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ORIGINAL RESEARCH

Differential attentional bias in generalized anxiety disorder and panic disorder

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Background: Cognitive theorists relate anxiety disorders to the way in which emotional information is processed. The existing research suggests that patients with anxiety disorders tend to allocate their attention toward threat-related information selectively, and this may differ among different types of anxious subjects. The aim of this study was to explore attentional bias in patients with generalized anxiety disorder (GAD) and panic disorder (PD) using the emotional Stroop task and compare the differences between them.

Methods: Forty-two patients with GAD, 34 patients with PD, and 46 healthy controls performed the emotional Stroop task with four word types, ie, GAD-related words, PD-related words, neutral words, and positive words.

Results: Patients with GAD and those with PD were slower than healthy controls to respond to all stimuli. Patients with GAD had longer response latencies in color-naming both PD-relevant words and GAD relevant words. Patients with PD had longer response latencies only in color-naming PD-related words, similar to healthy controls.

Conclusion: Patients with GAD and those with PD had a different pattern of attentional bias, and there was insufficient evidence to support the existence of specific attentional bias in patients with PD.

Keywords: generalized anxiety disorder, panic disorder, attentional bias, emotional Stroop task

Introduction

Cognitive theorists relate anxiety disorders to the way in which emotional information is processed.[1] According to cognitive theories, the attention of patients with anxiety disorders should be biased selectively towards threatening stimuli. The color-word emotional Stroop task has been proposed as an experimental procedure to assess interference between emotion and attention.[2,3] Longer response latencies when color-naming emotional words reflect attentional bias. A number of studies have administered the emotional Stroop task to patients with anxiety disorders. Some studies have shown that patients with generalized anxiety disorder (GAD) have longer latencies than healthy controls for some types of threat-related words.[4,5] Although several studies showed an attentional bias for threat information in patients with panic disorder (PD),[6–10] significant differences when compared with normal controls were found in few of them.[6,7]

The existing research suggests that patients with anxiety disorders tend to allocate their attention selectively toward threat-related information, and that this may differ among subjects with different types of anxiety. Mathews and MacLeod found that patients who worried mostly about physical harm were particularly slow in naming

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the color of physical threat words, whereas patients worrying about social threat were especially slow in naming social threat words.[11] Other studies found that patients with PD were slowed by physical threat cues, but not social threat cues, whereas the opposite was the case for social phobics.[12,13] Research conducted in 2001 by Becker et al showed that patients with GAD and those with social phobia demonstrated different types of attentional bias to threat words; the former showed delayed response times for all emotional words, but the latter showed only prolonged reaction times for speech-related words.[4]

GAD is an anxiety disorder characterized by consistent, uncontrollable, excessive, and often irrational worry. The content of persistent worrisome thoughts may include physical health, work difficulties, study obstacles, or general world problems. PD is an anxiety disorder characterized by recurring severe panic attacks which are periods of intense fear of dying or fear of losing control or going crazy that are of sudden onset. Patients with PD may have persistent concern about having additional attacks and worry about the implications of the attack or its consequences. These two forms of anxiety disorders differ greatly in terms of their manifestations and objects of worry, indicating that patients with GAD and those with PD may have different attentional bias to outside information. Patients with GAD could be expected to have an attentional bias towards a broader range of stimuli than patients with PD, and patients with PD may merely have an attentional bias to negative information related to panic attacks.

No comparative study of differences in attentional bias between GAD and PD have been reported as yet. In this research, we sought to explore attentional bias in patients with GAD and those with PD using the emotional Stroop task and to compare the differences between them.

Materials and methods

Participants

The study involved three groups of participants, ie, a PD group, a GAD group, and a healthy control group. The PD group consisted of 34 patients who met the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition Text Revision (DSM-IV-TR)[14] criteria for a diagnosis of PD, comprising five cases of PD with agoraphobia and 29 cases of PD without agoraphobia. Eighteen were medicine-naïve when performing the emotional Stroop task. The GAD group consisted of 42 patients who met the DSM-IV-TR criteria for a diagnosis of GAD. All patients were recruited from the Psychiatry Outpatient Department of Huashan Hospital at Fudan University. The healthy control group consisted of 46 subjects who had never met the diagnostic criteria for any mental disorder listed in the DSM-IV-TR. All healthy controls were relatives of patients treated for carpal tunnel syndrome at the Department of Hand Surgery, Huashan Hospital. Demographic data for all three groups of participants are shown in Table 1. All participants provided their written informed consent before entry to the study.

