

# Automatic Processing in Spider Phobia: Implicit Fear Associations Over the Course of Treatment

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This study evaluates the cognitive model of anxiety by investigating treatment-related changes in automatic associations to evaluate schematic processing. Spider-phobic participants ( $n = 31$ ) and healthy controls ( $n = 30$ ) completed fear-based Implicit Association Tests (IATs), which are reaction-time measures that tap implicit associations without requiring conscious introspection. The specific tasks involved classifying pictures of snakes and spiders along with semantic categorizations (good vs. bad, afraid vs. unafraid, danger vs. safety, and disgusting vs. appealing). Phobic individuals were assessed before and after group-based exposure treatment and 2 months later; controls were assessed at matched time points. Results supported clinical applications for implicit fear associations, including prediction of phobic avoidance, and treatment sensitivity of the fear- and disgust-specific automatic associations.

Cognitive models of anxiety and fear posit that maladaptive schemas guide information processing so the anxious person selectively attends to potentially threatening cues, interprets ambiguous cues as threatening, and preferentially recalls relevant threat cues (Beck, 1976; Beck, Emery, & Greenberg, 1985). These cognitive biases are believed to maintain anxiety and avoidance by keeping threat cues salient. In this article, we report on a study of implicit fear associations among individuals with spider phobia to test the prediction that automatic processing (as a proxy for schematic operations) would change over the course of therapy.

Schema-based theories imply that improvement in symptoms should be associated with, and perhaps even preceded by, changes in maladaptive schemas (e.g., Beck & Clark, 1997; Young, 1999). Yet, despite the importance of cognitive models in guiding research and treatment, and evidence of anxious-biased processing across a range of information-processing tasks, there has been little work directly investigating change in fear schemas. Our prediction of fear schema change following treatment is based on converging

lines of research examining the presence of fear schema, such as the work of Riskind, Williams, Gessner, Chrosniak, and Cortina (2000) on looming maladaptive style and the malleability of other cognitive processes, such as evidence of change over treatment on the modified Stroop task shown by Kindt and Brosschot (1999). We use the term *fear schema* to refer to maladaptive fear-related cognitive structures (sometimes defined as *interconnected associations in memory*) that can be activated automatically.

Evaluating schemas is challenging because cognitive structure is itself an abstract term. We rely on the definition offered by Posner and Warren (1972), who wrote, "When we say a structure exists in memory, we are really saying that one item will activate another in a quite direct and simple way, even perhaps when the subject does not intend for it to occur. If we had methods to tap structure uninfluenced by conscious search, we might reflect the structure of memory more simply" (p. 34). This approach recognizes the potential relationship between automaticity and structure (Bargh, 1982), which applies to schema research in that schemas are thought to exert an automatic influence on cognitive processes. Furthermore, evaluation of responding that is less vulnerable to controlled, strategic processes may minimize some of the confounds of self-report measures, such as social desirability (Ferguson, Rule, & Carlson, 1983).

The Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) shows promise for assessing memory-based cognitive structures referred to in schema theories. The IAT measures automatic associations in memory (automatic in the sense that evaluations occur outside conscious control and, at times, outside conscious awareness), thus appearing to share many of the qualities ascribed to schemas. In addition, this methodology minimizes the influence of self-presentational concerns (Greenwald et al., 1998) and typifies the relationship between automaticity and structure outlined by Posner and Warren (1972). Moreover, the IAT uses a within-subject design, so the influence of mood state is controlled because the anxiety-evoking stimuli are present in all conditions being compared.

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The IAT has been used increasingly to study constructs such as social prejudice (Dasgupta, McGhee, Greenwald, & Banaji, 2000; Rudman, Greenwald, Mellott, & Schwartz, 1999), and the instrument has adequate psychometric properties (for a review, see Greenwald & Nosek, 2001). Similar to many tasks used by social cognition researchers (Fazio, 2001), the IAT is a reaction-time task that purportedly reflects strength of association between concepts in memory. Specifically, the task involves comparing the time taken to classify stimuli when paired categories match a person's automatic associations versus the time taken when paired categories contradict automatic associations. In the case of spider phobia, we compared response time for classifying stimuli (e.g., photographs of spiders) when category pairs matched the hypothesized fear network or schema (e.g., spider was paired with negative attributes) with response time for classifying stimuli when category pairs contradicted the hypothesized fear schema for spider-phobic individuals (i.e., spider was paired with positive attributes). The IAT is a relative measure; therefore, we used snakes as a comparison for each classification trial (see *Measures* section for more detail).

In an earlier study, we evaluated whether fearful individuals would show implicit fear associations consistent with cognitive models of fear (Teachman, Gregg, & Woody, 2001). We examined whether self-reported fears of particular animals would be associated with specific implicit associations toward the feared stimulus, as measured by the IAT. Participants included individuals who were extremely afraid (but not phobic) of either snakes or spiders but unafraid of the other animal. These groups served as useful controls for one another, given that spiders and snakes both theoretically represent evolutionarily prepared fears (Seligman, 1971) and share a comparably negative societal evaluation. The IAT response latencies effectively discriminated between individuals with specific animal fears and were robust across several different semantic categorizations (e.g., afraid, dangerous). In addition, Egloff and Schmukle (2002) demonstrated that automatic anxiety associations with the self, measured by the IAT, showed good psychometric properties, including internal consistency and predictive validity.

The current study tested the prediction that automatic associations would change following fear-reduction treatment for spider phobia. This extends our initial findings through the use of a clinical sample, behavioral assessment, and investigation of changes over treatment. Even in specific phobias, researchers have hypothesized that cognitive biases—along with avoidance—maintain pathological anxiety (see review by Merckelbach, de Jong, Muris, & van den Hout, 1996). Accordingly, the present study evaluated whether implicit fear associations among spider-phobic individuals change over the course of successful treatment, and whether such changes are consistent with changes observed in behavioral and self-report measures of fear immediately after treatment and at 2 months follow-up.

