Covariation Detection in Treated and Untreated Spider Phobics

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Twenty treated and 18 untreated spider phobics were exposed to a series of 72 slides. Three different categories of slides were used: phobia-relevant slides (spiders), alternative fear-relevant slides (weapons), and neutral slides (flowers). Slides were randomly paired with either a shock, a tone, or nothing at all. Despite the absence of a systematic correlation between slides and outcomes, untreated phobics strongly overestimated the covariation between spider slides and shock. Treated phobics did not show a covariation bias, suggesting that such bias can be modulated by behavioral treatment. In addition, untreated subjects were more confident about their contingency estimates than were treated subjects. The present results fit with earlier studies.

One of the striking features of simple phobia is the persistence of anxiety for certain stimuli (e.g., spiders) in the absence of contingent aversive events. Recently, Tomarken, Mineka, and Cook (1989) suggested that phobic subjects tend to overestimate the covariation between phobic stimuli and aversive events. Such a bias could be one of the mediating factors in the maintenance of phobic fear.

To investigate the relationship between fear and covariation bias, Tomarken et al. (1989; see also Mineka & Tomarken, 1989) exposed high- and low-fear students to an extensive series of slides depicting fear-relevant (spider or snake) and neutral (mushroom and flower) objects. All slides were equally frequently followed by aversive (i.e., electric shock) and neutral (i.e., nothing/tones) outcomes. Despite the fact that all slide-outcome combinations occurred equally frequently, Tomarken et al. (1989) found that high-fear students in contrast to low-fear students systematically overestimated the contingency between fear-relevant slides and electric shock. The authors argued that this "illusory correlation" is a manifestation of a more general bias in anxious subjects to associate fear-relevant stimuli with aversive events. They concluded that such covariation bias might play a critical role in the maintenance of phobic fear.

To further explore this hypothesis, de Jong and Merckelbach (1991) employed the same experimental procedure using untreated and treated women who were spider phobics. From Tomarken et al.'s study it was inferred that untreated but not treated spider phobics would show a covariation bias. However, that study only partially sustained the earlier findings of Tomarken and colleagues. That is, untreated spider phobics, indeed, significantly overestimated the spider-shock contingency, but quite unexpectedly, successfully treated phobics likewise showed a covariation bias (and to a similar degree). Thus, although spider fear was dramatically reduced as a result of a one-session in vivo exposure treatment (Öst, 1989), the covariation bias of treated subjects appeared to be similar to that of untreated subjects. To some extent, the discrepancy between the findings reported by Tomarken et al. and those reported by de Jong and Merckelbach might be due to sample differences. Note that Tomarken et al. worked with undergraduates, whereas subjects in the de Jong and Merckelbach study were older and less educated. Furthermore, the fear level of treated subjects in this study was substantially higher than that of the low-fear subjects in the Tomarken et al. study. The residual fear of treated subjects might have been sufficient to induce a considerable covariation bias.

The present study was undertaken to investigate two additional explanations for the apparent absence of treatment effect on covariation bias in spider phobics. First, not only the quantitative overestimation of the spider-shock contingency but also subjects' confidence in the reported covariations may be important to the covariation bias phenomenon. It could be hypothesized that although treated subjects overestimated the spider-shock contingency to the same extent as untreated phobics, they were less confident about their estimates than were untreated subjects. Therefore, in the present study subjects were asked to report contingency estimates as well as their confidence in these estimates.

Second, it can be argued that subjects in general selectively overestimate the contingency between aversive events and salient danger stimuli. From this perspective, it could be reasoned that in the de Jong and Merckelbach (1991) study, treated subjects still evidenced a strong bias to associate spiders with shock because no concurrent danger-related stimuli were available.
This would mean that the occurrence of additional danger stimuli may render the spider stimulus less salient (for treated subjects), which in turn makes it more likely to detect a treatment effect on covariation bias, if present. For that reason, alternative danger-related stimuli were included in the present study. More specifically, slides of armed weapons were used instead of slides depicting mushrooms.

It seems reasonable to argue that subjects in general tend to associate shock with those stimuli that have the potency to cause aversive events. Therefore, adding weapons as a third category results in a sequence of slides that can be considered as even more ambiguous as to the stimulus–shock contingencies than the sequences used so far (comprising flowers, mushrooms, and spiders). The perception of contingency can be described as a function of a priori expectation and current situational information. The more ambiguous the situational information, the more subjects rely on a priori expectations (e.g., Alloy & Tabachnik, 1984). Obviously, before treatment, spiders are more closely associated with aversive events than both weapons and flowers. Predominantly relying on a priori expectations would, therefore, result in (untreated) phobics specifically associating spiders with shock (despite the inclusion of weapon slides). One expects that successful treatment will reduce the strength of the a priori spider–danger connection to a degree that is roughly comparable to the strength of the a priori weapon–danger connection. Therefore, it was anticipated that the covariation bias would be attenuated or even absent in treated spider phobics. Moreover, treated subjects were expected to judge the covariations with lower confidence than were untreated spider phobics.

