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Evaluating implicit spider fear associations using the Go/No-go Association Task

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Abstract

The Go/No-go association task (GNAT) [Nosek, B.A., & Banaji, M.R. (2001). The Go/No-go Association Task. *Social Cognition*, *19*, 625–666], which measures automatic associations in memory, was administered to participants who were high ($N = 17$) versus low ($N = 17$) in spider fear along with other established fear measures to validate the tool as a proxy measure for fear schemata. The GNAT involves participants classifying stimuli into superordinate categories and looking at speed of categorization when categories match, versus contradict, participants' hypothesized implicit fear associations. Results showed that the GNAT successfully differentiated the fear groups, indicating its convergent validity, and there was no group difference on a GNAT control fear task, supporting its discriminant validity. In addition, the GNAT spider fear task was associated with questionnaire measures of spider fear, self-reported anxiety during a behavioral avoidance test (approaching a live spider), and whether or not participants touched the spider during the behavioral test, supporting the task's predictive validity. Findings suggest the GNAT provides an effective, single-target measure of involuntary fear associations.

Keywords: Spider fear; Implicit; Automatic; Go/No-go Association Task

1. Introduction

Cognitive models of fear and anxiety propose that a maladaptive fear schema or cognitive framework influences information processing to make the individual more attentive to potentially threatening cues, more likely to interpret ambiguous cues as

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threatening, and more likely to remember cues relevant to fear (e.g., Beck, 1976; Beck, Emery, & Greenberg, 1985). In turn, these information-processing biases are thought to maintain anxiety and avoidance by keeping threat cues salient to the vulnerable person. The fear schema is thought to operate implicitly in that it occurs outside of voluntary control; in fact, the uncontrollable nature of threat processing is thought to be the hallmark of automaticity in anxiety (McNally, 1995). For instance, a person with spider phobia can recognize at a rational level that they are not likely to be fatally attacked by a harmless daddylonglegs, but they still feel compelled to escape and avoid anxiety-provoking encounters with spiders. The current study evaluates this involuntary processing of threat cues using a novel measure of implicit associations, akin to those hypothesized for the fear schema, among persons with spider fears.

Implicit associations theoretically reflect simple elements of the fear schema. The term "implicit association" is used here to refer to memory-based links between two concepts. These associations share many of the qualities ascribed to schemata because the cognitive structures referred to in schematic processing are often described as interconnected associations in memory (Segal, 1988). They are cognitive structures in the sense described 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" (p. 34). Difficulties operationalizing the concept of schema have made it difficult to test cognitive models of fear (Fiske & Taylor, 1991; Teachman & Woody, 2004). Traditional questionnaire measures, for example, are unlikely to reflect implicit associations in memory because of their reliance on introspection and strategic processing. More recently, with the advent of new techniques in the fields of cognitive science and social cognition, researchers have relied on reaction time techniques and other innovative tools to test predictions derived from cognitive models of fear and anxiety.

The current study examines application of one such tool for fear research. The Go/No-go Association Task (GNAT; Nosek & Banaji, 2001) is related to the widely used measure of implicit social cognition, the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). Both tasks measure implicit associations in memory, and the IAT has been used previously to measure implicit spider fear (e.g., de Jong, van den Hout, Rietbroek, & Huijding, 2003; Teachman, Gregg, & Woody, 2001; Teachman & Woody, 2003). The GNAT procedure involves participants classifying words or pictures into superordinate categories and examining speed of categorization when categories are paired to match participants' hypothesized implicit associations (e.g., spider + afraid, for a spider-fearful individual), or contradict the associations (e.g., spider + calm). Participants are not asked to directly evaluate spiders, but simply to indicate whether or not a stimulus presented in the center of the screen belongs to either of the two category labels (e.g., "Spider" or "Afraid") paired on the screen. Average response latencies for the different category pairing conditions are contrasted because participants generally categorize stimuli faster when the paired categories are associated in their memory.

An advantage of the GNAT in assessing implicit fear associations is its within-subject design. This essentially holds constant the influence of state anxiety by presenting the feared stimuli in both of the conditions being compared (Spider + Afraid and Spider + Calm). Many information-processing tasks are potentially influenced by state anxiety because they compare responses to stimuli that are designed to be threatening to responses to non-threatening stimuli. Consequently, it is difficult to tease apart whether performance differences on these tasks result from information processing differences or from the influence of state anxiety in response to the stimuli.

