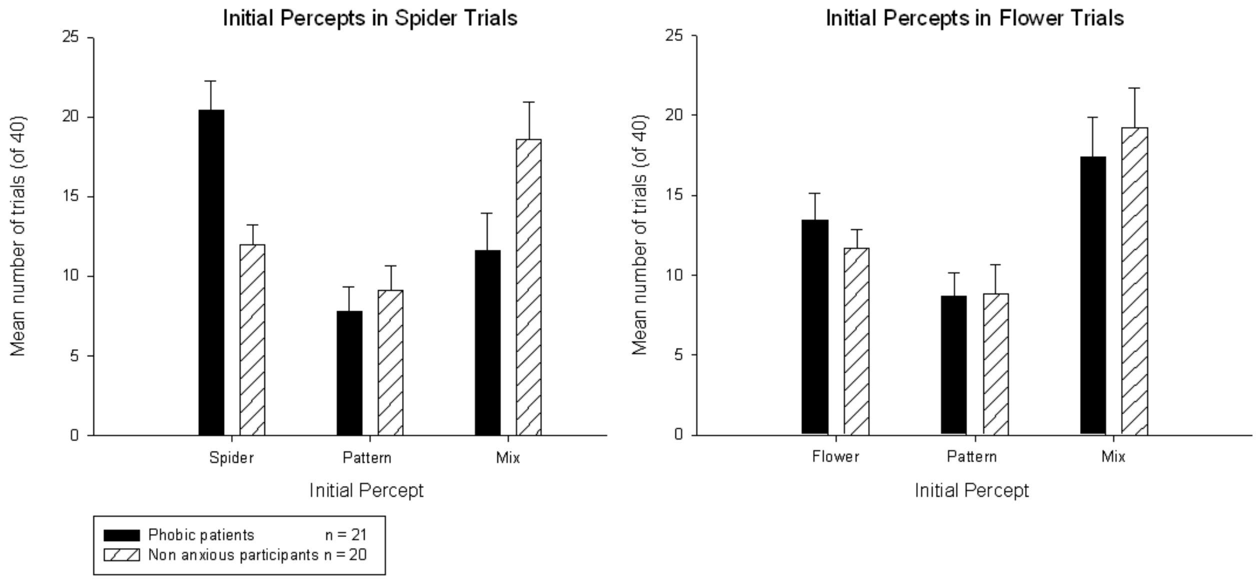

Figure 2: Left panel: Mean number (and standard error) of initial percepts of picture, pattern and mixed percepts in spider trials separately for spider-phobic patients and non-anxious participants. Right panel: Mean number (and standard error) of initial percepts of picture, pattern and mixed percepts in flower trials separately for spider-phobic patients and non-anxious participants.

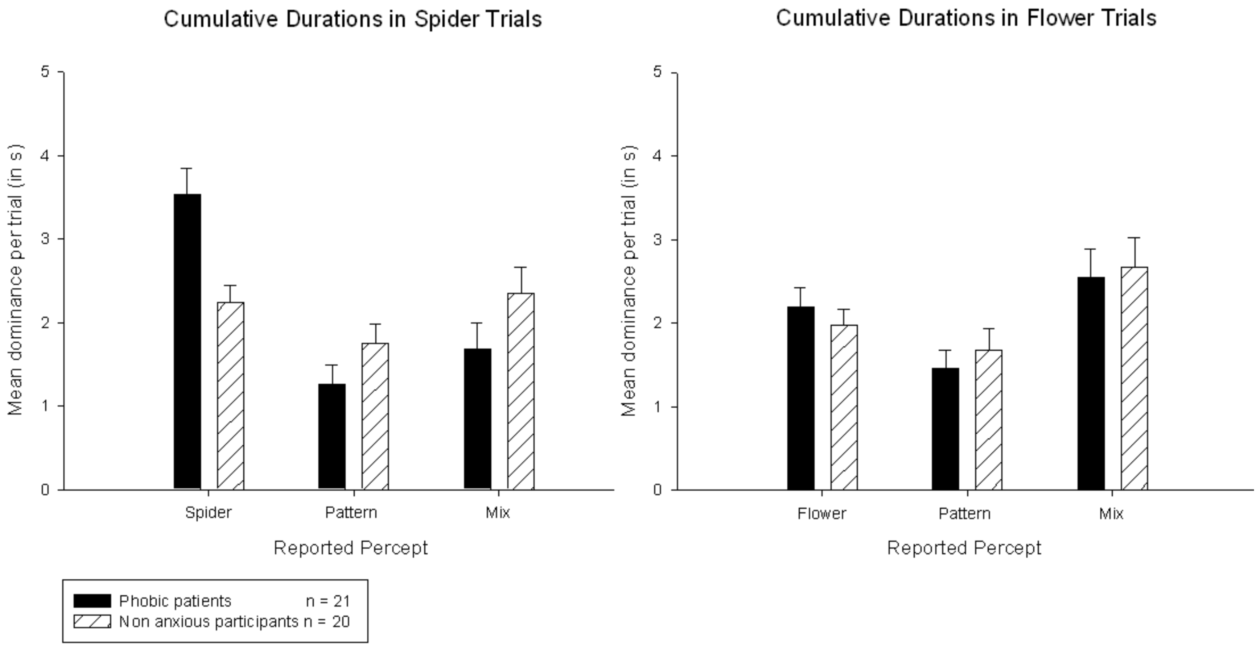

Figure 3: Left panel: Mean cumulative duration (and standard error) of picture, pattern and mixed percepts in spider trials separately for spider-phobic patients and non-anxious participants. Right panel: Mean cumulative duration (and standard error) of picture, pattern and mixed percepts in flower trials separately for spider-phobic patients and non-anxious participants.

