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\*Corresponding author: Shouxin Li,  
Department of Psychology, Shandong  
Normal University, Shandong Province,  
250014 Jinan, P. R. China  
E-mail: [shouxinli@sdu.edu.cn](mailto:shouxinli@sdu.edu.cn)

Reviewing editor:  
Peter Walla, University of Newcastle,  
Australia

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the end of the article

## COGNITIVE SCIENCE & NEUROSCIENCE | SHORT COMMUNICATION

# The effect of negative affects varying in motivational intensity on attentional flexibility

Yuanguang Ma<sup>1</sup> and Shouxin Li<sup>2\*</sup>

**Abstract:** Many studies have found that negative affect decreased attentional flexibility. But the motivational dimensional model of affect proposed that negative affect high in motivational intensity narrows attentional focus, whereas negative affect low in motivational intensity broadens attentional focus. The aim of the present study was to examine the relationship between negative affective states varying in motivational intensity and attentional flexibility. Experiment 1 compared the attentional consequences of negative affect low in motivational intensity (sadness) relative to a high-motivation negative affect (disgust). Results indicated that low-motivation negative affect increased attentional flexibility on a covert attentional orienting task. Experiment 2 compared the attentional consequences of negative affect low in motivational intensity (sadness) relative to a neutral affective state and found that the low-motivation negative affect (sadness) relative to the neutral affective state increased attentional flexibility. These experiments support the motivational dimensional model of affect.

**Subjects:** Education; Health and Social Care; Information Science

**Keywords:** motivation; attentional flexibility; affect; sadness; disgust

### 1. Introduction

The interaction of cognition and affect is an important aspect in psychology now. And a central question in the interaction is the effect of affect states on attentional processing. Many studies have



Yuanguang Ma

### ABOUT THE AUTHOR

Yuanguang Ma graduated from Shandong Normal University and obtained a doctorate in psychology in 2013. He is working in the Department of Education of Binzhou University in China now. He always has broad interests in many aspects of psychology. To date, he has mainly worked in two areas of studies: students mental health, emotion, and cognition. This perspective article, which describes the effect of negative affects varying in motivational intensity on attentional flexibility, belongs to the area of emotion and cognition.

### PUBLIC INTEREST STATEMENT

The traditional view is that negative affect always has a negative impact on people's cognition. For example, when one person is angry, disgusted, depression, or sad, he (she) is unwilling to learn, and the memory effect is poor. Is this really the case? This perspective article describes the effect of negative affects varying in motivational intensity on attentional flexibility, based on data gathered via two experiments. It was found that the relationship between negative affect and attentional flexibility is more complex, low and high motivationally intense negative affective states produce different effects on attentional consequence. Negative affect low in motivational intensity increases attentional flexibility, whereas negative affect high in motivational intensity decreases attentional flexibility. Understanding these effects can remind us to keep in motivational intensity low when we are in a negative affect.

showed that negative affective states and traits have been linked to decreased attentional flexibility (Compton, 2000; Derryberry & Reed, 2001).

Attentional flexibility is defined as the ability to adaptably shift focus among cognitive operations using executive control (Posner, 1982). Several researches using different attentional task have examined the relationship between negative affect states and attentional flexibility (Compton, 2000; Compton, Wirtz, Pajoumand, Claus, & Heller, 2004; Hu, Bauer, Padmala, & Pessoa, 2012; Kuhl & Kazén, 1999). In Kuhl and Kazén (1999)'s study, participants were experimentally induced into positive or negative affective states by affective words, then administered a Stroop task, and discovered that Stroop interference was significantly increased in participants in negative, relative to positive, affective states. Hu et al. (2012) used threat of bodily harm preceding a color-word Stroop task to test the effect of negative affect on attentional flexibility, and found a basic effect of threat consisting of a slowing down of performance during neutral Stroop trials. Several studies found that negative affect has been linked to decreased ability to shift attentional focus during orienting tasks (Compton, 2000), and that decreased attentional flexibility is particularly associated with reduced levels of positive affect (Compton et al., 2004).