## Method

### Participants

Thirty-one phobic participants completed the treatment program (mean age = 32.6 years,  $SD = 10.7$ , range = 18–55). Reflecting the disproportionate prevalence of spider phobia among females, 84% were female. In

addition to exhibiting extreme fear and avoidance toward spiders, phobic participants were required to be over 17 years old and not suffering from current major depression or psychosis. These exclusion criteria were included because of concerns about biased responding on the implicit association measures of fear (based on evidence that depression affects cognitive processing differently than fear does; e.g., Eysenck, 1992).

An additional exclusion criterion was that the spider-phobic participants could not have an extreme fear of snakes, as indicated by self-report during the initial telephone screen—a necessary criterion because the IAT compared relative associations toward snakes versus spiders. Approximately 20%–25% of potential participants were excluded because of this criterion. Four additional eligible phobic participants began treatment but dropped out before completing the treatment program. These participants were excluded from analyses because they did not receive treatment. Of the 31 who completed treatment, 2 participants did not return for the follow-up assessment, so their data were included in all analyses except those involving follow-up data.

Most of the 30 participants in the nonphobic control group were female (77%), and they had a mean age of 24.0 years ( $SD = 9.4$ , range = 17–56). Exclusion criteria were an extreme fear of either snakes or spiders, current clinical depression, or psychosis. One additional participant from the control group was omitted from the study because she did not return for the posttest assessment.

### Measures

**Diagnosis.** A trained research assistant administered the simple phobia, major depression, and psychotic screening sections of the *Structured Clinical Interview for DSM-IV (SCID-IV)* (First, Spitzer, Gibbon, & Williams, 1997) during an initial telephone interview for all participants. The principal investigator subsequently confirmed spider phobia diagnoses during an individualized interview in preparation for group treatment.

**Questionnaires.** Participants completed two spider fear questionnaires. The Fear of Spiders Questionnaire (FSQ; Szymanski & O'Donohue, 1995) is an 18-item endorsement measure that assesses avoidance and fear of harm from spiders, such as degree of agreement with the statement, "If I came across a spider now, I would leave the room." The Spider Phobia Questionnaire (SPQ; Klorman, Weerts, Hastings, Melamed, & Lang, 1974) is a 31-item true/false measure that describes a range of situations involving interactions with spiders, such as, "I avoid going to parks or on camping trips because there may be spiders about."

**IATs.** The IAT is a response-time task in which individuals classify words or pictures into superordinate categories to index the relative strength of their automatic associations to target constructs. (See <http://www.yale.edu/implicit> for more information and a sample test.) Implicit associations to one target category are assessed relative to associations with a comparison target category. In this case, automatic associations with spiders are measured relative to automatic associations with snakes. For each IAT task, we presented two sets of category pairs simultaneously. One pair was always spiders and snakes (the target categories); this pair was matched with a second, simultaneously displayed descriptive category pair (good and bad, danger and safety, disgusting and appealing, or afraid and unafraid).

Participants saw four category labels on the computer screen concurrently: a target and descriptor category paired on one side of the screen (e.g., spiders and disgusting) and the opposing set of target and descriptor categories paired on the other side of the screen (e.g., snakes and appealing). Stimuli representing one of these four categories appeared in the center of the screen on each classification trial; the task was for participants to indicate on which side of the screen each stimulus belongs (i.e., what category it fits into) by a key-response indicating left side or right side. Thus, participants are forced to classify stimuli related to all four concepts by using just two responses (left or right) because each side of the screen has two of the four concept labels.

Figure 1 illustrates a sample classification trial. The target category “snake” and the descriptor category “danger” have been paired on the left side, and “spider” and “safety” categories have been paired on the right. The correct response for all participants in this case is to classify the stimulus into the spider category on the right side of the screen using the right-sided key. Participants are simply placing the stimuli into the assigned category, not stating their direct opinion about the stimuli. (They learn which stimuli fit into each category during practice trials.) An incorrect response would be followed by feedback—that the classification was inaccurate—before immediately proceeding to the next classification trial. After a series of trials with these category pairings, the categories would be switched so that the snake category would be paired with safety, and spider would be paired with danger. In this example, the stimulus is a photograph of a spider, but in different trials, stimuli were pictures (of spiders or snakes) or words (fitting the descriptor categories, such as “harm” for the category “danger”).

The idea behind the task is that stimuli are classified more quickly when the target and descriptor category pairings match the individual’s automatic associations with the target categories (snake/spider) versus when the target and descriptor category pairings are mismatched. Phobic participants classified the pictorial and word stimuli when the target animal categories were paired with associatively “matched” descriptor categories and also when the target animal categories were paired with “mismatched” descriptor categories (matched in the sense of reflecting their hypothesized individual automatic associations to the constructs). The predicted matched category pairing for spider-phobic participants occurs when spider is paired with a negative descriptor (and snake with a positive descriptor), and the mismatched category pairing occurs when spider is paired with a positive descriptor (and snake with a negative descriptor). The control participants completed the identical tasks; however, neither category pairing condition was considered matched or mismatched, given that this group was expected to hold equally negative associations toward snakes and spiders (so no difference in classification times across the category pairing conditions was expected).

The dependent variable is the difference between average latency of responding across all trials when one set of categories is paired (e.g., spider + safety and snake + danger) minus average response latency when the opposing set of categories is paired (e.g., spider + danger and snake + safety). Thus, the average response time for matched category pairs (according to hypothesized automatic associations) is subtracted from response time for mismatched category pairs. We predicted that the phobic

sample would show a highly fearful view toward spiders and that this spider fear schema would be much stronger and more elaborated than their view toward snakes. Consequently, we would see the phobic participants displaying more negative automatic associations toward spiders than toward snakes. This *IAT effect* occurs when the phobic group is significantly slower at classifying stimuli when spider is paired with a positive descriptor compared with the condition when spider is paired with a negative descriptor. In contrast, the nonphobic control sample was expected to have moderately negative views toward both snakes and spiders; however, they were not expected to differ in their automatic associations toward these animals, so no IAT effects were expected.

