

Identification Differences among People under Context of Complex Images

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Abstract—Differences of depressed and normal peoples' behavior in identification tasks is explored for a long time in cognitive science experiments. Words, pictures and emotional faces were introduced into psychological experiments in latest studies. However, usually the priming effect of images is used frequently, which is not according with people's common sense. In this paper, competing effect is introduced. We selected two kinds of background scenes based on image voting results: negative scenes and positive scenes for testing. Correspondingly, positive faces and negative faces were also utilized as testing images. Three experiments were designed considering both the initiation and the distraction effect of background, especially the third experiment considering both priming effect and competing effect simultaneously. According to data analysis results, there exists more significant discrepancy considering competing effect in identification speeds and identification discriminations between depressed people and normal people.

Keywords—*depressed people; psychology; competing effect; background; emotional face*

I. INTRODUCTION

Based on previous psychological researches, words, questionnaires and faces were utilized to research on cognitive biases. It is generally acknowledged that there is an obvious discrepancy in cognitive biases between depressed people and normal people.

According to early researches, the attentional bias of depressed people for negative information is one of the most important attentional biases [1][2][3]. Attentional biases were firstly observed from the analysis of results in questionnaires or scale test results, such as The Depression Anxiety Stress Scale (DASS) [4], Cognitive Emotion Regulation Questionnaire (CERQ) [5] and Mini International Neuropsychiatric Interview [6]. In the early behavioral experiments, such as simple modified Stroop Test and visual probe task, only simple words or faces were utilized. In the last ten years, informative images have been introduced to behavioral experiments as new stimuli, and detectors are gradually transformed into identification objects (mostly emotional faces) [11][12][13]. The focus of these studies is to reveal the cognitive processes in complex

images or the interactions between backgrounds and foregrounds without any attentional bias in depression involved. In fact, recent researches reveal that different depression-related cognitive biases (i.e., attention, interpretation and memory) are interacted [14] and attentional biases in depression could only be observed under specific task conditions [15]. In earlier researches, people let backgrounds appear firstly. Then, emotional faces appear after backgrounds disappeared. There are statistically significant differences between depressed people and normal people during identification. However, people see things together and simultaneously in daily life, in another word, backgrounds are always disturbing not inspiring. If there exists an experiment more commonsensible, the results may be improved. And that's what our study is made for.

We have designed three experiments, according to the relationship between foregrounds and backgrounds. By analyzing the collected data, we found a serial of differences between normal people and depressed people. Experiment 1 (Study 1) was designed in which the foreground and the background were presented simultaneously with the background as a distractor. Experiment 2 (Study 2) was referred to affectively prim the research with the background as an initiator. In Experiment 3 (Study 3), we combined the characteristics of previous two experiments, firstly presented the background priming stimuli, followed by the foreground in the middle of the background. The background first worked as an initiator and then as a distractor. Then, we collected key-pressing response times of identification for emotional faces. We found out that there exist significant discrepancies distinguishing two kinds of people in all three experiments. Especially, Experiment 3 elucidates people's identification discrepancies better compared with other two experiments. Thus, it did improve the experiment to introduce competing effect.

II. METHOD

A. Participants

24 patients with depression disorder (19 males and 5 females, age $M=20.6$, $SD=2.16$) and 24 normal controls (18 males and 6 females, age $M=21.1$, $SD=2.65$) participated in Study 1; 24 patients with depression disorder (18 males and 6 females, age $M=20.2$, $SD=2.36$) and 24 normal controls (16 males and 8 females, age $M=21.9$, $SD=2.48$) participated in Study 2; 22 patients with depression disorder (17 males and 5 females, age $M=20.5$, $SD=2.42$) and 23 normal controls (18 males and 5 females, age $M=21.8$, $SD=2.57$) participated in Study 3. All participants were students of certain university in Beijing and none of them participated in two studies.

B. Stimuli

We used emotional images that came from IAPS and Google as the background scenes. Considering that all of the participants were from certain university in Beijing, we made an emotional attributes re-scoring for all the emotional images that were selected. According to the result of re-scoring, 50 positive and 50 negative images that showed clear discrimination were used as our experimental background. Emotional faces working as the foreground were from Taiwanese Facial Expression Image Database. Meanwhile, in order to eliminate differences of race, gender and identity, as well as the affections of background and accessories, we performed series of steps including major face area interception, changing of the color image into gray degree images, balanced posture and PCA dimension reduction. After that, we got 16 emotional faces (8 positive and 8 negative) as the foreground stimuli.