Materials

There were four categories of words used in the emotional Stroop task, comprising 24 PD-related words, 24 GAD-related words, 24 neutral words, and 24 positive words.

Table 1 Demographic information for PD, GAD and HC groups

	PD n = 34	GAD n = 42	HC n = 46	$F/z/\chi^2$	*P*
Gender (M/F)	11/23	19/23	15/31	$\chi^2 = 1.920$	0.383
Age (year)	31.59 ± 8.58	34.33 ± 7.98	31.07 ± 7.51	$F = 2.049$	0.133
Marriage (single/married)	8/26	13/29	19/27	$\chi^2 = 2.901$	0.234
Education years	12.21 ± 3.43	12.64 ± 4.36	13.89 ± 3.21	$F = 5.102$	0.078
Physical laborer	9	9	5	$\chi^2 = 8.265$	0.082
White-collar worker	18	30	37		
Unemployed	7	3	4		
Family history (yes/no)	8/26	3/39		$\chi^2 = 2.860$	0.091
Disease course (month)	16.97 ± 18.17	38.78 ± 37.48		$z = -3.349$	0.001
Medicine (naïve/use)	18/16	22/20		$\chi^2 = 0.213$	0.645
SSRI	8	6			
SSRI plus one antianxiety drug	4	6			
SSRI plus two antianxiety drugs	2	3			
Antianxiety drug	2	5			

Notes: Values are the mean ± standard deviation or numbers; Chi-square tests for categorical variables, analysis of variance for quantitative variables of three groups, and Kruskal-Wallis test for quantitative variables of two groups. Antianxiety drugs included buspirone, trazodone, and benzodiazepines.
Abbreviations: PD, panic disorder; GAD, generalized anxiety disorder; HC, healthy controls; M, male; F, female; SSRI, selective serotonin reuptake inhibitor.

Those emotional words were selected from the Chinese Affective Words System[15] and other Chinese studies.[16,17] The frequency[18] and strokes of each category of emotional words were matched (see Table 2).

Procedure

The task procedure was established using E-prime software (PST Inc, Sharpsburg, PA), and the stimulus materials were presented on a 14 inch Lenovo laptop computer. Each stimulus appeared consecutively on the computer screen and participants were instructed to identify the color of the word (red, yellow, green). The size of the words was 50, shown in the center of the computer screen on a white background. As soon as the word appeared on the screen, the participants were required to press one of the three specified buttons on the keyboard corresponding to the color of the word, ignoring the meaning of the word. All words appeared once in one of three possible colors to avoid bias related to color effect or the position of the buttons. A three block design was used, and each stimulus appeared for 1000 msec separated by an interval (white screen) of 500 msec. Each block was composed of 96 trials (24 words of each word category) pseudo randomized and presented such that neither the same type of word nor the same color could appear consecutively. Before each block, a cross appeared on the screen for 10 seconds in order to enable the participants to get ready. A short break was allowed between each block, and when participants were ready, they pressed the space key to start the next block. Reaction times were recorded between the appearance of the word and the end of the interval (1500 msec). The participants practiced a set of 30 trials before the test session. The stimuli in these trials were color capital letters.

Questionnaires

The Clinical Interview for DSM-IV-TR Axis I Disorders-Patient Edition (SCID-I/P, Chinese edition) was adopted for diagnostic evaluation of the study patients.[19] Psychiatrists trained in use of the SCID-I/P performed the interview. All participants completed the State-Trait Anxiety Inventory, Self-rating Anxiety Scale, and Self-rating Depression Scale.

