Cognitive Processing Bias of Children in a Real Life Stress Situation and a Neutral Situation

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The aim of this study was to investigate whether nonclinically anxious children, like anxious adults, favor the processing of threatening or concern-related information. Two experiments, using an emotional Stroop task, were carried out in high anxious and low anxious children aged 8 to 9 to examine whether a medical stressor elicited a processing bias. Results indicated that, independently of the presence of the medical stressor, all children give high priority to the processing of information related to physical harm. Moreover, like anxious adults in other studies, high anxious children showed a processing bias for generally threatening information. This bias was absent in the vicinity of an acute stressor and it was only significant in girls. However, unlike low anxious adults, low anxious girls also showed this processing bias. These results are interpreted in terms of cognitive developmental differences in the ability to inhibit the processing of meaningful information.

INTRODUCTION

There is ample evidence that anxious adults show information-processing biases for threatening information (MacLeod, 1991; MacLeod & Mathews, 1991; Mathews, 1990). Current theorists in developmental psychology argue that cognitive factors are similarly important in anxious children (Kendall & Ronan, 1990). However, it is unclear whether anxious children show these cognitive biases. The existence of biased processing has only been reported once in children who feared spiders (Martin, Horder, & Jones, 1992) and once in a preliminary study in clinically anxious children (Vasey, Daleiden, Williams, & Brown, 1995). When these biases exist in children and can be shown to be associated with anxiety, they may indicate a causal cognitive...
developmental link between trait anxiety and the onset and maintenance of pathological anxiety and fears. Therefore, investigation of these biases warrants considerable attention.

Originally, threat-related bias in anxious individuals was explained in terms of Beck’s schema theory of mood and cognition (Beck, 1976; Beck & Clark, 1988; Beck, Emery, & Greenberg, 1986) or Bower’s network model (Bower, 1981, 1987). Although both explanations predict that anxiety influences cognitive processing at all levels of information processing, striking differences have been shown for these levels. There is ample evidence for biases at the encoding stages of processing threatening information, but there is little evidence for biases in retrieval of this information (Williams, Watts, MacLeod, & Mathews, 1988). It has been suggested that anxious individuals are characterized by an increased tendency to selectively activate mood congruent representations, but not by an increased tendency to elaborate such representations (MacLeod & Mathews, 1991a). Moreover, MacLeod and Mathews (1991a) stated that mood congruency effects will only be loosely associated with trait or state emotion, but that these effects would be best predicted by the interactive functioning of both trait and state variables. Empirical evidence from a study by MacLeod and Mathews (1988) sustains this view. They studied processing bias for threatening information in a nonclinical population of high and low trait anxious students. The students were first tested when the anxiety state was low, early in the semester, and again when their state anxiety was high, in the week prior to an important examination. On the test occasion, when state anxiety was low, none of the subjects showed a bias when presented with threatening stimuli. However, on the test occasion just before the examination, high trait anxious subjects shifted attention toward examination-relevant threat words (e.g., failure and test), whereas low trait anxious subjects showed a shift of attention away from such stimuli. On the basis of these results, MacLeod and Mathews (1988) suggested that the cognitive effects of anxiety are seen most clearly in subjects in whom there is not only a long-standing vulnerability to anxiety responses, but where state anxiety is also elevated by the current situation. In their view, high trait anxious individuals respond to state anxiety with an increased tendency to selectively encode threatening information from their environment. This intensifies state anxiety, which will again elicit a biased pattern of encoding that results in a further increase in state anxiety, and so on. In this way, high trait anxious individuals seem to employ a ‘feed-forward’ system in processing threatening information (MacLeod, 1991). On the contrary, low trait anxious individuals respond to state anxiety with an increased tendency to selectively avoid encoding such threatening information. As a consequence, further enhancement of this emotion is prevented.

A range of different experimental methodologies have been employed to study processing biases related to anxiety. In all paradigms, subjects are presented with emotionally threatening and neutral stimulus words. Subjects
are explicitly instructed to ignore these emotional or neutral words (which are thus termed “distractor stimuli”) and to concentrate on performing some other simple central task. The degree to which subjects are able to successfully ignore these emotional distractor stimuli is revealed by the extent to which performance on this central task is impaired by the presentation of these distractors. The experimental paradigm that is most commonly employed in processing bias research is the emotional Stroop task, a modification of the Stroop color-naming task (Stroop, 1935). In this task, words written in different ink colors are presented and subjects are required to name the ink color as fast as possible while ignoring the word content. Color-naming latencies for threat words compared to neutral words provide a measure of the degree to which subjects favor the processing of threatening information.

It appears that anxious patients often show the greatest color-naming disruption on being confronted with those threat words which most closely correspond to their own particular domain of concern. For example, generalized anxiety patients, who worry mostly about health-related issues, show the greatest color-naming interference on threat words which are specifically related to physical concerns, such as “injury” or “cancer” (e.g., Mathews & MacLeod, 1985; Mogg, Mathews, & Weinman, 1989). In a study by Hope, Rapee, Heimberg, and Dombek (1990) color-naming times for physical and social threat words were compared in panic disorder and social phobic patients. As predicted, in the panic patients there was an increase in color-naming latencies for the physical threat words but not the social threat words. In the social phobics the reverse pattern was found, with increased color-naming times for social threat words but not for physical threat words.

