

**Spider Fear and Avoidance: A Preliminary Study of the Impact of Two Verbal Rehearsal Tasks on a Behavior-Behavior Relation and its Implications for an Experimental Analysis of Defusion**

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## **Abstract**

The current study examined the impact of a brief “verbal rehearsal” task on performance on two Implicit Relational Assessment Procedures (IRAPs), actual approach behavior towards a live spider (a BAT), and the relationship between the IRAPs and the BAT. Participants first completed the Fear of Spiders Questionnaire (FSQ), followed by one of two verbal rehearsal tasks, one of which focused on fear-acceptance and the other on fear-reduction as ways of coping with fear. All participants then completed two IRAPs similar to those employed by Leech, Barnes-Holmes, and Madden (2016). Finally, participants completed the BAT using a live common house spider. Broadly similar findings were obtained for performance on the IRAPs as were reported by Leech et al. No significant differences between the two verbal-rehearsal conditions emerged on the self-report measures, the IRAPs, or the BAT. However, correlations between performances on the IRAPs and the BAT were concentrated in the reduce-fear condition. When considered in the context of the results previously reported by Leech et al., the differential pattern of correlations observed in the current study suggest that the verbal rehearsal task impacted upon a behavior-behavior relation that may be directly relevant to the concept of defusion in the Acceptance and Commitment Therapy literature.

**Keywords:** Implicit Relational Assessment Procedure, Fear, Avoidance, Behavior-Behavior Relations, Defusion.

The traditional behavioral approach to the study of irrational fears and their treatment drew heavily on respondent conditioning and extinction (Rachman, 1977; Watson & Rayner, 1920). The basic model involved a conditioning history in which a neutral stimulus (CS) was directly paired with an unconditioned stimulus (UCS) that evoked a fear response. Across pairings the neutral stimulus gradually acquired fear-inducing properties. In order to undermine or treat this fear response the CS was presented in the absence of the UCS with the expectation that the conditioned fear would eventually subside (i.e., extinguish). The literature in this area is vast and many theories and models of exactly how and why such conditioning and extinction processes actually work (or sometimes fail to work) have been explored (Beckers, Krypotos, Boddez, Effting, & Kindt, 2013; Rachman, 1977; Seligman 1971).

More recent behavioral models of irrational fears and their treatment have drawn on the concept of derived stimulus relations and the transformation of functions (Dymond, Schlund, Roche, & Whelan, 2014). One of the distinguishing features of this recent approach is that irrational fears may emerge based on behavioral processes that have been linked to human language and cognition (Hayes, Barnes-Holmes, & Roche, 2001). The basic paradigm involves reinforcing a series of stimulus relations among arbitrary stimuli, establishing fear-inducing properties in one of the stimuli and then testing for the emergence of fear-inducing effects in the other stimuli. Unlike the traditional respondent conditioning approach to the study of irrational fears, the acquisition of fear does not occur through direct stimulus pairings but through transformations of functions based on relational networks (See Dougher, Augustson, Markham, Greenway, & Wulfert, 1994, for a seminal study). Similar derived transformation effects have also been employed in the study of the extinction of fear responses (Dougher et al., 1994) and also avoidance responding (Augustson & Dougher, 1997). More recent research has also explored the extent to which fear and avoidance responding based on derived transformations of function may be considered functionally

independent. For example, Luciano and colleagues reported a series of studies that showed that derived fear responses, using skin conductance as a measure, may be extinguished when derived avoidance responses continue (Luciano et al., 2013), and that it is also possible to reduce derived avoidance responding even when derived fear responses are maintained (Luciano et al., 2014).

Another line of behavioral research that is very much focused on human language and cognition has also begun to explore the functional independence of fear and avoidance, but using a different paradigm to that employed in derived transformation of function studies. Specifically, the research employs a method, known as the Implicit Relational Assessment Procedure (IRAP), which is a computer based task that requires participants to respond quickly and accurately (under time pressure) to sets of stimuli employing a response pattern that may be considered consistent or inconsistent with previous learning histories (see Barnes-Holmes, Barnes-Holmes, Stewart, & Boles, 2010). Participants are presented with trials where one of two label stimuli are presented at the top of a computer screen and one of two target stimuli that are presented in the middle of the screen. The task for the participant is to choose between two response options presented at the bottom right and left of the screen. The fundamental hypothesis is that relational responding should be quicker and more accurate on history-consistent rather than history-inconsistent blocks of trials.