C. Procedure

The procedure of three experiments was almost the same with a few differences. Before started, participants were asked to read the on-screen prompts which informed them that: 1) they should focus on the center of the screen during the whole experiment; 2) each trial was composed by a background scene and a foreground emotional face (emotional faces are in the center of scenes); 3) when a face appeared, half of them should make positive and negative attributes of the face judgment as fast as possible without sacrificing accuracy (All of the participants were right-handed); 4) the scene and face disappeared after pressing followed with an interval of 1.5s black background and then next trial arrived. Specific procedure of three experiments was shown in Fig.1. First, each participant was given the opportunity to practice 10 trials, then they would complete 80 formal experimental trials. Response time and accuracy for each trial were recorded.

Study 1 focused on the competing effect of the background. We presented the background and the foreground simultaneously.

Study 2 focused on the priming effect of the background. The background was presented first following with the foreground after the background disappeared.

In Study 3, we combined the features of Study 1 & 2, presenting the emotional faces in the center of the screen without the background disappeared, which led to a new paradigm. The rest experimental procedure of Study 3 was similar to study 2.

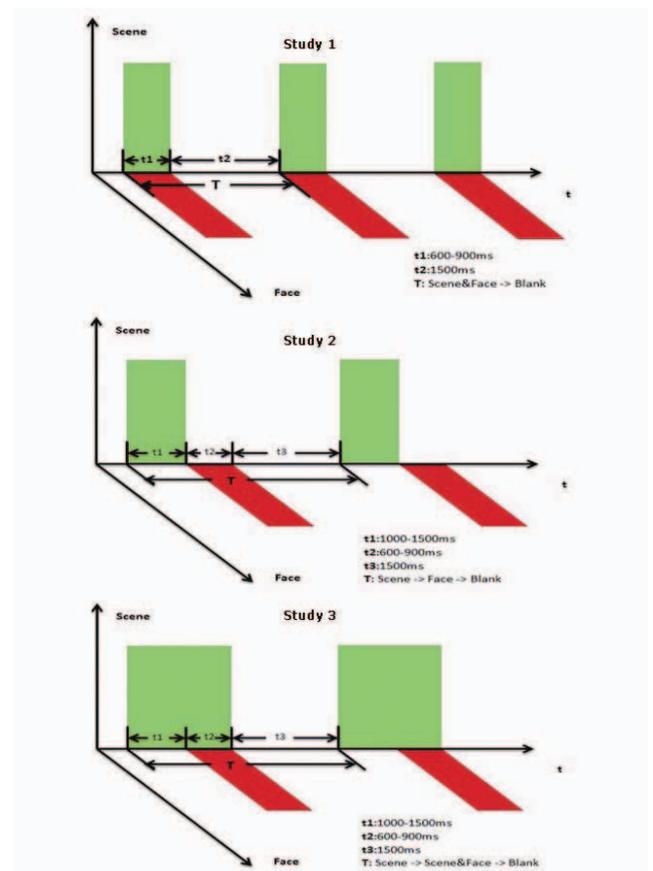


Figure 1. Specific experimental procedure of three studies.

III. RESULTS

A. Study 1

According to the experimental data, we found a significant main effect of group ($F=42.177$, $p<.001$). And the following independent samples t-test further showed that in four different combinations of foreground and background, the identification speed of depressed people was smaller than that of normal people (Fig.2a, $t_{ps&pf}=3.290$, $p=.002$, $t_{ps&nf}=3.047$, $p=.004$, $t_{ns&pf}=3.064$, $p=.004$, $t_{ns&nf}=3.570$, $p=.001$).

Subsequent repeated samples t-test showed that under the influence of negative scenes, depressed people identified positive faces faster than negative faces (Fig. 2b, $t=2.706$, $p=.013$), meanwhile, they identified negative faces under the influence of positive scenes faster than under the influence of negative scenes (Fig. 2c, $t=3.541$, $p=.002$). Normal people were just to the opposite. Their identification speed of negative faces under different positive-negative background scenes was not significant and their identification speed of different faces under the influence of negative scenes was not significant, either. Meanwhile, under the influence of positive scenes, they identified positive faces faster than negative faces (Fig. 2d, $t=2.639$, $p=.015$). And they identified positive faces under the influence of positive scenes faster than under the influence of negative scenes (Fig. 2e, $t=2.831$, $p=.009$).

We also made a drawing that showed the existence of cognitive differences (Fig .2f), where “PS” stood for positive scenes, “NF” stood for negative faces and so on. The pairs of combinations highlighted by red circles indicated there were significant differences between them, and the one with an arrow pointing to was faster than the other.