Latency of initial percept.

Mean latencies of the initial percept are shown in Table 2. The ANOVA for the latency of the initial percept (picture, pattern, or mixed percept in spider and flower trials) revealed a significant main effect for picture category, $F(2, 58) = 13.99$, $p < .001$, $\eta_p^2 = .33$, and a significant interaction between picture category and group, $F(2, 58) = 4.75$, $p = .022$, $\eta_p^2 = 0.14$. Follow-up t-tests showed that groups differed in the latency of initial spider percepts, $t(39) = 2.23$, *p* = .032. When spider-phobic patients reported that they saw a spider in the very beginning of a trial, the latency was longer compared to non-anxious participants.

Table 2: Mean and Standard Deviations of latency to first percept of a trial in milliseconds of spider-phobic patients (n = 21) and non-anxious participants (n = 20).

	Picture category	Percept	Phobic patients *M* (*SD*)	Non-anxious participants *M* (*SD*)
Latency (ms)	*Spider*	Picture	699 (326)	497 (247)
		Pattern	372 (228)	332 (223)
		Mix	606 (470)	872 (543)
	Flower	Picture	580 (367)	460 (263)
		Pattern	407(296)	330 (273)
		Mix	829 (417)	886 (518)

Discussion Experiment 1

The results of Experiment 1 clearly showed that spider-perception differed between spider-phobic patients and non-anxious controls. Patients reported spider pictures more often as the first percept of a trial. Also, the cumulative duration of spider percepts was significantly longer in patients compared to non-anxious control participants.

However, this finding can only be interpreted as evidence for preferential visual processing of phobia-related cues in phobic patients, if the results are not biased by different response criteria between spider-phobic patients and non-anxious control participants. Indeed, it is not unlikely that spider-phobic participants would tend to report seeing a spider although their actual percept was a mixture of a spider and the geometric pattern presented to the other eye. The reason might be that their response criterion for reporting threat might be lowered (see Becker & Rinck, 2004). Although shorter rather than longer latencies might speak to such a bias, we conducted a subsequent study to more rigorously rule out that phobic patients' dominance of spider pictures might be caused by response tendencies.

Experiment 2: Response Validation

The rationale for Experiment 2 was to simulate different percepts which can occur in binocular rivalry. We closely modeled the experimental set-up according to Experiment 1. In Experiment 2, however, we did not present different pictures to the two eyes. Instead, we simulated several critical stages of binocular rivalry, namely exclusive as well as mixed percepts by simultaneous presentations of two identical pictures of the spiders, the flowers, the geometric pattern, or mixtures of spiders or flowers and the pattern. Only if the presentation of simulated fluctuations of percepts resulted in accurate self-report – independent of picture content – a lowered threshold to report seeing spiders can be ruled out.

Method Experiment 2

Participants.

Participants were 17 highly spider-fearful participants (16 female). Their mean age was *M* = 29.47 years (*SD* = 2.46, range: 18-56). All participants were interviewed by trained research assistants who used a structured clinical interview (SCID, Wittchen et al., 1997). Ten participants met all criteria for spider phobia; the remaining 7 participants met all criteria except the criterion which requires significant impairment in everyday life. The mean score on the Fear of Spiders Questionnaire (FSQ, German version, Rinck et al., 2002) was *M* = 75.42 (*SD* = 6.00), and was thus comparable to the scores of the spider-phobic patient group of Experiment 1.

Material and apparatus.

Stimuli simulated exclusive as well as mixed percepts as they can occur during binocular rivalry; they were constructed from the same spider or flower pictures and the same geometric pattern which were presented in Experiment 1. Fifteen spider and 15 flower pictures were superimposed onto the pattern (Photoshop©). There were six levels of transparency (100% spider or flower picture with 0% pattern overlay, spider or flower picture with 20% pattern overlay, 40% pattern overlay, 60% pattern overlay, 80% pattern overlay, or 100% pattern – for examples see Figure 4A). Thus, we obtained 180 different pictures among which were 30 exclusive (spider or flower) pictures, 30 exclusive pattern stimuli, and 120 mixed pictures at different levels.

