

## Effect of Spatial Location on Emotional Conflict in the Faces - Word Stroop Paradigm

Ai-hua Tao

Chen Zhou

Xinglin College, Nantong University  
Jiangshu Nantong, 226007

### Abstract

*This study focuses on effect of spatial location on emotional conflict in the Faces - word Stroop paradigm. This study contains two experiments. In Experiment 1, we investigated the mechanisms of influences of spatial location on emotional conflict by using the Faces - word Stroop paradigm and 2×3×2 within-group design. Independent variable 1 is the task type ("face task" and "word task"). The independent variable 2 is the consistency of the meaning of the facial emotion and the emotion word. The independent variable 3 is the spatial position (upper, middle and below) of the emotional word. The mean correct rate and the mean response time were used as dependent variables. Results showed that in the case of correct rate, the main effect of consistency is very significant, but the main effect of spatial location and task type is not significant. The interaction of face - word task, spatial position, and consistency is not significant. In the reaction time, the main effect of consistency is not significant. The main effect of task type is significant. The reaction time of the face task is longer than that of the word task. In Experiment 2, the experimental paradigm and experiment design are the same as experiment 1. The independent variable 1 is the time (150ms or 1500ms), the independent variable 2 is the meaning of the face and the emotional words (consistent, inconsistent), the independent variable 3 is the spatial position of the emotional word (upper, middle and below). The mean correct rate and the mean response time were used as dependent variables. Results showed that in terms of correct rate, the main effect of consistency is significant, and the correct rate is significantly higher than the rate of inconsistency. The main effect of spatial location is significant, and the correct rate of the middle position is higher than that of the upper and lower position. When the reaction time is concerned, the main effect of consistency is not significant, the main effect of presentation time is extremely significant, and the correct rate is higher when the time is longer.*

**Key words:** A Faces - word Stroop; Stroop; spatial location; Emotional conflict

### 1 Introduction

In daily life, each person receives a lot of emotional information every day; this emotional information can be positive or negative. When two or more than two different valence emotional information appear at the same time, it constitutes the emotional conflict situation. In recent years, researchers have applied the Stroop paradigm to emotional conflict situations. Emotional Stroop effect mainly refers to the effect of the emotional information to the non emotional information in the stimulus, this paradigm is also changed from the classic Stroop paradigm<sup>[1]</sup>.

There are different views on whether there is a Stroop effect in emotional conflict information: (1) Emotional information exists a Stroop effect. Schirmer<sup>[2]</sup> et al found that gender specific Stroop effect in emotional information was found by ERP technology. In the tone - semantic interference task, Subjects were asked to listen to the words of a variety of tone, such as saying positive, neutral or negative words with a pleasant, neutral and angry tone, then subjects were asked to make judgments. The results show that the reaction time of the consistent tone - semantic is relatively faster and the correct rate is higher than that of inconsistent tone - semantic. At the same time, there are gender differences in this phenomenon, that is to say, compared to men, women are more likely to be affected by the tone of voice. In addition, the study also confirmed that under the same conditions, the N400 amplitude was smaller, and the ERP effect was more significant in the judgment of the word valence compared to inconsistent conditions.

Moreover Brooke<sup>[3]</sup> also found the emotional Stroop effect, A group of subjects pretend to be mild brain injury, another group of subjects was diagnosed with mild brain injury, two groups of subjects were asked to name the writing color of words containing neutral words and malingered words. The results showed that mild brain injury had no significant difference in the neutral words and malingered words of naming reaction time, while malingered subjects in neutral words and malingered word naming performance was significantly lower than mild brain injury subjects. Similarly, MacKay<sup>[4]</sup> also found that the Stroop effect of emotion in the taboo language, compared to the color of neutral words, the reaction time of taboo words color naming is longer, and become less with the words of the repetition. To explain this phenomenon, MacKay<sup>[4]</sup> thinks it may be because that the taboo words prime a specific emotional reaction, which is conducive to the integration of the meaning of the obvious taboo words in the context. This shows that some of the previous studies of emotional information is the existence of the Stroop effect.