Three pretested words were used to represent each of the descriptor categories, such as “tempting” to reflect the category “appealing.” The stimuli were approximately matched for length and ease of categorization on the basis of pilot data. Similarly, three photos of snakes and spiders were used to represent the target categories. Snakes were selected as the relative target category to compare with spiders because both are common, specific animal fears; moreover, in our pilot work, we established that the snake and spider stimuli were evaluated equally negatively and were matched for the degree to which they evoke fear and disgust. (For more details on the selection of the snake category and the word and pictorial stimuli, see Teachman et al., 2001.) Equal numbers of stimuli from each of the four categories (snake, spider, and two descriptors) appeared during each IAT task, so that participants classified both words and pictures in all four of the snake/spider IAT tasks.

In addition to the four snake/spider IAT tasks, two control tasks were included to ascertain whether observed changes over treatment in the phobic group were due to spider-specific fear reduction rather than more general changes or testing effects. A task comparing associations toward “fruit” versus “garbage” (paired with the attribute categories “bad” vs. “good”) was included as a control for the effects of practicing the IAT tasks repeatedly over time.

Furthermore, the snake/spider tasks were intended to measure fearful associations toward spiders specifically rather than fear responding more generally. Thus, we included a second control task that was a more general fear-related task to increase confidence that change on the snake/spider tasks was due to a change in spider fear rather than changes in fear more broadly. This second control task compared associations toward “fire” versus “other elements” (paired with the attribute categories “afraid” vs. “unafraid”). The pictorial stimuli for the two control tasks were photographs of fruit, garbage, fire, and various natural elements (such as clouds

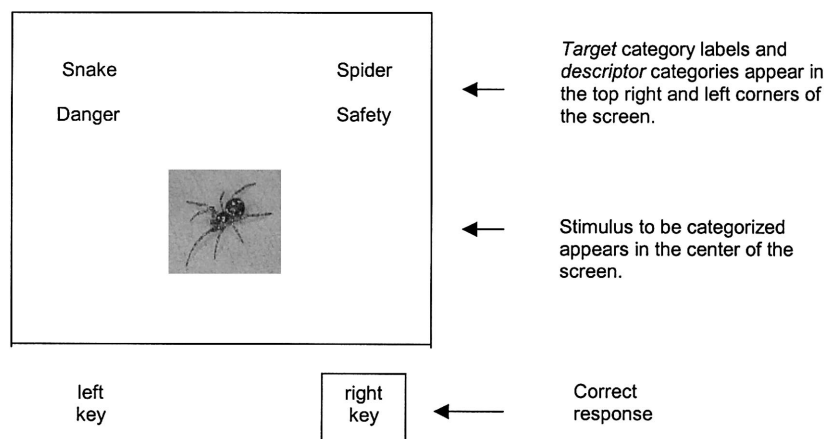


Figure 1. Schematic depiction of the Implicit Association Test procedure. Participants classify the stimulus by using either the right or the left key. The correct classification of the spider picture is on the right key in this example. This classification trial would represent an associatively mismatched pairing for spider-phobic individuals (as they are not expected to associate spiders with safety).

and water), rated by an independent sample of participants as comparable to the snake and spider pictures in valence and fearfulness. The word stimuli used in the control tasks were those used in the afraid/unafraid and bad/good tasks for the snake/spider IATs.

In each IAT task, there were two critical trial blocks: one block of trials where the sets of target and descriptor categories were matched for spider-phobic participants (e.g., spider + disgusting, and snake + appealing) and one block in which the sets of target and descriptor categories were mismatched for spider-phobic participants (e.g., spider + appealing, and snake + disgusting). Based on standard IAT design, and following the methodology used in Teachman et al. (2001), each critical block consisted of 48 classification trials: The first 12 were practice trials, and the remaining 36 constituted the experimental data. The data for the word and picture stimuli were combined because each block (i.e., category pairing condition) of classification trials involved classifying both words and pictures (an equal number of stimuli from all four categories was classified). The analysis examined the average response time for all classification trials in a given block.

The IATs were completed on desktop PC computers and programmed using Inquisit (Draine, 1999) running in either Windows 95 or Windows NT. Participants gave responses for the left-side categories by pushing the "A" key with their left forefinger and responses for the right-side categories by pushing the "5" key (on the numeric keypad) with their right forefinger.

**Behavioral avoidance task (BAT).** This task measures fear and avoidance in response to a fear-evoking spider. A large (4-inch long) harmless tarantula was placed in a cage at one end of a room. Participants were asked to enter the room and approach the spider as close as possible, ultimately touching the spider. Participants were explicitly told that they could escape this task at any point. At several steps throughout the task, the experimenter prompted participants to give a verbal report of their current anxiety and disgust levels on a 0–100 scale, where 100 represented extreme emotion. To avoid influencing participants' sense of safety, an independent evaluator (i.e., not the therapist) conducted the BAT.<sup>1</sup> As soon as participants indicated that they did not want to continue further in their approach to the spider (or when they touched the spider), final ratings of anxiety and disgust were obtained.

## Procedure

Participants were recruited from the Yale University campus and surrounding communities by posting signs and advertisements in local newspapers and offering monetary compensation. Notices directed toward phobic participants also offered free treatment in conjunction with participation in a research study. Interested participants phoned the clinic, and a trained research assistant administered the diagnostic screening interview by telephone. Phobic participants subsequently took part in an idiographic assessment session with Bethany A. Teachman, followed by three weekly 90-min group sessions of fear reduction.

During the first assessment, all participants completed the six IAT tasks (four snake/spider tasks and two control tasks), the behavioral avoidance task, and the snake fear questionnaires in counterbalanced order. The IAT tasks were presented in random order. In addition, within each IAT task, the order in which the spider + positive attributes versus spider + negative attributes blocks appeared was counterbalanced. After receiving initial instructions on the task, all participants initially completed an unrelated practice IAT task (categorizing green vs. white objects) to ensure that they understood the procedure. Participants were asked to proceed as quickly and as accurately as possible. Error feedback after each incorrect classification trial, and accuracy data at the end of each block, were provided (e.g., participants were told the percentage of stimuli they had classified correctly after each block). Following the pretest session, the phobic group immediately began treatment.

Once the phobic participants had concluded the three 90-min sessions, they completed a posttreatment assessment that was identical to the pre-

treatment assessment. The normal control group also returned after 2 weeks for their second assessment (to match the phobic group for time between assessments), which was the same as the initial assessment. Finally, the spider-phobic group returned to the clinic 2 months following the end of treatment, again completing the identical assessment procedures.