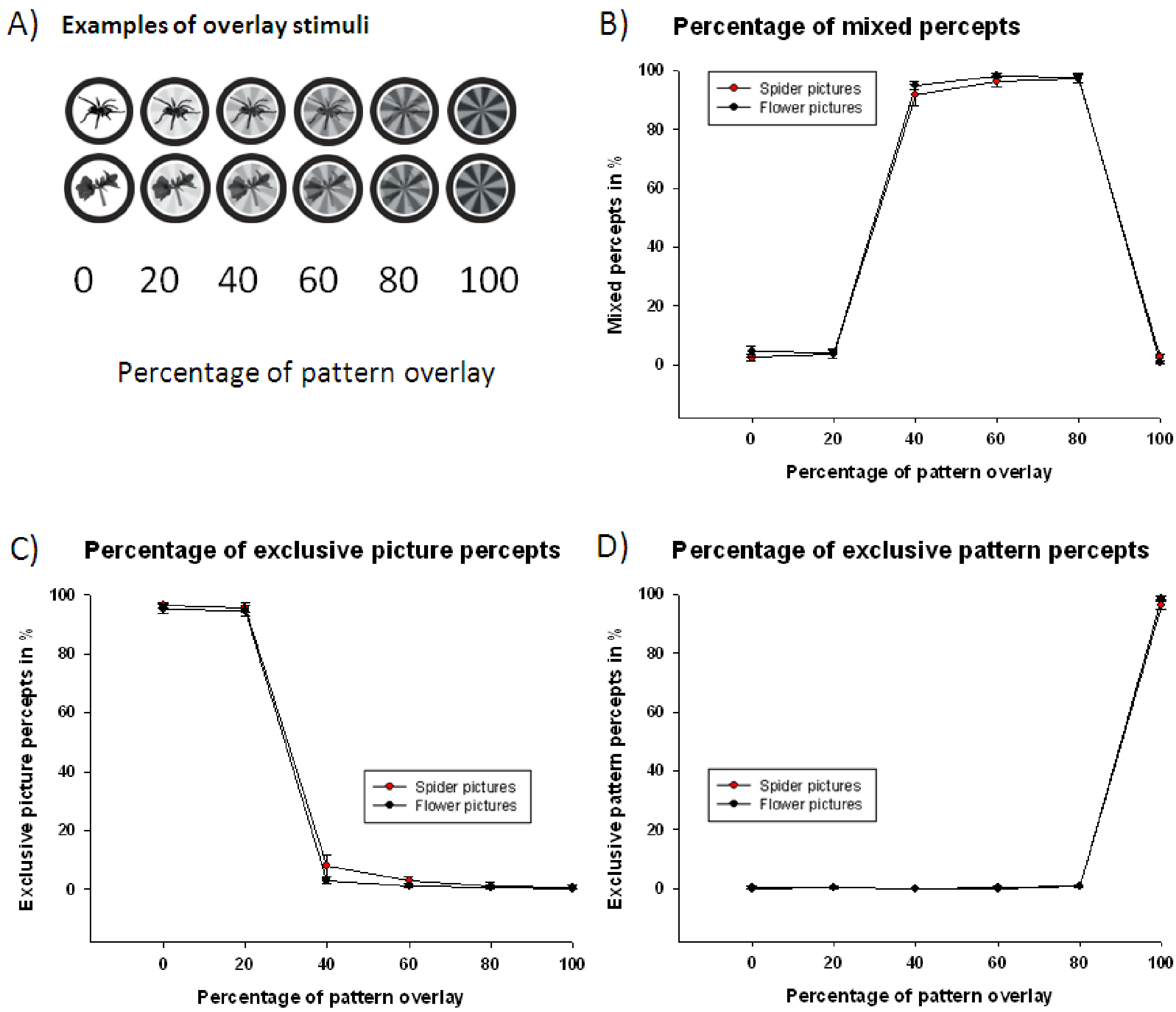

Figure 4: A) Examples of spider and flower pictures (each with 0% pattern overlay, 20% pattern overlay, 40% pattern overlay, 60% pattern overlay, 80% pattern overlay, or 100% pattern) used in Experiment 2. B) Mean percentage (and standard error) of reported mixed percepts in spider and flower trials separately for the different overlay levels (0% pattern overlay, 20% pattern overlay, 40% pattern overlay, 60% pattern overlay, 80% pattern overlay, or 100% pattern). C) Mean percentage (and standard error) of reported exclusive spider or flower percepts separately for the different overlay levels (0% pattern overlay, 20% pattern overlay, 40% pattern overlay, 60% pattern overlay, 80% pattern overlay, or 100% pattern). D) Mean percentage (and standard error) of reported pattern percepts in spider and flower trials separately for the different overlay levels (0% pattern overlay, 20% pattern overlay, 40% pattern overlay, 60% pattern overlay, 80% pattern overlay, or 100% pattern).

Procedure.

Comparable to Experiment 1, the participants viewed the pictures through the mirror stereoscope. To simulate perception states comparable to those occurring in binocular rivalry, we presented trials with a changing presentation order of two identical pictures. Each trial consisted of the consecutive but randomized presentation of two spider or two flower pictures at three different overlay levels, each picture pair remaining for 2.67 s resulting in an overall trial duration of 8 s with an inter trial interval of 3 s. Overall, the experiment took 12 minutes including 30 different spider and 30 flower trials each consisting of three randomly chosen pictures with different overlay levels.