Emotional information does not exist a Stroop effect. Emotional Stroop effect is not equivalent to emotional priming. There are two kinds of emotion priming: one is that the individual is more sensitive to the target stimulus associated with the priming stimulus; one is that the individual is processed by some emotional stimuli, and the subsequent processing is easy to be covered by the corresponding emotion<sup>[5]</sup>. With the same group of normal subjects as subjects, in priming of the same emotional stimulation, Yang et al found that there is no a Stroop effect when the under threshold emotion priming effect and the emotional Stroop effect were compared. Algom et al<sup>[5]</sup> confirmed by experiments that the color naming and vocabulary decision are the same that when accompanied by emotional words, processing is slowed down, which is not affected by the change of Unrelated task and the obvious changes of the color of words, so there is no Stroop effect. In addition, Klauer<sup>[6]</sup> used between-group design with 6 SOA (-100ms, 0 ms, 150 100ms, 200 ms, 600 ms and 1200ms), and words were used as priming stimulations and target stimulations which was found to have a significant priming effect when SOA was 0 ms and 100 ms. Stroop effect is exactly what time, there is still a controversy.

The face - word Stroop paradigm is derived from the Stroop paradigm and is widely used in the study of Stroop effects of emotional conflict situations. The face - word Stroop paradigm is that the emotional word is increased in the central part of the face, emotional information of face and words form consistent, inconsistent and unrelated conditions. The task is to judge the value of the face by ignoring the emotional words, or judge the value of the emotional words by ignoring the value of the emotional face<sup>[7-9]</sup>. Etkin<sup>[8]</sup> et al. used the research paradigm, the two most typical emotional materials, in which the red "happy" or "fear" was written in the middle of the black and white faces, which emotional conflict were more obvious. Subjects were asked to try to judge the emotional type of face. The results show that the reaction time under different conditions is longer than the reaction time under the same conditions, and the reaction time is the shortest under control conditions. Risko<sup>[10]</sup> etc. has been studied by the combination of the Stroop and the visual search paradigm. It is found that spatial attention has a great effect on the visual processing of words, but some researchers think that word processing is automatic. Risko and Besner<sup>[11]</sup> et al. showed their subjects 3, 5, and 7 words, including a target word of color. The position of the relationship has the whole and the separation. Through four experiments, they think that the recognition of visual words depends on the subject to spatial attention. The increase of spatial attention uncertainty to some extent reduces the possibility of peripheral words being processed.

From the above research, it can be inferred that there is a certain influence of the spatial location on the emotional conflict effect in the Stroop paradigm. Therefore, this study continues to study the effect of emotional conflict in the Stroop paradigm of the face, the same as 150ms and 1500ms<sup>[12]</sup>, which is required to complete the "face" and "task" to explore the effect of the spatial location on emotional conflict in the Stroop paradigm. To sum up, this study assumes that the Stroop effect of face - word exists asymmetric effects; spatial location has a significant effect on Stroop effect. In case of inconsistency, the reaction time was significantly higher than the reaction time under the same conditions, and the correct rate was lower than the correct rate under the same condition. Compared to the top of the face, the reaction time is longer and the correct rate is lower. There was no significant difference between the reaction time and the correct rate of the face task and words task. When presentation time was 1500ms, the correct rate was higher and the reaction time was not significant. When presentation time was 150ms, the correct rate was lower and the space position had a significant effect on the correct rate and reaction time. Under the condition of consistency, only when the time is 150ms, there is a significant effect.

## 2 Experiment 1 Effect of spatial location on emotional conflict in the Stroop paradigm

### Method

**Participants** A group of 60 individuals (30 female, 30 male) between 18 and 25 years old (mean age = 21 years) participated in return for payment. The participants were recruited from the University of Nantong, were right-handed with normal or corrected-to-normal vision and no physical or mental illness, not to previously participate in similar experiments.

**Stimuli** Emotional face pictures selected from the Chinese Facial Expression Picture System, the selected emotional face pictures include 20 fear face pictures and 20 happy faces, Male and female faces were accounted for half. Use the computer's own image processing software to add the emotional word "happy" and "fear" to the image of the face. Emotional faces and emotional words in the emotional valence are consistent or inconsistent, while an emotional word on the face of the position also has the difference. The size of the picture is 5cm × 7cm, the size of the emotional word is about 1.5cm × 1.5cm.