However, it is important to note that not all forms of negative affect lead to the same attentional consequence. Gable and Harmon-Jones' motivational dimensional model of affect proposed that negative affect high in motivational intensity narrows attentional focus, whereas negative affect low in motivational intensity broadens attentional focus (Gable & Harmon-Jones, 2010b). Does the motivational intensity of negative affective states also play a role in how negative affect influences attentional flexibility? To our knowledge, there are no prior studies. Therefore, the aim of the present study was to examine the relationship between negative affective states varying in motivational intensity and attentional flexibility.

In the present study, on the basis of the motivational dimensional model of affect, we predicted that negative affects low in motivational intensity would increase attentional flexibility, whereas negative affects high in motivational intensity would decrease attentional flexibility.

Experiment 1 focused on comparing sadness with disgust. Because Friedman and Förster (2011) proposed one limitation of the studies of Gable and Harmon-Jones is that the overwhelming majority of the studies were not properly structured to assess their predictions, inasmuch as they failed to manipulate high vs. low motivation affective states in the same design. And negative affect varies in motivational intensity, with some being higher in motivational intensity (e.g. disgust, fear) and others being lower in motivational intensity (e.g. sadness) (Gable & Harmon-Jones, 2010a).

Experiment 2 focused on comparing sadness with neutral affect. Some studies indicated that individuals with depression tend to be more creative than average (Ludwig, 1994). These results suggest that negative affects low in motivational intensity may increase attentional flexibility much as positive affects low in motivational intensity do. However, no direct tests of this hypothesis have been performed.

In both experiments, attentional flexibility was measured with a covert attentional orienting task (modeled after the task used by Johnson, Waugh, & Fredrickson, 2010). Participants were asked to detect the appearance of a peripheral target while fixating on a central point in the task. Usually, the target was preceded by a cue that either appears in the same location (valid cue) or in a different location (invalid cue) as the target. High performance on this attentional orienting task required an ability to flexibly shift attention to valid cues while being able to divert attention away from invalid cues.

## 2. Experiment 1

### 2.1. Method

#### 2.1.1. Participants

Forty-two right-handed participants (22 females and 20 males; mean age = 20.00 years) were recruited from the Shandong Normal University and were paid five yuan for their participation. All reported normal or corrected-to-normal color vision. Participants were randomly assigned to one of the two-mood induction conditions.

#### 2.1.2. Materials

Two hundred forty color photographs collected from the Internet and the International Affective Picture System (Lang, Bradley, & Cuthbert, 2005). Half of the photographs were selected because they were likely to evoke disgust; the other half were unpleasant, low in arousal, and selected because they were likely to evoke sadness. The disgusting pictures were matched with the sad pictures for color, brightness, and object size. Each photograph was used twice in the experiment.

#### 2.1.3. Self-assessment manikin

Participants used the self-assessment manikin (Bradley & Lang, 1994) to indicate their pleasure (1 = very unpleasant, 9 = very pleasant) and arousal (1 = calm, 9 = excited). They also rated how disgusted and sad the picture made them feel (1 = no emotion, 9 = strongest feeling) (Gable & Harmon-Jones, 2010a).

#### 2.1.4. Covert attentional orienting task

Originally developed by Posner (1980), the attentional orienting task was modeled after Johnson et al. (2010). The computer monitor was positioned approximately 80 cm from the participant. Reaction times were recorded with a stimulus–response box. During the task, three boxes were displayed, a central box containing a fixation cross and boxes positioned 10° to the left and right of fixation. Each box subtended approximately a 1.3° × 1.3° area of visual angle.

