Please cite this article as: Moriya, H., & Nittono, H. (2010, February). *Influence of mood state on the spatial gradient of visual attention*. Paper presented at the Third International Workshop on Kansei, Fukuoka, Japan (Proceedings, pp. 239–242).

Influence of Mood State on the Spatial Gradient of Visual Attention

Hiroki Moriya and Hiroshi Nittono

Graduate School of Integrated Arts and Sciences, Hiroshima University, Higashi-Hiroshima 739-8521, Japan
E-mail: moriyah@hiroshima-u.ac.jp

Abstract

The present study examined how positive and negative mood states influence the gradient of visual attention. Eighteen students performed a flanker task after viewing neutral, positive or negative affective pictures. The spacing between the target and the flanker letters was manipulated to be near (0.5°) or far (1.5°). Participants were asked to respond to the central target letter (*H* or *S*) by pressing the left or right button. Subjective ratings showed that positive and negative affective pictures induced positive and negative mood states, respectively. Reaction times (RTs) were longer when the flanker letters were incompatible with the target letter than when they were compatible. This flanker compatibility effect (calculated as incompatible RT – compatible RT) varied with the target–flanker distance and mood. The flanker compatibility effect was smaller for the far flankers than for the near flankers in the neutral and negative mood sessions. However, this effect was not observed in the positive mood session. These results suggest that the gradient of spatial attention may become shallower in positive mood state as compared to neutral and negative mood states.

Key words: *Positive mood, Negative mood, Interference, Flanker task*

Introduction

Mood states influence our daily behavior by changing the focus of attention. Several studies suggest that positive mood broadens the focus of visual attention, whereas negative mood narrows the focus of visual attention (Fredrickson & Branigan, 2005; Gasper & Clore 2002; Rowe, Hirsh, & Anderson, 2007). Rowe et al. (2007) examined the influence of positive mood on the spatial breadth of attention using a flanker task (Eriksen & Eriksen, 1974). In their study, happy and sad moods were induced by music being softly played during the task. During the flanker task, the central target letter was flanked by letters presented at near, middle, or far distance positions. The flanker compatibility effect was calculated by subtracting the median reaction time (RT) in response to target stimuli with compatible flankers from the median RT in response to target stimuli with incompatible flankers. Results indicated that there was a larger interference from distracters presented at far distance positions in positive mood than in neutral and sad moods. They concluded that positive mood induced by music broadened the focus of attention.

In this study, we attempted to replicate the effect of mood on the focus of visual attention by using a different mood inducing method. The change in the size of attentional focus is assumed to be accompanied by a change in the spatial gradient of attentional resources (Eriksen & St. James, 1986; Mattler, 2006). In this view, when the focus of visual attention is broader, the spatial gradient of visual attentional resources becomes shallower. To examine changes in the spatial gradient of attention accompanying positive and negative moods, we manipulated the spacing between the target letter and flanker letters presented in the flanker task to be near or far. We compared the flanker compatibility effect of the near flankers and that of the far flankers as an index of the spatial gradient of attention. If the spatial gradient of attention is shallower under positive mood, the flanker compatibility effect would be similar in size between the near and far flankers.

Methods

Participants

Eighteen university students participated in the study (nine men and nine women, M = 21.7 yeas old). All participants were right-handed and had normal or corrected-to-normal vision, according to self-reports. They gave written informed consent.

Stimuli and Task

In the flanker task, five horizontally aligned capital letters (*H* or *S*) were presented. Each letter was black and subtended approximately 0.5° × 0.5° of the visual angle. A central fixation cross (+) subtending about 0.35° was presented throughout the flanker task. In compatible trials (67%), the same letters were presented (e.g., HHHHH). In incompatible trials (33%), only the central letter was different from the other letters (e.g., HHSHH). The spacing between the adjacent letters was manipulated to be near (with a center-to-center spacing of 0.5°) or far (with a center-to-center spacing of 1.5°). In most of the flanker task trials (80%), a white flash was presented at one of four positions in the background (probe-present trial), but these trials were excluded from analysis in this study. Flanker task stimuli were presented 0.7° above the fixation cross for 100 ms. Stimulus onset asynchrony varied between 950 and 1,100 ms (M = 1,025 ms). All stimuli were presented on the gray screen of a 21-inch cathode ray tube display. The viewing distance was 60 cm.

Mood Induction

To induce moods, we selected 30 neutral, 30 positive, and 30 negative affective pictures from the International Affective Picture System (IAPS: Lang, Bradley, and Cuthbert, 2005) according to normative valence and arousal scores. Pictures used in this study were selected from picture sets used in the previous study (Sugimoto, Nittono, & Hori, 2007). Mean (standard deviation) normative valence and arousal scores of each picture set were as follows, neutral: 5.04 (0.19), 2.72 (0.36); positive: 7.17 (0.45), 5.20 (0.43); and negative: 3.16 (0.49), 5.11 (0.46). Each picture subtended approximately 12° × 16° of the visual angle and presented in the center of the display in full color.