An additional methodological benefit of many implicit association measures is that participants often find it difficult to control their responses on the measure (even though they can easily identify the stimuli being classified and perhaps even the purpose of the task; Greenwald et al., 1998). Thus, this procedure appears to reduce the impact of self-presentation on task performance. This feature is valuable because admitting to fear can be perceived as undesirable, especially as therapy progresses.

The GNAT and IAT are based on similar theoretical principles and design features. However, the GNAT has the advantage that it can be used to examine implicit associations toward a single target[1] category (in the context of a general set of stimuli), whereas the IAT has a strongly comparative design (evaluating one target relative to another). Thus, with the GNAT, one can look at implicit associations toward spiders without requiring a specific contrasting category (de Houwer, 2002; Nosek & Banaji, 2001). The GNAT also has alternate design possibilities; one can either examine errors using signal detection analyses by including a response deadline, or compare average response latencies as the dependent variable. In the current study, the design will focus on response latency because of early indications that this approach may be more reliable (partly because response latency is a continuous variable, whereas errors are dichotomous), making it more useful for individual differences research (Nosek & Banaji, 2001).

The current study was designed to evaluate the validity of the GNAT for fear research by examining whether the task differentiates fear groups, and relates to other well-established questionnaire-based, affective, and behavioral markers of spider fear. Finally, given that this is the first application of the GNAT in the clinical domain (to our knowledge), a GNAT control task was incorporated to insure that the implicit associations measured were specific to spider fear, rather than reflecting fearful associations more broadly.

2. Method

2.1. Participants

Participants ($N = 17$ high fear, $N = 17$ low fear; 67% female; mean age = 18.82 years, $SD = 1.13$)[2] were recruited through the psychology participant pool at the University of Virginia (this pool consists of approximately 700 students who complete a battery of measures at the start of each semester). Individuals who met the eligibility criterion for the present study (see below) were invited by email to participate. Specifically, the sample was pre-selected based on responses to the "spider" distress item on the nine-item animal/insect fears subscale of the Fear Survey Schedule-III (*FSS-III*; Wolpe & Lang, 1964; the item "crawling insects" was replaced with "spiders"). Participants who rated their spider fear as a 1 (*not at all*) or a 2 (*a little*; for the low fear group), or as a 5 (*very much*; for the high fear

[1]We use the term 'target' to refer to the attitude object (e.g., spider) and 'descriptor' to reflect the associated attribute (e.g., calm, afraid).

[2]Due to an administrative error, demographic data were not recorded for a subset of participants ($n = 7$). However, using the available data, the fear groups did not significantly differ with respect to gender ($\chi^2 = .08$, $p > .10$).

group) were invited to participate. Previous research using this subscale as a screening measure has recruited samples that were equivalently fearful to other diagnosed samples (e.g., Teachman et al., 2001).

2.2. Materials

2.2.1. Questionnaires

The Fear of Spiders Questionnaire (FSQ; Szymanski & O'Donohue, 1995) is an 18-item scale that assesses participants' avoidance and fear of harm from spiders, such as their degree of endorsement 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." Both measures have adequate psychometric properties and have been widely used in treatment studies on spider phobia. In addition, the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) was administered to assess the severity of depressive symptoms.

2.2.2. Behavioral avoidance test (BAT) and subjective anxiety

This task measures the extent of anxiety experienced and the degree of avoidance in response to a live spider. A completely harmless but frightening-looking spider was placed in a cage at one end of a room, and participants were asked to enter the room and approach the spider as closely as possible (steps ranged from 0 = not entering the room to 8 = touching the spider). Participants were not under any time pressure and were told they could stop the task at any point, and that we did not expect everyone to complete the task. The task ended when participants had either touched the spider (the final step), or reported that they did not wish to proceed further. At several steps throughout the task, the experimenter prompted participants to verbally report their current anxiety using a Subjective Units of Distress Scale (SUDS) ranging from 0 (very low) to 100 (very high).