Participants' primary task was to press a central key on the keyboard as soon as they detected a target inside one of the lateral boxes. The target was a small solid black box (0.9° × 0.9°). On uncued trials, the target simply appeared in one of the lateral boxes. On cued trials, one of the lateral boxes became bold for 250 ms, which signaled that the target would appear inside one of the lateral boxes moments later. The target remained on the screen until a keypress or disappeared after 1000 ms. A stimulus onset asynchrony (SOA) of either 100 or 500 ms separated the cue and the target. On valid cue trials, the target appeared in the same location as the cue, whereas on invalid cue trials the target appeared in the other lateral box. The orienting task had 200 trials, of which, one-third (66 trials) were uncued. Within cued trials, one-third used invalid cues (44 trials) and two-thirds used valid cues (90 trials). Interspersed throughout were 20 “catch” trials, in which a cue was given without an accompanying target. Additionally, interspersed throughout were 20 fixation-check trials, in which a number between 1 and 9 was displayed for 50 ms at the fixation point. Participants were required to report the number aloud. With “catch” trials and fixation checks, the attentional orienting task was 240 total trials. A 500-ms delay separated each trial.

#### 2.1.5. Procedure

At the start of the experimental session, participants completed a survey of demographic information. Then the experimenter instructed participants on the covert attentional orienting task. Participants were allowed to practice until they felt prepared to begin the task. After the practice trials, participants saw the picture and completed the attentional orienting task. Each experimen-

tal trial began with a picture which appeared for 1,000 ms and then the attentional orienting task was displayed. Lastly, participants saw the pictures again and completed the self-assessment manikin.

## 2.2. Results

### 2.2.1. Self-assessment manikin

For the picture ratings, sad pictures were similar in valence (Mean = 2.25, SD = 0.61) and arousal (Mean = 4.25, SD = 1.79) to disgusting pictures (Mean = 2.50, SD = 0.53, and Mean = 5.22, SD = 1.39, respectively),  $t(21) < 1.95$ ,  $p > 0.05$ ,  $d > 0.41$ . Sad pictures (Mean = 5.38, SD = 0.89) evoked significantly more sadness than disgusting pictures (Mean = 1.85, SD = 0.38),  $t(21) = -16.70$ ,  $p < 0.0001$ ,  $d = 5.56$ . Disgusting pictures (Mean = 5.96, SD = 1.31) evoked significantly more disgust than sad pictures (Mean = 1.51, SD = 0.41),  $t(21) = 14.86$ ,  $p < 0.0001$ ,  $d = 5.17$ . These results indicate that the mood induction procedures were effective.

### 2.2.2. Covert attentional orienting task performance

Excessively fast (B100 ms) RTs were removed to eliminate fast responses due to anticipatory errors. Fewer than 1% of responses were eliminated by this procedure. Similar to Johnson et al. (2010), we were not interested in the “inhibition of return” attentional mechanism prevalent at longer SOAs, and so only responses to 100 ms SOA trials were analyzed.

Three indices of attentional performance were calculated from the valid, invalid, and uncued trial types. Attentional benefits were calculated by subtracting valid cue reaction times from uncued reaction times. Higher scores indicate relatively faster responding resulting from the attentional cue. Attentional costs were calculated by subtracting uncued reaction times from invalid cue reaction times. Higher scores indicate relatively slower responding resulting from an invalid distracter. Validity effect was calculated by subtracting valid cue reaction times from invalid cue reaction times. The validity effect is a measure of how much attentional orienting is influenced by cueing. Higher times indicate greater fixation to the cue while lower times indicate greater flexibility in shifting attention regardless of cue (Johnson et al., 2010; Posner, 1980; Posner & Petersen, 1990).

### 2.2.3. Effects of emotion induction on attentional orienting

Table 1 shows three indices of attentional performance in the two negative affect conditions. Independent sample t-tests were performed with the independent variables of negative affect (high-motivation negative affect vs. low-motivation negative affect), separately for each index of attentional orienting performance.