**Therapist.** Bethany A. Teachman served as the therapist for the study. She was trained and supervised (using audiotapes of sessions) by a licensed clinical psychologist specializing in the treatment of anxiety disorders, and supervision was maintained throughout the study. A trained research assistant accompanied the therapist during each session to serve as a note-taker and to model interactions with the spider. Different assistants were used for various groups, but all were graduate students who were familiar with the principles of cognitive behavior therapy.

**Treatment.** The treatment protocol was based on *Mastery of Your Specific Phobia: Therapist Guide* (Antony, Barlow, & Craske, 1997). The protocol was modified to fit a weekly, three-session group format, given evidence that spider phobia can be effectively treated with a short, intensive exposure program (Arntz, Lavy, van den Berg, & van Rijssoort, 1993; Öst, 1996). Groups ( $N = 11$ ) varied in size from 2 to 6 persons (mean size = 3.7 persons,  $SD = 1.0$ ). The treatment involved gradual in vivo exposure. Participants were simultaneously encouraged to counter their maladaptive beliefs, such as that spiders are dangerous or that anxiety is unmanageable. Furthermore, the therapist provided factual information about the general dangerousness of spiders as well as information about poisonous local spiders.

## Results

### Data Reduction

Prior to conducting the planned analyses, data were examined for outliers and excessive error rates following standard IAT analysis procedures (Greenwald et al., 1998). Response latencies less than 300 ms or greater than 3,000 ms were counted as erroneous and recoded as 300 or 3,000 ms, respectively. Data were also deleted if the error rates (i.e., percentage of stimuli classified incorrectly) on the critical IAT blocks were greater than 30%.<sup>2</sup> As a result of these checks, data from the control IAT tasks for 3 participants were omitted.

### Descriptive Statistics

The phobic and control groups differed markedly on measures of spider fear, as expected. On the FSQ and SPQ, our phobic group was comparable to the phobic sample in the Muris and Merckelbach (1996) study (our sample means: FSQ =  $84.9 \pm 13.7$ , SPQ =  $19.7 \pm 4.8$ ; Muris & Merckelbach means: FSQ =  $89.1 \pm 19.6$ , SPQ =  $23.2 \pm 2.9$ ). To simplify analyses, the spider fear questionnaires were standardized and averaged for a composite score. At the initial evaluation, the correlation between the FSQ and SPQ was .65 for the phobic group and .50 for the

<sup>1</sup> Due to scheduling conflicts, on occasion the therapist was the only person available to conduct the BAT for the phobic participant. In these instances, all efforts were made to reduce demand characteristics and safety effects.

<sup>2</sup> We used a more conservative cutoff rate of 20% in an earlier study (Teachman et al., 2001) because the sample was composed of college students. Given the more heterogeneous community sample in the present study, a 30% cutoff rate seemed more appropriate given that participants probably had less computer experience, which conceivably contributed to higher error rates.



control group. Cronbach's alphas at initial evaluation were .97 for the FSQ, .94 for the SPQ, and .96 for the composite questionnaire. Phobic participants scored significantly higher than the control group on the composite questionnaire at pretest,  $t(58) = 10.30$ ,  $p < .0001$ ,  $d = 2.70$ . Phobic participants were also significantly more avoidant of the spider during the BAT,  $t(59) = 6.94$ ,  $p < .0001$ ,  $d = 1.81$ , and they reported more anxiety and disgust at the last step of the BAT,  $t(58) = 6.86$ ,  $p < .0001$ ,  $d = 1.80$ , and  $t(58) = 3.59$ ,  $p < .001$ ,  $d = 0.94$ , respectively. Means and standard deviations for each fear measure are listed in Table 1.

### Effectiveness of Treatment

**Behavioral and self-report measures.** Repeated measures analyses of variance (ANOVAs) were calculated to examine treatment effectiveness as measured by the questionnaires and BAT (see Table 1 for raw scores). With a two-level between-groups variable (phobic group vs. control group) and a repeated measures variable (pretreatment vs. posttreatment), a significant interaction was expected, showing reduced fear responding following treatment for the phobic group but no change over time for the control group. As predicted, significant Group  $\times$  Treatment interactions were found on the combined spider fear questionnaires,  $F(1, 58) = 41.96$ ,  $p < .0001$ ,  $f = 0.85$ , and approach during the BAT,  $F(1, 59) = 65.04$ ,  $p < .0001$ ,  $f = 1.05$ . The interaction terms for self-reported anxiety and disgust during the BAT were weaker,  $F(1, 58) = 3.21$ ,  $p = .08$ ,  $f = 0.23$ , and  $F(1, 58) = 2.80$ ,  $p = .10$ ,  $f = 0.21$ , respectively.

To further specify treatment effectiveness, simple effects showing change from pretest to posttest for just the phobic group were examined. Paired samples  $t$  tests indicated significant improve-

ment across all variables related to fear: composite spider questionnaire,  $t(29) = 12.87$ ,  $p < .0001$ ,  $d = 4.78$ ; BAT approach,  $t(30) = -8.65$ ,  $p < .0001$ ,  $d = 3.16$ ; and self-reported anxiety during the BAT,  $t(29) = 3.65$ ,  $p = .01$ ,  $d = 1.35$ . Decline in self-reported disgust during the BAT (which has not typically been examined in fear treatment studies) showed a weaker effect,  $t(29) = 1.87$ ,  $p = .07$ ,  $d = 0.69$ .

Data from the follow-up assessment with the phobic group indicated that treatment gains were maintained for all measures. Comparison of scores from immediately posttreatment to 2 months later indicated no significant return of fear for behavioral approach, the spider fear questionnaires, or self-reported disgust (all  $ps > .10$ ). At follow-up, participants showed significant further treatment gains on self-reported anxiety during the BAT,  $t(29) = 2.35$ ,  $p = .03$ ,  $d = 0.50$ . Overall, results showed clearly that phobic fear was reduced over the course of treatment; these gains were maintained or enhanced at follow-up.