**Procedure** We investigated the mechanisms of influences of spatial location on emotional conflict by using the Faces - word Stroop paradigm and 2×3×2 within-group design. Using E-Prime2.0 to program, the experiment is composed of practice and formal experiment. Subjects are familiar with the test procedure and requirement in practice. Practice and formal experiments have the appropriate guidance. The formal experiment is divided into four block, the task was to judge pictures be "happy" or "active" based on the previous guidance of the judgment (face or word) ". In the first block, the beginning of the experiment will appear "+", and then presents the picture, subjects are ask to try to ignore the words to judge the face is positive or negative. Second block is required to try to ignore the face to determine the words, during a period of 3 minutes of rest time. The subjects were "happy" or "active" under the guidance of the previous instruction ". In the first two block pictures appear after 1500ms again "?", in the back two block pictures appear after 150ms again "?", the instruction is the same as in the previous two block. Judge for the positive by the "Q" key, the judge is negative by "P". Fig. 1 is schematic diagram of the task trails.

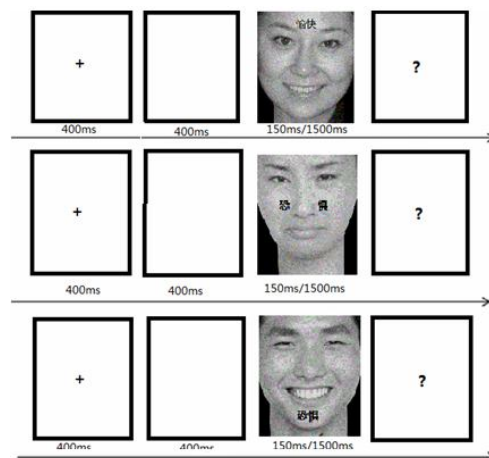


Figure1. Schematic diagram of the task trails.

### 3 Results

#### 3.1 Means and standard deviations) of correct rate and reaction time under various experimental treatments

The computer automatically records the keys and response time, correct rate, data consolidation. The invalid response data are excluded from 3 standard deviation. The error response is only involved in the correct rate statistics; the data does not enter the follow-up statistical analysis. The average number and the standard deviation of the correct rate and the reaction time were shown in table 1.

**Table 1 Means and standard deviations) of correct rate and reaction time**

consistency	spatial location	correct rate (%)		reaction time (ms)	
		face task	word task	face task	word task
consistent	upper	92.73±11.81	95.45±7.58	841.18±488.13	639.47±266.10
	middle	95.15±7.00	97.59±7.67	867.90±422.97	585.12±318.56
	below	96.51±7.87	91.50±10.50	792.62±470.48	723.33±329.70
inconsistent	upper	91.11±13.54	90.19±19.42	842.63±454.06	652.72±291.45
	middle	89.82±16.40	91.36±17.59	827.54±406.89	605.75±256.12
	below	88.52±14.60	92.83±22.41	915.44±448.09	541.76±316.13

### 3.2 Analysis of variance of correct rate and reaction time under different conditions

**Table 2 Analysis of variance of correct rate and reaction time**

	correct rate			reaction time	
	df	F	Sig.	F	Sig.
task	1	0.57	0.46	69.44	.000***
consistency	1	7.85	.007**	0.39	0.54
spatial location	2	1.25	0.29	0.63	0.54
task * consistency	1	0.60	0.44	2.69	0.11
task * spatial location	2	1.14	0.32	0.87	0.64
consistency * spatial location	2	1.35	0.26	0.36	0.70
task * consistency * spatial location	2	7.57	.001***	6.10	.003**

Note: the figures in the table are the values of F in the results of analysis of variance,

\*\*\* mean significant at 0.001 level, \*\*indicates significant at 0.01 level.