2.2.3. Implicit fear associations

The GNAT was modified from Nosek and Banaji's (2001) initial GNAT publication, particularly Experiment 5 (which used response latency as the dependent variable). The task involves classifying word and picture stimuli into more general level categories, and the speed of classification is used to infer strength of automatic associations in memory. To assess spider fear, response latency was measured when the categories Spider and Afraid were jointly presented versus when Spider and Calm were presented. Relatively faster responses when Spider was paired with Afraid indicate more fearful spider associations. Affective fear associations with spiders were selected because these associations have previously demonstrated treatment sensitivity with spider phobic individuals (relative to danger or simple valence associations with spiders; Teachman & Woody, 2003). A second task was included to assess an alternate fear that was unrelated to spiders to check that the GNAT captures specific fear associations, rather than threat or negativity more broadly. The control fear task looked at associations between Fire and Afraid, versus between Fire and Calm. Fire was chosen because it is a common threat that is unrelated to animal phobias. Although the GNAT does not require a direct comparison category, allowing for single target analyses (i.e., just evaluating spider or fire fear associations in this case), a background category is often used as part of the distracter stimulus set. For the GNAT Spider Fear task, pictures of other animals were used because of their semantic relatedness to spiders and equivalent ease of categorization. For the GNAT Control Fear task, pictures of other outdoor elements (e.g., water, clouds in the sky) were used, following the analogous IAT control fear task from Teachman and Woody (2003).

During the critical blocks for the task, participants see two category labels on the screen simultaneously, and are asked to evaluate whether stimuli that appear in the middle of the screen belong to one of these two categories (see Fig. 1). Unlike the IAT, the GNAT does not require classifying stimuli into one category pair versus into a contrasting category pair. Instead, participants need only identify whether the presented stimulus belong to the target categories or not. Participants are instructed to press the space bar (the 'Go' response) if the presented stimulus belongs to either of the categories whose labels appear on the screen (e.g., Spider and Afraid), or to *not* press any key (the 'No-go' response) if the stimulus is a distracter (e.g., is a picture of another animal). Participants are told, "The task moves very quickly. It is designed to be difficult and no one is expected to perform it perfectly. Please persevere and just try to catch as many words as possible." Error feedback is provided after each trial.

Picture stimuli were used for the target and distracter categories (Spider, Fire, Other animals, and Other elements) in order to have a large number of stimuli for each category, to broadly sample the domains, and to enhance the ecological validity of the stimuli. Pictures of all different types of spiders were used, and the other animals included a broad range of animal photos that varied in their ferocity (e.g., rabbit, snake, bear, moose, koala, alligator). Word stimuli were used for the descriptor categories (e.g., Afraid: anxious, scared, terrified, nervous; Calm: relaxed, serene, tranquil, peaceful). For each category, 20 stimuli were used; selection was based on extensive piloting to insure that all stimuli were easy to categorize, and all picture stimuli were edited to be similar in size and shape.

The GNAT Control Fear task was always completed first to insure that participants would be comfortable with the procedure for the critical Spider Fear task. Three single categorization blocks were initially completed in random order to familiarize participants with classifying items into the Calm, Afraid, and Fire categories. These blocks included 12 trials each. Next, the critical combined blocks for the GNAT Control Fear task (Fire + Afraid and Fire + Calm) were completed in counterbalanced order. These blocks consisted of 16 practice trials followed by 60 critical trials, based on Experiment 6 in Nosek

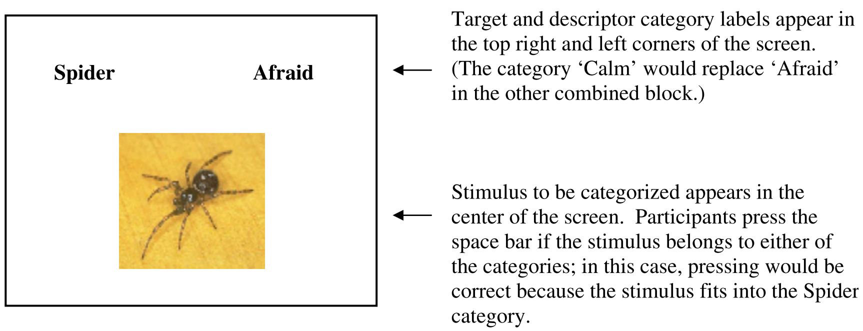

Fig. 1. Schematic description of the GNAT procedure based on the computer screen seen by a participant on a typical classification trial.