Procedure

There were neutral, positive, and negative mood sessions in the experiment. In each session, participants performed 30 blocks of 30 trials of the flanker task. At the beginning of each trial block, an affective picture was presented for 5,000 ms, followed by the central fixation cross. Participants were asked to watch the picture and not to suppress the mood that was induced by the picture. The flanker task started 500 ms after the offset of affective picture. Participants were instructed to identify the central letter by pressing the left or right hand button assigned to each letter with the left or right index finger as quickly and accurately as possible. The target–flanker spacing was manipulated between blocks. Participants performed 15 far-flanker blocks and 15 near-flanker blocks in each session. In each block, 4 compatible, 2 incompatible, and 24 probe-present trials were presented in random order.

At the beginning and end of each mood session, participants rated their mood and arousal in the Affect Grid (Russel, Weiss, & Mendelsohn, 1989) by checking the cell in the 9 (1 = *unpleasant* to 9 = *pleasant*) × 9 (1 = *sleepy* to 9 = *aroused*) grid that best represented their current state. To avoid carrying over a previously induced mood to the next session, participants took a 10 minute break after each mood session. The order of the mood sessions, the order of target–flanker spacing blocks, and the assignment of response hands to the letters were counterbalanced across participants.

Data Analysis

Reaction times (RTs) in response to flanker stimuli were calculated for each mood, flanker compatibility, and target–flanker spacing conditions. Responses earlier than 150 ms and later than 850 ms were excluded from analysis. Repeated measures analyses of variance (ANOVAs) were performed on the data. Whenever appropriate, the degrees of freedom were corrected using the Greenhouse-Geisser epsilon. Mood (neutral, positive, and negative) × Time (before and after the mood session) ANOVAs were performed on the valence and arousal scores of the Affect Grid. A Mood (neutral, positive, and negative) × Flanker compatibility (compatible and incompatible) × Spacing (far and near) ANOVA was performed on RTs. Post hoc comparison was made by paired t tests with the Bonferroni correction.

Results

Subjective Mood Rating

Table 1 shows mean valence and arousal scores at the beginning and the end of each mood session. A Mood × Time ANOVA on valence score showed a main effect of mood, $F(2, 34) = 23.42$, $p < .001$, $\eta_p^2 = .58$, and time, $F(1, 17) = 41.30$, $p < .001$, $\eta_p^2 = .72$. The interaction effect was also significant, $F(2, 34) = 21.02$, $p < .001$, $\varepsilon = .69$, $\eta_p^2 = .55$. The simple main effect of mood was significant only at the end of the session, $F(2, 34) = 35.70$, $p < .001$, $\eta_p^2 = .68$. Post hoc comparison showed that valence scores differed significantly between the three moods, all *ps* < .001. A two-way ANOVA on arousal score revealed an effect of time, $F(1, 17) = 23.82$, $p < .001$, $\eta_p^2 = .58$. Neither the main effect of mood nor the interaction between mood and time was significant, *Fs* < 1. These results indicate that presentation of neutral, positive, and negative affective pictures induced neutral, positive, and negative moods, respectively, without arousal differences.

Flanker Task Performance

Table 2 shows the mean RTs in response to flanker stimuli in each mood session. A Mood × Flanker compatibility × Spacing ANOVA showed a marginal main effect of mood, $F(2, 34) = 2.84$, $p < .10$, $\eta_p^2 = .14$. Main effects of spacing and compatibility were significant, $F(1, 17) = 138.07$, $p < .001$, $\eta_p^2 = .89$; $F(1, 17) = 78.96$, $p < .001$, $\eta_p^2 = .82$, respectively. The interaction between spacing and flanker compatibility was also significant, $F(1, 17) = 14.78$, $p < .005$, $\eta_p^2 = .47$. The flanker compatibility effect (calculated as incompatible RT – compatible RT) was larger for the near flankers (27 ms) than for the far flankers (14 ms).

Table 1

Means ± standard deviations of the valence and arousal scores in the Affect Grid before and after the neutral, positive, and negative mood sessions

		Neutral	Positive	Negative
Valence	Before	5.8 ± 1.0	5.7 ± 1.0	5.8 ± 1.0
	After	4.8 ± 1.2	6.0 ± 1.1	3.0 ± 1.1
Arousal	Before	6.1 ± 1.8	6.0 ± 1.3	6.2 ± 1.5
	After	4.6 ± 1.4	5.2 ± 1.7	4.9 ± 2.1

Table 2

Means ± standard deviations of reaction time for flanker task stimuli in each condition

	Near		Far	
	Compatible	Incompatible	Compatible	Incompatible
Neutral	385 ± 42	415 ± 44	363 ± 38	378 ± 48
Positive	381 ± 37	400 ± 38	360 ± 34	372 ± 43
Negative	383 ± 37	415 ± 37	369 ± 37	385 ± 40

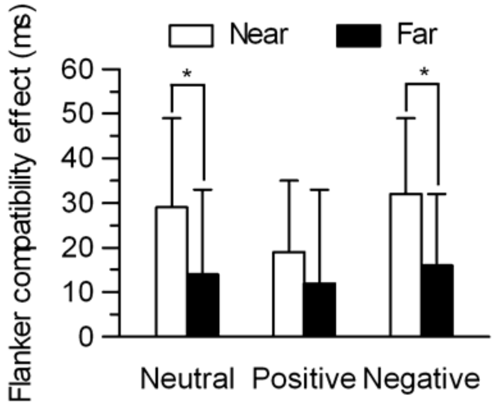

Figure 1. The flanker compatibility effects of the near and far flankers in each mood session. Error bars indicate standard deviations. *$p < .001$.

