Covariation Bias, Classical Conditioning, and Phobic Fear

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Abstract—The present study investigated whether phobics show an illusory correlation (IC) between phobia-relevant stimuli and aversive events. Nineteen treated and 19 untreated spider phobics were exposed to a series of 72 slides. Three different categories were used: Phobia-relevant slides (spiders), alternative fear-relevant slides (weapons), and neutral slides (flowers). Slides were randomly paired with either a shock, a siren, or nothing at all. All slide/outcome combinations occurred equally frequently. A posteriori recorded contingency estimates indicated that untreated phobics dramatically overestimate the covariation of spiders and shock. On-line recorded outcome expectancies revealed that the bias to overestimate the spider-shock contingency is highly resistant to extinction. The covariation bias was accompanied by differentially heightened electrodermal first interval responses (FIR) and unconditioned electrodermal responses (third interval responses: TIR) on phobia-relevant trials. Treated phobics did not show a covariation bias, indicating that such bias can be modulated by behavioral treatment. The present findings sustain the hypothesis that phobic subjects process information in a fear-confirming way.

PAVLOVIAN CONDITIONING IS STILL one of the important theories on phobic fear. In recent cognitive theories on conditioning, the phobic stimulus is considered as a predictor of aversive events (e.g., Eelen, 1982), or, in other words, as a danger signal (e.g., Reiss, 1980). Yet, it is evident that there is no such sequential relationship between phobic stimuli and aversive events in real life. In fact, one of the diagnostic criteria for simple phobia is that the phobic fear is irrational. In order to reconcile this apparent inconsistency, it can be hypothesized that even in the absence of a systematic correlation, phobic subjects perceive phobic stimuli as a predictor of aversive events. One major implication of such cognitive interpretation of classical conditioning is that subjects may associate a conditioned stimulus (CS) with an aversive unconditioned stimulus (UCS), without objective contingencies given rise to this association.

Experimentally Induced Illusory Correlation

In an attempt to explore this assumption, we recently performed a study (de Jong, Merckelbach, & Arntz, 1990), which aimed at inducing an "illusory correlation" (IC) between a target stimulus and an aversive UCS. In that study, subjects were exposed to two series of slides (CSs) randomly paired with the occurrence or nonoccurrence of shock outcome (UCS). For both series, base rate probabilities of the two slides were equal, as were the conditional probabilities (i.e., 50%). The first series (IC induction phase) started,

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however, with a number of pairings of one slide category (target slide) with shock. Across all trials, shock/slide contingency was equal for both slides. During the second phase, subjects were exposed to a random series of slide/shock pairings (IC extinction phase). Again, shock/slide contingency was equal for both slides. The results of that study clearly indicated that it is possible to induce an "illusory correlation" between a formerly neutral stimulus and an aversive outcome. That is, subjects overestimated the covariation between the target stimulus and the aversive outcome, though the probability of shock outcome was equal for both stimuli. Most importantly, that study demonstrated that an IC once induced, can become "self-supporting": The subjects' on-line probability estimates of shock given the target slide increased during the second (extinction) phase, whereas the estimates of shock given the control slide declined. Thus, an acquired IC can act in such a way as to promote the assessment of selective associations. This finding sustains the hypothesis that subjects may associate a CS with an aversive UCS even in the complete absence of objective contingencies.

Illusory Correlation and Spider Phobia

Following this line, it can be speculated that conditioning experiences in phobics likewise induce a bias to overestimate the contingency of phobia-relevant stimuli and aversive events. Such bias in information processing would be a particularly direct and powerful way to confirm or enhance fear. In order to investigate whether phobic subjects, indeed, show a bias to overassociate aversive events and phobic stimuli we performed an experiment employing an "illusory correlation" paradigm adopted from Tomarken, Mineka, and Cook (1989). Subjects in this study were 38 severe spider phobics who applied for behavioral therapy at our department. Subjects were exposed to a series of 72 slides (CSs). Three different categories were used: Slides of spiders (phobia-relevant), slides of weapons (alternative danger-related), and slides of flowers (neutral). Immediately at slide offset one of three outcomes (UCSs) occurred: A 1 s siren, a 1 s shock, or nothing at all. The conditional probability of all slide/outcome combinations was one-third, and so were the base-rate probabilities of slides and outcomes. At the end of the experiment, subjects were asked to estimate the covariation of all slide/outcome combinations. Furthermore, they were asked to indicate the best predictor of shock by means of a forced-choice procedure. On-line, subjects indicated which outcome they expected at slide offset by means of a button. Electrodermal activity was measured on a trial-by-trial basis. Half of the phobics were tested before treatment, while the other half were tested after treatment. Treatment consisted of one-session exposure therapy (Ost, 1989), which yields good short- and long-term effects (e.g., Arntz & Lavy, in press).