and Banaji (2001), which also used picture stimuli. A 12-trial single categorization block was then completed for the Spider category. This was followed by the critical GNAT Spider Fear task combined blocks in counterbalanced order (Spider + Afraid and Spider + Calm), also consisting of 16 practice trials followed by 60 critical trials.

During the critical combination blocks, stimuli from the target, descriptor, or distracter categories could appear. Presentation of stimuli from within categories was random, but each stimulus appeared once before repetition within a given category occurred. Given the interest in target and descriptor associations (e.g., Spider and Calm) versus distracters (which are treated as noise), there were twice as many target and descriptor trials relative to the distracter trials (see further rationale in Nosek & Banaji, 2001, Experiment 2b). This was done to increase reliability because only the target and descriptor trials are ultimately used for analyses (see scoring details below).

To set the response window for participants to classify the stimulus (i.e., duration the stimulus remains on the screen), recommendations from Nosek and Banaji (2001, Experiment 5) were followed because of its use of the response latency dependent variable. When signal detection analyses are utilized, the deadline for the response window becomes increasingly brief. However, for the response latency design, "The response deadline for target items was extended to minimize errors and maximize the range of possible response times. The deadline was not extended for distracter items because the task requires some pressure to respond quickly. If the items all appear for an extended period of time, subjects could intentionally slow down and decrease the automaticity of their responses." (Nosek & Banaji, 2001, p. 647). In the current study, the window for target and correct descriptor trials was 1400 ms; the window for incorrect descriptor trials (e.g., a word from the Calm category when Afraid was the category label on the screen) and for distracter trials was 1000 ms. These times were selected based on piloting the task to balance the need for some time pressure while keeping the error rate relatively low (we aimed for approximately 5%). The inter-stimulus interval was 850 ms.

2.3. Procedure

The measures were administered as part of a larger study on interpretation biases in spider fear (participants in the current study completed a recognition test at the start of the session for this other study, which is not reported here). Following informed consent, a mood check and the recognition test, participants completed the GNAT followed by the questionnaires (in random order), and then the BAT (approaching the live spider and reporting subjective distress). This fixed order was chosen because of the interest in administering the GNAT without priming from the other fear measures, and because we did not want residual anxiety from the BAT to influence the other measures. Finally, participants were fully debriefed, provided compensation, and offered relaxation if they were experiencing any remaining distress.

3. Results

3.1. Establishing fear group allocation

Means and standard deviations for each variable are listed in Table 1 by fear group (with significant differences noted). Mean SPQ and FSQ scores for the high fear group

Table 1
Mood and symptom measures by fear group

Measure	High fear group		Low fear group	
	M	*SD*	*M*	*SD*
GNAT Spider Fear Task	.26*	.23	−.03	.33
GNAT Control Fear (Fire) Task	.20	.32	.23	.27
Spider Phobia Questionnaire	16.81*	4.84	2.71	3.65
Fear of Spiders Questionnaire	73.47*	22.07	24.72	13.88
Behavioral Avoidance Test (BAT; last step completed, 0–8)	3.94*	1.71	7.47	1.18
Anticipatory Anxiety for BAT (0–100)	36.94*	19.18	12.00	17.95
Peak Anxiety during BAT (0–100)	55.94*	27.05	17.06	20.11
Beck Depression Inventory—II	12.00	8.91	11.06	6.59

Note. Means that have an asterisk (*) differ at $p<.05$.

were within 1 *SD* from those reported in other phobic samples (e.g., Teachman & Woody, 2003 means: SPQ = 19.69 ± 4.75, FSQ = 84.93 ± 13.68). Further, as expected, the fear groups were significantly different on each of the previously established questionnaire, affective and behavioral measures of spider fear (see Table 1), supporting the fear group classification and validity of the other fear markers.