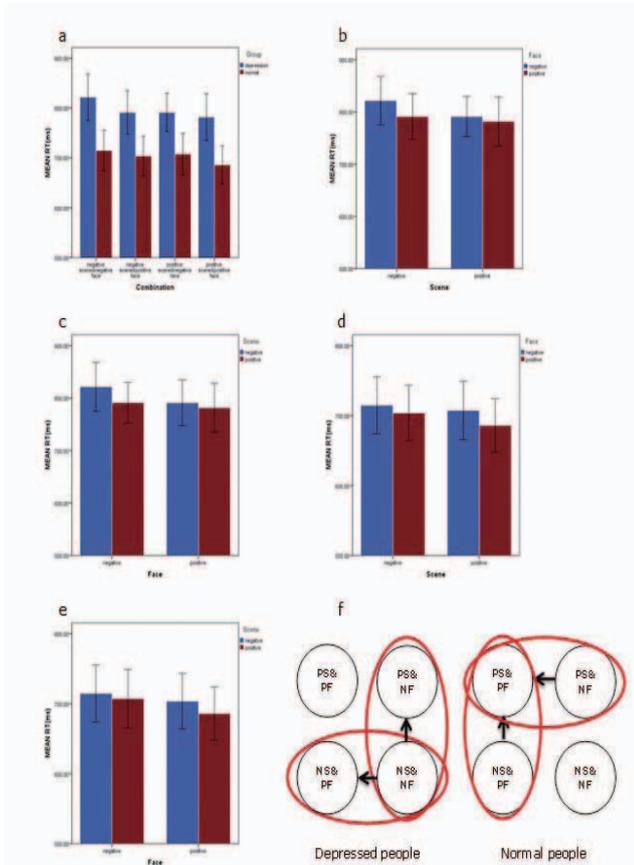


Figure 2. Results of Study 1. (a) Identification speed of two groups in four combinations, (b) Identification speed of depressed people under different scenes, (c) Identification speed of depressed people for different faces, (d) Identification speed of normal people under different scenes, (e) Identification speed of normal people under different faces, (f) Identification discrimination of two groups.

B. Study 2

Similar to Study 1, we found a significant main effect of group ($F=41.583, p<.001$). The following independent samples t-test also showed that in four different combinations, the identification speed of depressed people was slower than that of normal people (Fig. 2a).

Subsequent repeated samples t-test showed that depressed people had no significant differences between any pair of four combinations (Fig .3b&3c). Meanwhile, normal people identified positive faces faster than negative faces under both different positive-negative background scenes (Fig. 3d). Besides, when identifying negative faces, they responded faster under the influence of positive scenes than under the influence of negative scenes (Fig .3e).

We also made a drawing that showed the existence of cognitive differences (Fig .3f), with the meaning same as Study 1.

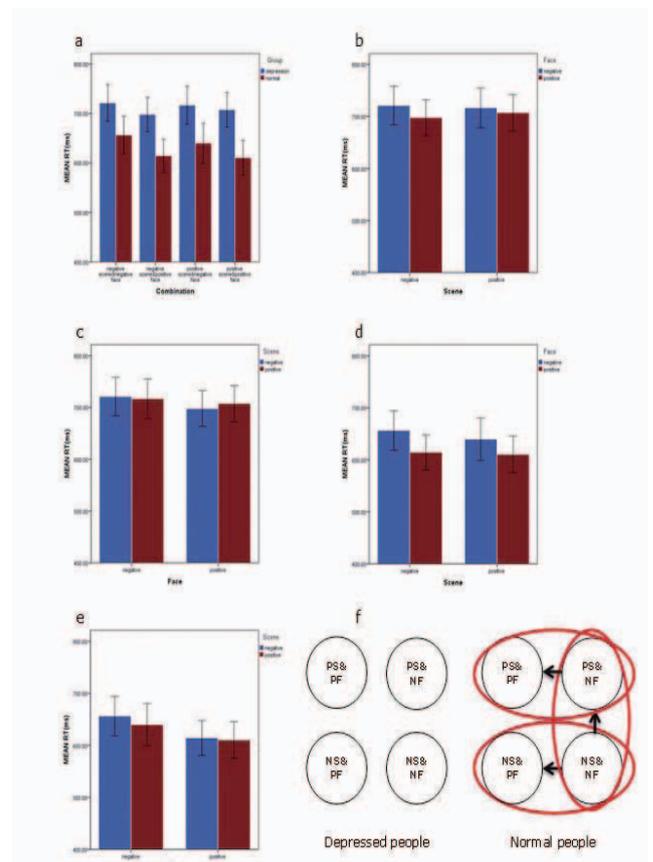


Figure 3. Results of Study 2. (a) Identification speed of two groups in four combinations, (b) Identification speed of depressed people under different scenes, (c) Identification speed of depressed people for different faces, (d) Identification speed of normal people under different scenes, (e) Identification speed of normal people under different faces, (f) Identification discrimination of two groups.