Design and data handling

Pressing a button which did not correspond to the color appearing on the screen was considered to be an error. Color-naming errors and individual reaction times of more than two standard deviations[20] from a participant's mean and reaction times less than 100 msec[5] were excluded. We defined the difference between mean reaction times for emotional words and neutral words as the emotional interference score.[20]

Frequency and stroke of the emotional words and participants' mean questionnaire scores were analyzed using the Kruskal-Wallis test and the Wilcoxon rank sun test. A repeated-measures analysis of variance was conducted with the group (three levels, ie, a PD group, a GAD group, and a healthy control group) as a between-subject variable, and word type (four levels, ie, PD-relevant, GAD-relevant, positive and neutral) and block (three levels, blocks 1–3) as within-subject variables. Spearman correlation analysis of emotional interference scores and mean questionnaire scores were conducted. Differences were considered to be statistically significant at a two-sided alpha of 0.05.

Results

Mean questionnaire scores for the three groups are shown in Table 3. The numbers of errors for each category of emotional word are presented in Table 4. There was a significant main effect of word type ($F_{3,357} = 4.864$, $P = 0.002$), and least squares difference (LSD) post hoc tests showed that the errors on positive words were less than those for the other three types of words (positive words versus neutral words, $P = 0.026$; positive words versus GAD-related words $P = 0.013$; positive words versus PD-related words, $P = 0.001$). No significant main effect of group was observed ($F_{2,119} = 2.411$, $P = 0.094$), and no interaction between word type and group was observed ($F_{6,357} = 1.324$, $P = 0.246$).

The reaction times for the three groups of participants are shown in Table 5. There was a significant main effect of word type ($F_{3,357} = 76.181$, $P < 0.001$) and group ($F_{2,119} = 7.876$, $P = 0.001$), and the interaction between word type and group was significant ($F_{6,357} = 2.197$, $P = 0.043$), indicating that participants in the three groups had a different pattern of responses.

Table 2 Frequency and stroke of four types of emotional words

	Neutral	GAD-related	PD-related	Positive
Frequency	150.96 ± 152.61	133.25 ± 215.40	144.37 ± 273.16	183.25 ± 243.88
Stroke	18.04 ± 3.87	18.38 ± 5.79	19.54 ± 3.86	18.87 ± 4.07

Notes: Values are the mean ± standard deviation; Kruskal-Wallis test: frequency, $\chi^2 = 6.906$, $df = 3$, $P = 0.075$; stroke: $\chi^2 = 2.508$, $df = 3$, $P = 0.474$.
Abbreviations: GAD, generalized anxiety disorder; PD, panic disorder.

Table 3 Mean questionnaire scores for GAD, PD, and HC groups

	PD n = 34	GAD n = 42	HC n = 46	χ^2	*P*	PD versus HC	GAD versus HC	PD versus GAD
SAI	48.47 ± 14.87	44.40 ± 13.06	28.17 ± 7.08	47.680	<0.001	*	*	ns
TAI	50.50 ± 12.10	49.43 ± 9.75	31.61 ± 7.43	59.794	<0.001	*	*	ns
SAS	57.29 ± 13.41	53.00 ± 9.20	31.65 ± 5.74	74.544	<0.001	*	*	ns
SDS	42.85 ± 9.08	39.17 ± 8.01	29.02 ± 6.26	48.566	<0.001	*	*	ns

Notes: Values are the mean ± standard deviation; Kruskal-Wallis test, use Wilcoxon rank sum test for multiple comparisons; *Wilcoxon rank sum test $P < 0.001$; ns, Wilcoxon rank sum test $P > 0.05$.

Abbreviations: PD, panic disorder; GAD, generalized anxiety disorder; HC, healthy control; SAI, State Anxiety Inventory; TAI, Trait Anxiety Inventory; SAS, Self-rating Anxiety Scale; SDS, Self-rating Depression Scale.

In the PD group, the reaction times for PD-related words were longer than those for neutral words, and the reaction times for positive words were shorter than those for neutral words ($F_{3,99} = 35.499$, $P < 0.001$; LSD post hoc tests, PD-related words versus neutral words, $P < 0.001$; positive words versus neutral words, $P < 0.001$; GAD-related words versus neutral words, $P = 0.447$; GAD-related words versus PD-related words, $P < 0.001$; GAD-related words versus positive words, $P < 0.001$; and PD-related words versus neutral words $P < 0.001$). The PD group shared similar variability of reaction times for different word types with that of the control group ($F_{3,135} = 19.954$, $P < 0.001$; LSD post hoc tests, PD-related words versus neutral words, $P < 0.001$; positive words versus neutral words, $P < 0.001$; GAD-related words versus neutral words, $P = 0.954$; GAD-related words versus PD-related words, $P = 0.001$; GAD-related words versus positive words, $P < 0.001$; and PD-related words versus positive words, $P < 0.001$). In the GAD group, the reaction times for GAD-related words and PD-related words were longer than those for neutral words, whereas the reaction times for positive words were shorter than those for neutral words ($F_{3,123} = 29.741$, $P < 0.001$; LSD post hoc tests, PD-related words versus neutral words, $P < 0.001$; positive words versus neutral words, $P < 0.001$; GAD-related words versus neutral words, $P < 0.001$; PD-related words versus GAD-related words, $P = 0.152$; GAD-related words versus positive words, $P < 0.001$; and PD-related words versus positive words, $P < 0.001$).

We observed a significant main effect of block ($F_{2,238} = 14.070$, $P < 0.001$). No interaction between block and group was observed ($F_{4,238} = 0.315$, $P = 0.868$), indicating that over the three blocks, all three groups of participants were reacting faster, indicating a learning effect, and there was no interaction between block and word type ($F_{6,714} = 1.595$, $P = 0.146$).

The PD and GAD groups were divided into a medicine-naïve group and a medicine-experienced group. A repeated-measures analysis of variance was conducted, with group (two levels, ie, medicine-naïve and medicine-experienced) as the between-subject variable and word type as the within-subject variable. There was no significant main effect of group in patients with GAD and PD (GAD, $F_{1,40} = 0.336$, $P = 0.566$; PD, $F_{1,32} = 0.108$, $P = 0.744$), nor was there a significant interaction between group and word type in any of the patients (GAD, $F_{3,120} = 0.947$, $P = 0.420$; PD, $F_{3,96} = 0.607$, $P = 0.612$). There were no significant correlations between emotional interference score and any of the mean questionnaire scores in each of the three groups.

Discussion

This study shows that, in comparison with controls, participants with GAD and those with PD are slower to respond to all kinds of stimuli, suggesting that attention to an ongoing task may be interfered with in patients with an anxiety disorder. In other words, these patients may have cognitive impairment to some extent. The study conducted by Gualtieri and Morgan showed that substantial numbers of patients with anxiety were cognitively impaired in five domains, ie, memory, psychomotor speed, reaction time, attention, and cognitive flexibility.[21] Our findings are consistent with their results. However, the strength of our conclusion is limited by the possibility of a false-positive result due to the small sample size.

We found that all three groups of participants had longer response latencies in color-naming PD-relevant words. PD-relevant words such as "impending death", "smothered", and "palpitation", are closely related to human survival. From the perspective of biological evolution, preferential processing of dangerous survival-relevant information tends to be an adaptive process in humans.[22]

We found that patients with GAD had longer response latencies in color-naming both PD-relevant words and GAD-relevant words. Becker et al found that patients with GAD took longer than controls to name the color of GAD-related

Table 4 Error numbers for four types of emotional words in the three groups

	Four stimuli	Neutral	GAD-related	PD-related	Positive
PD (n = 34)	14.74 ± 16.13	3.85 ± 4.26	3.68 ± 4.35	3.88 ± 4.58	3.32 ± 3.98
GAD (n = 42)	12.05 ± 9.69	2.74 ± 2.77	3.29 ± 2.59	3.64 ± 3.23	2.36 ± 2.44
HC (n = 46)	9.35 ± 4.81	2.59 ± 1.92	2.22 ± 1.53	2.54 ± 1.91	2.11 ± 1.61

Notes: Values are mean ± standard deviation; repeated-measures analysis of variance: word type effect $F_{3,357} = 4.864$, $P = 0.002$; group effect $F_{2,119} = 2.411$, $P = 0.094$, interaction between word type and group $F_{6,357} = 1.324$, $P = 0.246$.
Abbreviations: PD, panic disorder; GAD, generalized anxiety disorder; HC, healthy controls.

and speech-related words.[4] Taghavi et al found that children and adolescents with GAD displayed a Stroop interference effect for threat-related as well as depression-related words.[5] Studies using other experimental procedures, such as visual search tasks and visual probe tasks, also found that patients with GAD had attentional bias to threatening and negative stimuli.[23–25] Our findings were consistent with the results of these studies. GAD is characterized by excessive worry or concern about a variety of everyday problems, such as health issues, money, family problems, or difficulties at work, even though there is little or nothing to provoke it. The anxiety of the GAD patient is more intense than the situation warrants. The more extensive interference effect observed for patients with GAD might be due to a greater array of stimuli able to trigger the anxiety schema in these patients.

The results of this study show that patients with PD shared a variability of reaction times for emotional words that was similar to that in healthy controls. During the last 20 years, several studies have investigated attentional bias in PD, and inconsistent results have been obtained. The first study in this field was conducted by Ehlers et al in 1988. They found that patients with PD tended to be slower in color-naming threat words, and nonclinical panickers showed greater interference than controls in color-naming threat words.[26] In a study by Maidenberg et al, patients with PD showed significantly longer response times to PD-related and general threat words than to neutral words.[7] A study conducted by Hope et al found that panickers had longer latencies for physical threat words.[12] The results of a study by Lundh et al showed that patients with PD and agoraphobia showed Stroop interference for PD-related words both subliminally and supraliminally.[6] Two recent studies also showed that patients with PD exhibited an attentional bias towards panic-relevant stimuli.[27,28] Meanwhile, there were some studies which found the opposite results. Some studies found that patients with PD exhibited greater Stroop interference for all threat words, especially those associated with catastrophe[8,9] and panic-threat words[10] compared with neutral words, but no significant difference from normal controls was found. Kampman et al did not find differing Stroop interferences between patients with PD and normal controls.[29] The results of a study by Schneider et al revealed that the children of patients with PD did not show an attentional bias for panic-relevant stimuli.[30] In a study by De Cort et al, there were no differences in reaction time between a PD group and a healthy control group, or for different word types (panic threat, general threat, and neutral).[31]

Further, we did not find specific attentional bias in patients with PD, and studies had found that other phenomena could suppress a specific Stroop effect. One possible source of suppression is external stressors.[32,33] In our study, all participants completed the emotional Stroop task under the same conditions. According to the mean questionnaire scores, patients with PD were more anxious than the healthy controls. Nevertheless, correlation analysis revealed no significant relationship between mean State-Trait Anxiety Inventory, Self-rating Anxiety Scale, and emotional interference scores. Differences in mean State-Trait Anxiety Inventory and Self-rating Anxiety Scale scores between the GAD group and the PD group were not significant, whereas they showed different variability of reaction times for emotional words. Therefore, the overall anxiety level during the experiment did not seem to explain the results.

Table 5 Reaction times for four types of emotional words in the three groups

	Neutral	GAD-related	PD-related	Positive	Four stimuli
PD (n = 34)	656.47 ± 110.05	654.36 ± 105.18	671.63 ± 112.45	641.20 ± 109.85	655.99 ± 109.03
GAD (n = 42)	688.90 ± 97.79	696.32 ± 99.85	700.38 ± 102.29	679.56 ± 99.32	691.21 ± 99.26
HC (n = 46)	614.46 ± 64.71	614.63 ± 69.74	625.94 ± 62.90	602.58 ± 66.53	614.36 ± 64.77

Notes: Values are the mean ± standard deviation in msec; repeated-measures analysis of variance: word type effect, $F_{3,357} = 76.181$, $P < 0.001$; group effect, $F_{2,119} = 7.876$, $P = 0.001$ (least squares difference post hoc tests, PD versus HC, $P = 0.046$; GAD versus HC, $P < 0.001$; PD versus GAD, $P = 0.094$), interaction between word type and group $F_{6,357} = 2.197$, $P = 0.043$.
Abbreviations: PD, panic disorder; GAD, generalized anxiety disorder; HC, healthy controls.

Another possible source of suppression of the Stroop effect was the presence of depression.[34,35] In this study, the mean Self-rating Depression Scale score for the PD group was remarkably higher than that for a control group. No significant relationship between mean Self-rating Depression Scale score and Stroop interference score was observed according to correlation analysis. Further, the difference in mean Self-rating Depression Scale score between the GAD group and the PD group was not significant. Therefore, it was not depression that suppressed the specific Stroop effect in patients with PD.

The subjects were required to respond to 288 stimuli in this research, which was a time-consuming process. One study using a dot-probe task demonstrated that participants with a high level of anxiety showed attentional bias to threat-related words on the first occasion, and that the attentional bias vanished when the participants were presented with more stimuli.[36] Although we found a learning effect for the emotional Stroop task, the interaction between block and word type was not significant, indicating that the reaction times for all types of emotional words were becoming faster over the three blocks. Therefore, the lack of specific attentional bias in patients with PD did not result from task habituation.

Patients with PD are characterized by their fear of fear, their bodily sensations, and their catastrophic misinterpretations. Patients with PD may have specific attentional bias towards physical sensations. Palpitation and a sensation of asphyxia are the most common physical symptoms of a panic attack. Kroeze and van Den Hout[37,38] conducted studies to investigate the attentional bias towards heartbeat information and hyperventilatory sensations in patients with PD. Compared with healthy controls, no evidence was found to support specific selective attention to tachycardia and hyperventilation in patients with PD.

A drawback of the emotional Stroop task is that attentional processes are not measured independently.[39] The dot-probe detection task does not have this disadvantage. Asmundson and Sandler compared responses to social threat cues, and found that patients with PD had reduced detection latencies to probes presented when they were actively reading stimuli pertaining to a physical threat, and this effect was not observed among control subjects.[40] However, these investigators failed to replicate their findings in subsequent research, in which no differences were observed in detection latencies for visual probes that followed neutral, social threat, or panic symptom/fear cues between a PD group and a healthy control group.[41]

To summarize, there is insufficient evidence as yet to support the existence of specific attentional bias in patients with PD. Our study found that errors for positive words were less than those for neutral words, and reaction times for positive words were shorter than those for neutral ones. Previous studies were seldom concerned about words with a positive valence, with some research showing that positive words did not produce a Stroop effect[42] and that prolonged reaction times were shorter than those for negative words.[4] In a study by Waters et al, severely anxious children with GAD also showed an attentional bias toward happy faces.[25] Our results are in contrast with those of Waters et al, possibly because of the varied setting of emotional Stroop tasks. The emotional words were all displayed on cards in early studies,[4] and the same type of emotional words were presented in succession within a block in the study conducted by Demily et al,[42] whereas pseudo random presentation was adopted in the present investigation. Research carried out by Zen's study showed that when the emotional words were presented pseudorandomly or presented after positive emotional pictures as effective priming, the reaction times of positive words were shorter than neutral words,[43] which is consistent with the findings of our study. It is suggested that in circumstances where negative and positive stimuli are presented alternately, the positive stimulus tends to be neglected by subjects, and does not interfere with ongoing cognitive activity.

Limitations

Several limitations of this study merit discussion. First, its conclusion might be limited due to its small sample size. Second, about half of our patients were on antidepressant medication. The impact of this on the emotional Stroop task in patients with anxiety is not clear. A recent meta-analysis concerning executive dysfunction in unipolar major depressive disorder suggested that significant improvements in Stroop performance might be obtained during the course of antidepressant treatment.[44] Further, the side effects of other drugs, such as benzodiazepines, might interfere with attentional performance. Therefore, the patients were grouped according to whether they had taken medication or not. Further analysis showed no remarkable difference in performance of the emotional Stroop task between medication users and nonusers, nor was there a correlation between Stroop interference scores and mean questionnaire scores. However, given the small sample size and complex medication used in patients in our study, we cannot fully assess the effect of medication.

For now, a complete system of emotional words like the Affective Norms for English Words has not been devel-

oped in China. The Chinese Affective Words System only distinguishes positive emotional words from negative ones, but does not further distinguish between different types of negative emotional words. Therefore, when choosing stimulus materials, we referred to other Chinese research.

Conclusion

Despite the above limitations, the present study is the first to the authors' knowledge to compare differences in attentional bias between patients with GAD and those with PD. We found that patients with GAD and those with PD had different patterns of attentional bias, and that there is not sufficient evidence to support the existence of specific attentional bias in patients with PD at this time. Future research might include an investigation of the effects of antidepressant medication on Stroop performance.

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Disclosure

The authors report no conflicts of interest in this work.

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