3.2. *Evaluation of the GNAT for fear research*

3.2.1. *Data reduction and scoring*[3]

Data reduction and scoring followed recommendations from Nosek and Banaji (2001), and applied suggestions from Greenwald, Nosek, and Banaji (2003) that were originally proposed for the IAT. Error rates for the target, descriptor and distracter trials were examined separately to check that no participant had greater than 40% errors on a given block, or 30% errors on the task overall. Next, data were examined to determine if any participants had more than 10% trials with unusually fast responses (under 300 ms). No deletions were needed based on these criteria. Distracter trials (e.g., other animals and elements) were then removed, so that only target and descriptor trials were used for analyses. This deletion occurs because the distracter items are considered noise. Trials under 300 ms were then deleted because these may reflect random responding. The average error rate for the remaining trials was ~2%; errors were not excluded, and no error penalty was incorporated. The GNAT *D* score is then calculated separately for each GNAT task, reflecting the difference in mean reaction time across critical blocks divided by the standard deviation across blocks. This is conceptually similar to Cohen's *d* (see Greenwald et al., 2003). The scoring was set so that higher scores indicate greater implicit spider and fire fear associations on the GNAT Spider and Control Fear tasks, respectively.

3.2.2. *Reliability*

Split-half reliability was calculated for each task by correlating two GNAT *D* scores, each reflecting half the critical trials within the task. For the GNAT Spider Fear task, $r = .46$, and for the GNAT Control Fear task, $r = .49$, suggesting reasonable reliability for

[3]GNAT data for two participants were missing due to a computer problem.

reaction time data (e.g., see Bosson, Swann, & Pennebaker, 2000, for comparison of reliabilities across implicit measures of self-esteem).

3.2.3. Order effects

Independent sample *t*-tests indicated no significant order effects (based on order of category pairing condition) on either the GNAT Spider ($t_{(30)} = .02$, $p > .10$, $d = .01$) or Control Fear ($t_{(30)} = 1.18$, $p > .10$, $d = .43$) task, suggesting that order of completing the Afraid (+ target attitude) versus Calm (+ target attitude) pairing did not influence the results. Moreover, analysis of variance (ANOVA) indicated no significant interaction between fear group and order of category pairing condition on the GNAT Spider task ($F_{(1,28)} = .02$, $p > .10$, $\eta^2 = .001$).

3.2.4. Validity

An independent samples t-test indicated significantly greater GNAT Spider Fear *D* scores for the high, relative to low, fear group ($t_{(30)} = 2.88$, $p = .007$, $d = 1.05$), providing known-groups convergent validation (see Fig. 2). Further, as noted in Table 2, the GNAT Spider Fear task showed positive relations to each of the other spider fear markers, including the FSQ, SPQ, anticipatory anxiety about the BAT, and peak anxiety during the BAT. The BAT indicator of avoidance showed a significant negative relationship because it is scored so that a negative correlation indicates less likelihood of touching the spider with higher implicit spider fear. (Note the BAT correlation was calculated using Spearman's ρ because the BAT was recoded dichotomously as completed or not, given the highly skewed nature of the variable as a continuous measure of avoidance.) Finally, incremental validity for the GNAT Spider Fear task was evident based on a stepwise regression analysis (using forward selection method) predicting peak anxiety during the BAT by the FSQ and GNAT concurrently. The overall model with both variables entered was significant (Model $F = 20.54$, $p < .001$), and both the FSQ ($\beta = .54$, $p < .001$) and GNAT ($\beta = .39$, $p = .004$, R^2 change with GNAT entered into model = .14) were