The a posteriori reported contingency estimates showed that untreated spider phobics specifically overestimated the covariation of phobia-relevant slides and aversive shock outcome. On the contrary, most of the treated subjects considered the weapon slides rather than the spider slides as being the best predictor of shock outcome (see Figure 1).

The on-line data showed that only among the untreated subjects shock expectancies were higher during spider slides than during weapon or flower slides. Despite the random slide/outcome presentation, the enhanced shock expectancy on spider trials in untreated spider phobics appeared to be highly resistant to extinction. In the treated subjects there was only a slight overestimation of the base-rate of shock outcome, which declined to the actual probability of one-third during the experiment. The enhanced expectancy of shock outcome was paralleled by larger FIRs during spider slides and larger UCRs on shocked

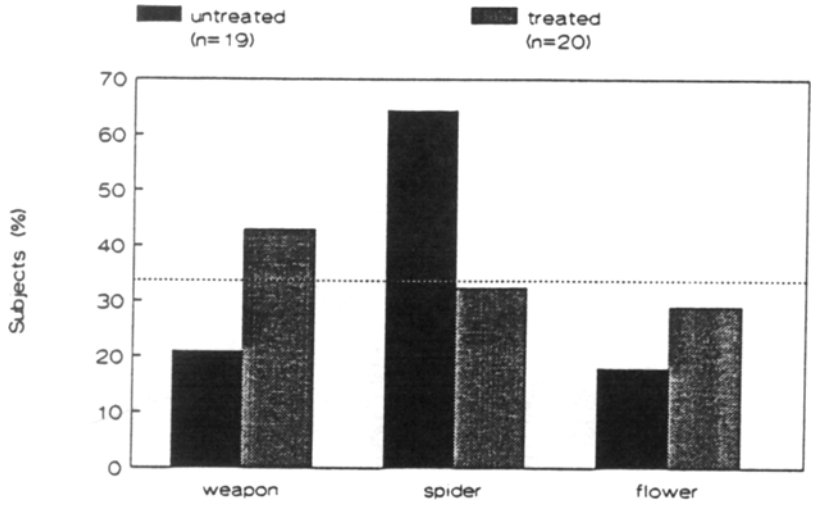

FIG. 1. Distribution of subjects' forced choices, indicating which stimulus was considered as the best predictor of shock outcome. Note that the actual contingency is 33.3%.

spider trials, indicating that there is a close relationship between on-line processes and covariation bias. FIRs during the flower and the weapon slides were equal for both groups. Initially, FIRs during the weapon slides tended to be slightly larger than during the flower slides, however after about 10 trials responses were strongly habituated. Only the untreated phobics showed larger responses during the spider slides than during the weapon or flower slides. The electrodermal responding to spider slides remained elevated during the entire experiment. That is, specifically in untreated subjects, the habituation to spider slides was retarded. The UCRs on shocked trials revealed a similar pattern of results: Only untreated subjects showed larger responses on shocked spider trials as compared to shocked weapon and flower trials. In addition, only UCRs on shocked spider trials in untreated subjects did not habituate.

It can be concluded (1) that subjects under some conditions associate a CS with an aversive UCS, without objective contingencies given rise to this association; (2) that spider phobics dramatically overestimate the contingency between phobic stimuli and aversive events both as indexed by a posteriori reported contingency estimates and as indexed by on-line outcome expectancies; (3) that covariation bias can be reduced by behavior therapy; (4) that covariation bias is accompanied by differentially heightened electrodermal responding.

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