**Table 1. Three indices of attentional performance as a function of negative affect ( $M \pm SD$ , ms)**

	High-motivation negative affect (n = 21)	Low-motivation negative affect (n = 21)	t	p
Attention benefits	57.06 ± 26.19	57.24 ± 29.41	-0.02	0.98
Attention costs	-18.59 ± 22.88	-39.27 ± 29.89	2.52	0.02
Validity effect	38.46 ± 34.18	17.96 ± 18.84	2.41	0.02

As shown in Table 1, participants in the high-motivation negative affect group was a significantly higher attention costs relative to the low-motivation negative affect group,  $p < 0.05$ ,  $d = 0.78$ . Participants in the high-motivation negative affect group was a significantly larger validity effect relative to the low-motivation negative affect group,  $p < 0.05$ ,  $d = 0.77$ . These results indicate that the low-motivation negative affect increased attentional flexibility, whereas high-motivation negative affect decreased attentional flexibility.

### 3. Experiment 2

#### 3.1. Method

##### 3.1.1. Participants

Thirty-two university students (18 females and 14 males; mean age = 20.21 years) were recruited in the same manner as for Experiment 1. All reported normal or corrected-to-normal color vision.

##### 3.1.2. Materials

Two hundred forty color photographs collected from the Internet and the International Affective Picture System (Lang et al., 2005). Half of the photographs were selected because they were likely to evoke sadness. The other half were neutral, and matched with the unpleasant pictures for color, brightness, and object size. Each photograph was used twice in the experiment.

##### 3.1.3. Self-assessment manikin

Participants used the self-assessment manikin (Bradley & Lang, 1994) to indicate their pleasure (1 = very unpleasant, 9 = very pleasant) and arousal (1 = calm, 9 = excited). They also rated how sad the picture made them feel (1 = no emotion, 9 = strongest feeling) (Gable & Harmon-Jones, 2010a).

##### 3.1.4. Covert attentional orienting task

The same as the experiment 1.

##### 3.1.5. Procedure

We used the same method as in experiment 1, except that all participants finished the experimental trials that began with a neutral picture, and then finished the experimental trials that began with a sad picture after a 10-minute break.

#### 3.2. Results

##### 3.2.1. Self-assessment manikin

For the picture ratings, sad pictures (Mean = 2.01,  $SD = 0.42$ ) evoked significantly more unpleasant than neutral pictures (Mean = 4.28,  $SD = 0.91$ ),  $t(32) = 14.50$ ,  $p < 0.0001$ ,  $d = 3.39$ . Sad pictures evoked significantly more arousal (Mean = 4.05,  $SD = 1.83$ ) and sadness (Mean = 5.33,  $SD = 0.84$ ) than neutral pictures (Mean = 2.61,  $SD = 1.36$ , and Mean = 1.22,  $SD = 0.18$ , respectively),  $t(32) s > -5.78$ ,  $ps < 0.0001$ ,  $ds > 0.9$ . These results indicate that the mood induction procedures were effective.

##### 3.2.2. Effects of emotion induction on attentional orienting

Table 2 shows three indices of attentional performance in the two affect conditions. Paired-sample  $t$ -tests were performed with the independent variables of affect (neutral affect vs. low-motivation negative affect), separately for each index of attentional orienting performance.

**Table 2. Three indices of attentional performance as a function of affect ( $M \pm SD$ , ms)**

	Low-motivation negative affect	Neutral affect	t	p
Attention benefits	57.16 $\pm$ 27.06	74.73 $\pm$ 45.91	-1.86	0.07
Attention costs	-27.29 $\pm$ 32.38	-28.36 $\pm$ 43.67	0.13	0.89
Validity effect	29.87 $\pm$ 31.54	46.37 $\pm$ 32.53	-3.32	0.002

As shown in Table 2, participants in the neutral affect condition was a significantly larger validity effect relative to the low-motivation negative affect condition,  $p < 0.01$ ,  $d = 0.52$ . Consistent with predictions, these results indicate that the low-motivation negative affect increased attentional flexibility, relative to the neutral affect.