The correct rate was made 2 (consistency: consistency, inconsistency) × 3 (spatial position: upper, middle, below) × 2 (task: face task, word task) repeated measures analysis of variance, and the results showed that the main effect of emotional consistency of faces and words was significant,  $F(1,59) = 7.85$ ,  $p < 0.001$ , the correct rate under the inconsistency conditions was higher than those under the consistency conditions; The main effect of task type is not significant  $F(1,59) = 0.57$ ,  $p = 0.46$ ; The main effect of spatial position is not significant

$F(1,59) = 1.25$ ,  $p = 0.29$ ; The interaction between task and consistency is not significant

$F(1,59) = 0.60$ ,  $p = 0.44$ ; The interaction between task and spatial position is not significant

$F(1,59) = 1.14$ ,  $p = 0.32$ ; The interaction between consistency and spatial position is not significant

$F(1,59) = 1.35$ ,  $p = 0.26$ ; The interaction of the three factors is extremely significant

$F(1,59) = 7.57$ ,  $p < 0.01$ .

The reaction time was made 2 (consistency: consistency, inconsistency) × 3 (spatial position: upper, middle, below) × 2 (task: face task, word task) repeated measures analysis of variance, and the results showed that The main effect of task type is significant  $F(1,59) = 69.44$ ,  $p < 0.001$ , The response time of the face task is longer than the word task. the main effect of consistency was not significant,  $F(1,59) = 0.39$ ,  $p = 0.54$ ; The main effect of spatial position is not significant  $F(1,59) = 0.63$ ,  $p = 0.54$ ; The interaction between task and consistency is not significant  $F(1,59) = 2.69$ ,  $p = 0.11$ ; The interaction between task and spatial position is not significant

$F(1,59) = 0.87$ ,  $p = 0.64$ ; The interaction between consistency and spatial position is not significant

$F(1,59) = 0.36$ ,  $p = 0.70$ ; The interaction of the three factors is extremely significant

$F(1,59) = 6.10$ ,  $p < 0.001$ .

### 3.3 Discussion

In Experiment 1, In terms of correct rate, the main effect of the consistency is very significant, and the interaction of space position and task type and consistency is very significant. Obviously, the Stroop conflict effect is obvious, the inconsistency of the emotion of the face and the words caused a cognitive conflict, It takes a long reaction time to judge when it is judged. .

Secondly, there is no significant interaction between task type and spatial location, and the interaction between task type and consistency is not significant, and The interaction between consistency and spatial position is not significant, but the interaction of the three is significant. Perhaps this is a significant time related to the presentation of the stimulus material. In the case of reaction time, the main effect of consistency is not significant. The main effect of task type is significant, and the response time of face task is longer than that of word task. This may be caused by selective role of visual processing. Specifically, when subjects were asked to ignore face and see word judgment, because of the small gaze, the face has little effect on the word. But when subjects is required to try to ignore the words to judge the face, the words will have a effect on the whole face , resulting in the longer reaction time. The interaction between the two is not significant, but the interaction between the three is very significant, the reason is still need to further explore.

#### **4 Experiment 2 The effect of spatial position and presentation time on emotional conflict in the Stroop paradigm**

##### **Method**

**Participants** A group of 60 individuals (30 female, 30 male) between 18 and 25 years old (mean age = 21 years) participated in return for payment. The participants were recruited from the University of Nantong, were right-handed with normal or corrected-to-normal vision and no physical or mental illness, not to previously participate in similar experiments.

**Stimuli** Emotional face pictures selected from the Chinese Facial Expression Picture System, the selected emotional face pictures include 20 fear face pictures and 20 happy faces, Male and female faces were accounted for half. Use the computer's own image processing software to add the emotional word "happy" and "fear" to the image of the face. Emotional faces and emotional words in the emotional valence are consistent or inconsistent, while emotional words on the face of the position also have the difference. The size of the picture is 5cm × 7cm, the size of the emotional word is about 1.5cm × 1.5cm.

**Procedure** We investigated the mechanisms of influences of spatial location on emotional conflict by using the Faces - word Stroop paradigm and 2×3×2 within-group design. Using E-Prime2.0 to program, the experiment is composed of practice and formal experiment. Subjects are familiar with the test procedure and requirement in practice. Practice and formal experiments have the appropriate guidance. The formal experiment is divided into four blocks, the task was to judge pictures are "happy" or "active" based on the previous guidance of the judgment. In the first block, the beginning of the experiment will appear "+", and then presents the picture, subjects are ask to try to ignore the words to judge the face is positive or negative. In the first two block pictures appear after 1500ms again "?", in the back two block pictures appear after 150ms again "?", the instruction is the same as in the previous two block. Judge for the positive by the "Q" key, the judge is negative by "P". Schematic diagram of the task trails is the same as the experiment 1.