C. Study 3

In this study, we found a significant main effect of group ($F=47.02, p<.001$). As the mutual influence of the background scenes, and taking into account of the results in former studies, it could be easily inferred that in four different combinations of foreground and background, the identification speed of depressed people was slower than that of normal people. In fact, the following independent samples t-test proved it. (Fig. 4a, $t_{ps\&pf}=4.013, p<.001, t_{ps\&nf}=3.280, p=.002, t_{ns\&pf}=3.864, p<.001, t_{ns\&nf}=2.686, p=.010$).

Subsequent repeated samples t-test showed that under the influence of negative scenes, depressed people identified positive faces faster than negative faces (Fig .4b, $t=2.399, p=.026$), but under the influence of positive scenes, they did not show significant difference. Meanwhile, they did not show significant differences for faces under different attributes of background scenes (Fig .4c). Normal people identified positive faces faster than negative faces under both attributes of background scenes (Fig .4d, $t=3.170, p=.004$ for positive background and $t=3.404, p=.003$ for negative background). Besides, no matter what attribute of the faces, they responded faster under the influence of positive scenes than under the influence of negative scenes (Fig .4e, $t=2.165, p=.041$ for positive face and $t=2.453, p=.023$ for negative face).

We also made a drawing that showed the existence of cognitive differences (Fig .4f), with the meaning same as former studies. It could be simply observed that when the background worked both as initiator and distracter, normal people have better identification discrimination than depressed people.

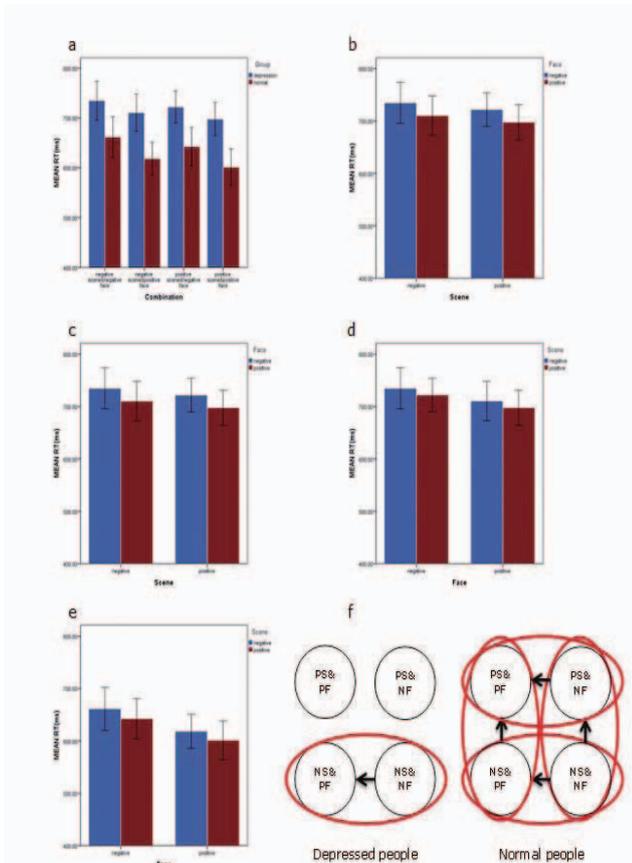


Figure 4. Results of Study 3. (a) Identification speed of two groups in four combinations, (b) Identification speed of depressed people under different scenes, (c) Identification speed of depressed people for different faces, (d) Identification speed of normal people under different scenes, (e) Identification speed of normal people under different faces, (f) Identification discrimination of two groups.

IV. DISCUSSION

Through the three experiments, we combined image cognition with psychology research. By analyzing the keyboard response time, we found the cognitive differences between normal people and depressed people. Three experiments all indicated that no matter whether images worked as a distracter or an initiator, the cognitive speed of depressed people was lower than that of normal people. By comparing the discrepancy of people under different combinations of backgrounds and foregrounds, we have drawn these conclusions: 1) when the background works only as a distracter, depressed people have the same identification discrimination as normal people; 2) once the background works as an initiator, the identification discrimination of normal people is better than that of depressed people. Totally, normal

people have better identification ability than depressed people. Besides, our experiment 3 elucidated people's identification discrepancies better, compared with other two experiments.

Our research finds out a difference in mental state among people while gets the relation between image-cognition and psychology more closely, furthermore, through which we could come up with a new method suitable for people to diagnose depression simply using a computer with all-right accuracy. We can use linear classifier e.g. SVM to distinguish the difference among normal people and depressed people, which may provide an easy, cheap, friendly new way in diagnosis.

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