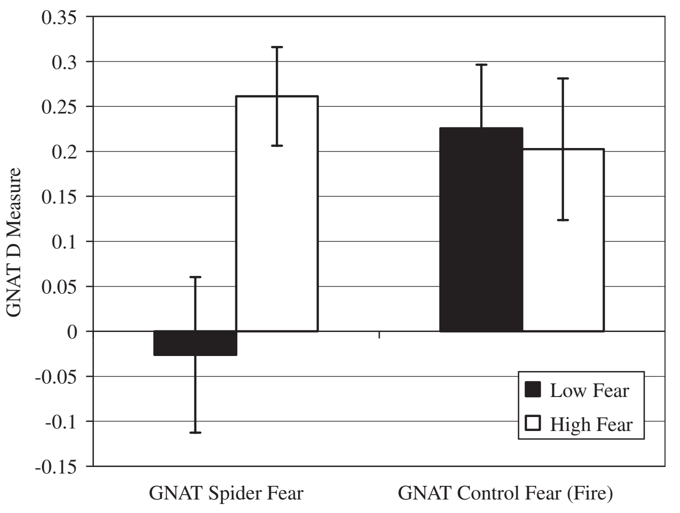

Fig. 2. Go/No-go Association Task (GNAT) spider fear and control fear associations by spider fear group.

Table 2
Relationship between the GNAT and established spider fear measures

	GNAT spider fear task (Spider + Afraid vs. Calm)	GNAT control task (Fire + Afraid vs. Calm)
Convergent and predictive validity: Spider fear measures		
Fear of Spiders Questionnaire	.34^{+}	.19
Spider Phobia Questionnaire	.41*	.11
Behavioral Avoidance Test (BAT; touching live spider)	−.41*	.04
Anticipatory Anxiety for BAT	.67**	−.04
Peak Anxiety during BAT	.58**	−.001
Discriminant Validity:		
Beck Depression Inventory-II	.10	.08

** $= p \leqslant 0.001$, * $= p < 0.05$, $^{+} = p < .10$.
Note: All correlations are Pearson's correlation coefficients with the exception of those with the Behavioral Avoidance Test, which are Spearman's ρ because the BAT was coded dichotomously as completed (touched the spider) or not. Also, note that the magnitude of the correlations should be interpreted with caution because of the extreme groups design.

significant, unique predictors, suggesting that the implicit and explicit fear measures explain unique aspects of spider fear.

Discriminant validity for the GNAT Spider Fear task follows from the lack of a relationship between the GNAT and the BDI (see Table 2), and findings that the GNAT Control fear task does not distinguish the high and low fear groups ($t_{(30)} = .22$, $p > .10$, $d = .08$) or relate to any of the other measures of spider fear (see Table 2). Moreover, a repeated measures ANOVA demonstrated specificity of the GNAT based on the expected significant fear group (high versus low) by GNAT task (spider versus fire) interaction ($F_{(1,30)} = 4.70$, $p = .04$, $\eta^2 = .14$). These results provide support for the convergent (known-groups validation), predictive (of other fear markers), incremental (unique prediction of anxiety in presence of spider) and discriminant (particular to spider fear) validity of the GNAT to measure specific fear associations.[4]

4. Discussion

Implicit spider fear associations were examined using the GNAT to evaluate its potential for psychopathology research in general, and fear research in particular. The GNAT Spider Fear task showed strong known-groups validation, and correlated with a range of other spider fear markers, including behavioral avoidance, subjective anxiety when encountering a live spider, and questionnaire measures of spider phobia, even predicting

[4]Note that a similar pattern of results emerges when using a difference score to calculate GNAT effects, rather than the D score. For instance, the GNAT spider fear difference score is greater for the high versus low fear group ($t_{(30)} = 2.19$, $p = .04$, $d = .80$), and the GNAT Control fear difference score does not distinguish the groups ($t_{(30)} = .04$, $p > .10$, $d = .01$). Further, the GNAT spider fear difference score is significantly correlated with peak ($r = .57$, $p = .001$) and anticipatory ($r = .67$, $p < .001$) anxiety during the BAT, with the SPQ ($r = .37$, $p = .04$), and there was a trend for the correlation with touching the spider during the BAT ($r_s = -.34$, $p = .06$). The correlation with the FSQ did not reach significance ($r = .29$, $p = .11$).

subjective anxiety when a traditional spider fear questionnaire was also entered in the model. Importantly, a control fear task, evaluating implicit fear of fire, did not distinguish the fear groups or relate to the spider fear measures. These results provide solid support for the convergent, incremental and discriminant validity of the GNAT to assess specific fear associations. Further, reliability analyses suggested adequate split-half reliability for reaction time data. Overall, these findings speak to the robust nature of implicit fear associations and the utility of the GNAT for psychopathology research.