##### **5 Results**

5.1 Means and standard deviations) of correct rate and reaction time under various experimental treatments

The means and the standard deviation of correct rate and reaction time are shown in Table 3.

**Table 3: Means and standard deviations) of correct rate and reaction time**

Presentation time	spatial location	correct rate (%)		reaction time (ms)	
		consistent	inconsistent	consistent	inconsistent
150ms	upper	91.67±11.14	90.56±11.17	798.97±437.52	825.32±403.10
	middle	94.33±9.63	88.33±18.34	749.98±376.70	715.09±356.84
	below	91.82±9.42	89.63±13.86	749.43±339.18	915.44±448.09
1500ms	upper	96.21±8.42	89.44±21.79	681.18±402.77	670.04±382.68
	middle	98.17±16.40	93.00±12.80	734.29±449.06	686.66±349.78
	below	95.83±9.97	92.83±22.41	780.41±478.61	541.76±316.29

5. 2 Analysis of variance of correct rate and reaction time under different conditions Analysis of variance of correct rate and reaction time are shown in Table 4.

**Table 4: Analysis of variance of correct rate and reaction time**

	df	F	Sig.	F	Sig.
consistency	1	9.05	.004**	0.86	.36
spatial location	2	10.40	.000***	3.26	.04**
presentation time	1	0.15	0.70	13.59	.000***
consistency * spatial location	2	0.16	0.86	10.19	.000***
consistency * presentation time	1	1.45	0.23	13.69	.000***
spatial location * presentation time	2	2.17	0.12	1.80	.17
consistency * spatial location * presentation time	2	2.87	0.06	1.92	.15

Note: the figures in the table are the values of F in the results of analysis of variance,

\*\*\* mean significant at 0.001 level, \*\*indicates significant at 0.01 level.

The correct rate was made 2 (presentation time: 150ms, 1500ms)  $\times$  3 (spatial position: upper, middle, below)  $\times$  2 (consistency: consistency, inconsistency) repeated measures analysis of variance, and the results showed that the main effect of consistency was significant  $F(1,59) = 9.05$ ,  $p < 0.01$ , regardless of presentation time, the correct rate under the consistency condition is higher than that of the inconsistency condition; The main effect of spatial position is also significant  $F(1,59) = 10.40$ ,  $p < 0.001$ ; There were significant differences between middle and below, between middle and upper, but no difference between upper and below, and correct rate was the highest in the middle of the face.

The reaction time was made 2 (presentation time: 150ms, 1500ms)  $\times$  3 (spatial position: upper, middle, below)  $\times$  2 (consistency: consistency, inconsistency) repeated measures analysis of variance, and the results showed that the main effect of presentation time was significant  $F(1, 59) = 13.59$ ,  $p < 0.001$ , the correct rate of 150ms was higher than that of 1500ms; The main effect of spatial position is significant  $F(1, 59) = 3.26$ ,  $p < 0.05$ , There were significant differences between middle and below. The interaction between consistency and spatial position is significant  $F(1,59) = 10.19$ ,  $p < 0.001$ ; The interaction between presentation time and consistency is significant  $F(1,59) = 13.69$ ,  $p < 0.001$ . In particular, when the time is 150ms, under the condition of consistency the reaction time of middle is longer than the reaction time of below. When the time is 1500ms, under the condition of consistency the reaction time of middle is shorter than the reaction time of below. But under the condition of inconsistency the reaction time of middle is longer than the reaction time of below.

### 5.3 Discussion

In the correct rate, the main effect of consistency is significant, and the correct rate under the consistency condition is higher than that of the inconsistency condition; the correct rate of middle is higher than that of upper and below. There is no obvious effect in the spatial position of experiment 1, which is mainly because of the presentation time of the words task and the face task, so that the difference may be masked. The difference of spatial position is not significant because the time is the same as the two tasks, so the spatial position of the experiment is not significantly different in the 1.