Method

Subjects

Subjects were 38 women who were spider phobics (mean age = 29.6 years, range = 17–61 years). They applied for treatment after reading articles in regional and national newspapers about an earlier “spider project” at Limburg University. Phobic subjects were invited to participate in research in return for “free” treatment. One group of subjects (n = 18) was tested before treatment, and a second group of subjects (n = 20) was tested after treatment. All subjects met criteria from the Diagnostic and Statistical Manual of Mental Disorders (rev. 3rd ed.; American Psychiatric Association, 1987) for specific phobia. The mean scores on the Spider Phobia Questionnaire (SPQ; Klorman, Weerts, Hastings, Melamed, & Lang, 1974) for the untreated and treated groups were 22.4 and 8.6, respectively. It is worthy of note that before treatment, SPQ scores were similar for both groups, t(36) = 1.42, p > .1. SPQ scores were comparable to the mean scores that Fredriksen (1983) and de Jong and Merekelbach (1991) reported for their phobic groups. Subjects also underwent a behavioral approach test (BAT), both before and after treatment. The BAT was scored on a 13-point scale ranging from 0 (300 cm) to 12 (spider on hand). The treated subjects strongly benefited from therapy as indexed by SPQ scores, t(19) = −11.1, p < .001 (Ms = 21.6 and 9.0), and by BAT scores, t(19) = 14.4, p < .001 (Ms = 2.5 and 9.1).

Apparatus and Stimulus Materials

Three categories of stimuli were used: four different slides depicting flowers, four different slides depicting spiders, and four different slides depicting weapons (knives and guns directed toward the subject; e.g., Hughes & Johnson, 1989). The slides were projected onto a white screen (80 cm × 120 cm), approximately 3 m in front of the subject. A Kodak Carousel was used for stimulus presentation. Three types of outcomes occurred during the experiment: a 1-s shock, a 1-s tone, or nothing at all. Electric shocks (dc) were delivered from a specially designed shock generator (0–40 mA) and administered to the subjects’ lateral side of the upper right arm through two electrodes (8-mm diameter Ag–AgCl). Tones were delivered by a tone generator (60 Hz, 50 dB) connected to a loudspeaker inside the experimental (sound-attenuated) room. Stimulus presentation, delivery of tones and shocks, and intertrial intervals were controlled by a PDP Minicomputer.

Procedure

Subjects were randomly assigned to one of two groups. Subjects in the after-treatment group first underwent a 2.5-hr (approximately) one-session in vivo exposure (as described by Öst, 1989) before they participated in the experiment. Subjects in the before-treatment group participated in the experiment before they received exposure therapy. The one-session treatment employed consists of exposure in vivo and modeling and has been found to yield good immediate and long-term results (Merekelbach, de Jong, & Arnts, 1991; Öst, 1989).

During the experiment, subjects were seated in a comfortable chair in a sound-attenuated room. A one-way screen separated the experimental and the registration room. The subject was told that it was her task to determine the relationship between categories of slides and outcomes. Then electrodes were attached. Next, shock intensity level was determined using a shock work-up procedure. Stepwise, electrical current was increased until the subject indicated that the shock was uncomfortable but not painful. After the subject confirmed that the task was clear to her, she was left alone and the lights were dimmed. Subjects were exposed to 72 slides each of 8-s duration. Three different categories were used: flowers (neutral stimuli), weapons (ontogenetically fear-relevant stimuli), and spiders (phylogenetically fear-relevant stimuli). One of three possible outcomes occurred at slide disappearance: a 1-s shock (aversive outcome) or a 1-s tone or nothing at all (neutral outcomes). Across all trials, the conditional probability of any outcome given the prior occurrence of any category of slide was 33% and so was the probability of occurrence of each category of slide and each type of outcome. Intertrial intervals ranged from 10 to 30 s. Stimulus–outcome combinations were randomly distributed across trials, with the restriction that on two successive trials no identical stimulus–outcome combinations occurred. To cancel out order effects, three different sequences were used. At the end of the experiment, subjects completed the Covariation Questionnaire (CQ). The CQ asked subjects to estimate the percentage of occurrence of each outcome given the prior occurrence of each slide type. In addition, subjects were asked to indicate their confidence in each reported probability estimate. For all estimates, 100-mm visual analogue scales (VAS) were used ranging from 0% to 100%.

Data Reduction and Analysis

Contingency estimates were subjected to a set of prior t tests in order to evaluate (a) whether the spider–shock contingency estimates differed from the weapon–shock, flower–shock, spider–tone, and spider–nothing contingency estimates and (b) whether the posttreatment estimates of the spider–shock contingency differed from the pre-treatment spider–shock contingency estimates. To control for experimental error, a Dunn–Bonferroni strategy was adopted. Therefore, each of the four within-group comparisons of the contingency estimates was tested at an alpha of .05/4 = .0125 (See Tomarken et al., 1982; Williams & Loewenstein, 1981).
In 1989, for a detailed justification of this strategy, To investigate the relation between covariation bias and treatment outcome, Pearson's correlation was computed between pretreatment spider-shock contingency estimates and posttreatment SPQ scores.