The first publication on processing bias in childhood anxiety appeared in 1992 (Martin et al., 1992). Using a card version of the emotional Stroop task, a biased cognitive processing for spider related words was found in children with spider fear. This was found in children as young as 6 to 7 years and the magnitude of the observed bias did not significantly change over the range of age (6–12 years) studied. The role of state anxiety was not tested in this work. To our knowledge no other studies have been reported which assessed worry-congruent processing bias in trait anxious children with the emotional Stroop task, either in neutral or in stressful situations.

In the current study processing bias in children aged 8 to 9 was tested in two situations: a neutral situation and a medically stressful situation. The stressful situation was an inoculation session, which was of interest from a research standpoint for several reasons. First, because inoculations are required for all (Dutch) children aged 8 to 9, a sizeable number of normal, healthy children could be selected. Second, all children who undergo medical procedures experience at least some fear (Siegel, 1988). Specifically, children associate syringes with the most dreaded part of visiting the doctor (Steward & Steward, 1981). Third, anticipating an injection has the advantage of being a real life source of stress. Fourth, in a comparable dental situation, high-
anxious children seem to differ from low anxious children in their cognitive functioning in such a way that the emergence of a processing bias is very likely. Kent (1987) noted that while low anxious children were able to dismiss threatening thoughts during dental treatment, high anxious children could not. In addition, high anxious children in a dental situation reported more negative cognitions than low anxious children, indicating a stronger preoccupation with the external aversive stimuli (Prins, 1985). Finally, children who demonstrated only preoperational reasoning ability were able to produce accounts that included descriptions of anticipatory thoughts of threat (Vasey, 1993). Thus, the anticipation of inoculation should be a suitable means for studying anxiety-related processing of threatening information in childhood.

The primary purpose of the present study was to test whether high and low anxious children show differential processing biases for (1) threatening information and (2) information related to physical harm in a medical situation. The existence of processing biases was tested in a medically stressful situation using the emotional Stroop task. This was presented to high and low anxious children aged 8 to 9, 20 min before they were inoculated. In the current experiment, stimulus words were separated in two sets. One set consisted of both threatening and nonthreatening items related to the medical stressor and to the fears of the anxious subjects, and the other set consisted of threatening and nonthreatening words which were unrelated to this domain of concern. These two sets were created because, as mentioned before, anxiety-linked processing biases are often found to be most pronounced with stimulus materials that are directly related to subjects’ specific domain of concern (Hope et al., 1990; Mathews & MacLeod, 1985; Mogg et al., 1989).

In summary, we had the following expectations. First, induction of stress will elicit selective processing of threat words in high anxious children, but not in low anxious children. Second, it was expected that this processing bias would be most pronounced for the concern-related words, i.e., the words associated with physical harm in a medical situation.

EXPERIMENT 1

Method

Subjects. Children were recruited from 27 elementary schools. After parents granted permission for cooperation of their child in the study, a total of 587 children aged 8 to 9 were given two self report measures of anxiety: the Trait form of the Spielberger State-Trait Inventory for children (STAIC: Bakker, Wieringen, van der Ploeg, & Spielberger, 1989; Spielberger, 1973) and the Fear Survey Schedule for Children Revised (FSSC-R: Ollendick, 1983; Oosterlaan, Kindt, Prins, & Sergeant, 1993).

The children were assigned to the high anxiety group if they met the following criteria: (i) a score above the 75th percentile on the trait version of the Spielberger test, (ii) a score above the 75th percentile on the Fear
Survey, (iii) answering ‘a little afraid’ or ‘very much afraid’ to item 21 of the Fear Survey: ‘Are you afraid of getting an injection?’ and (iv) a score above the 75th percentile of a sum score of 11 items about physical harm related to several aspects of a medical situation (medical fear). Since factor analysis of the Fear Survey (Ollendick, 1983) did not reveal a factor that specifically covered the scope of concern in this study, 11 items out of Factors 3, 4, and 5 were selected which were related to both physical harm and medical situations. The low anxiety group scored below the 25th percentiles on the Spielberger test and the Fear Survey. Moreover, they answered ‘not afraid’ to item 21 of the Fear Survey.

Sixty-one subjects were selected, but 14 subjects dropped out before testing with the Stroop task, due to technical and logistic problems. A total of 47 subjects participated in the experiment, consisting of 25 high anxious children (12 males and 13 females) and 22 low anxious children (12 males and 10 females). The children were aged 8 or 9. In addition, all subjects passed the tests for reading abilities and color blindness.

Materials. Children were administered a Stroop task which consisted of a standard Stroop and an emotional Stroop. The stimulus words in the standard color–word Stroop task were: (i) incongruent color words (red, blue, yellow, and green) and (ii) nonwords. The words used in the emotional Stroop task were four categories of words based on two factors: relatedness (related to physical harm in a medical situation versus unrelated to physical harm in a medical situation) and valence (threat versus nonthreat). The four resulting categories of words were: (iii) concern-related/threat; (iv) concern-related/nonthreat; (v) concern-unrelated/threat and (vi) concern-unrelated/nonthreat. The stimulus words were not matched on frequency since no frequency tables for children are available in Dutch. However, they were empirically matched on familiarity, i.e., readability. The concern-related words were drawn from a larger pool of 189 words which were all related to medical situations and physical harm. These words were rated by 184 children, who judged the familiarity and fearfulness of each word. Threat words and nonthreat words were matched on familiarity by selecting pairs of words. These pairs were selected if the percentages of children that judged each of the two words to be ‘very familiar’ did not differ for more than 2%. Care was taken that threat words were rated as fearful by at least 70% of the children and that the nonthreat words were rated as not fearful by at least 70% of the children. In this way four concern-related threat words and four concern-related nonthreat words were selected. They were rated as familiar by—respectively—89 and 85% of the children. The words were related to concerns similar to those covered by the physical harm items of the Fear Survey, on the basis of which the anxious subjects were selected.

For the concern-unrelated words we could make use of the results from an earlier study. In this study a perceptual clarification task was performed, in which 40 children aged 8–12 assigned 300 words as fast as possible to
one of four categories including ‘fear’ and ‘neutral.’ The threat and neutral words were selected when assignment percentages for the fear and neutral category were the highest and response latencies were the lowest. High assignment percentage indicates high agreement between the subjects on the emotional meaning and a low response latency indicates a fast recognition of the emotional meaning. Threat and neutral words were matched on assignment percentages and care was taken that they did not differ in response latencies.

In the emotional Stroop task each word was presented four times in one of the four colors: red, blue, yellow, and green. In the standard Stroop task incongruent color words were never presented in ink of the same color. In order to obtain the same number of stimuli as in the other word categories, every color word was presented one extra time in one of the four colors. In summary, there were six word categories: two categories in the standard Stroop task (incongruent color words and nonwords) and four categories in the emotional Stroop task (concern-related and concern-unrelated threat and nonthreat words). There were 16 stimulus words in each word category. Thus, there were \( 6 \times 16 = 96 \) stimuli presented to each subject.

Each subject was given a practice phase of 18 trials. All of the 96 stimuli were presented in trials of six blocks, each block consisting of one of the six word categories. The order of presentation of the six blocks was randomly determined for each subject within one group and matched across the two groups. The order of presentation within each block was a fixed random order. The only constraints were that neither a word nor a color appeared more than twice in succession.

**Apparatus.** The Stroop words were presented to the subject via an IPC microcomputer with an Intel 80386 microprocessor and color monitor. Color-naming responses were detected by a Voice Key, connected to the microcomputer. A Keithley 575 measurement and control system was used to present stimuli and to record response times with millisecond accuracy. The presentation software recorded response latencies per word in milliseconds, operationally defined as the interval between stimulus word presentation and the detection of the vocal response. Errors were marked with the use of an interface response box containing four buttons for each of the colors, operated by the experimenter.

All words appeared in the center of the computer screen. On each color-naming trial, a little fixation block appeared for 500 ms at the center of the screen 1000 ms before word onset. Each word was on the screen until the subject reacted, but for no more than 2000 ms. If there was no record of a response latency within 2000 ms, the trial was considered as missing and an error was registered.

**Procedure.** Testing was conducted on two occasions. The first test session took place at school. The subjects were informed about the long-term purpose of the experiment: to help children in medical situations. Subjects filled in the trait version of the Spielberger test and the Fear Survey.
The second test session took place at a medical service center, approximately six weeks after the first session. Each subject was tested individually; parents were sitting in the waiting room. The experimenter was unaware of the group to which each subject was assigned. All subjects were informed that before they were injected, they would be given some questionnaires and a computer task. The subjects were first asked to fill in on a visual analogue scale how much they feared getting the injections (injection-fear scale). Furthermore, a reading ability test was administered to all subjects. They were asked to read as fast as possible ten difficult words presented on a sheet. Both the standard Stroop task and the emotional Stroop task were administered to the subjects. They were instructed to name aloud as fast as possible the color of the ink in which each word or nonword was written, while ignoring the meaning of the word. The task started with a color blindness test in which subjects were asked to name the color of blocks which were presented in the middle of the screen. All children started with 18 practice words. After the last trial, subjects completed the State version of the Spielberger test. Finally, the child and the parent were escorted to the injection room. After the inoculation the parent returned to the waiting room and the child was again asked on a visual analogue scale to fill in how afraid they had been of getting the injection (injection-fear scale). Children were given a small reward for participating.

Statistical analyses. Mean color-naming latencies were calculated for each stimulus type. Standard Stroop data were analyzed with a three-way analysis of variance (ANOVA) for repeated measures with stimulus type (nonwords, color words) as a within-subject factor, and group (low trait anxiety, high trait anxiety) and sex (girls, boys) as between-subjects factors. Emotional Stroop data were analyzed with a four-way ANOVA for repeated measures with two between-subjects factors and two within-subject factors. The between-subjects factors were the same as in the standard Stroop. The within-subject factors were valence (threat words versus nonthreat words) and relatedness (physical harm versus nonphysical harm).

Results

Anxiety scores. Mean scores on the Spielberger test, Fear Survey, and injection-fear scale are shown in Table 1. A series of analyses of variance were performed on the questionnaire scores for the high and low anxiety groups (see Table 1 for mean scores). As expected, analysis of trait anxiety measured by the Spielberger test showed a significant difference between the two anxiety groups, $F(1,43) = 75.2, p < .001$. There were no effects of sex. Trait anxiety measured by the Fear Survey was significantly different for the two anxiety groups, $F(1,43) = 214.8, p < .001$, and for the two sexes, $F(1,43) = 5.7, p < .05$, with girls reporting some more fear than boys. There was no interaction between group and sex. Analysis of medical fear measured by
the Fear Survey yielded a significant effect of group, $F(1,43) = 299.6, p < .05$. Again, there were no effects of sex.

Analyses of state anxiety confirmed that in the stressful situation in which the Stroop task was administered, the state level of the high anxiety group was higher than the state level of the low anxiety group. These groups differed significantly in terms of their state anxiety measured by the Spielberger test, $F(1,43) = 25.9, p < .001$, and measured by the injection-fear scale before treatment, $F(1,43) = 4.6, p < .05$, and after treatment, $F(1,43) = 10.9, p < .01$. There were no effects of sex on any of the state scores.

**Stroop data.** Mean color naming latencies and standard deviations for the standard Stroop task and the emotional Stroop task are presented in Table 1. Outlier latencies below 300 ms were eliminated from the analyses and outliers above 3000 ms were not recorded by the computer. Mean error percentage was low ($M = 3.8\%; SD = 3.3\%)$. There were neither main effects nor interaction effects on error percentages of the factors group and sex. As expected, in the standard Stroop task, there was a significant main effect of stimulus type, $F(1,43) = 121.98, p < .001$, with mean latencies larger for

<table>
<thead>
<tr>
<th></th>
<th>Low trait anxiety</th>
<th>High trait anxiety</th>
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<tbody>
<tr>
<td></td>
<td>Boys ($n = 12$)</td>
<td>Girls ($n = 10$)</td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trait</td>
<td>94.4 (8.6)</td>
<td>107.2 (16.3)</td>
</tr>
<tr>
<td>Medical fear</td>
<td>11.6 (1.1)</td>
<td>12.6 (2.1)</td>
</tr>
<tr>
<td>Spielberger test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trait</td>
<td>26.3 (5.2)</td>
<td>28.4 (8.1)</td>
</tr>
<tr>
<td>State</td>
<td>33.0 (4.1)</td>
<td>34.0 (4.6)</td>
</tr>
<tr>
<td>Injection-fear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>20.3 (23.1)</td>
<td>29.4 (18.8)</td>
</tr>
<tr>
<td>After</td>
<td>13.3 (22.0)</td>
<td>19.0 (25.0)</td>
</tr>
<tr>
<td>Stroop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonwords</td>
<td>1248 (118)</td>
<td>1118 (235)</td>
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<tr>
<td>Incongruent color</td>
<td>1456 (192)</td>
<td>1380 (242)</td>
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<tr>
<td>Concern unrelated</td>
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<tr>
<td>Nonthreat</td>
<td>1314 (160)</td>
<td>1190 (206)</td>
</tr>
<tr>
<td>Threat</td>
<td>1311 (177)</td>
<td>1212 (202)</td>
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<tr>
<td>Concern related</td>
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<td></td>
</tr>
<tr>
<td>Nonthreat</td>
<td>1352 (188)</td>
<td>1229 (213)</td>
</tr>
<tr>
<td>Threat</td>
<td>1322 (196)</td>
<td>1258 (247)</td>
</tr>
</tbody>
</table>

*Note.* Standard deviations are shown in parentheses.
color words (1434 ms) than for nonwords (1165 ms). There were no other effects of group, sex and stimulus type.

The only significant effect of the emotional Stroop task was a main effect of relatedness, $F(1,43) = 6.6, p < .05$. Thus, color-naming of all subjects were slower for concern-related words (1270 ms) than for concern-unrelated words (1229 ms). Separate analysis of the words which directly pertain to the stressful situation the subjects anticipated (injection and fainting) did not reveal different results. For the emotional Stroop task, there were no main effects of group, sex, and valence, and there were no interactions between any of the factors.

Discussion

First of all, both high and low anxious children displayed a standard Stroop effect, which indicates that the most important prerequisite for administering an emotional Stroop task to children was met. The results indicate that high anxious children did not differ from low anxious children in their bias for threatening information in general, nor for threatening information related to their specific concern and to the source of stress. These differential biases were absent despite the fact that the stressful situation was associated with significantly higher state anxiety in the high anxious children than in the low anxious children. On the other hand, a processing bias for concern-related information was present in all children. While these findings are not in line with the differential effects found by MacLeod and Mathews (1988), who used examination stress, they are consistent with the findings of Mogg, Mathews, Bird, and Macgregor-Morris (1990). In the latter study, all subjects under high stress, which was induced by a difficult anagram task with false negative feedback, showed a processing bias favoring stimuli relevant to the stressor. This bias could not be accounted for by state anxiety, nor by trait anxiety. A plausible explanation for the discrepancy between the MacLeod and Mathews study on the one hand and the Mogg et al. study and our study on the other hand, pertains to differences in the type of stressor used. Mogg et al. provided a relatively acute source of stress, i.e., a stress induction immediately before assessing cognitive bias, whereas MacLeod and Mathews provided a prolonged stressor. As Mogg et al. suggested, following acute stress, all individuals selectively allocate processing resources to threat stimuli. This bias may result from the stressful event directly priming cognitive representations of threat. Therefore, the response to acute stress may not easily be modified by individual differences in susceptibility to anxiety. On the other hand, cognitive responses to prolonged stressors like MacLeod and Mathews’ may more easily be modified by these individual differences. In an acute stressful situation both high and low anxious individuals adopt a strategy which gives priorities to the processing of stressor-related information. However, in a prolonged stressful situation, this biased processing is dysfunctional because it unnecessarily intensifies and prolongs stress-related
state anxiety. It is therefore conceivable that in a prolonged stress situation only high anxious individuals show a bias for stressor-related information. Hence, our finding that the high anxious as well as the low anxious children showed a processing bias for concern-related information, regardless of their threat value, might be accounted for by the relative acuteness of the medical stressor.

An alternative explanation for the absence of a differential bias in an acute stress situation is offered by the findings of Mathews and Sebastian (1993). They showed that the presence of a simultaneous stressor abolished the interference effect of threat words. This was evidenced by a reappearance of a differential bias for threatening information in a neutral situation in a subsequent experiment. They argued that the presence of a simultaneous stressor might cause subjects to allocate priority to the more real and threatening event, at the expense of processing word meaning. In other words, the presence of a real danger alters processing priorities in fearful subjects (Mathews & Sebastian, 1993). In a study by MacLeod and Rutherford (1992) a similar prolonged stressor as in the MacLeod and Mathews (1988) study induced even a reverse pattern of selective processing of stress relevant stimuli, in both low and high trait-anxious individuals. Hence, it is still possible that high and low anxious children differ in their processing bias for threatening relevant information, but that the near presence of the stressful inoculation in our study abolished this difference. However, while this explanation can account for the absence of threat-related bias, it does not account for the bias for concern-related words.

In summary, the role of the acute stressor in eliciting a processing bias is unclear. Therefore, a second experiment was needed to clarify whether high anxious children in contrast with low anxious children would show a processing bias in the absence of an acute stressor.

**EXPERIMENT 2**

A second experiment was thus designed to investigate whether the presence of the medical stressor in the first experiment contributed to the absence of the cognitive bias effects related to anxiety. We expected that, in a neutral situation, high anxious children in contrast to low anxious children show a cognitive bias for threatening information.

**Method**

*Subjects.* From an additional sample of 579 children aged 8 or 9 years, recruited from 20 elementary schools, 56 subjects were selected using the same criteria as in Experiment 1. Six subjects dropped out before testing with the Stroop task, due to illness of the children. The children who participated in the experiment were 26 high anxious children (12 males and 14 females) and 24 low anxious children (13 males and 11 females). Again, all children passed the tests for reading abilities and color blindness.
TABLE 2
Means of the Spielberger Test, Fear Survey, and Mean Color Naming Latencies in Milliseconds in Experiment 2

<table>
<thead>
<tr>
<th>Scores</th>
<th>Low trait anxiety</th>
<th>High trait anxiety</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Boys (n = 13)</td>
<td>Girls (n = 11)</td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
<td></td>
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<tr>
<td>Fear survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trait</td>
<td>97.9 (23.9)</td>
<td>101.2 (10.0)</td>
</tr>
<tr>
<td>Medical fear</td>
<td>12.9 (3.8)</td>
<td>12.9 (2.0)</td>
</tr>
<tr>
<td>Spielberger test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trait</td>
<td>26.0 (4.6)</td>
<td>25.8 (2.4)</td>
</tr>
<tr>
<td>State</td>
<td>29.7 (3.4)</td>
<td>31.4 (2.6)</td>
</tr>
<tr>
<td>Stoop</td>
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</tr>
<tr>
<td>Nonwords</td>
<td>1173 (145)</td>
<td>1019 (99)</td>
</tr>
<tr>
<td>Incongruent color</td>
<td>1513 (224)</td>
<td>1347 (243)</td>
</tr>
<tr>
<td>Concern unrelated</td>
<td>1246 (136)</td>
<td>1038 (118)</td>
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<tr>
<td>Nonthreat</td>
<td>1259 (157)</td>
<td>1132 (140)</td>
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<tr>
<td>Threat</td>
<td>1298 (147)</td>
<td>1102 (140)</td>
</tr>
<tr>
<td>Concern related</td>
<td>1327 (212)</td>
<td>1196 (154)</td>
</tr>
</tbody>
</table>

Note. Standard deviations are shown in parentheses.

Materials and apparatus. The same stimulus words and Stroop program were used as in Experiment 1.

Procedure. The procedure was similar to the procedure of Experiment 1, with one major exception. In this experiment the Stroop task was administered to the children in a nonstressful situation, at school. Children got the same information about the purpose of the study as in Experiment 1.

Results

Anxiety scores. Mean scores on the Spielberger test, Fear Survey and injection-fear scale are shown in Table 2. It was found that, as expected, the two groups differed in terms of trait anxiety measured by the Spielberger test, \( F(1,46) = 240.2, p < .001 \). There were no effects of sex. Trait anxiety measured by the Fear Survey differed also significantly between the two groups, \( F(1,43) = 197.8, p < .001 \) and between the sexes, \( F(1,43) = 4.4, p < .05 \), and there was no interaction between group and sex. Medical fear measured by the Fear Survey was only influenced by group, \( F(1,43) = 184.5, p < .001 \). State anxiety, measured by the Spielberger test, was significantly higher in the high anxiety group than in the low anxiety group, \( F(1,43) = 4.7, p < .05 \). There were no other effects on state anxiety.
Stroop data. Data were analyzed in the same way as in Experiment 1. Mean color naming latencies and standard deviations for the standard Stroop task and the emotional Stroop task are presented in Table 2. Outlier latencies below 300 ms were eliminated from the analyses and outliers above 3000 msec were not recorded by the computer. Mean error percentage was again low (M = 2.6%; SD = 2.4%). Analysis of the error percentages showed no difference between the two anxiety groups. There was a significant main effect of sex on error rates, \( F(1,48) = 117.07, p < .001 \), with boys showing more errors (M = 3.3%; SD = 3.0%) than girls (M = 1.9%; SD = 1.3%). There was no interaction effect between group and sex. In the standard Stroop, there was a significant main effect of stimulus type, \( F(1,46) = 111.5, p < .001 \), with mean latencies considerably larger for color words (1451 msec) than for nonwords (1123 ms). There were no other significant effects in the standard Stroop.

The Emotional Stroop task revealed no main effect of group, but a significant main effect of sex, \( F(1,46) = 4.3, p < .05 \), with boys (1270 msec) showing larger color naming latencies than girls (1187 ms). There was a significant interaction between group and sex, \( F(1,46) = 4.2, p < .05 \). Examination of the means showed that only in the low anxiety group boys (1283 ms) reacted slower than girls (1117 ms). Unlike the results of Experiment 1, there was a main effect of valence, \( F(1,46) = 11.2, p < .01 \). Color-naming of all subjects was slower for threat words (1253 ms) than for nonthreat words (1204 ms). There was also a significant interaction between sex and valence, \( F(1,46) = 4.7, p < .05 \), with girls showing more bias for threat words (\( RT_{\text{threat}} - RT_{\text{nonthreat}} = 80 \) ms) than boys (\( RT_{\text{threat}} - RT_{\text{nonthreat}} = 18 \) ms). T tests showed that this bias for threat information was only significant in girls, \( t(24) = 4.2, p < .001 \). It was possible that this effect was due to higher trait anxiety in girls, as it was measured by the Fear Survey. We investigated this possibility by calculating a correlation between a bias for threat words and the Fear Survey scores. This correlation was not significant. Hence, this sex difference could not be accounted for by anxiety. Finally, as in Experiment 1, there was a main effect of relatedness, \( F(1,46) = 14.8, p < .001 \). Color-naming latencies of all subjects were larger for concern-related words (1255 ms) than for unrelated words (1202 ms). There were no other significant effects.

Discussion

The results of this second experiment failed to confirm our expectations that removing the stressor would yield a differential processing bias. Hence, the lack of a differential processing bias in Experiment 1 was clearly not due to the presence of a medical stressor. Furthermore, in the neutral situation in Experiment 2, high and low anxious children showed a bias for the concern-related words, just like the medical situation in Experiment 1. This suggests that the near presence of the medical stressor was not responsible for the
PROCESSING BIAS OF CHILDREN

processing bias for this information. Therefore, the results of Experiment 1 can not be explained by assuming that an acute stressor causes interference in all subjects (Mogg et al., 1990). On the other hand, in the neutral situation of Experiment 2 a bias appeared for general threat, which was absent in Experiment 1. This finding is in line with the suggestion of Mathews and Sebastian (1993) that the presence of a stressor might abolish such a bias. These issues are pursued in the general discussion.

Surprisingly, the bias for generally threatening information was only significant in girls. This result, combined with the fact that anxiety disorders are more prevalent in women, is in line with the view that a bias for threat might play an etiological role in anxiety disorders. However, the finding that this bias was not associated with trait anxiety in children throws doubt on the theory that it is a causal link between trait anxiety and the development of anxiety disorders. Finally, the finding that not only the high anxious girls but also the low anxious girls showed a processing bias for threatening information is remarkable because this is generally not found in low anxious adults (e.g., MacLeod & Mathews, 1988; Mathews & Sebastian, 1993; Mogg et al., 1990). This issue is also pursued in the General Discussion.

GENERAL DISCUSSION

The present experiments were aimed at clarifying the question whether anxious children, like anxious adults, show a cognitive bias that favors threatening information. Together, the results from the two experiments allow the following three conclusions. First, threat-related processing bias in children seems not to be related to their anxiety. Second, independently of the presence of a medical stressor, all children give high priorities to the processing of information which is related to physical harm. Third, under nonstressful conditions but not under stressful conditions, all children show a processing bias for threatening information.

The finding that trait anxiety was not related to processing bias in children irrespective of state anxiety related to current concerns, is in contrast with the current cognitive-behavioral theories of anxiety. These theories state that these biases are characteristic of cognitive processing in trait anxious individuals, especially when state anxiety is elevated (MacLeod, 1991; MacLeod & Mathews, 1991a). It is possible that these theories are not applicable to children, at least not for nonclinically anxious children. These theories rest upon the supposition that information is cognitively organized around a theme of threat (Eysenck & Mathews, 1987; Mathews, 1990). Given this supposition, the question may be raised whether the fear network of the children in the present study was developed well enough to meet the implicit assumption of an emotional Stroop paradigm. This assumption involves that the stimulus words activate a fear network of the subjects, in order to produce processing biases for the threatening information. Mandler (1983) has argued that young children’s memories are organized schematically—and not yet categori-
cally—in ways that reflect relationships found in real world events and stories. However, according to Bjorklund (1985) such schematic relationships are gradually replaced by categorical relationships by 7 to 8 years of age. Furthermore, Campbell and Rapee (1994) did not find any developmental change in internal feared outcome representations, at least not from an age of around 6 years. They suggested that threat representations in long-term memory are similar both in children and in adults. Hence, there is no reason to doubt that the theories about the relation between cognitive bias and anxiety are applicable to children. Another and related possibility is that the cognitive representation of the specific fear domain in this study is not well enough developed in the children. However, fear outcome representations in children seemed to be clustered around two factors: concerns about social threat and physical threat (Campbell & Rapee, 1994), just like in adults (Lovibond & Rapee, 1993). In summary, it is reasonable to assume that the fear representations of the children in our study were sufficiently developed to yield concern-related information processing biases associated with anxiety. Consequently, the explanation of a not well-developed categorical network as a reason for the lack of differential processing bias is unlikely. This bias may simply not yet be present in children that are as young as those we studied. In a preliminary study, a bias for threatening information has been shown in 12 children that were somewhat older (9–14 years) and who were clinically anxious (Vasey et al., 1995).

Although our findings suggest the absence of anxiety related bias in 8–9 year old children, such a bias has been found in children with spider fear as young as 6 years (Martin et al., 1992). It might be that spider fear is a more specific fear than medical fear and therefore might have more easily triggered a bias in the latter study. On the other hand, there are differences in method which may also explain the divergence between their findings and our findings. Martin et al. used a traditional “card Stroop,” while we used a computerized “single-trial Stroop.” A difference between the card format and the single-trial format is that the stimuli in the card Stroop are presented in a context of the same valence and therefore might have been more effective in eliciting a processing bias. However, in the single-trial format the responses are timed by the computer with millisecond accuracy, which cannot be realized with the card format. In the card format the experimenter determines the response times. Consequently, when a card format is used to assess differential processing bias in anxious individuals, it is even more important for the experimenter to be ignorant of the group to which each individual belongs. This was not the case in the Martin et al. (1992) study. Moreover, since the differences in response times between the spider fear and nonfear children were only seconds, the influence of the experimenter cannot be excluded. This obscures the interpretation of their results and therefore do not decisively challenge our suggestion that there is no differential bias in children.

The finding that all children showed a bias for concern-related words
in the stress situation as well as in the neutral situation is difficult to understand. It is clear that this bias is not due to the presence of a stressor, which suggests that it might be a word effect that is not related to the content of the words, but to their readability. Stimulus word sets are usually matched on readability, operationalized in terms of familiarity or lexical frequency, word length and number of syllables. From the standard Stroop studies it is well-known that nonwords yield a significantly smaller interference effect than words. However, in the emotional Stroop task, it is unlikely that the magnitude of the differences in readability that may still exist between reasonably well-known word sets, which differ in meaning for the subjects, accounts for bias effects. In two recent studies (Riemann, Amir & Louro, 1995; Riemann & MacNally, 1995), it was shown that the emotional Stroop interference was not attributable to word length and frequency of usage. In one of their studies (Riemann et al., 1995) it was demonstrated that, irrespective of large differences in word length and lexical frequency between neutral words and emotional words, there was no differential emotional interference effect in the normal control subjects, whereas this effect was present in the anxious subjects. In the other study (Riemann & MacNally, 1995), highly significant differences between neutral and emotional words in word length and frequency also did not yield differences in Stroop interference. There is some further evidence that emotional interference cannot be accounted for by familiarity. In several studies (Lavy & van den Hout, 1993; Lavy, van den Hout & Arntz, 1993; Mattia, Heimberg & Hope, 1993; Watts, McKenna, Sharrock & Trezise, 1986) it is shown that the processing bias for threatening information in anxious subjects was reduced after treatment. Since it is not plausible that the familiarity of the threat words is decreased after treatment, emotional interference must be due to the emotional salience of the stimuli rather than to cognitive expertise (Watts, 1986). Thus, emotional Stroop interference seems not to be confounded by factors related to readability. The concern-related bias in both experiments must be due to other factors than readability. One possible explanation is provided by a recent study of Campbell and Rapee (1994). They showed that children between the age of 6 and 9, are especially concerned about physical threat and that worry for physical harm decreases with age. It is feasible that children appraise information related to physical harm as particularly meaningful. This may have caused a bias for this information in both experiments. The finding that this bias was found for all concern-related stimuli, irrespective of their threat valence, is in line with findings of Mathews and Klug (1993). They showed that the bias for concern-related information assessed by the emotional Stroop task can be independent of the valence of the stimuli. Besides, we might have primed concerns about physical harm in both experiments because all children got the same information about the purpose of the study (“to help children in medical situations”). This priming
may have caused automatic activation of the concern-related words resulting in a cognitive bias.

Finally, all children showed a bias for threatening information in the neutral situation whereas this was not the case in the stressful situation. This is in line with the results of Mathews and Sebastian (1993) who showed that the presence of a stressor abolished the bias in high-fear subjects. Processing capacity is allocated to the real life stressor instead of to the words, because the former is clearly more threatening than the latter. If this is true for our finding, it remains to be explained why in the present study the low anxious children also showed a processing bias for threatening information. This is in contrast with findings of adults, and therefore suggests a cognitive developmental explanation. During development, the child acquires skill in regulating emotional responses. An important aspect of emotion regulation are cognitive control processes. MacLeod and Mathews (1991b) suggested that emotions are associated with changes in the control of cognitive operations, rather than with changes in the efficiency of basic processes. They showed that adult anxiety is associated with an increase in the likelihood that threat words are encoded, instead of an increase in the efficiency with which they are processed. The likelihood of encoding a stimulus is co-determined by the ease by which distracting information is inhibited. The Stroop task measures in fact the degree in which subjects are able to inhibit processing the content of a word while naming the color of this word (MacLeod, 1991). While low anxious adults are believed to be able to inhibit processing of threatening but irrelevant information during the Stroop task, our results suggest that low anxious children seem less able to do so.

In summary, our findings suggest the following tentative picture of the relation of anxiety with cognitive processing bias in children aged 8 to 9. First, in these children there is no relation between nonclinical anxiety and processing bias, irrespective of their state anxiety. This throws some doubt on the suggestion that such biases form a causal link between trait anxiety and the development of anxiety disorders. Second, like adults, these children show a processing bias for threatening information that seems to diminish in the near presence of an acute stressor. The results suggest that this bias is restricted to girls. In contrast with adult cognitive performance, non anxious girls also show this processing bias, i.e., there is no differential effect for high and low anxious girls. This was explained by assuming that in a certain cognitive developmental stage children still lack abilities to inhibit the processing of emotional information. However, it is unclear why this lack of inhibitional abilities should be more pronounced in girls since this effect was not due to a difference in anxiety scores.

More work is needed before we shall have a clear understanding of the role of processing biases for emotional information in children and its consequence for the development of adult anxiety disorders. Future research should
be directed to cognitive developmental factors underlying the regulation of adverse emotions.

APPENDIX

Stimuli Used in the Emotional Stroop Task: Concern-Related Threat Words, Concern-Related Nonthreat Words, Concern-Unrelated Threat Words, and Concern-Unrelated Nonthreat Words

<table>
<thead>
<tr>
<th>Concern-unrelated</th>
<th>Concern-related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonthreat</td>
<td>Threat</td>
</tr>
<tr>
<td>baker</td>
<td>suffocate</td>
</tr>
<tr>
<td>(bakker)</td>
<td>(stikken)</td>
</tr>
<tr>
<td>paper</td>
<td>killer</td>
</tr>
<tr>
<td>(papier)</td>
<td>(moordenaar)</td>
</tr>
<tr>
<td>shoe</td>
<td>poisonous snake</td>
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<td>(schoen)</td>
<td>(gifslang)</td>
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<tr>
<td>curtain</td>
<td>kidnap</td>
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<tr>
<td>( gordijn)</td>
<td>(ontvoeren)</td>
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</table>

REFERENCES


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