The task instructions were comparable to those of Experiment 1: Participants were instructed to continuously indicate whether they perceived a picture, pattern, or mixture of the two by button presses. Afterwards, participants were asked to rate all spider and flower pictures on valence and arousal.

Results Experiment 2

Stimulus ratings.

As in Experiment 1 spider pictures were rated significantly more negative (spider pictures: M = 2.40, SD = 1.08; flower pictures: M = 6.06, SD =.65; $t(16)$ = 4.92, p < .001) and more arousing (spider pictures: M = 6.42, SD = 2.02; flower pictures: M = 3.62, SD = 1.63; $t(16)$ = 12.57, p < .001) than the flower pictures. The mean ratings were comparable to those obtained for the phobic patient group in Experiment 1.

Response criteria.

For the analysis of the experimental trials, we calculated the percentage of picture, pattern and mixed responses to the different overlay levels separately for spider and flower trials. In contrast to Experiment 1, we were interested whether the phobic patients had different criteria between spider and flower pictures in what they indicate as mixed percept. Therefore we focused on the mixed percepts and conducted an ANOVA for the mean percentage of mixed response for the two picture categories (spider, flower) and the six different overlay levels (0%, 20%, 40%, 60%, 80%, 100% pattern overlay). This crucial ANOVA did not reveal a significant main effect of picture category, $F(1, 16) = 2.35$; p = .15; η_p^2 = .13 and most importantly no significant interaction between picture category and overlay level, $F(5, 80) = .75$, p =.47, η_p^2 = .05. A significant main effect of overlay level, $F(5, 80) = 1678.69$; p = .01; η_p^2 = .99 showed that mixed responses were more frequent for the overlay levels 40%, 60%, 80% than for the other levels (see Figure 4B).

Because the response categories were not statistically independent, we did not conduct separate ANOVAs for the picture or pattern responses, but a visual inspection clearly shows that there are no differences between the responses to spider and flower pictures (see Figure 4C and Figure 4D).

Discussion Experiment 2

Spider-fearful participants did not respond differently to exclusive or mixed pictures of spiders and flowers which simulated typical rivalry percepts. Therefore, it is not likely that the results of Experiment 1 were simply caused by different response criteria to (mixed) spider and flower pictures. Although, not all participants of Experiment 2 meet full criteria of spider phobia, the questionnaire scores and ratings were comparable to those obtained for the phobic patient group in Experiment 1. These results clearly support the validity of the findings of Experiment 1.

General Discussion

The findings of the present study reveal that individuals more clearly see what they are afraid of; phobia-related cues gain preferential access to conscious perception in spider-phobic patients during binocular rivalry. Our results clearly demonstrate that under conditions of binocular rivalry, spider pictures predominate more in spider-phobic patients than in non-anxious control participants. Two indices of predominance in binocular rivalry converge: The spider pictures are perceived more frequently as the first percept of a trial and spider pictures are perceived dominantly longer throughout the trials. These findings demonstrate that preferential processing of phobic material in the visual system which was previously documented with respect to attention or neural processing is also reflected in a preferential access to perceptual awareness.

Importantly, we are confident that the differences we observed between patients and non-anxious controls were not simply caused by different response criteria to spider and flower pictures. In an additional experiment spider-fearful participants did not reveal any kind of response bias with respect to spiders compared to flower pictures. This is in accordance with previous validations of self-report with a physiological measure (Alpers et al., 2005).

In line with other paradigms which were previously used to study visual processing in anxiety disorders (for reviews see Derakshan & Eysenck, 2009; Mathews & MacLeod, 2005; Weierich, Treat, & Hollingworth, 2008), our results confirm that phobia-related cues are preferentially processed in spider-phobic patients. While previous studies typically used (very) brief picture presentations, this binocular rivalry study demonstrates that such preferential processing can be observed during a longer period of time when active avoidance is not possible. Specifically, this observation adds to evidence obtained from behavioral paradigms demonstrating a threat superiority effect in visual search tasks (Flykt & Caldara, 2006; Öhman, Flykt, & Esteves, 2001) as well as increased attentional allocation toward pictures of feared objects (Miltner, Krieschel, Hecht, Trippe, & Weiss, 2004; Rinck, Reinecke, Ellwart, Heuer, & Becker, 2005). While these previous studies demonstrate that fear-related content possesses perceptual advantages over neutral contents, which enables fearful subjects to more rapidly detect them and to allocate attentional resources at short exposure times, our paradigm documents preferential processing in the visual system over prolonged periods of exposure to phobia-related pictures.

It has been suggested that there is an evolutionary advantage to preferentially process threatening stimuli even in healthy individuals (Öhman & Mineka, 2001), but these effects seem to have become dysfunctional in phobic patients. Our results, it should be noted, are not necessarily based on early automatic processing or selective engagement of attention (see Lin & He, 2009). Although phobic patients report more frequent first percepts of spider pictures in rivalry trials, we found no evidence that latency of initial percept differed in comparison to non-anxious participants. Thus, slowed attentional disengagement from threat (see Gerdes et al., 2008) and the perceptual dominance of spider pictures shown in this study can be interpreted as a generally limited ability to disengage from phobia-related cues (Gerdes et al., 2009; Paulitzki, Risko, Oakman, & Stolz, 2008). This inflexibility in disengagement locks the individuals focus on the source of fear and may contribute to the maintenance and enhancement of anxiety (Fox, Russo, & Dutton, 2002).

Although voluntary influences on the perceptual changes in binocular rivalry could be shown under certain conditions, it is not likely that the predominance of spider pictures in spider phobia resulted exclusively from voluntary attentional allocation to spiders. First, binocular rivalry is relatively immune to conscious control (Meng & Tong, 2004). Second, it is not plausible that spider-phobic patients would intentionally expose themselves to their feared objects for longer than necessary (see Hamm, Cuthbert, Globisch, & Vaitl, 1997; Rinck & Becker, 2006). Third, the predominance of spiders in phobic patients was already observable in the initial percept, which is thought to be relatively unaffected by subsequent evaluation processes (Gray et al., 2009).

The study clearly extends findings that highly arousing and negative stimuli predominate over neutral stimuli during binocular rivalry in healthy population to psychopathology. Our previous studies have demonstrated this effect for healthy participants with naturally arousing pictures and with conditioned cues (Alpers & Gerdes, 2007; Alpers & Pauli, 2006; Alpers et al., 2005). The present study extents these findings to spider-phobic patients by showing that they dominantly perceive what they specifically fear.

With respect to the underlying neural processes of binocular rivalry, one may speculate that conscious perception under ambiguity is processed at stages where brain regions which are involved in fear processing (e.g. amygdala, see Alpers et al., 2009; LeDoux, 2000). A possible mechanism may be that the influence of phobic fear on visual competition is mediated by direct neural links between sensory pathways of the amygdala to the visual cortex (Amaral, Behniea, & Kelly, 2003; Amaral & Price, 1984). Enhanced activation of fear circuits may influence activation in the visual cortex and thus promote the conscious perception of fear-relevant stimuli. Because switching between percepts is for the most part beyond voluntary control, our data support the idea that emotional relevance of visual stimuli can preattentionally influence visual information processing, which results in improved conscious perception of relevant stimuli. However, there is also some evidence that attention can influence binocular rivalry to some extent (Mitchell et al., 2004; Paffen, Alais, & Verstraten, 2006). Thus, enhanced attention toward phobia-related cues (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007) as well as delayed disengagement (Gerdes et al., 2008) might act as mediators during the competition for conscious perception at least for the overall dominance duration. A recent study showed that high attentional load already enhances activity in the primary visual cortex (V1) which is the lowest level of visual processing (Bahrami, Lavie, & Rees, 2007). Consequently, even if the competition is decided early in visual processing (e.g., at V1), attention may contribute to the predominance of phobic pictures (Vuilleumier, 2005).

Although we cannot identify the underlying mechanisms with our data, the study design used here has several methodological advantages over previous binocular rivalry studies which have examined emotional inferences (see e.g., Alpers & Pauli, 2006; Bannerman et al., 2008; Blake, 2001; Walker, 1978). Because we compared the perception between two groups (which only differed in their emotional responses to the cues), this eliminates nearly all influences of the stimulus material beyond semantic (emotional) picture content. The presentation of spider and flower stimuli each paired with a neutral abstract pattern further reduces the probability that response biases influenced our results.

We conducted a second experiment to further rule out that our results are different due to response criteria in patients. The results of this study showed that spider-fearful participants do not label percepts of spiders (exclusive or mixed) differently than percepts of neutral pictures. Therefore, the reported dominance of spider pictures in phobic patients does not seem to be due to response biases.

Future research should address the underlying mechanisms of the perceptual dominance of threatening pictures in binocular rivalry. In particular, neuroimaging may very well help to identify the neural routes through which the competition for perceptual consciousness is affected by emotion. Furthermore, a systematic manipulation of attention (see for example Paffen et al., 2006) could help to clarify the extent to which attentional influences are involved in binocular rivalry and emotion. Future directions of phobia research may also focus on the sensitivity of the paradigm for detecting therapeutic changes. Recent findings suggest that exposure and cognitive-behavioral therapy may affect dysfunctional neural circuitry in anxiety (Paquette et al., 2003). Therefore, we expect that therapeutic interventions should also affect perception (see Lavy, Van den Hout, & Arntz, 1993).

Taken together, our results provide a substantial contribution to both the perception of threatening stimuli under condition of stimulus competition and to the debate of a prioritized role of threat in visual processing. Our results provide clear evidence that phobic individuals predominantly see what they fear.

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References

Alpers, G. W., & Gerdes, A. B. M. (2007). Here is looking at you: Emotional faces predominate in binocular rivalry. *Emotion, 7*, 495-506. http://dx.doi.org/10.1037/1528-3542.7.3.495

Alpers, G. W., Gerdes, A. B. M., Lagarie, B., Tabbert, K., Vaitl, D., & Stark, R. (2009). Attention and amygdala activity: an fMRI study with spider pictures in spider phobia. *Journal of Neural Transmission, 116*, 747–757. http://dx.doi.org/10.1007/s00702-008-0106-8

Alpers, G. W., & Pauli, P. (2006). Emotional pictures predominate in binocular rivalry. *Cognition and Emotion, 20*, 596-607. http://dx.doi.org/10.1080/02699930500282249

Alpers, G. W., Ruhleder, M., Walz, N., Mühlberger, A., & Pauli, P. (2005). Binocular rivalry between emotional and neutral stimuli: a validation using fear conditioning and EEG. *International Journal of Psychophysiology, 57*, 25-32. http://dx.doi.org/10.1016/j.ijpsycho.2005.01.008

Amaral, D. G., Behniea, H., & Kelly, J. L. (2003). Topographic organization of projections from the amygdala to the visual cortex in the macaque monkey. *Neuroscience, 118*, 1099-1120. http://dx.doi.org/10.1016/S0306-4522(02)01001-1

Amaral, D. G., & Price, J. L. (1984). Amygdalo-cortical projections in the monkey (Macaca fascicularis). *Journal of Comparative Neurology, 230*, 465-496. http://dx.doi.org/10.1002/cne.902300402

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, D.C.: Author.

Anderson, E., Siegel, E. H., Bliss-Moreau, E., & Barrett, L. F. (2011). The visual impact of gossip. *Science, 332*, 1446-1448. http://dx.doi.org/10.1126/science.1201574

Anderson, E., Siegel, E. H., & Feldmann Barrett, L. (2011). What you feel influences what you see: The role of affective feelings in resolving binocular rivalry. *Journal of Experimental Social Psychology, 47*, 8556-8860. http://dx.doi.org/10.1016/j.jesp.2011.02.009

Bahrami, B., Lavie, N., & Rees, G. (2007). Attentional load modulates responses of human primary visual cortex to invisible stimuli. *Current Biology, 7*, 509-513. http://dx.doi.org/10.1016/j.cub.2007.01.070

Bannerman, R. L., Milders, M. V., de Gelder, B., & Sahraie, A. (2008). Influence of emotional facial expressions on the dynamics of binocular rivalry. *Ophthalmic and Physiological Optics, 28*, 317-326. http://dx.doi.org/10.1111/j.1475-1313.2008.00568.x

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

Becker, E. S., & Rinck, M. (2004). Sensitivity and response bias in fear of spiders. *Cognition and Emotion, 18*, 961-976. http://dx.doi.org/10.1080/02699930341000329

Blake, R. (2001). A primer on binocular rivalry, including current controversies. *Brain and Mind, 2*, 5-38. http://dx.doi.org/10.1023/A:1017925416289

Blake, R., & Logothetis, N. K. (2002). Visual competition. *Nature Reviews Neuroscience, 3*, 13-21. http://dx.doi.org/10.1038/nrn701

Blake, R., O'Shea, R. P., & Mueller, T. J. (1992). Spatial zones of binocular rivalry in central and peripheral vision. *Visual Neuroscience, 8*, 469-478. http://dx.doi.org/10.1017/S0952523800004971

Carlsson, K., Petersson, K. M., Lundqvist, D., Karlsson, A., Ingvar, M., & Öhman, A. (2004). Fear and the amygdala: Manipulation of awareness generates differential cerebral responses to phobic and fear-relevant (but nonfeared) stimuli. *Emotion, 4*, 340-353. http://dx.doi.org/10.1037/1528-3542.4.4.340

Carter, O. L., Presti, D. E., Callistemon, C., Ungerer, Y., Liu, G. B., & Pettigrew, J. D. (2005). Meditation alters perceptual rivalry in Tibetan Buddhist monks. *Current Biology, 15*, R412-R413. http://dx.doi.org/10.1016/j.cub.2005.05.043

Chong, S. C., & Blake, R. (2006). Exogenous attention and endogenous attention influence initial dominance in binocular rivalry. *Vision Research, 46*, 1794-1803. http://dx.doi.org/10.1016/j.visres.2005.10.031

Derakshan, N., & Eysenck, M. W. (2009). Anxiety, Processing Efficiency, and Cognitive Performance New Developments from Attentional Control Theory. *European Psychologist, 14*, 168-176. http://dx.doi.org/10.1027/1016-9040.14.2.168

Flykt, A., & Caldara, R. (2006). Tracking fear in snake and spider fearful participants during visual search: A multi-response domain study. *Cognition and Emotion, 20*, 1075-1091. http://dx.doi.org/10.1080/02699930500381405

Fox, E., Russo, R., & Dutton, K. (2002). Attentional bias for threat: Evidence for delayed disengagement from emotional faces. *Cognition and Emotion, 16*, 355-379. http://dx.doi.org/10.1080/02699930143000527

Gerdes, A. B. M., Alpers, G. W., & Pauli, P. (2008). When spiders appear suddenly: Spider phobic patients are distracted by task-irrelevant spiders. *Behaviour Research & Therapy, 46*, 174-187. http://dx.doi.org/10.1016/j.brat.2007.10.010

Gerdes, A. B. M., Pauli, P., & Alpers, G. W. (2009). Toward and away from spiders: eye-movements in spider-fearful participants. *Journal of Neural Transmission, 116*, 725-733. http://dx.doi.org/10.1007/s00702-008-0167-8

Gray, K. L., Adams, W. J., & Garner, M. (2009). The influence of anxiety on the initial selection of emotional faces presented in binocular rivalry. *Cognition, 113*, 105-110. http://dx.doi.org/10.1016/j.cognition.2009.06.009

Hamm, A. O., Cuthbert, B. N., Globisch, J., & Vaitl, D. (1997). Fear and the startle reflex: blink modulation and autonomic response patterns in animal and mutilation fearful subjects. *Psychophysiology, 34*, 97-107. http://dx.doi.org/10.1111/j.1469-8986.1997.tb02420.x

Hofmann, S. G., Alpers, G. W., & Pauli, P. (2008). Phenomenology of Panic Disorder, Social Anxiety Disorder, and Specific Phobia. In M. M. Antony & M. B. Stein (Eds.), *Oxford Handbook of Anxiety and the Anxiety Disorders* (pp. 34-46). New York: Oxford University Press. http://dx.doi.org/10.1093/oxfordhb/9780195307030.013.0003

Kolassa, I. T., Musial, F., Mohr, A., Trippe, R. H., & Miltner, W. H. (2005). Electrophysiological correlates of threat processing in spider phobics. *Psychophysiology, 42*, 520-530.

Krohne, H. W., Egloff, B., Kohlmann, C.-W., & Tausch, A. (1996). Untersuchungen mit einer deutschen Version der "Positive and Negative Affect Schedule" (PANAS) [Investigations with a german version of the Positive and Negative Affect Schedule (PANAS)]. *Diagnostica, 42*, 139-156.

Lang, P. J., & Bradley, M. M. (2010). Emotion and the motivational brain. *Biological Psychology, 84*, 437-450. http://dx.doi.org/10.1016/j.biopsycho.2009.10.007

Larson, C. L., Schaefer, H. S., Siegle, G. J., Jackson, C. A. B., Anderle, M. J., & Davidson, R. J. (2006). Fear is fast in phobic individuals: Amygdala activation in response to fear-relevant stimuli. *Biological Psychiatry, 60*, 410-417. http://dx.doi.org/10.1016/j.biopsych.2006.03.079

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

Lavy, E., Van den Hout, M., & Arntz, A. (1993). Attentional bias and spider phobia: Conceptual and clinical issues. *Behaviour Research and Therapy, 31*, 17-24. http://dx.doi.org/10.1016/0005-7967(93)90038-V

LeDoux, J. E. (2000). Emotion circuits in the brain. *Annual Review of Neuroscience, 23*, 155-184. http://dx.doi.org/10.1146/annurev.neuro.23.1.155

Leopold, D. A., Fitzgibbons, J. C., & Logothetis, N. K. (1995). *The role of attention in binocular rivalry as revealed through optokinetic nystagmus*. Technical Report. Massachusetts Institute of Technology, Cambridge, MA, USA.

Leopold, D. A., & Logothetis, N. K. (1999). Multistable phenomena: changing views in perception *Trends in Cognitive Sciences, 3*, 254-264. http://dx.doi.org/10.1016/S1364-6613(99)01332-7

Levelt, W. J. M. (1965). *On binocular rivalry*. Assen: Van Gorcum.

Lin, Z., & He, S. (2009). Seeing the invisible: The scope and limits of unconscious processing in binocular rivalry. *Progress in Neurobiology, 87*, 195-211. http://dx.doi.org/10.1016/j.pneurobio.2008.09.002

Mamassian, P., & Goutcher, R. (2005). Temporal dynamics in bistable perception. *Journal of Vision, 5*, 361-375. http://dx.doi.org/10.1167/5.4.7

Mathews, A., & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology, 1*, 167-195. http://dx.doi.org/10.1146/annurev.clinpsy.1.102803.143916

Meng, M., & Tong, F. (2004). Can attention selectively bias bistable perception? Differences between binocular rivalry and ambiguous figures. *Journal of Vision, 4*, 539-551. http://dx.doi.org/10.1167/4.7.2

Miltner, W. H. R., Krieschel, S., Hecht, H., Trippe, R., & Weiss, T. (2004). Eye movements and behavioral responses to threatening and nonthreatening stimuli during visual search in phobic and nonphobic subjects. *Emotion, 4*, 323-339. http://dx.doi.org/10.1037/1528-3542.4.4.323

Mitchell, J. F., Stoner, G. R., & Reynolds, J. H. (2004). Object-based attention determines dominance in binocular rivalry. *Nature, 429*, 410-413. http://dx.doi.org/10.1038/nature02584

Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy, 36*, 809-848. http://dx.doi.org/10.1016/S0005-7967(98)00063-1

Mogg, K., & Bradley, B. P. (2006). Time course of attentional bias for fear-relevant pictures in spider-fearful individuals. *Behaviour Research and Therapy, 44*, 1241-1250. http://dx.doi.org/10.1016/j.brat.2006.05.003

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

Öhman, A., Lundqvist, D., & Esteves, F. (2001). The face in the crowd revisited: A threat advantage with schematic stimuli. *Journal of Personality & Social Psychology, 80*, 381-396. http://dx.doi.org/10.1037/0022-3514.80.3.381

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review, 108*, 483-522. http://dx.doi.org/10.1037/0033-295X.108.3.483

Ooi, T. L., & He, Z. J. (1999). Binocular rivalry and visual awareness: the role of attention. *Perception, 28*, 551-574. http://dx.doi.org/10.1068/p2923

Paffen, C. L. E., Alais, D., & Verstraten, F. A. J. (2006). Attention Speeds Binocular Rivalry. *Psychological Science, 17*, 725-756. http://dx.doi.org/10.1111/j.1467-9280.2006.01777.x

Paquette, V., Levesque, J., Mensour, B., Leroux, J. M., Beaudoin, G., Bourgouin, P., & Beauregard, M. (2003). "Change the mind and you change the brain": Effects of cognitive-behavioral therapy on the neural correlates of spider phobia. *Neuroimage, 18*, 401-409. http://dx.doi.org/10.1016/S1053-8119(02)00030-7

Paulitzki, J. R., Risko, E. F., Oakman, J. M., & Stolz, J. A. (2008). Doing the unpleasant: How the emotional nature of a threat-relevant task affects task-switching. *Personality and Individual Differences, 45*, 350–355. http://dx.doi.org/10.1016/j.paid.2008.05.003

Rinck, M., & Becker, E. S. (2006). Spider fearful individuals attend to threat, then quickly avoid it: Evidence from eye movements. *Journal of Abnormal Psychology, 115*, 231-238. http://dx.doi.org/10.1037/0021-843X.115.2.231

Rinck, M., Bundschuh, S., Engler, S., Müller, A., Wissmann, J., Ellwart, T., & Becker, E. S. (2002). Reliability and validity of German versions of three instruments measuring fear of spiders. *Diagnostica, 48*, 141-149. http://dx.doi.org/10.1026//0012-1924.48.3.141

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

Sheth, B. R., & Pham, T. (2008). How emotional arousal and valence influence access to awareness. *Vision Research, 48*, 2415-2424. http://dx.doi.org/10.1016/j.visres.2008.07.013

Sterzer, P., Hilgenfeldt, T., Freudenberg, P., Bermpohl, F., & Adli, M. (2011). Access of emotional information to visual awareness in patients with major depressive disorder. *Psychological Medicine, 41*, 1615-1624. http://dx.doi.org/10.1017/S0033291710002540

Straube, T., Mentzel, H.-J., & Miltner, W. H. R. (2006). Neural mechanisms of automatic and direct processing of phobogenic stimuli in specific phobia. *Biological Psychiatry, 59*, 162-170. http://dx.doi.org/10.1016/j.biopsych.2005.06.013

Tong, F., Meng, M., & Blake, R. (2006). Neural bases of binocular rivalry. *Trends in Cognitive Sciences, 10*, 502-511. http://dx.doi.org/10.1016/j.tics.2006.09.003

Vuilleumier, P. (2005). How brains beware: neural mechanisms of emotional attention. *Trends in Cognitive Sciences, 9*, 585-594. http://dx.doi.org/10.1016/j.tics.2005.10.011

Walker, P. (1978). Binocular rivalry: Central or peripheral selective processes? *Psychological Bulletin, 85*, 376-389. http://dx.doi.org/10.1037/0033-2909.85.2.376

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

Weymar, M., Gerdes, A. B. M., Löw, A., Alpers, G. W., & Hamm, A. O. (2013). Specific fear modulates attentional selectivity during visual search: Electrophysiological insights from the N2pc. *Psychophysiology, 50*, 139-148. http://dx.doi.org/10.1111/psyp.12008

Wittchen, H.-U., Gruschwitz, S., Wunderlich, U., & Zaudig, M. (1997). *Strukturiertes Klinisches Interview für DSM-IV (SKID-I). Achse I: Psychische Störungen [Structured Clinical Interview for DSM-IV (SCID-I)]*. Göttingen: Hogrefe.

Yoon, K. L., Hong, S. W., Joormann, J., & Kang, P. (2009). Perception of facial expressions of emotion during binocular rivalry. *Emotion, 9*, 172-182. http://dx.doi.org/10.1037/a0014714