The reported confidence in the spider-shock contingency estimates before and after treatment were subjected to between-groups a priori t tests.

Results

As is evident from Figure 1, untreated spider phobics dramatically overestimated the spider-shock association. All planned comparisons reached significance: The spider-shock contingency estimates were significantly higher than both the weapon-shock, \( t(17) = 2.71, p < .01 \), and flower-shock, \( t(17) = 3.97, p < .01 \), contingency estimates. Additionally, the spider-shock contingency estimates were significantly higher than the spider-tone, \( t(17) = 3.85, p < .01 \), and the spider-nothing, \( t(17) = 3.00, p < .01 \), contingency estimates. In contrast to untreated subjects, treated subjects did not show a covariation bias. None of the planned comparisons reached significance, \( t(19) < 1.25, ps > .20 \).

A between-groups t test indicated that the spider-shock association was stronger in untreated than in treated phobics, \( t(36) = 2.20, p < .05 \). Moreover, the confidence of the spider-shock contingency estimates was higher in untreated subjects than in treated subjects. However, this effect only reached borderline significance, \( t(36) = 1.88, p = .07 \) (Ms of confidence percentages = 59 and 41, respectively). Overall, contingency estimates and reported confidence correlated only weakly. Pearson's \( r(38) = .17, p = .02 \). The spider-shock contingency estimates of untreated subjects were not related to posttreatment SPQ scores (therapy success), Pearson's \( r(18) = -.12, p = .31 \).

Discussion

In line with earlier findings (de Jong & Merckelbach, 1991; Tomarken et al., 1989), the present study clearly shows that spider phobics specifically overestimated the contingency of the phobia-relevant stimuli (slides of spiders) and aversive events (i.e., electric shock). In contrast to untreated spider phobics, treated subjects did not show a bias to associate spiders and shock, suggesting that the robust bias of spider phobics to associate phobia-relevant stimuli with aversive events can be modified by behavioral treatment. In addition, it was found that treated subjects were less certain about the covariation of stimuli and outcomes than untreated subjects.

The present findings underline the suggestion made earlier by Tomarken et al. (1989) that (untreated) spider phobics process information in an emotion-congruent way. In addition, the finding that untreated but not treated phobics show a strong bias to associate shock with phobia-relevant stimuli is in line with the hypothesis that the covariation bias phenomenon might play a critical role in the maintenance of phobic fear.

Some remarks are in order as to the underlying mechanism of the treatment effect. Obviously, before treatment, spiders were more closely related to danger than were both weapons and flowers. It seems reasonable to argue that successful treatment weakened the connection between spiders and danger. There-
fore, for treated phobics as opposed to untreated phobics, spiders and weapons may be expected to be approximately equally related to danger. Consequently, the presence of two competing threat-related stimuli is likely to undermine the covariation bias between spiders and shock after treatment. The lack of treatment effect on covariation bias that was reported by de Jong and Merckelbach (1991) can also be interpreted along these lines. That is, it may well be that the residual fear of the treated subjects in that study was still sufficient to induce a considerable bias to associate spiders with shock in the absence of alternative danger-related stimuli. Note that SPQ scores of treated subjects in that study (i.e., M = 8.6) were considerably higher than those of the low-fear students in the Tomarken et al. study (M = approximately 2).

The finding that untreated phobics in contrast to treated phobics dramatically overestimate the spider-shock covariation suggests that untreated subjects predominantly rely on a priori expectations, whereas treated subjects rely more on the available situational information. However, one could counter that after treatment, subjects were biased against spider-shock information rather than being more accurate. In other words, treated subjects might have been unwilling to give spider-shock contingencies much weight. Such an attitude would also result in lower contingency estimates but for reasons quite different than that of relying more on situational information. As in the present study, base rates were not manipulated (e.g., by inclusion of a shock-spider 50% condition); these results are not conclusive in this respect.¹

The present data show that untreated phobics not only overestimated the spider–shock association but also were more confident about their contingency estimates than were treated subjects. This high confidence in detected covariations in phobic subjects may add to the robust covariation bias in the maintenance of phobic fear.

In the present study, no relationship was found between pre-treatment spider-shock contingency estimates and treatment outcome (as indexed by posttreatment SPQ scores). Thus, although a strong bias of associating phobic stimuli with aversive events may act in a way to confirm fear, it does not seem to have an impact on (short-term) therapy prognosis. However, it should be noted that in the present study, the length of treatment varied among subjects (range = 2 to 3 hours). It can not be ruled out, therefore, that strength of bias does covary with length of treatment (and long-term treatment outcome).

To summarize, the current data show (a) that spider phobics dramatically overestimate the contingency between phobic stimuli and aversive events, (b) that untreated spider phobics have more confidence in their (distorted) covariation detection than treated subjects, (c) that covariation bias is probably reduced by behavioral therapy, and (d) that the strength of the covariation bias seems not to be related to therapy outcome.

¹ We are indebted to an anonymous reviewer for drawing our attention to this point.

References


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