However, the interaction between mood, flanker compatibility, and spacing was not significant.

Figure 1 shows the flanker compatibility effects of the near and far flankers in each mood session. In order to test whether the flanker compatibility effects differed between the near and far spacing flankers in each mood session, we performed further separate ANOVAs on RTs with factors of flanker compatibility (compatible and incompatible) and spacing (far and near) for each of the neutral, positive, and negative mood sessions. In the neutral and negative mood sessions, the interactions between compatibility and spacing were significant, neutral: $F(1, 17) = 9.93$, $p < .01$, $\eta_p^2 = .37$; negative: $F(1, 17) = 16.25$, $p < .001$, $\eta_p^2 = .49$. The flanker compatibility effect was significantly larger for near flankers than for far flankers, neutral: $t(17) = 3.11$, $p < .01$; negative: $t(17) = 3.99$, $p < .001$. In contrast, in the positive mood session, the interaction between flanker compatibility and spacing was not significant, $F(1, 17) = 1.35$, $p > .20$, $\eta_p^2 = .07$.

Discussion

According to the subjective rating, viewing the positive and negative affective pictures effectively induced participants' positive and negative mood states, respectively. Importantly, arousal did not differ between different mood sessions. This result indicates that RT differences in the flanker task between mood sessions are due to differences in mood state, rather than in arousal.

Under positive mood state, compared to neutral and negative mood states, flanker distracters located at the two different distances similarly interfered the processing of the central target. This suggests that the spatial gradient of visual attention became shallower under positive mood state. This finding partly supports the previous finding that positive mood broadens the focus of attention (Fredrickson & Branigan, 2005; Gasper & Clore 2002; Rowe et al., 2007).

In the present study, the influence of mood state on the flanker compatibility effect was not statistically significant. This may be due to weaker positive and negative mood states compared to previous studies. Mood induction by presenting affective pictures before the task might induce weaker mood states during the task, as compared with other methods used in previous studies, such as playing music throughout the task. Although the evidence was weak, the present finding agrees with the idea that the spatial gradient of visual attention is shallower under positive mood state. Further research is required to examine the detailed mechanisms of the effect of mood on the focus of attention by manipulating the strength of mood states.

Appendix

The IAPS slide numbers used in this study were as follows: neutral: 2880, 5510, 5530, 5740, 6150, 7000, 7002, 7004, 7006, 7009, 7020, 7030, 7034, 7035, 7050, 7080, 7090, 7100, 7150, 7170, 7185, 7187, 7217, 7233, 7235, 7491, 7500, 7705, 7710, and 7950; positive: 1463, 1590, 1720, 1722, 1999, 2058, 2209, 2216, 2655, 4598, 5480, 5600, 5623, 5628, 5849, 5910, 7220, 7230, 7260, 7270, 7282, 7330, 7470, 7480, 7481, 7502, 8031, 8120, 8460, and 8496; negative: 1220, 1270, 1275, 1301, 2110, 2205, 2682, 2692, 2700, 2900, 6190, 6213, 6241, 6610, 6940, 7360, 9102, 9290, 9340, 9404, 9470, 9530, 9584, 9592, 9611, 9621, 9830, 9911, 9912, and 9920.

References

Eriksen, B. A., & Eriksen, C. W. (1974). Effect of noise letters upon the identification of a target letter in a nonsearch task. *Perception and Psychophysics*, **16**, 143–149.

Eriksen, C. W., & St. James, J. D. (1986). Visual attention within and around the field of focal attention: A zoom lens model. *Perception and Psychophysics*, **40**, 225–240.

Fredrikson, B. L., & Branigan, C. (2005). Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition and Emotion*, **19**, 313–332.

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

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2005). *International Affective Picture System (IAPS): Digitized photographs, instruction manual and affective ratings*. Technical report A-6, University of Florida, Gainsville, FL.

Mattler, U. (2006). Distance and ratio effects in the flanker task are due to different mechanisms. *The Quarterly Journal of Experimental Psychology*, **59**, 1745–1763.

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

Russel, J. A., Weiss, A., & Mendersohn, G., A. (1989). Affect Grid: A single-item scale of pleasure and arousal. *Journal of Personality and Social Psychology*, **57**, 493–502.

Sugimoto, S., Nittono, H., & Hori, T. (2007). Visual emotional context modulates brain potentials elicited by unattended tones. *International Journal of Psychophysiology*, **66**, 1–9.