In the reaction time, the main effect of consistency is not significant, the main effect of presentation time is extremely significant, and the correct rate is higher when the time is longer. That is to say, The correct rate is higher when the presentation time is 1500ms, The correct rate is higher when the presentation time is 150ms, because the time is too short to make a response to the first impression and intuition, and the correct rate will be very low. The interaction between the consistency and the presentation time is also extremely significant, when the time is relatively short time by intuition and the first impression to make judgments, this time judging the difference is more easy than the judgment same, So the reaction time in the middle of the face is higher than that in the below of face, under the consistent conditions the reaction time in the middle of the face is lower than that in the below of the face. Under the inconsistent conditions the reaction time in the middle of the face is higher than that in the below of the face.

### 6 Conclusions

Results of experiment1 showed that in the case of correct rate, the main effect of consistency is very significant, but the main effect of spatial location and task type is not significant. The interaction of face - word task, spatial position, and consistency is not significant.

In the reaction time, the main effect of consistency is not significant. The main effect of task type is significant. The reaction time of the face task is longer than that of the word task. Results of experiment2 showed that in terms of correct rate, the main effect of consistency is significant, and the correct rate is significantly higher than the rate of inconsistency. The main effect of spatial location is significant, and the correct rate of the middle position is higher than that of the upper and lower position. When the reaction time is concerned, the main effect of consistency is not significant, the main effect of presentation time is extremely significant, and The correct rate is higher when the time is longer.

### ***Acknowledgment***

This work was supported by Project (2014K106) “The effect of Task dependence and spatial location on emotion conflict in the Stroop paradigm”. (Xingling College, Nantong Uni.), \*Ai-hua Tao, corresponding author, E-mail: taoaihua450617@163.com;

### ***Reference***

- Chen Jun, Liu Haiyan & Zhang Jijia. New progress in the study of Stroop effect - theory, paradigm and influence factors. *Psychological science*, 2007,30 (2), 415-418. (In Chinese)
- Schirmer A, Kotz S A. ERP evidence for a sex-specific Stroop effect in emotional speech. *Journal of Cognitive Neuroscience*, 2003,15(8):1135-1148
- Brooke J Cannon. An emotional stroop effect to malin-gering-related words. *Perceptual and Motor Skills*, 2003, 96 (3: 827-834.
- Mackay D G, Shafto M, Taylor J K, et al. Relations between emotion, memory, and attention: Evidence from taboo Stroop, lexical decision, and immediate memory tasks. *Memory& Cognition*,2004,32(3):474-488
- Melara R D, Algom D. Driven by information: A tectonic theory of Stroop effects. *Psychological Review*, 2003,110 (3):422
- Klauer K C, Rosnagel C, Musch J. List-context effects in evaluative priming. *Journal of Experimental Psychology:Learing,Memory,and Cognition*,1997,23(1):246-255.
- Egner T, Etkin A, Gale S, & Hirsch J (2008). Dissociable neural systems resolve conflict from emotional versus nonemotional distracters. *Cerebral Cortex*, 18, 1475-1484.
- Etkin A , Egner T , Peraza D M , Kandel E R , & Hirsch J. (2006) . Resolving emotional conflict: A role for the rostral anterior cingulate cortex in modulating activity in the amygdala. *Neuron*, 51, 871 - 882.
- Zhu X R , Zhang H J , Wu T T , Luo W B , & Luo Y J (2010). Emotional conflict occurs at an early stage: Evidence from the emotional face - word Stroop task. *Neuroscience Letters*, 478, 1-4.
- Risko Evanf, Jennifer A Stolz, Derek Besner. Basic processes in reading: Is visual word recognition obligatory. *Psychonomic Bulletin & Review*, 2005, 12(1):119-124.
- Besner D, Stloz J A. Unconsciously controlled processing: The stroop effect reconsidered. *Psychonomic Bulletin and Review*, 1999a, 6:449-455.
- Cheng Zhenbo, Huang Yuxia. Study on the effect of emotional conflict in the face of the Stroop paradigm, *psychological science*, 2013, 36 (4): 822-826. (In Chinese)