The first published study to employ the IRAP as a measure of fear and avoidance presented pictures of spiders in the IRAP to determine if performance on the measure predicted<sup>1</sup> self-reported fear and avoidant behavior to a live tarantula in a behavioral approach task (BAT) (Nicholson & Barnes-Holmes, 2012). Specifically, participants were required to respond in a pattern that was consistent with an anti-spider bias on some blocks of trials and a pro-spider bias on other blocks of trials. The spider trials were intermixed with an equal

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<sup>1</sup> The concept of prediction is assumed to be synonymous with correlation throughout the current article and is not used to infer, unless explicitly stated, a causal relationship.

number of neutral trials that presented pictures of nature scenes, which functioned as a contrast category. Results indicated that response latencies were faster for anti-spider blocks of trials compared to pro-spider blocks of trials. However, the anti-spider bias effect on the IRAP was significantly larger for participants who were rated as highly fearful, relative to those rated as low in fear, based on a self-report measure, the Fear of Spiders Questionnaire (FSQ; Szymanski & O'Donohue, 1995). Furthermore, performance on the IRAP successfully predicted avoidant behavior on the BAT, which involved approaching a live tarantula.

One key limitation to the study conducted by Nicholson and Barnes-Holmes (2012) is that the IRAP conflated the measurement of fear and avoidance/approach. Specifically, participants were required to confirm or deny that spiders were aversive (e.g., fear-inducing) on some trials and to confirm or deny that they could approach spiders on other trials. Although the IRAP performance predicted both self-reported fear and actual approach behavior, it is not possible to determine the extent to which the fear and/or approach trial-types were independently predictive of these two response domains. For example, perhaps the spider-fear trials would be more predictive of self-reported fear whereas the spider-approach trials would be more predictive of performance on the BAT.

A recently published study sought to replicate and extend the results reported by Nicholson and Barnes-Holmes (2012), in an attempt to measure fear, avoidance, and approach as independent response biases using two IRAPs (Leech, Barnes-Holmes, & Madden, 2016). One IRAP (the Fear-IRAP) contained trials with statements pertaining to fearful versus pleasant reactions to spiders, whereas the other IRAP (the Avoidance-IRAP) contained statements pertaining to avoiding versus approaching spiders. Both IRAPs also presented pictures of pets as positive contrast categories. In the second experiment reported by Leech et al. (2016), performance on the Fear-IRAP predicted self-reported fear but not actual approach behavior on the BAT, whereas performance on the Avoidance-IRAP successfully predicted

approach behavior. Overall, therefore, the findings were consistent with the findings of Nicholson and Barnes-Holmes, and in a broader sense with the data reported by Luciano and colleagues (2013, 2014), in that fear and avoidance/approach responses towards spiders may be conceptualized as two functionally independent classes of behavior.

The research reported by Nicholson and Barnes-Holmes (2012) and by Leech et al., (2016) indicate that the IRAP may be used to assess fear and avoidance/approach. However, neither study sought to determine if performances on the IRAP and/or a BAT would be modified by a relevant “intervention” or “treatment” for spider fear and/or avoidance. One recent study, however, has examined the impact of a relevant intervention (Ritzert, Forsyth, Berghoff, Barnes-Holmes, & Nicholson, 2015). Specifically, participants were assigned to one of three conditions; a control condition, a defusion intervention (based on Acceptance and Commitment Therapy, ACT; Hayes, Strosahl, & Wilson, 1999), or a thought distraction intervention. The two intervention conditions were designed to target phobic thoughts of spiders, whereas the control condition was irrelevant to spider fear. Results demonstrated a significant reduction in the spider-fear IRAP effects for participants in the defusion intervention compared to those in both the control and distraction conditions. In addition, participants assigned to the defusion intervention demonstrated a significant reduction in thought believability (using self-report measures) relative to those assigned to the other conditions. Overall, therefore, the study showed that both IRAP performance and a self-report measure of fusion with thoughts were sensitive to an intervention that was designed to reduce levels of fusion.

Although the results reported by Ritzert et al., (2015) were encouraging, a spider BAT was not employed in the study, and thus the impact of the interventions on actual approach behavior towards spiders remains unknown. Furthermore, only IRAP effects for trials directly assessing relations targeted during the interventions were examined. Specifically, the trials

were those containing an image of a spider paired with fear or disgust phrases. Thus, trials which included spider images paired with approach statements were excluded from analysis and interpretation.

The current research seeks to replicate and extend the studies reported by Leech et al. (2016) by including two different types of “intervention” designed to target fear responses. In one sense, therefore, the current research involved an attempt to combine the general strategies adopted by Leech et al. (2016) and Ritzert et al. (2015). Specifically, rather than simply determining if relational responding on the IRAP predicts fear, approach and avoidance, the current research focused on attempting to manipulate the IRAP performances and to determine the impact, if any, on actual approach behavior towards a spider. In designing a task to manipulate the IRAP and BAT performances we aimed to identify the minimal level of “intervention” required to change these measures. In the study by Ritzert et al., a relatively complex ACT-based protocol was used, which included an experiential exercise, and thus it was not possible to determine if all or just some elements of the protocol were necessary. A limited number of studies have attempted to isolate the specific properties of “analog” ACT-based interventions to determine the active ingredients (e.g., McMullen et al., 2008), but none have involved the IRAP as a measure.

In the current study, we employed a “minimal level” intervention, which involved a simple “verbal rehearsal” task (with no highly detailed therapeutic rationale, metaphors, analogies, or experiential exercises). Some participants were assigned to a condition in which they were required simply to confirm a strategy of reducing their fear to cope with fear-inducing situations, whereas other participants were required to confirm a strategy of accepting their fear, rather than attempting to control or reduce it; the task also involved denying that the opposite strategy applied to them. The main rationale behind employing these tasks was to determine if requiring participants to rehearse such verbal relations, and

little else, would produce relevant changes in performances on the IRAPs and/or the BAT, or relations between the two measures. For example, would participants who were required to rehearse “reduce-fear” statements produce reduced fear effects on the Fear-IRAP relative to participants who were required to rehearse the “accept-fear” statements. And if so, would there be any difference between the groups’ actual approach behaviors on the BAT. Given that the verbal rehearsal tasks were deliberately “minimal” and developed for the current study (i.e., they were not the tasks employed by Ritzert et al., 2015), the research was somewhat exploratory and thus we refrained from making specific predictions.

## **Method**

### **Ethical Considerations**

The study reported here was conducted in accordance with the ethical guidelines of Ghent University. Prior to the experiment, participants read and signed a consent form informing them that they could withdraw from the study at any time. Upon completion, participants were fully debriefed.

### **Design**

There were five stages involved in the current study: 1. Questionnaires; 2. Condition Script and Fear-Related Verbal Rehearsal Task; 3. Three IRAPs (Practice-IRAP, Fear-IRAP, and Avoidance-IRAP); 4. Fear-Related Verbal Rehearsal Task; and 5. BAT. The current study comprised of two verbal rehearsal conditions: 1. accept-fear, and 2. reduce-fear.

### **Participants**

One hundred and five undergraduate students attending Ghent University, Belgium, volunteered to participate in the study ( $N = 105$ , 73 Females, 32 Males). Participants were paid €10 for their participation. Prior to the experiment, participants read and signed a consent form informing them that they could withdraw from the study at any time. Thirty eight participants were eliminated due to their failure to achieve the necessary performance criteria



on the verbal rehearsal task and/or the IRAPs (see “procedure” section), leaving 48 females and 29 males ( $N = 67$ ), the results of whom were subject to analysis. The mean age was 22.6 years ( $SE = .512$ ), with a range of 18 – 43 years. The participants completed the study individually in the Department of Experimental-Clinical and Health Psychology at Ghent University. Based on the recent meta-analysis of criterion effects for the IRAP (Vahey, Nicholson, & Barnes-Holmes, 2015) a sample size greater than 29 is required for first order correlations to achieve statistical power of 0.8 when testing criterion validity of clinically focussed IRAP effects.

## **Materials**

The study employed four questionnaires: the Depression, Anxiety and Stress Scale-21 (DASS, deBeurs, vanDyck, Marquenie, Lange, & Blonk, 2001); the Acceptance and Action Questionnaire II (AAQ-II 7-item version; Bernaerts, De Groot, & Kleen, 2012); and the Fear of Spiders Questionnaire (FSQ, Muris & Merckelbach, 1996); a Fear-Related Verbal Rehearsal Task; three IRAPs (i.e., Practice-IRAP, Fear-IRAP, and Avoidance-IRAP); and a Behavioral Approach Task (BAT). All materials used in the current study were presented to participants in Dutch.

**Depression, Anxiety and Stress Scale (DASS-21).** The Depression Anxiety and Stress Scale is a 21 item self-report questionnaire which covers a range of core symptoms of anxiety, depression and stress. The English version of this scale (Lovibond & Lovibond, 1995), for a non-clinical sample, has demonstrated excellent internal consistencies among its three subscales (Cronbach’s Alpha’s = .82 - .90), good convergent and discriminant validity ( $r$ ’s = .70 - .72) and adequate reliability (Cronbach’s alpha = .90 - .95) (Henry & Crawford, 2005). The Dutch translation has been reported to yield similar excellent internal consistency (deBeurs, et al. 2001).

**Acceptance and Action Questionnaire – II (AAQ- II 7-item version).** The Acceptance and Action Questionnaire – II is a 7-item self-report scale which measures acceptance, experiential avoidance and psychological inflexibility. The AAQ yields an overall score with a maximum of 49 indicating *low psychological flexibility* and a minimum of 7 indicating *high psychological flexibility*. The English version of this scale has been shown to have good psychometric properties and good convergent, discriminant, and incremental validity (Bond et al., 2011). The Dutch translation has yielded similar reliability values (Bernaerts, et al., 2012).

**Fear of Spiders Questionnaire (FSQ).** The Fear of Spiders' Questionnaire (FSQ) is an 18-item self-report scale for assessing spider phobia. The FSQ is capable of assessing both low and high levels of reported spider phobia with high retest reliability (.97) and high internal consistency (Cronbach's Alpha = .92; Szymanski & O'Donohue, 1995). The Dutch translation has yielded similar reliability values (Muris & Merckelbach, 1996).

**Condition Script.** The condition script comprised of a written paragraph that described two core ways in which people may respond to fear, and was used to categorise participants into one of the two conditions (i.e., accept-fear or reduce-fear). The script was presented to all participants in Dutch; an English example of the script was as follows:

*There are two strategies on how to deal with fear. The first strategy involves feeling fearful and accepting the fear but not allowing it to influence your behavior so you can succeed in your goals. This strategy involves accepting how frightened you are but ignoring it and continuing with what you are doing, even if you are terrified. The second strategy involves reducing, controlling and conquering your fear in order to achieve goals and succeed. This strategy involves trying to reduce your fear to become calm and eliminate the fear so you can continue with your goals. Both strategies are legitimate ways of dealing with fear.*

*[Participants in the accept-fear condition were given the following instruction: "For the next task you are required to respond as if you live your life by the first strategy."]*

*[Participants in the reduce-fear condition were given the following instruction: “For the next task you are required to respond as if you live your life by the second strategy.”]*

*Please write down in your own words what you have been asked to do in the next task.*

**Fear-Related Verbal Rehearsal Task.** The task was programmed in Windows Visual Basic 6.0. The task presented 60 statements (30 of which were related to reducing fear and 30 to accepting fear) along with two response options “Me” and “Not Me” (see Table 1). The 10 statements were presented quasi-randomly, such that they each appeared six times across the 60 trials. Participants were required to categorise each of the statements as “Me” or “Not Me” according to their assigned condition. For example, in the reduce-fear condition, participants were required to respond “Me” to “*Controlling my fear is essential for success*” and “Not Me” to “*Being frightened will never stop me*”. No feedback was presented during any stage of this task, participants were simply instructed to respond as accurately as possible to the statements according to their assigned condition.

Insert Table 1 Here

**The Implicit Relational Assessment Procedure (IRAP).** Participants were required to respond in a manner that was either deemed consistent with an anti-spider/pro-pet bias or inconsistent with that bias. Participants were required to complete three separate IRAPs, one practice IRAP, one targeting fear (i.e., Fear-IRAP) and another targeting avoidance/approach (i.e., Avoidance-IRAP).

**Practice-IRAP.** The practice IRAP consisted of the labels “Furniture” and “Vehicles” presented with four furniture picture targets (i.e., chair, bed, couch, table) and four vehicle picture targets (i.e., airplane, car, train, bicycle). The response options provided to participants were “True” and “False”.

***Fear-IRAP.*** The label stimuli for the Fear-IRAPs consisted of twelve images: six were color images of various spiders and the other six were various images of either puppies or kittens. All of the pet and spider images were taken from Leech et al. (2016). In the case of the spider images, the pictorial stimuli were chosen because they reflected a range of spiders, some of which were common house spiders, some highly poisonous and the rest unknown. The pet images were selected because they represented a range of different popular breeds of puppies or kittens. The pictures of pets presented to participants depended on whether they had a preference for cats or for dogs; this preference was assessed simply by asking participants which they preferred. If participants preferred cats they were presented pictures of kittens as label stimuli, whereas if they preferred dogs they were presented pictures of puppies as label stimuli. This method had previously been employed by Leech et al. Each label stimulus was presented with one of sixteen target statements, eight of which were positive and eight were negative. Target stimuli for the Fear-IRAP can be found in Table 2.

Insert Table 2 Here

***Avoidance-IRAP.*** The Avoidance-IRAP was similar to the Fear-IRAP except the target stimuli presented were modified. Specifically, the target stimuli referred to approach and avoidance responses (see Table 3).

Insert Table 3 Here

**Behavioral Approach Task (BAT).** A live common house spider approximately 5cm in diameter (including legs) was employed in the current study. The live spider was housed in a transparent container with a flexible lid. The spider was cared for throughout the study and was used with all participants. Upon completion of the study, the spider was released. Participants were given a BAT script, in Dutch, which outlined what was involved in the BAT. See below for an English version.

*“The following test is to measure how willing you are to approach a live spider. I will ask you if you are willing to do a number of items, one at a time, and if you are willing to do the items, I’ll ask you to do so. If at any time you do not want to continue, please feel free to stop.”*

There were five steps involved in the BAT, which took participants closer to the tarantula moult and was scored 0 – 5. Participants were informed they could stop or withdraw at any point. The first step involved participants opening the door to the room where the tarantula moult was kept. If participants failed to complete the first step of opening the door they scored 0, if they opened the door they scored 1 (this score was increased as participants completed the different steps). For the second step, participants were asked if they were willing to enter the room and look at the tarantula moult. The third step brought participants closer again and required them to touch the box containing the tarantula moult for thirty seconds. The fourth step required participants to open the lid of the box where the tarantula moult was kept. The fifth and final step required participants to put their hand into the box and touch the tarantula moult for ten seconds.

### **Procedure**

Participants were randomly assigned to the two conditions (accept-fear and reduce-fear) before being exposed to the five stages of the study.

**Questionnaires.** Participants completed the three questionnaires in a fixed sequence (DASS, the AAQ-II, and the FSQ).

**Fear-Related Verbal Rehearsal Task.** Before beginning the task, participants were asked to read the condition script (one for each condition), which described the two core ways in which people respond to fear, and were then asked to summarise the strategy presented in the script to ensure that participants understood the difference between the two ways of

responding to fear, and to promote adherence to this strategy in the subsequent part of the task. If participants did not summarise the script correctly, the experimenter described the relevant strategy again until participants indicated they were willing to proceed. During the rehearsal task, participants were required to categorise the 60 statements according to the strategy provided in the script (as either “Me” or “Not Me”).

**Practice IRAP.** No instructions were provided to participants during the practice IRAP. Performance was shaped or prompted on an individual basis until participants had achieved performance criteria on a pair of practice blocks (see below for details of the prompting procedure). At this point, rather than progress to the test phase of the practice IRAP, participants were presented immediately with either the Fear- or Avoidance-IRAP.

*Details of the prompting procedure.* At the beginning of the experiment, participants were seated in front of the computer. Before interacting with the IRAP the experimenter described to participants what they would see during the task. They were told that they would see a picture appear at the top of the screen, a word in the middle of the screen, and that they would be required to respond to the combination of the picture and word by choosing one of two response options that appeared at the bottom of the screen, one on the left and one on the right. They were also informed that the response options would be “Yes” or “No”. