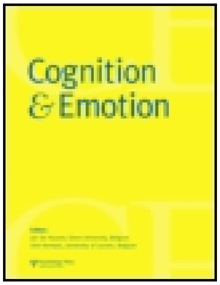

Cognition and Emotion
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/pcem20

The influence of motivational and mood states on visual attention: A quantification of systematic differences and casual changes in subjects' focus of attention

Stefanie Hüttermann[a] & Daniel Memmert[a]
[a] Institute of Cognitive and Team/Racket Sport Research, German Sport University Cologne, Cologne, Germany
Published online: 27 May 2014.

COGNITION AND EMOTION, 2014
http://dx.doi.org/10.1080/02699931.2014.920767

The influence of motivational and mood states on visual attention: A quantification of systematic differences and casual changes in subjects' focus of attention

Stefanie Hüttermann and Daniel Memmert

Institute of Cognitive and Team/Racket Sport Research, German Sport University Cologne, Cologne, Germany

A great number of studies have shown that different motivational and mood states can influence human attentional processes in a variety of ways. Yet, none of these studies have reliably quantified the exact changes of the attentional focus in order to be able to compare attentional performances based on different motivational and mood influences and, beyond that, to evaluate their effectivity. In two studies, we explored subjects' differences in the breadth and distribution of attention as a function of motivational and mood manipulations. In Study 1, motivational orientation was classified in terms of regulatory focus (promotion vs. prevention) and in Study 2, mood was classified in terms of valence (positive vs. negative). Study 1 found a 10% wider distribution of the visual attention in promotion-oriented subjects compared to prevention-oriented ones. The results in Study 2 reveal a widening of the subjects' visual attentional breadth when listening to happy music by 22% and a narrowing by 36% when listening to melancholic music. In total, the findings show that systematic differences and casual changes in the shape and scope of focused attention may be associated with different motivational and mood states.

Keywords: Attentional focus; Breadth of attention; Regulatory focus; Valence.

We may stand in the same place and have the same vision as another person; nevertheless, within our focus of attention, we perceive things differently. While one person may perceive things across a great area of space, another person may merely perceive a much smaller part of the same visual field of view, but with higher perceptual potential (Huntsinger, 2013). Based on various attentional theories (e.g., Derryberry & Reed, 1998; Kuhl, 2000), one might attribute the reason for attentional differences to subjects' current affective state. There has been a great deal of recent research investigating the effects of different mood states that guide subjects' focused attention. Several studies have explored the effects on information processing and visual attentional skills caused by emotional as well as motivational variables and processes (e.g., Engelmann, Damaraju, Padmala, & Pessoa, 2009; Förster,

Correspondence should be addressed to: Stefanie Hüttermann, Institute of Cognitive and Team/Racket Sport Research, German Sport University Cologne, Am Sportpark Müngersdorf 6, 50933 Köln, Germany. E-mail: s.huettermann@dshs-koeln.de

Friedman, Özelsel, & Denzler, 2006; Seifert, Hewig, Hagemann, Naumann, & Bartussek, 2006; Trippe, Hewig, Heydel, Hecht, & Miltner, 2007); yet, none of these studies have actually quantified these differences with regard to maximum extent and exact spatial distribution of focused attention.

Visual attentional processes have been studied in psychological sciences for decades and motivational orientation (e.g., Förster et al., 2006) as well as mood (e.g., De Dreu, Baas, & Nijstad, 2008) have always been considered as two of the most important predictors of attentional performance. They may influence people's judgments, decisions and information processing (Bless, Bohner, Schwarz, & Strack, 1990; Carver & Scheier, 1990; Reed & Aspinwall, 1998).

The present research concerns the processes underlying the effects of motivational and mood manipulations in a visual attentional task. Although many studies have shown effects of both, motivational orientation and mood states, none have systematically measured such manipulation differences in the maximum breadth and spatial distribution of focused attention. We explored differences in the shape and scope of attention by comparing promotion- and prevention-oriented people in Study 1 and by comparing positive and negative mood states in Study 2. In both experiments, we used the *attention-window paradigm* developed by Hüttermann, Memmert, Simons, and Bock (2013)—an attention-demanding conjunction task in which subjects have to simultaneously focus on two peripheral targets. By systematically varying the stimulus positions and the distance between them, we compared the maximum size and shape of the attentional focus as well as the identification rate of stimuli presented within the focus for the different subject groups.

STUDY 1

Several research has documented the influence of motivation on cognition (e.g., Elliot & Harackiewicz, 1996; Higgins & Tykocinski, 1992; Liberman & Trope, 1998). The *regulatory focus theory* by Higgins (1997) accounts for how motivation and behaviour are connected and helps to understand in which way motivation can influence subjects' cognitive system. The theory distinguishes two motivational systems—termed promotion and prevention—which subserve different survival-relevant needs and relate to different desired end states (Higgins, 1997, 2002). The regulatory focus may influence the way an individual acts and can vary according to individuals' permanent regulatory orientation (chronic focus) as well as to momentary situations (situational focus). Both, physical behaviours (e.g., Friedman & Förster, 2000) and cognitive processes (e.g., Förster et al., 2006), can be influenced by motivational states. Several studies have examined the influence on cognitive performance caused by manipulations of promotion and prevention cues in different contexts (e.g., Friedman & Förster, 2001; Roese, Hur, & Pennington, 1999; Seibt & Förster, 2004). Among others, an influence of cognitive performance caused by manipulations of promotion or prevention cues has been documented for attention-related tasks (e.g., Derryberry & Tucker, 1994; Easterbrook, 1959; Friedman & Förster, 2005). Different research provides evidence that a prevention motivation results in better performance on detail-oriented tasks, whereas a promotion motivation results in better performance on global-oriented tasks (Derryberry & Reed, 1998; Förster & Higgins, 2005; Förster et al., 2006). However, no research has investigated the visual shape and size of the attentional focus as a function of regulatory focus cues yet. Although past studies concerned with the effects of motivational factors on subjects' visual attention have shown a relative tendency towards an expanded attentional scope, they could neither really make a statement about the exact size of subjects' attentional focus nor about the perceptual potentials within it. To our best knowledge, the present study was the first one being able to determine the percentage increase or decrease in attentional breadth due to regulatory focus cues.

Generally, and somewhat trivially, due to previous research addressing the relationship between cognition and motivational states (e.g., Friedman

& Förster, 2005; Markman, Baldwin, & Maddox, 2005), we expected that promotion-focused subjects would reveal a greater attentional focus than prevention-focused subjects. Given the fact that prevention-focused subjects commonly act more precisely and accurately (e.g., Förster, Higgins, & Taylor Bianco, 2003), we also unsurprisingly expected that they would reveal a higher accuracy rate than subjects with a promotion state, when stimuli are presented closer to the fixation point. While these expectations would only replicate already existing research findings, the present study distinguished from previous ones by trying to provide evidence in quantified values, for the first time, that subjects would perform better when an attentional task (central or peripheral) matches their regulatory orientation.

Method

Subjects

Altogether, Study 1 included 20 voluntary subjects (9 females) aged 16–24 years (M_{age} = 21.65 years, SD = 1.79 years). All subjects reported normal vision without the need for corrective lenses. Visual functions were additionally controlled by the use of a visual field test (perimetry test) in which subjects were supposed to identify a single stimulus at eccentricities up to a score of M = 58.18° (SD = 1.48°) with both eyes individually. Subjects had not participated in similar research in the preceding six months prior to the testing. In accordance with the principles of the Helsinki Declaration of 1975, a written informed consent was obtained before commencing the study.

Materials

Situational promotion- and prevention-focused states were manipulated using the paper-and-pencil task by Friedman and Förster (2001) in which a cartoon mouse had to be guided out of a maze. In the promotion condition, a piece of cheese was lying outside the maze; in the prevention condition, an owl was depicted hovering above the maze. In total, subjects were given three different illustrations according to their condition.

In the attention-demanding conjunction task (see Hüttermann et al., 2013), a stimulus pair generated with E-Prime® was presented on a 2.80 m × 2.20 m white projection screen. A stimulus pair was located symmetrically around the fixation point in the middle of the screen with stimulus separations ranging from 5° to 40° in 2.5°-steps along the same of four meridians (one horizontal, one vertical, and two diagonal) with eight directions (0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315°), as illustrated in Figure 1. Each stimulus consisted of a cluster of four elements which were either 9 cm × 9 cm (equal to 3.97°) light or dark grey circles or triangles; the size of each stimulus was 19 cm × 19 cm (equal to 8.38°), with a gap of 1 cm (equal to 0.44°) between the elements. A mobile eye tracking system (Mobile Eye®, Applied Science Laboratories, Bedford, USA) was used to monitor the eye position at a sampling rate of 30 Hz and a resolution of 1°.

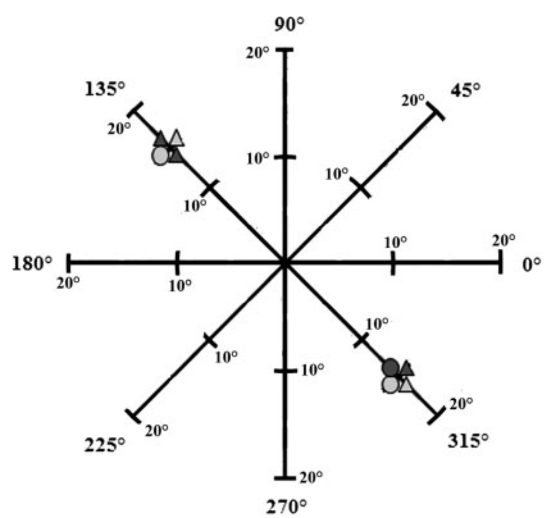

Figure 1. *The stimuli on the screen were presented at 15 distances from the centre of the screen on four meridians (one horizontal, one vertical, and two diagonal) with eight directions (0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315°). The figure (adapted from Hüttermann et al., 2013) represents a stimulus pair located on the diagonal meridian with a stimulus separation of 30°. (This figure is supposed to give an example of a possible location of the stimuli during the presentation in the study. Of course, subjects were not able to see the meridians and locations of the stimuli the way they are presented in the figure).*

Procedure

Subjects sat approximately 1.30 m away from the projection screen with a visual angle of 94° in the horizontal direction and 80° in the vertical direction. They were randomly assigned to either a promotion or a prevention condition and were tested individually. At first, subjects were asked to complete one of the Friedman and Förster (2001) mazes depending on their assigned condition. The maze task was described to the subjects as a test of "abstract imagination skills" (cf. Förster et al., 2006). Subjects were given one minute to solve the mazes; all of them completed the tasks in the allotted time.

Subsequently, subjects performed 16 practice trials before commencing the attention-demanding conjunction task, which included 180 trials divided into three blocks of 60 trials each. Before completing the second and third block, subjects were required to complete a maze corresponding to their manipulation condition (promotion or prevention) once more.

Figure 2 illustrates the serial order of events in the attention-demanding conjunction task, showing a stimulus pair along the horizontal meridian (cf. Hüttermann et al., 2013). One trial consisted of six display sequences. Each trial started with a 1000 ms central fixation cross, equidistant from each stimulus location. Subsequently, 200 ms pre-cues (empty outlined circles of 8 cm diameter, equal to 3.52°) indicated the locations at which each stimulus appeared. The pre-cues were 100% predictive. Following a 200 ms blank interval, the stimulus pair appeared at the pre-cued locations for 300 ms. Subjects were required to fixate their gaze between the two presented stimuli and to process both of them peripherally. The trials in which they failed to maintain fixation (assessment via eye tracking) were later excluded from the data analysis. A pair of stimuli was equally likely to

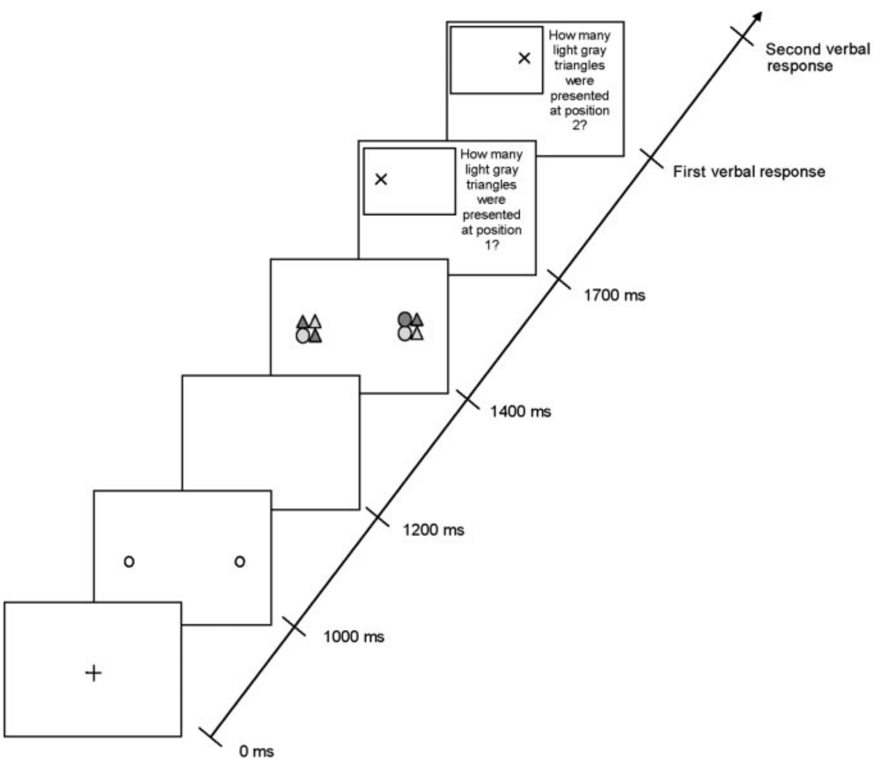

Figure 2. *Sequence of events in a trial with stimuli along the horizontal meridian (from Hüttermann et al., 2013).*

appear along the vertical, horizontal, or the two diagonal meridians. For analyses, we combined data from the two diagonal meridians. The meridian and stimulus separation were randomised with each combination being tested four times (15 separations × 3 meridians × 4 repetitions). Both, the form (circle and triangle) and the shading (light grey and dark grey) of all elements, varied randomly from trial to trial. As the subjects had to detect the conjunction of both, form and shading of the stimulus elements, the experiment was classified as an attention-demanding task (Schneider, Dumais, & Shiffrin, 1984; Shiffrin & Schneider, 1977). Subjects were instructed to verbally report the number (between zero and four) of light grey triangles for each cluster without time pressure. Only when the subjects reported the correct number of light grey triangles for both stimuli in a trial, responses were treated as correct. Subjects' verbal responses were manually keyed in by the experimenter. Attentional performance was analysed for each stimulus separation independently. In accordance with the procedure of Hüttermann, Memmert, and Simons (2014), the maximum attentional focus was determined by analysing the largest stimulus separation for each meridian at which subjects reliably identified the number of light grey triangles in both stimuli in at least 75% of the trials (cf. Vida & Maurer, 2012). This means that the performance level was evaluated for each stimulus separation beginning with the smallest distance, and it was enlarged to the highest possible separation in which subjects attained at least 75% accuracy. As soon as the accuracy rate was less than 75%, the closest smaller stimulus separation was determined as the subject's maximum attentional breadth. This procedure was applied for each meridian.

Results

Data from trials in which the subjects failed to maintain fixation were excluded: this corresponded to a total of 4% for promotion-focused and 3% for prevention-focused subjects. A 2 × 3 [regulatory focus (promotion motivation and prevention motivation) × meridian (horizontal, vertical, and diagonal)] analysis of variance (ANOVA) with repeated measures on the last factor and a Greenhouse-Geisser correction revealed significantly greater attentional breadth across meridians for promotion-focused than for prevention-focused subjects, $F(1, 18) = 4.486$, $p = .048$, $\eta_p^2 = .199$ (see Table 1). There was a significant main effect for the factor meridian, $F(1.516, 27.286) = 7.670$, $p = .004$, $\eta_p^2 = .299$, $\varepsilon = .758$. The focus of attention was largest along the horizontal and smallest along the vertical meridian. The interaction between regulatory focus and meridian, $F(2, 36) = 1.826$, $p = .176$, $\eta_p^2 = .092$, was non-significant: promotion-focused subjects performed at 75% accuracy with greater distance between the stimuli than prevention-focused subjects on all of the three meridians (see Table 1).

To examine the subjects' identification success rate of stimuli within their maximum attentional foci, we analysed the effects of regulatory focus using a 2 × 2 × 3 (regulatory focus [promotion motivation and prevention motivation] × stimulus separation [5°–20° and >20°–40°] × meridian [horizontal,

Table 1. *Mean attentional breadth with 75% accuracy (SD) in degrees of visual angle as a function of meridian (horizontal, vertical, and diagonal) and regulatory focus (promotion motivation and prevention motivation)*

	Meridian			
	Horizontal	*Vertical*	*Diagonal*	*Average—all meridians*
Promotion motivation	32.25° (5.33°)	30.00° (3.91°)	32.00° (3.29°)	31.42° (2.91°)
Prevention motivation	31.75° (3.13°)	25.00° (4.08°)	29.25° (5.01°)	28.67° (2.89°)
Average—both groups	32.00° (4.26°)	27.50° (4.66°)	30.63° (4.36°)	30.04° (3.16°)

vertical, and diagonal]) ANOVA with repeated measures on the last two factors. The ANOVA revealed a significant main effect for stimulus separation, $F(1, 18) = 53.583$, $p = .001$, $\eta_p^2 = .749$ and meridian, $F(2, 36) = 19.277$, $p = .001$, $\eta_p^2 = .517$, although no significant difference was evident between the subjects' success rates, $F(1, 18) = 0.122$, $p = .731$, $\eta_p^2 = .007$. Of far greater interest was the fact that the ANOVA yielded a significant interaction between regulatory focus and stimulus separation, $F(1, 18) = 21.493$, $p < .001$, $\eta_p^2 = .544$. Across meridians, prevention-focused subjects (M = 87.38%, SD = 3.90%) were more accurate in stimuli identification presented with separations of 5°–20° than promotion-focused subjects (M = 81.07%, SD = 2.21%), $t(18) = 4.457$, $p < .001$. In contrast, promotion-focused subjects had higher success rates for stimuli presented with separations greater than 20° (M = 77.14%, SD = 3.80%), as compared with prevention-focused subjects (M = 69.88%, SD = 6.76%, see Figure 3), $t(18) = 2.962$, $p = .008$. The ANOVA revealed a significant interaction between stimulus separation and meridian, $F(2, 36) = 5.106$, $p = .011$, $\eta_p^2 = .221$, but neither for the interaction between regulatory focus and meridian, $F(2, 36) = 0.771$, $p = .470$, $\eta_p^2 = .041$, nor for the three-way interaction, $F(2, 36) = 0.659$, $p = .524$, $\eta_p^2 = .035$.

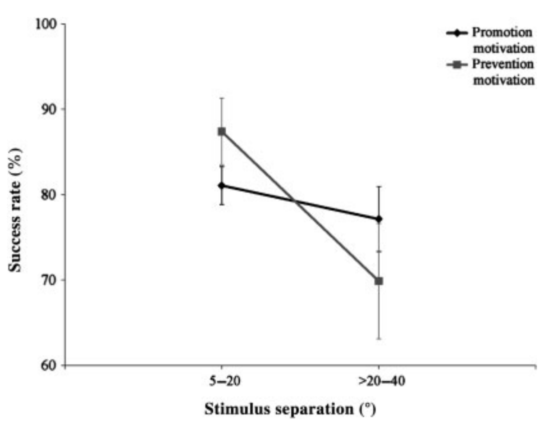

Figure 3. *Success rate for subjects with promotion and prevention motivation as a function of stimulus separation. Symbols represent across-subject means and error bars represent standard deviations.*

Discussion

The purpose of Study 1 was to add the growing literature that investigates the interaction between attention and motivation (e.g., Engelmann & Pessoa, 2007; Engelmann et al., 2009; Friedman & Förster, 2008; Small et al., 2005). Previous research provided evidence that motivational orientation affects subjects' attentional focus (e.g., Förster et al., 2006). For the first time in the literature, the attentional focus' maximum size and performance level were quantified for subjects with a situational-induced promotion or prevention focus. By determining a subtler measure, also for the first time, we were able to specify variations of the focus of attention due to motivational cues.

We provided evidence in quantified values that a prevention motivation results in better performance on central attention-demanding tasks while a promotion motivation results in better performance on peripheral tasks. The maximum size of the attentional focus was about 32° horizontally and 30° vertically for promotion-focused subjects and about 32° horizontally and 25° vertically for those with a prevention focus. Within their focus, prevention-oriented subjects identified stimuli with separations of up to 20° correctly in 87% of the cases, whereas promotion-focused subjects attained success rates of only 81%. Promotion-oriented subjects, however, identified stimuli presented with separations greater than 20° up to 40° with 10% more accuracy than prevention-oriented subjects. As expected, the spherical shape of the attentional focus did not differ as a function of size differences caused by regulatory focus cues.

STUDY 2

Study 1 revealed manipulation effects classified in terms of motivational orientation (promotion vs. prevention focus) in the spatial distribution and stimulus accuracy rate of subjects' visual attentional focus with added scientific value indicating measured changes precisely. In order to be able to estimate these findings in comparison to the influence of other manipulations of subjects' mental state, Study 2 was designed to explore possible differences as a function of manipulation effects classified in terms of mood (positive vs. negative valence). As opposed to Study 1, the goal was not to examine whether there are inter-individual differences but rather to what extent a subject's focus of attention is changed when the subject is influenced by positive or negative mood. Additionally, we added a control group without any experimental treatment to validate our test procedure.

Mood is defined as an individual's affective state representing positive or negative feelings that occur in a specific situation (Eagly & Chaiken, 1993). Several studies have explored the effects of positive and negative moods on cognition (e.g., Rowe, Hirsh, & Anderson, 2007). The broaden-and-build theory, postulated by Fredrickson (2001, 2003), addresses how mood and cognitive processes are connected and how they interact. The theory suggests that positive emotions broaden subjects' thought-action repertoires (Fredrickson, 2001, 2003), increase their flexibility, and enhance their global scope. Studies examining global precedence point out that a positive mood evokes greater global or holistic processing (i.e., seeing the forest before the trees) than local processing (i.e., seeing the trees before the forest; Basso, Schefft, Ris, & Dember, 1996; Gasper, 2004; Gasper & Clore, 2002). Hence, somewhat trivially, we expected that subjects would show greater attentional breadth in the attention-window paradigm of Hüttermann et al. (2013) under the influence of positive mood while showing a smaller focus of attention under the influence of negative mood. Our primary goal and the distinction to previous studies in this research area was the differentiation of these expected effects by quantifying the exact changes of the attentional focus based on influence of mood states classified in terms of positive and negative valence. Since a great number of studies have documented that music can affect mood states, emotions, and performances (e.g., Eifert, Craill, Carey, & O'Connor, 1988; Rauscher, Shaw, & Ky, 1993), subjects were exposed to happy or melancholic music inducing either positive or negative mood (cf. Rowe et al., 2007).

Method

Subjects

Twenty-six subjects (8 females) aged 15–68 years (M_{age} = 31.12 years, SD = 13.42 years) participated under the same ethical and health constraints as in Study 1. Data from three additional subjects were excluded because they did not reliably perform better than 75% as the separation decreased and one additional subject was excluded because he failed to maintain fixation.

Materials and procedure

The design of Study 2 was identical to that of Study 1 except for the fact that the subjects' manipulated mood states were not classified in terms of motivational orientation but in terms of valence (positive vs. negative). Subjects were randomly assigned to either a positive mood, a negative mood, or a neutral condition. The experimenters were blind to the subjects' assigned conditions. Following the procedure of Rowe et al. (2007), the positive mood was induced by listening to a jazzed-up version of Bach's *Brandenberg Concerto No. 3* (played by Hubert Laws). The negative mood was induced by listening to a piece of melancholic music, namely Prokofiev's *Alexander Nevsky: Russia under the Mongolian Yoke* played at half speed (cf. Rowe et al., 2007; see also Green, Sedikides, Saltzberg, Wood, & Forzano, 2003; Wood, Saltzberg, & Goldsamt, 1990, for validations of these selections in previous mood research). In an additional neutral mood induction, the subjects were asked to read a collection of basic facts about their country, e.g., population size, land mass, gross national product, etc. (cf. Rowe et al., 2007). All other aspects of the design including the attention-window paradigm (see also Hüttermann et al., 2013, 2014) were identical to those of Study 1.

Results

Attentional breadth data were submitted to a 3 × 3 × 2 repeated measures ANOVA with mood (positive, negative, and neutral) as a between-subject variable and meridian (horizontal, vertical, and diagonal) and time of measure (pre- and post-test) as within-subject variables. The ANOVA revealed no main effect of time of measure, $F(1, 23) = 0.260$, $p = .615$, $\eta_p^2 = .011$, confirming that across all mood states, subjects' maximum attentional breadth was comparable in the pre-test and in the post-test (see Table 2). There was a significant main effect of mood, $F(2, 23) = 4.815$, $p = .018$, $\eta_p^2 = .295$. In the post-test, a significantly greater attentional breadth was reached when the subjects were in a positive mood compared to a negative mood, $t(14) = 4.337$, $p = 001$, and in a neutral mood compared to a negative mood, $t(16) = 5.465$, $p < .001$ (see Figure 4). The difference between positive mood and neutral mood was not significant, $t(16) = 1.323$, $p = .205$. Furthermore, there was a significant interaction between time of measure and mood, $F(2, 23) = 6.536$, $p = .006$, $\eta_p^2 = .362$: subjects in the negative mood condition showed greater breadth of attention in the pre-test compared to the post-test, $t(7) = 3.680$, $p = .008$. The descriptively found difference between the maximum attentional breadth of subjects in the positive condition was not significant in the pre- and post-test, $t(7) = 1.428$, $p = .196$. Subjects in the neutral condition showed comparable attentional breadth in the post-test and the pre-test, $t(9) = 0.425$, $p = .681$ (see Table 2). The ANOVA showed no significant main effect of meridian, $F(2, 46) = 0.232$, $p = .794$, $\eta_p^2 = .010$. Neither the interaction between meridian and mood, $F(4, 46) = 2.442$, $p = .060$, $\eta_p^2 = .175$, nor the interaction between time of measure and meridian, $F(2, 46) = 0.060$, $p = .942$, $\eta_p^2 = .003$, nor the three-way interaction were significant, $F(4, 46) = 1.866$, $p = .133$, $\eta_p^2 = .140$.

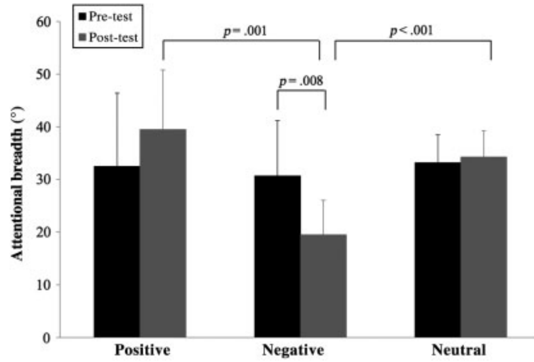

Figure 4. *Effect of mood manipulation (positive, negative, and neutral) on maximum attentional breadth for subjects in the pre- and post-test. Symbols represent across-subject means and error bars represent standard deviations.*

Discussion

Based on the trends in Study 1 where we provided evidence—by indicating exactly measured data—that depending on subjects' motivational state, they performed better when the respective task (central or peripheral) matched their regulatory orientation; our core hypothesis in Study 2 was that other dimensions of subjects' mental state—more precisely positive and negative mood states—would show an effect on the distribution of subjects' visual attention as well. In line with the hypothesised influence of positive effects on visual attention (Fredrickson, 2001, 2003), positive moods increased subjects' attentional breadth and negative affective states caused a constriction of the attention-window (Derryberry & Reed, 1998; Easterbrook, 1959; Gasper, 2004). But more specifically, the maximum attentional breadth of subjects descriptively increased up to 7° of visual

Table 2. *Mean attentional breadth with 75% accuracy (SD) in degrees of visual angle as a function of subjects' mood state (positive, negative, and neutral) and the time of measure (pre-test and post-test)*

	Mood state			
	Positive	*Negative*	*Neutral*	*Average—all mood states*
Pre-test	32.50° (13.91°)	30.67° (10.52°)	33.20° (5.27°)	32.20° (9.82°)
Post-test	39.50° (11.29°)	19.50° (6.53°)	34.27° (4.95°)	31.33° (11.23°)
Average—both tests	36.00° (10.60°)	25.08° (7.64°)	33.73° (3.22°)	31.77° (8.55°)

angle by listening to happy music and decreased up to 11° of visual angle by listening to melancholic music whereby the attentional focus did not change from the pre-test to the post-test in the neutral condition. Altogether, positive mood increased subjects' attention-window by 22% and negative mood decreased the window even by 36%.

GENERAL DISCUSSION

Although the effects of different motivational and mood states on attention have been investigated for decades now, there are several attentional biases in affective disorders (MacLeod, Mathews, & Tata, 1986), and no reliable methods quantifying the exact changes of subjects' attentional focus due to motivational and mood manipulations. For the first time, we were able to compare attentional performances based on influences of different motivational and mood states and, beyond that, to evaluate their effectivity in order to manage situations requiring a broadening of the attentional focus. Both a situational promotion focus and positive mood cause a broadening of subjects' attentional focus. The purely descriptive comparison of the maximum reached attention-windows in both studies highlights a larger benefit of positive mood than of a situational promotion focus (Note, however, that the results are not directly comparable due to the subjects' potentially different base levels of attentional performance).

Moreover, our findings might have implications for research regarding the relation between the breadth of attention and other related cognitive abilities. Among others, a broader scope of attention has been shown to improve creativity (e.g., Förster, 2012; Friedman, Fishbach, Förster, & Werth, 2003). Other studies revealed an influence of controllable and uncontrollable outcomes on the attentional breadth (e.g., Brandtstädter & Rothermund, 2002; Lee & Maier, 1988; Reed & Antonova, 2007). The application of the attention-window paradigm of Hüttermann et al. (2013) now enables to conceptually replicate important findings from the literature (e.g., the effect of attention on creativity) and to determine the percentage increase or decrease in attentional breadth due to all kind of manipulation types and influencing factors. Traditional measurements of attentional breadth, like the useful field of view (UFOV; Ball & Owsley, 1992) task, usually focus on situations in which observers perform one task at fixation and detect another target in the periphery. The UFOV task does not address situations in which both targets are presented in the visual periphery. Furthermore, it does not equate the two task components for their demands on attention. While the fixation task demands sustained focused attention, the peripheral task just requires detection. However, in many real-life situations (e.g., in driving or sports), people must attend to two equally attention-demanding stimuli simultaneously. In addition, previous research found that the scope of visual attention was greater with two peripheral stimuli than with one central and one peripheral stimulus (e.g., Hüttermann et al., 2013). However, probably the most important distinction and advantage of our used attention-window paradigm towards traditional measurements of attentional breadth is the potential to quantify the distribution of visual attention and to specify variations of the focus of attention due to all kinds of influencing factors. While our two studies quantitated the influence of motivational and mood states on visual attention, future studies could explore the influence of other influencing factors on our visual attention-window.

Due to the fact that the present research investigated the effects of regulatory focus and mood states on attentional breadth for neutral stimuli, it might be of great interest to change the neutral stimuli to valent ones in the attention-window paradigm for bottom-up studies. In this way, it would be possible to examine whether the effects of motivational or mood-concerning manipulation on attentional breadth interact with the valence of the stimuli that have to be perceived. By systematically varying the congruency between participants' mood or regulatory focus and the valence of the stimuli (e.g., schematic faces exhibiting either a positive, negative, or neutral expression), we should be able to determine how mood and regulatory focus influence attentional breadth in dependence on the valence of the used stimuli. A multitude of previous research highlights incongruent effects of motivation, emotion, and mood states on the attentional sensitivity modulated by the valence of the stimuli that draw or hold attention (e.g., Derryberry, 1993; Ellenbogen, Schwartzman, Stewart, & Walker, 2002; Rothermund, 2003; Rothermund, Voss, & Wentura, 2008; Rothermund, Wentura, & Bak, 2001; Wentura, Voss, & Rothermund, 2009). Among others, Rothermund, Gast, and Wentura (2011) found an incongruent effect of motivational manipulation on the detection of valent stimuli in a visual search task by replicating previous studies that point to an affective motivational counter-regulation (e.g., De Lange & van Knippenberg, 2007; Rothermund et al., 2008; Sassenberg, Sassenrath, & Fetterman, 2014; Schwager & Rothermund, 2013b; Wentura et al., 2009). Furthermore, Schwager and Rothermund (2013a, 2014) investigated whether counter-regulation in affective processing is triggered by emotions and found out that emotional states have an incongruent effect on attention for valent stimuli as well.

In sum, our two experimental studies yielded two main insights. First, we quantified the different maximum extents of subjects' spherical attentional foci along the horizontal, vertical, and diagonal meridians as a function of regulatory focus cues. The maximum size of subjects' attentional foci decreased by 10% in subjects with a situational promotion focus as compared to those with a situational prevention focus. Promotion-oriented subjects recognised peripheral stimuli with great separation (>20°–40° of visual angle) with 10% more accuracy, while subjects with a prevention state recognised stimuli located near to the fixation cross (5°–20° of visual angle) with 8% more accuracy than promotion-focused subjects. Second, we quantified differences between subjects regarding their distribution of attention as a function of mood manipulation. The maximum attentional focus increased by 22% when listening to happy music and decreased by 36% when listening to melancholic music. In conclusion, it may be maintained that the distribution of subjects' visual attention can be changed by both, manipulations of motivational orientations and mood states.

Manuscript received 24 February 2014
Revised manuscript received 29 April 2014
Manuscript accepted 30 April 2014
First published online 27 May 2014

REFERENCES

Ball, K., & Owsley, C. (1992). The useful field of view test: A new technique for evaluating age-related declines in visual function. *Journal of the American Optometric Association*, *63*, 71–79.

Basso, M. R., Schefft, B. K., Ris, M. D., & Dember, W. N. (1996). Mood and global-local visual processing. *Journal of the International Neuropsychological Society*, *2*, 249–255. doi:10.1017/S1355617700001193

Bless, H., Bohner, G., Schwarz, N., & Strack, F. (1990). Mood and persuasion: A cognitive response analysis. *Personality and Social Psychology Bulletin*, *16*, 331–345. doi:10.1177/0146167290162013

Brandtstädter, J., & Rothermund, K. (2002). Intentional self-development: Exploring the interfaces between development, intentionality, and the self. In L. J. Crockett (Ed.), *Agency, motivation, and the life course: Nebraska symposium on motivation* (pp. 31–75). Lincoln, NE: University of Nebraska Press.

Carver, C. S., & Scheier, M. F. (1990). Origins and functions of positive and negative affect: A control-process view. *Psychological Review*, *97*(1), 19–35. doi:10.1037/0033-295X.97.1.19

De Dreu, C. K. W., Baas, M., & Nijstad, B. A. (2008). Hedonic tone and activation level in the mood–creativity link: Toward a dual pathway to creativity model. *Journal of Personality and Social Psychology*, *94*, 739–756. doi:10.1037/0022-3514.94.5.739

De Lange, M. A., & van Knippenberg, A. (2007). Going against the grain: Regulatory focus and interference by task-irrelevant information. *Experimental Psychology*, *54*(1), 6–13. doi:10.1027/1618-3169.54.1.6

Derryberry, D. (1993). Attentional consequences of outcome-related motivational states: Congruent, incongruent, and focusing effects. *Motivation and Emotion*, *17*(2), 65–89. doi:10.1007/BF00995186

Derryberry, D., & Reed, M. A. (1998). Anxiety and attentional focusing: Trait, state and hemispheric influences. *Personality and Individual Differences*, *25*, 745–761. doi:10.1016/S0191-8869(98)00117-2

Derryberry, D., & Tucker, D. M. (1994). Motivating the focus of attention. In P. M. Niedenthal & S. Kitayama (Eds.), *The heart's eye* (pp. 167–196). Diego, CA: Academic Press.

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitude*. Orlando, FL: Harcourt Brace Jovanovich.

Easterbrook, J. A. (1959). The effect of emotion on cue utilization and the organization of behavior. *Psychological Review*, *66*, 183–201. doi:10.1037/h0047707

Eifert, G. H., Craill, L., Carey, E., & O'Connor, C. (1988). Affect modification through evaluative conditioning with music. *Behaviour Research and Therapy*, *26*, 321–330. doi:10.1016/0005-7967(88)90084-8

Ellenbogen, M. A., Schwartzman, A. E., Stewart, J., & Walker, C.-D. (2002). Stress and selective attention: The interplay of mood, cortisol levels, and emotional information processing. *Psychophysiology*, *39*, 723–732. doi:10.1111/1469-8986.3960723

Elliot, A. J., & Harackiewicz, J. M. (1996). Approach and avoidance achievement goals and intrinsic motivation: A mediational analysis. *Journal of Personality and Social Psychology*, *70*, 461–475. doi:10.1037/0022-3514.70.3.461

Engelmann, J. B., Damaraju E., Padmala S., & Pessoa L. (2009). Combined effects of attention and motivation on visual task performance: Transient and sustained motivational effects. *Frontiers in Human Neuroscience*, *3*, 4. doi:10.3389/neuro.09.004.2009

Engelmann, J. B., & Pessoa L. (2007). Motivation sharpens exogenous spatial attention. *Emotion*, *7*, 668–674. doi:10.1037/1528-3542.7.3.668

Förster, J. (2012). GLOMO sys: The how and why of global and local processing. *Current Directions in Psychological Science*, *21*(1), 15–19. doi:10.1177/0963721411429454

Förster, J., Friedman, R. S., Özelsel, A., & Denzler, M. (2006). Enactment of approach and avoidance behavior influences the scope of perceptual and conceptual attention. *Journal of Experimental Social Psychology*, *42*(2), 133–146. doi:10.1016/j.jesp.2005.02.004

Förster, J., & Higgins, E. T. (2005). How global versus local perception fits regulatory focus. *Psychological Science*, *16*, 631–636. doi:10.1111/j.1467-9280.2005.01586.x

Förster, J., Higgins, E. T., & Taylor Bianco, A. (2003). Speed/accuracy in performance: Tradeoff in decision making or separate strategic concerns? *Organizational Behavior and Human Decision Processes*, *90*, 148–164. doi:10.1016/S0749-5978(02)00509-5

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist*, *56*, 218–226. doi:10.1037/0003-066X.56.3.218

Fredrickson, B. L. (2003). The value of positive emotions. *American Scientist*, *91*, 330–335. doi:10.1511/2003.4.330

Friedman, R. S., Fishbach, A., Förster, J., & Werth, L. (2003). Attentional priming effects on creativity. *Creativity Research Journal*, *15*, 277–286. doi:10.1080/10400419.2003.9651420

Friedman, R. S., & Förster, J. (2000). The effects of approach and avoidance motor actions on the elements of creative insight. *Journal of Personality and Social Psychology*, *79*, 477–492. doi:10.1037/0022-3514.79.4.477

Friedman, R. S., & Förster, J. (2001). The effects of promotion and prevention cues on creativity. *Journal of Personality and Social Psychology*, *81*, 1001–1013. doi:10.1037/0022-3514.81.6.1001

Friedman, R. S., & Förster, J. (2005). The influence of approach and avoidance cues on attentional flexibility. *Motivation and Emotion*, *29*(2), 69–81. doi:10.1007/s11031-005-7954-4

Friedman, R. S., & Förster, J. (2008). Activation and measurement of motivational states. In A. Elliott (Ed.), *Handbook of approach and avoidance motivation* (pp. 235–246). Mahwah, NJ: Lawrence Erlbaum Associates.

Gasper, K. (2004). Do you see what I see? Affect and visual information processing. *Cognition and Emotion*, *18*, 405–421. doi:10.1080/02699930341000068

Gasper, K., & Clore, G. L. (2002). Attending to the big picture: Mood and global versus local processing of visual information. *Psychological Science*, *13*(1), 34–40. doi:10.1111/1467-9280.00406

Green, J. D., Sedikides, C., Saltzberg, J. A., Wood, J. V., & Forzano, L. B. (2003). Happy mood decreases self-focused attention. *British Journal of Social Psychology*, *42*, 147–157. doi:10.1348/014466603763276171

Higgins, E. T. (1997). Beyond pleasure and pain. *American Psychologist*, *52*, 1280–1300. doi:10.1037/0003-066X.52.12.1280

Higgins, E. T. (2002). How self-regulation creates distinct values: The case of promotion and prevention decision making. *Journal of Consumer Psychology*, *12*, 177–191. doi:10.1207/S15327663JCP1203_01

Higgins, T., & Tykocinski, O. (1992). Self-discrepancies and biographical memory: Personality and cognition at the level of psychological situation. *Personality & Social Psychology Bulletin*, *18*, 527–535. doi:10.1177/0146167292185002

Huntsinger, J. R. (2013). Narrowing down to the automatically activated attitude: A narrow conceptual scope improves correspondence between implicitly and explicitly measured attitudes. *Journal of Experimental Social Psychology*, *49*(1), 132–137. doi:10.1016/j.jesp.2012.07.018

Hüttermann, S., Memmert, D., & Simons, D. J. (2014). The size and shape of the attentional "spotlight" varies with differences in sports expertise. *Journal of Experimental Psychology: Applied*. doi:10.1037/xap0000012

Hüttermann, S., Memmert, D., Simons, D. J., & Bock, O. (2013). Fixation strategy influences the ability to focus attention on two spatially separate objects. *PLoS ONE*, *8*(6), e65673. doi:10.1371/journal.pone.0065673.t003

Kuhl, J. (2000). A functional-design approach to motivation and self-regulation: The dynamics of personality systems interactions. In M. Boekaerts, P. R. Pintrich, and M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 111–169). San Diego, CA: Academic Press.

Lee, R. K., & Maier, S. F. (1988). Inescapable shock and attention to internal versus external cues in a water discrimination escape task. *Journal of Experimental Psychology Animal Behavior Processes*, *14*, 302–310. doi:10.1037/0097-7403.14.3.302

Liberman, N., & Trope, Y. (1998). The role of feasibility and desirability considerations in near and distant future decisions: A test of temporal construal theory. *Journal of Personality and Social Psychology*, *75*(1), 5–18. doi:10.1037/0022-3514.75.1.5

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, *95*(1), 15–20. doi:10.1037/0021-843X.95.1.15

Markman, A. B., Baldwin, G. C., & Maddox, W. T. (2005). The interaction of payoff structure and regulatory focus in classification. *Psychological Science*, *16*, 852–855. doi:10.1111/j.1467-9280.2005.01625.x

Rauscher, F. H., Shaw, G. L., & Ky, C. N. (1993). Music and spatial task performance. *Nature*, *365*, 611. doi:10.1038/365611a0

Reed, P., & Antonova, M. (2007). Interference with judgments of control and attentional shift as a result of prior exposure to controllable and uncontrollable feedback. *Learning and Motivation*, *38*, 229–241. doi:10.1016/j.lmot.2006.08.005

Reed, M. B., & Aspinwall, L. G. (1998). Self-affirmation reduces biased processing of health-risk information. *Motivation and Emotion*, *22*(2), 99–132. doi:10.1023/A:1021463221281

Roese, N. J., Hur, T., & Pennington, G. L. (1999). Counterfactual thinking and regulatory focus: Implications for action versus inaction and sufficiency versus necessity. *Journal of Personality and Social Psychology*, *77*, 1109–1120. doi:10.1037/0022-3514.77.6.1109

Rothermund, K. (2003). Motivation and attention: Incongruent effects of feedback on the processing of valence. *Emotion*, *3*, 223–238. doi:10.1037/1528-3542.3.3.223

Rothermund, K., Gast, A., & Wentura, D. (2011). Incongruency effects in affective processing: Automatic motivational counter-regulation or mismatch-induced salience? *Cognition and Emotion*, *25*, 413–425. doi:10.1080/02699931.2010.537075

Rothermund, K., Voss, A., & Wentura, D. (2008). Counter-regulation in affective attentional biases: A basic mechanism that warrants flexibility in emotion and motivation. *Emotion*, *8*(1), 34–46. doi:10.1037/1528-3542.8.1.34

Rothermund, K., Wentura, D., & Bak, P. M. (2001). Automatic attention to stimuli signaling chances and dangers: Moderating effects of positive and negative goal and action contexts. *Cognition and Emotion*, *15*, 231–248. doi:10.1080/02699930126213

Rowe, G., Hirsh, J. B., & Anderson, A. K. (2007). Positive affect increases the breadth of attentional selection. *Proceedings of the National Academy of Sciences of the United States of America*, *104*, 383–388. doi:10.1073/pnas.0605198104

Sassenberg, K., Sassenrath, C., & Fetterman, A. (2014). Threat ≠ prevention, challenge ≠ promotion: The impact of threat, challenge, and regulatory focus on attention to negative stimuli. *Cognition and Emotion*, 1–8. doi:10.1080/02699931.2014.898612

Schneider, W., Dumais, S. T., & Shiffrin, R. M. (1984). Automatic and control processing and attention. In R. Parasuraman & D. R. Davies (Eds.), *Varieties of attention* (pp. 1–27). Orlando, FL: Academic Press.

Schwager, S., & Rothermund, K. (2013a). Counter-regulation triggered by emotions: Positive/negative affective states elicit opposite valence biases in affective processing. *Cognition and Emotion*, *27*, 839–855. doi:10.1080/02699931.2012.750599

Schwager, S., & Rothermund, K. (2013b). Motivation and affective processing biases in risky decision-making: A counter-regulation account. *Journal of Economic Psychology*, *38*, 111–126. doi:10.1016/j.joep.2012.08.005

Schwager, S., & Rothermund, K. (2014). On the dynamics of implicit emotion regulation: From counter-regulation to stabilization. *Cognition and Emotion*. doi:10.1080/02699931.2013.866074

Seibt, B., & Förster, J. (2004). Stereotype threat and performance: How self-stereotypes influence processing by inducing regulatory foci. *Journal of Personality and Social Psychology*, *87*(1), 38–56. doi:10.1037/0022-3514.87.1.38

Seifert, J., Hewig, J., Hagemann, D., Naumann, E., & Bartussek, D. (2006). Motivated executive attention – incentives and the noise-compatibility effect. *Biological Psychology*, *71*(1), 80–89. doi:10.1016/j.biopsycho.2005.03.001

Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending, and a general theory. *Psychological Review*, *84*, 127–190. doi:10.1037/0033-295X.84.2.127

Small, D. M., Gitelman, D., Simmons, K., Bloise, S. M., Parrish, T., & Mesulam, M.-M. (2005). Monetary incentives enhance processing in brain regions mediating top-down control of attention. *Cerebral Cortex*, *15*, 1855–1865. doi:10.1093/cercor/bhi063

Trippe, R. H., Hewig, J., Heydel, C., Hecht, H., & Miltner, W. H. R. (2007). Attentional blink to emotional and threatening pictures in spider phobics: Electrophysiology and behavior. *Brain Research*, *1148*, 149–160. doi:10.1016/j.brainres.2007.02.035

Vida, M. D., & Maurer, D. (2012). Gradual improvement in fine-grained sensitivity to triadic gaze after 6 years of age. *Journal of Experimental Child Psychology*, *112*, 243–256. doi:10.1016/j.jecp.2012.02.002

Wentura, D., Voss, A., & Rothermund, K. (2009). Playing TETRIS for science: Counter-regulatory affective processing in a motivationally "hot" context. *Acta Psychologica*, *131*, 171–177. doi:10.1016/j.actpsy.2009.05.008

Wood, J. V., Saltzberg, J. A., & Goldsamt, L. A. (1990). Does affect induce self-focused attention? *Journal of Personality and Social Psychology*, *58*, 899–908. doi:10.1037/0022-3514.58.5.899