**Change on implicit fear associations.** Our central question concerned the treatment sensitivity of the implicit fear associations. Repeated measures ANOVAs were used to examine this question, with between-groups (phobic vs. control group) and repeated measures (first vs. second assessment) effects. Note that the repeated measure represents a treatment effect only for the phobic group, as the control group received no treatment. There were significant main effects for assessment time for the afraid/unafraid,  $t(58) = 3.22$ ,  $p = .02$ ,  $d = 0.85$ ; and disgusting/appealing IATs,  $t(58) = 2.01$ ,  $p < .05$ ,  $d = 0.53$ ; and a marginally significant effect on the bad/good IAT,  $t(58) = 1.82$ ,  $p = .07$ ,  $d = 0.48$ . There was no main effect for the danger/safety IAT,  $t(58) = 0.20$ ,  $p > .10$ ,  $d = 0.05$ . All four snake/spider IAT tasks showed significant main effects for diagnostic group: afraid/unafraid,  $t(58) = 2.47$ ,  $p = .02$ ,  $d = 0.65$ ; disgusting/appealing,  $t(58) = 2.08$ ,  $p = .04$ ,  $d = 0.55$ ; bad/good,  $t(58) = 3.72$ ,  $p < .001$ ,  $d = 0.98$ ; and danger/safety,  $t(58) = 2.29$ ,  $p = .03$ ,  $d = 0.60$ .

The tests of change over the course of treatment were the Group  $\times$  Treatment interactions. As with the behavioral and questionnaire measures, significant interactions were expected, such that implicit spider fear would decrease following treatment for the phobic group but not for the control group. As predicted, significant Group  $\times$  Treatment interactions were found on the disgusting/appealing,  $F(1, 58) = 4.54$ ,  $p = .04$ ,  $f = 0.28$ , and afraid/unafraid IATs,  $F(1, 58) = 6.14$ ,  $p = .02$ ,  $f = 0.33$ , but not for the bad/good,  $F(1, 58) = 0.02$ ,  $p > .10$ ,  $f = 0.02$ , or danger/safety tasks,  $F(1, 58) = .11$ ,  $p > .10$ ,  $f = 0.04$ . For easier visual inspection, see Figure 2, depicting the mean latency difference score and standard error for each Group  $\times$  Treatment interaction for the four snake/spider IAT tasks.

Simple effects tests to understand the Group  $\times$  Treatment interactions on the disgusting/appealing and afraid/unafraid IATs revealed an identical pattern on the two tasks. As expected, using paired samples  $t$  tests with a protected alpha of .01, the phobic group showed a significant treatment effect: disgusting/appealing,  $t(29) = 2.65$ ,  $p = .01$ ,  $d = 0.98$ , and afraid/unafraid,  $t(29) = 3.46$ ,  $p = .002$ ,  $d = 1.28$ , whereas the control group showed no significant change from pre- to posttest: disgusting/appealing,  $t(29) = 0.00$ ,  $p > .10$ ,  $d = 0.00$ , and afraid/unafraid,  $t(29) = 0.66$ ,  $p > .10$ ,  $d = 0.24$ . Furthermore, using independent samples  $t$  tests with a protected alpha of .01, the phobic group showed significantly more spider-aversive associations than the control group at

Table 1  
Descriptive Statistics for the Phobic and Control Groups

Fear measure	Phobic group		Control group	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Spider Phobia Questionnaire				
Pretest	19.69	4.75	2.97	1.74
Posttest	11.95	3.77	5.40	3.38
Follow-up	11.13	5.06		
Fear of Spiders Questionnaire				
Pretest	84.93	13.68	26.34	6.77
Posttest	44.63	15.09	26.83	10.35
Follow-up	42.10	15.50		
Behavioral avoidance task				
Pretest	7.29	2.97	11.30	1.12
Posttest	10.94	1.59	11.43	1.14
Follow-up	10.83	1.67		
Self-reported anxiety				
Pretest	66.07	27.51	24.33	18.79
Posttest	46.48	23.11	16.67	19.89
Follow-up	37.24	26.00		
Self-reported disgust				
Pretest	35.00	32.78	11.77	13.38
Posttest	23.87	27.01	11.77	20.43
Follow-up	23.14	28.43		

*Note.* The behavioral avoidance task is a 0–12 indicator of approach during the behavioral assessment (higher numbers indicate closer approach). Self-reported anxiety and disgust were taken at the closest point of approach to the spider during the behavioral assessment.