#### 4. General discussion

These experiments revealed that negative affects low in motivational intensity increased attentional flexibility, whereas negative affects high in motivational intensity decreased attentional flexibility. These results are in accordance with our hypotheses.

Experiment 1 demonstrated that relative to negative affects low in motivational intensity, negative affects high in motivational intensity decreased attentional flexibility. This result is consistent with the findings from the study by Hu et al. (2012), who found a basic effect of threat consisting of a slowing down of performance during Stroop trials. Although Hu et al. (2012) used threat of bodily harm in the study, the present experiment used disgusting picture. Both of stimuli evoke high-withdrawal-motivated negative affect. Therefore, the result with Hu et al. (2012) together reveals that high-withdrawal-motivated negative affects in general may cause a decreasing of attentional flexibility. According to the theory of attentional resource, in the high-withdrawal-motivated negative affect, attentional resource are allocated principally toward the threatening stimuli, the individuals engage in paying attention to the threatening stimuli and have no more resource to operate the attention task, so their attentional flexibility were attenuated.

A promising theoretical approach is provided by Gable and Harmon-Jones (2010a) who suggest that negative affects high in motivational intensity will result in enhanced attentional focusing. When attention focus becomes smaller, the ability of shifting attention to a new focus would become slower. So high-motivation negative affective states could decrease attentional flexibility. According to the motivational dimensional model of affect (Gable & Harmon-Jones, 2010b), decreased attentional flexibility in high-intensity negative affective states might serve a specific function and may be associated with the avoidance of a specific goal.

The present results showed that compared to negative affects high in motivational intensity or neutral affect, negative affects low in motivational intensity increased attentional flexibility. There is one study which supported the result, Gable and Harmon-Jones (2010a) compared the attentional consequences of negative affect low in motivational intensity (sadness) relative to a neutral affective state and found that low-motivation negative affect caused attentional broadening. When attention focus becomes bigger, the ability of shifting attention to a new focus would become faster. So low-motivation affective states could increase attentional flexibility. According to the motivational dimensional model of affect, increased attentional flexibility in low-intensity negative affective states might serve a less-specific function and may not be associated with the avoidance of a specific goal or action orientation. Klinger (1975) suggests that negative affect low in motivational intensity (e.g. sadness) may promote attentional flexibility because they assist with disengagement from terminally blocked goals and cause the organism to become open to new and previously irrelevant possibilities. In such negative-affect situations (e.g. sadness), “a more open, unfocused, unselective, low-effort mode of attention would prove not deficient but, on the contrary, beneficial” (von Hecker & Meiser, 2005). Low motivationally intense negative affect may encourage resource conservation in the face of a terminally blocked goal (Gable & Harmon-Jones, 2010b).

In summary, the present study supports motivational dimensional model of affect (Gable & Harmon-Jones, 2010b). That is, the relationship between negative affect and attentional flexibility is more complex, low and high motivationally intense negative affective states produce different effects on attentional consequence. Negative affect low in motivational intensity increase attentional flexibility, whereas negative affect high in motivational intensity decrease attentional flexibility.2013Y18ZR2015CL026

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#### Competing Interests

The author declares no competing interests.

#### Author details

Yuanguang Ma<sup>1</sup>

E-mail: [mayg11@sina.com](mailto:mayg11@sina.com)

ORCID ID: <http://orcid.org/0000-0002-3361-3714>

Shouxin Li<sup>2</sup>

E-mail: [shouxinli@sdu.edu.cn](mailto:shouxinli@sdu.edu.cn)

<sup>1</sup> Department of Education, Binzhou University, Shandong Province, 256600 Binzhou, P. R. China.

<sup>2</sup> Department of Psychology, Shandong Normal University, Shandong Province, 250014 Jinan, P. R. China.

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