The primary rationale for validating the GNAT with a fearful sample was the need for further measures of implicit associations that permit single-target evaluations. The requirement of a relative comparison category is a significant constraint of the IAT (De Houwer, 2002; Greenwald et al., 1998), arguably the most popular measure to date of implicit associations in psychopathology research. The concept 'spider' is typical of the challenge—unlike gender, age, and other social categories frequently assessed with the IAT in social cognition research; there is no natural dichotomy that provides a contrasting category to Spider. As a result, prior investigations have relied on various contrasts (e.g., snakes: Teachman et al., 2001; Teachman & Woody, 2003, neutral household items: de Jong et al., 2003, blood-injection: Teachman & Saporito, 2005), leading to different conclusions about the nature of implicit spider fear associations. Moreover, it has not been possible with relative measures to comment on the *absolute* evaluation of the target,[5] yet this is the goal when trying to validate cognitive models of fear and anxiety. It also limits recruitment because samples are constrained by the need to consider variation on both target categories (e.g., selecting participants who are high in spider fear but low in snake fear; Teachman & Woody, 2003). This constraint is significant both practically and theoretically because it can lead to sample bias (i.e., one might reasonably argue that persons with spider phobia who are low in snake fear are not typical of spider phobic samples, limiting generalizability of the findings). Further, for more complicated anxiety disorders, establishing an appropriate relative target becomes even more challenging. For instance, what is an appropriate contrast for fears of bodily changes, a key target in anxiety sensitivity and panic disorder (see Teachman, 2005)? Thus, the search for non-relative, implicit association measures that can be applied to psychopathology research is critical.

The GNAT is not alone in attempting to fill this void. For instance, Wigboldus, van Knippenberg, and Holland (2001) used an IAT in which only one target concept and two attribute concepts were presented to evaluate attitudes toward the Islam faith, which had promising results. This single-target format of the IAT has also recently been applied to health psychology research, evaluating automatic smoking associations (Huijding & de Jong, 2006a). In addition, De Houwer (2003) developed the Extrinsic Affective Simon Task (EAST), which has received considerable attention and shows potential for assessing implicit associations in psychopathology (e.g., De Houwer, Crombez, Koster, & De Beul, 2004), including variants used to examine spider fear (de Jong et al., 2003; Huijding & de Jong, 2005, 2006b). It will be important to determine which questions the GNAT, versus the EAST or another implicit association measure, most appropriately assesses and to directly compare the tasks within the same study. We suspect that the GNAT will be particularly helpful for treatment outcome research, because of early indications that the

[5] Even with the GNAT, the single-target evaluation occurs in the *context* of the distracter set, and the descriptors are still relative in nature (i.e., afraid versus calm), but the evaluation of spiders is not comparative.

effects are larger and more reliable with the GNAT than other single-target measures (see De Houwer, 2003).

Clearly, more research is needed to ultimately determine the potential of the GNAT for psychopathology studies. Limitations of the current study include the use of a non-clinical, fearful sample, and the absence of test–retest reliability assessment to determine treatment sensitivity of the GNAT. It will also be helpful in subsequent studies to compare the GNAT to other indicators of fear-relevant, information processing biases, and to evaluate the influence of instructions to 'fake' responding on the task to more firmly establish the uncontrollability of the measure. Nonetheless, the current data providing promising initial support for the utility of the GNAT to provide a valid measure of implicit fear associations that effectively distinguishes fear groups, and relates to other known behavioral, affective and self-reported measures of fear. Finding effective tools to capture involuntary processing may one-day help us understand how these seemingly irrational associations lead to the development and maintenance of pathological fear and anxiety.

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References

Beck, A. T. (1976). *Cognitive therapy and the emotional disorders*. New York: International Universities Press.

Beck, A. T., Emery, G., & Greenberg, R. I. (1985). *Anxiety disorders and phobias*. New York: Basic Books.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck depression inventory—Second edition: Manual*. San Antonio, TX: The Psychological Corporation.