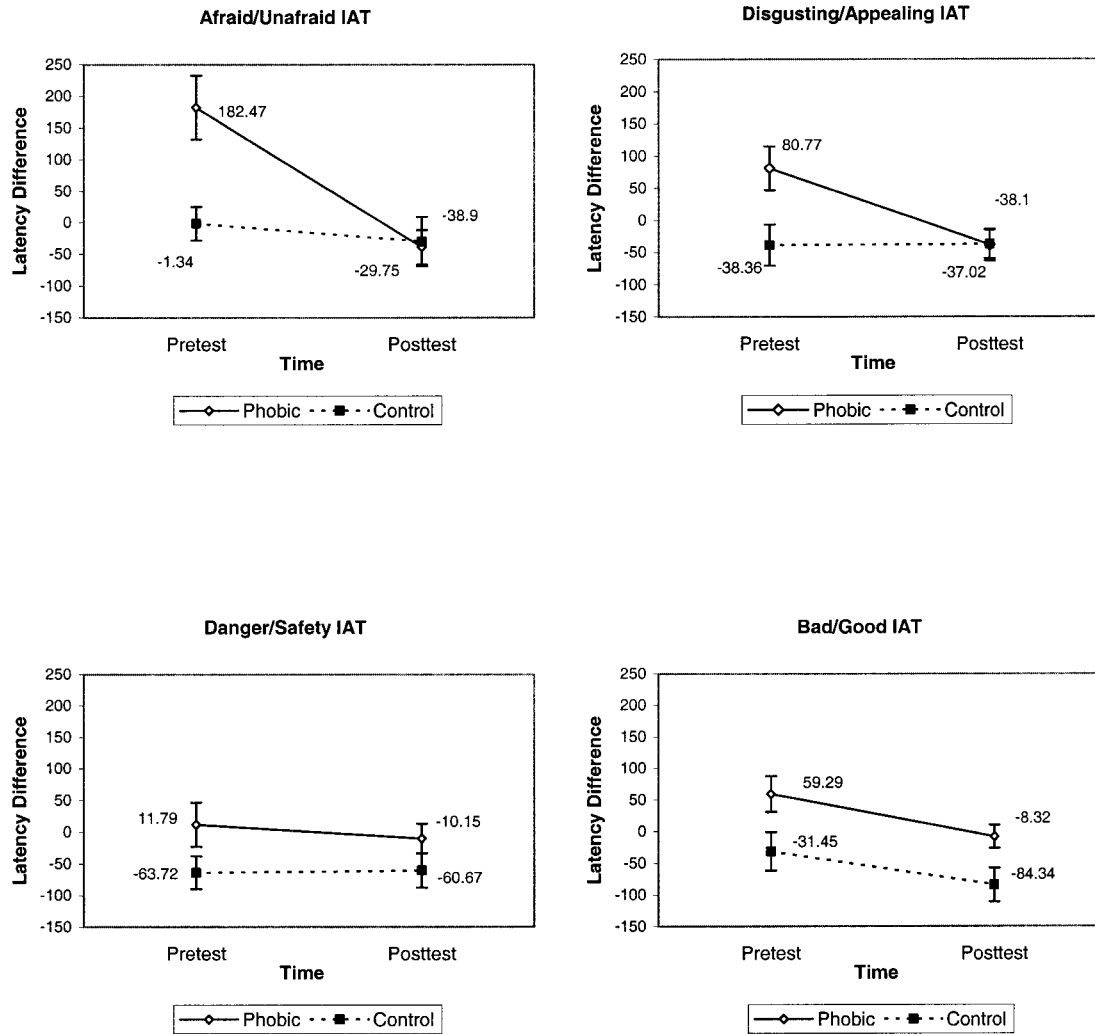


Figure 2. Group  $\times$  Treatment interactions for the snake and spider IAT tasks: Mean latency difference scores (response time, in milliseconds, for spider + positive attribute conditions minus spider + negative attribute conditions) and standard error bars. IAT = Implicit Association Test.

pretest: disgusting/appealing,  $t(59) = 2.54$ ,  $p = .01$ ,  $d = 0.67$ , and afraid/unafraid,  $t(59) = 3.23$ ,  $p = .002$ ,  $d = 0.85$ ; but the two groups were not significantly different at posttest: disgusting/appealing,  $t(59) = 0.00$ ,  $p > .10$ ,  $d = 0.00$ , and afraid/unafraid,  $t(59) = 0.20$ ,  $p > .10$ ,  $d = 0.05$ .

Consistent with the follow-up behavioral and questionnaire data, implicit associations on the disgusting/appealing and afraid/unafraid IATs remained stable from posttreatment to the follow-up assessment,  $t(29) = -0.50$ ,  $d = 0.19$ , and  $t(29) = -1.11$ ,  $d = 0.41$ ,  $ps > .10$ , respectively. As expected, the control IAT tasks showed no significant interaction: fruit/garbage,  $F(1, 57) = 1.05$ ,  $p > .10$ ,  $f = 0.14$ , and fire/other elements,  $F(1, 56) = 0.41$ ,  $p > .10$ ,  $f = 0.09$ , indicating that neither practice effects nor changes in general fear or valence explain the treatment effects on the spider-specific IAT tasks.

**Correlates of change.** To investigate how treatment gains on the IATs relate to treatment gains on questionnaire and behavioral measures of fear, residual gain scores were calculated for the

phobic group using the procedures outlined by Manning and Dubois (1962). Residual gain scores can be considered as pre-post difference scores that account for reliability of the measures. Correlations were calculated among residual gains on the afraid/unafraid and disgusting/appealing IATs as well as the behavioral and questionnaire measures. Results showed modest correlations between residual gains on all indicators of symptom improvement. Gains on the two IAT tasks were moderately correlated ( $r = .44$ ), but this was the only correlation strong enough to be considered statistically significant with this sample size (see Table 2 for residual gains correlations).

### Validity of Implicit Fear Associations

Because the IAT is just beginning to be applied to psychopathology research, we also examined several indicators of validity of the IAT as a measure of automatic fear processing, using data from the initial evaluation.

Table 2  
Correlations Between Residual Gain Scores for IAT and Outcome Variables  
for Phobic Participants

Residual gain score	Afraid/unafraid IAT	BAT Approach	BAT Anxiety	FSQ/SPQ
Disgusting/appealing IAT	.44	.07	.21	.09
Afraid/unafraid IAT	—	.14	.33	.09
BAT Approach		—	-.13	-.31
BAT Anxiety			—	.00

*Note.* Note that BAT Approach (degree of approach toward the spider during behavioral assessment) is scored in the opposite direction from the other measures. A correlation of .44 is the cutoff for  $p < .05$  with this sample size ( $n = 30$ ). IAT = Implicit Association Test; BAT = behavioral avoidance task; FSQ/SPQ = combination of Fear of Spiders Questionnaire and Spider Phobia Questionnaire.

*Criterion-related validity.* Performance on the snake/spider IAT tasks significantly distinguished between the phobic and control groups: afraid/unafraid,  $t(58) = 3.23$ ,  $p = .002$ ,  $d = 0.85$ ; disgusting/appealing,  $t(58) = 2.54$ ,  $p = .01$ ,  $d = 0.67$ ; and bad/good,  $t(58) = 2.19$ ,  $p = .03$ ,  $d = 0.57$ , with the exception of the danger/safety IAT,  $t(58) = 1.75$ ,  $p = .09$ ,  $d = 0.46$ , which showed a weaker effect. As expected, the control IAT tasks did not differentiate the phobic and control participants, providing support for the specificity of the IAT spider fear measures. The groups performed similarly on a task that controlled for the effect of general valence and practice: fruit/garbage + bad/good,  $t(57) = 0.50$ ,  $p > .10$ ,  $d = 0.13$ . Similarly, the groups were equivalent on a task that evaluated associations about a general fear stimulus category (fire/other elements + afraid/unafraid),  $t(56) = 0.68$ ,  $p > .10$ ,  $d = 0.18$ , providing evidence for *spider-specific* implicit fear associations.