Bosson, J. K., Swann, W. B., Jr., & Pennebaker, J. (2000). Stalking the perfect measure of implicit self-esteem: The blind men and the elephant revisited? *Journal of Personality & Social Psychology*, *79*, 631–643.

de Houwer, J. (2002). The Implicit Association Test as a tool for studying dysfunctional associations in psychopathology: Strengths and limitations. *Journal of Behavior Therapy and Experimental Psychiatry*, *33*, 115–133.

De Houwer, J. (2003). The extrinsic affective Simon task. *Experimental Psychology*, *50*, 77–85.

De Houwer, J., Crombez, G., Koster, E. H. W., & De Beul, N. (2004). Implicit alcohol-related cognitions in a clinical sample of heavy drinkers. *Journal of Behavior Therapy and Experimental Psychiatry*, *35*, 275–286.

de Jong, P. J., van den Hout, M. A., Rietbroek, H., & Huijding, J. (2003). Dissociations between implicit and explicit attitudes toward phobic stimuli. *Cognition and Emotion*, *17*, 521–545.

Fiske, S. T., & Taylor, S. E. (1991). *Social cognition* (2nd ed). New York: McGraw-Hill.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*, 1464–1480.

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, *85*, 197–216.

Huijding, J., & de Jong, P. J. (2005). A pictorial version of the Extrinsic Affective Simon Task: Sensitivity to generally affective and phobia-relevant stimuli in high and low spider fearful individuals. *Experimental Psychology*, *52*, 289–295.

Huijding, J., & de Jong, P. J. (2006a). Automatic associations with the sensory aspects of smoking: Positive in habitual smokers but negative in non-smokers. *Addictive Behaviors*, *31*, 182–186.

Huijding, J., & de Jong, P. J. (2006b). Specific predictive power of automatic spider-related affective associations for controllable and uncontrollable fear responses toward spiders. *Behaviour Research and Therapy*, *44*, 171–176.

Klorman, R., Weerts, T. C., Hastings, J. E., Melamed, B. G., & Lang, P. J. (1974). Psychometric description of some specific-fear questionnaires. *Behavior Therapy*, *5*, 401–409.

McNally, R. J. (1995). Automaticity and the anxiety disorders. *Behaviour Research and Therapy*, *33*, 747–754.

Nosek, B. A., & Banaji, M. R. (2001). The Go/No-go association task. *Social Cognition*, *19*, 625–666.

Posner, M. I., & Warren, R. E. (1972). Traces, concepts and conscious constructions. In A. W. Melton, & E. Martin (Eds.), *Coding processes in human memory* (pp. 25–43). Washington, DC: Winston and Sons.

Segal, Z. V. (1988). Appraisal of the self-schema construct in cognitive models of depression. *Psychological Bulletin*, *103*, 147–162.

Szymanski, J., & O'Donohue, W. (1995). Fear of Spiders Questionnaire. *Journal of Behavior Therapy and Experimental Psychiatry*, *26*, 31–34.

Teachman, B. A. (2005). Information processing and anxiety sensitivity: Cognitive vulnerability to panic reflected in interpretation and memory biases. *Cognitive Therapy and Research*, *29*, 483–503.

Teachman, B., Gregg, A., & Woody, S. (2001). Implicit attitudes toward fear-relevant stimuli in individuals with snake and spider fears. *Journal of Abnormal Psychology*, *110*, 226–235.

Teachman, B. A., & Saporito, J. (2005). Implicit and explicit disgust cognitions in BII and spider fear. In Paper presented at the *annual meeting of the Association for the behavioral and cognitive therapies*, Washington, DC.

Teachman, B. A., & Woody, S. (2003). Automatic processing among individuals with spider phobia: Change in implicit fear associations following treatment. *Journal of Abnormal Psychology*, *112*, 100–109.

Teachman, B. A., & Woody, S. (2004). Staying tuned to research in implicit cognition: Relevance for clinical practice with anxiety disorders. *Cognitive and Behavioral Practice*, *11*, 149–159.

Wigboldus, D., van Knippenberg, A., & Holland, R. (2001). The difference between relative and absolute implicit associations. In Paper presented at the *third meeting of the European social cognition network*, Houffalize, Belgium.

Wolpe, J., & Lang, P. J. (1964). A fear survey schedule for use in behaviour therapy. *Behavior Research and Therapy*, *2*, 27–30.