*Convergent and discriminant validity.* To evaluate the relations among the different fear measures, correlation coefficients were calculated for the snake/spider IAT tasks and the behavioral and self-report measures of fear for the whole sample at the initial evaluation (see Table 3). The overall pattern of relationships indicated moderate positive correlations among the IAT tasks, although these monomethod correlation coefficients are not as consistently strong as those represented by the BAT.

Correlations between the IAT tasks and the behavioral and self-report measures of fear were somewhat variable, which is not

surprising given the heterogeneity of methods as well as the desynchrony typically found in the anxiety disorders (Lang, 1985). It is important to note that the fruit/garbage and fire/other elements control IAT tasks did not relate to the behavioral or self-report measures, supporting the discriminant validity of the spider fear IAT tasks.

*Incremental validity.* Behavior is a critical indicator of clinical functioning because of the disruption caused by phobic avoidance. To investigate whether implicit and explicit measures each explain unique variance in phobic behavior, a hierarchical regression was conducted for the phobic group, with behavioral approach at pretest (i.e., degree of avoidance of the spider) as the criterion variable. The explicit measure (combined fear questionnaires) was entered as the first predictor in the model, followed by the implicit measure (combined average of the four IAT tasks).

As expected, the fear questionnaires significantly predicted phobic avoidance in the first step of the analysis: for model,  $F(2, 26) = 19.27$ ,  $R^2 = .42$ , adjusted  $R^2 = .39$ ; for fear questionnaires,  $B = -2.02$ ,  $SE B = .46$ ,  $\beta = -.65$ ,  $p < .001$ . When both predictors were included, the overall model was significant,  $F(2, 26) = 12.60$ ,  $R^2 = .49$ , adjusted  $R^2 = .45$ , and both the IAT and spider fear questionnaires were predictive: for combined fear questionnaires,  $B = -1.85$ ,  $SE B = .45$ ,  $\beta = -.59$ ,  $p < .001$ ; for combined IATs,  $B = -.007$ ,  $SE B = .004$ ,  $\beta = -.28$ ,  $p = .06$ , suggesting that implicit fear associations

Table 3  
Correlations Among Fear Measures for the Full Sample at the Initial Testing

Fear measure	Disgust IAT	Danger IAT	Bad IAT	BAT Approach	BAT Anxiety	BAT Disgust	FSQ/SPQ	Fruit/garbage IAT	Fire/other elements IAT
Afraid IAT	.34	.08	.07	-.35	.14	.03	.34	.13	.13
Disgust IAT	—	.41	.35	-.34	.03	.42	.22	.07	-.19
Danger IAT		—	.39	-.23	.14	.19	.16	-.03	-.19
Bad IAT			—	-.32	.28	.40	.29	.17	-.28
BAT Approach				—	-.46	-.39	-.77	-.00	.16
BAT Anxiety					—	.55	.62	-.13	-.11
BAT Disgust						—	.52	.05	-.11
FSQ/SPQ							—	.04	.01
Fruit/garbage IAT								—	.32

*Note.* A correlation of .28 is the cutoff for  $p < .05$  with this sample size ( $ns = 59-61$ , depending on missing data for a given correlation coefficient). Full names of the Implicit Association Tests (IATs) were afraid/unafraid, disgusting/appealing, danger/safety, and bad/good. The fruit/garbage and fire/other elements IATs are control tasks that are not expected to correlate with fear measures. BAT = behavioral avoidance task; FSQ/SPQ = combination of Fear of Spiders Questionnaire and Spider Phobia Questionnaire.

uniquely predict avoidance behavior beyond standard questionnaire measures.<sup>3</sup>

### Discussion

This study evaluated the prediction that automatic processing among individuals with spider phobia would change over the course of exposure therapy. Fear-related implicit associations did change over the course of treatment, consistent with the prediction of schema change in cognitive models of anxiety disorders. Implicit associations of spiders with the constructs “afraid” and “disgusting” were reduced over the course of exposure therapy (and maintained during follow-up) for treated phobic participants, whereas normal controls’ associations about spiders in relation to snakes remained stable over time. Implicit associations of spiders with the constructs “bad” and “danger” did not show the expected Group  $\times$  Treatment interactions. Automatic associations generally differentiated the spider-phobic and control groups before treatment, and implicit associations explained phobic avoidance even when accounting for the effects of explicit measures, suggesting incremental validity for implicit processing to explain avoidance behavior. Overall, this study supports cognitive models of maladaptive fear, providing evidence that implicit associations, thought to reflect an element of schematic processing, change over the course of treatment.

#### *Using Implicit Association Measures to Investigate Cognition in Psychopathology*

By using an automatic processing paradigm that reflects simple associations and controls for state anxiety effects, this study represents one potential strategy for assessing fear schemas. Whereas schema theories frequently refer to “cognitive structures,” this turn of phrase is used for ease of communication and reflects a hypothetical construct (Young, 1999). At the outset of our article, we described how we conceptualized cognitive structure for this study and how we see implicit fear associations mapping onto this construct; however, we recognize that it is not possible to conclude with certainty that the IAT captures schematic functioning. Nevertheless, we feel confident that the measure reflects basic associations in memory and thus corresponds to many of the critical features ascribed to schemas. Whether the implicit fear associations should rightly be labeled schemas or simply constitute evidence of an automatic-processing bias, the results nonetheless support the value of information processing in explaining clinical phenomena, a sometimes contentious issue (e.g., Thorpe & Salkovskis, 1997a).

Given that the IAT is a new tool in psychopathology research, we examined several indicators of validity of the measure. Results generally showed good psychometric properties. This study also helps to address some of the common criticisms of the IAT methodology. The validity of the tool has been challenged in terms of both incremental validity (i.e., whether it contributes added value beyond self-report measures) and predictive validity (i.e., predicting behavior). In our sample, the IAT distinguished fear groups and predicted phobic avoidance even after accounting for the variance explained by questionnaires, providing some response to these criticisms. Furthermore, the IAT has been disparaged as a measure of individual implicit attitudes because it has been ac-

cused of reflecting cultural norms only (see discussion in Banaji, 2001). The present study demonstrated strong individual differences in measures of specific animal fear, making it difficult to argue that culture entirely explains the implicit associations on the IAT.

One limitation in the current study is the relative nature of the IAT, which limits the precision with which we could identify what aspects of automatic evaluations changed over treatment. Because the IAT relies on difference scores, it is theoretically possible (although not necessarily plausible) that spider-phobic individuals changed in their associations toward snakes rather than in their associations toward spiders (which were obviously the focus of treatment). The difference score is an inherent part of the IAT because it is a measure that relies on comparisons between sets of conditions. It is not possible to make valid interpretations of single-category data from the IAT (Nosek & Banaji, 2001) because evaluations of one object are always made relative to another object; thus, there is no meaningful baseline to use in separating out evaluations of the feared animals. For this reason, we can only confidently interpret the data in terms of changes in evaluations of spiders relative to snakes. Consequently, although it seems very unlikely that the spider-phobic participants’ associations about snakes became more fearful over the course of treatment (rather than that their associations about spiders became less fearful), this design does not permit us to rule out that possibility.

In addition, the relative nature of this task leaves open the interesting question of whether the spider-phobic participants are becoming less negative in their evaluation of spiders or are actually approaching a state of positive evaluation. An additional limitation in this study is the absence of an untreated spider-phobic group to serve as a further control. (They would be expected to show no change on the implicit association tasks, demonstrating that the observed differences for the treated phobic group are due to the fear reduction intervention.) To address this concern, the fire/other elements IAT task was included as an internal control, establishing that an untreated fear domain (i.e., fear of fire) did not change following the spider-specific fear therapy.

#### *Variability in Change Across Implicit Associations*

Overall, the “afraid” and “disgusting” implicit spider associations were strongly reduced following exposure therapy, as predicted, and these changes remained stable through the 2 months follow-up period. The “danger” and “bad” automatic spider associations did not change over treatment, which was surprising given that cognitive models of anxiety posit that anxious persons interpret situations and events as dangerous or threatening.

One possibility is that the relative nature of the IAT task accounted for the lack of change on “danger” and “bad” evaluations of spiders because associations with spiders were always

<sup>3</sup> The negative beta weights were expected in these analyses because the higher scores on the criterion variable indicated greater approach during the BAT (i.e., less avoidance), whereas higher scores on the predictor variables indicated greater fear.



evaluated relative to associations with snakes.<sup>4</sup> Snakes and spiders may be considered equally dangerous and bad, regardless of phobic status, because some poisonous exemplars exist for both these animals. Thus, phobic responding might better be distinguished by the emotional responses (i.e., implicit associations to “afraid” and “disgust”). Future tests that look at danger associations with spiders, using a relative category other than “snake” or using a nonrelative measure, could evaluate this explanation. Another potential methodological explanation is that the small sample size accounts for the null results.<sup>5</sup>

Alternatively, the results may reflect variance in phobic participants’ individual danger associations about the feared object. For example, Thorpe and Salkovskis (1997b) found that phobic individuals strongly endorsed danger cognitions reflecting potential harm from the anxiety reaction, such as, “I would make a fool of myself,” rather than danger caused by the spider itself (e.g., from a bite). Thus, danger associations may differ considerably across phobic individuals, obscuring group differences.

The residual gains correlations indicated wide variability in how closely change on the different fear response channels were related. This variability was comparable within the traditional measures of fear (questionnaire, behavior, and subjective anxiety) and between the IAT and the traditional measures. We suspect that this variability occurred because different rates of change can occur across fear response channels (e.g., cognitive and behavioral change may not occur simultaneously for a given individual; Lang, 1985), so one might not see parallel changes across fear measures immediately following treatment. Furthermore, the lack of shared method variance (given the multimethod approach used) and our relatively small sample also probably suppressed correlations among the phobics’ treatment gains. Finally, symptomatic improvement might have been associated with changes in neutralizing behavior or coping without corresponding change occurring in schematic processing.

### *Clinical Implications and Conclusion*

Clinical implications potentially follow from the finding that implicit associations are sensitive to treatment. On the basis of cognitive theories, we hypothesize that individuals who do not show reduced implicit fear associations following treatment (but do show change on other fear measures, such as self-report) will be at risk for return of fear or relapse because their residual automatic fear associations will render them more vulnerable to anxiety and avoidance when unexpectedly faced with the stimulus. (Participants in this study maintained their gains too well to permit us to examine this question.) In addition, future research may profit from evaluating whether incremental treatment gains ensue from more directly addressing schema modification in treatment at the level of basic associations. The IAT task itself may be one way to promote more positive basic associations with the feared object by repeatedly doing the classification task while pairing the feared object with positive adjectives (i.e., practicing only the category pairing condition that contradicts pretreatment automatic associations).

The IAT was used to approximate evaluation of cognitive structures in memory in an attempt to examine cognitive theories of emotional dysregulation. The findings of implicit fear associations show support for basic associations in memory analogous to key

elements of schemas, and the content appears to be specific to the feared stimulus. The treatment sensitivity of the implicit fear associations suggests that important aspects of schemas can change over the course of exposure therapy, implying that fear schemas can be modified by experience. Many open questions remain about the utility of the IAT for examining cognition in psychopathology. However, this initial assessment of the treatment sensitivity of automatic processing speaks to the clinical utility of implicit fear associations and provides empirical support to help bridge cognitive theory, information-processing research, and treatment outcome.

<sup>4</sup> In an earlier study (Teachman et al., 2001), we found differences across groups on the “danger” and “bad” IAT tasks; however, that study compared spider-fearful with snake-fearful participants, heightening differences between the groups because the IAT measures associations toward one animal versus the other. In the current study, spider-phobic participants were compared with a control group who were neither snake nor spider fearful, providing a less extreme counterpoint to the spider-phobic group than the snake-fearful group had in the earlier study.

<sup>5</sup> Based on the effect sizes found for the Group  $\times$  Treatment interactions for the “afraid” and “disgusting” IATs, the power to find an interaction effect with this sample size was .64.

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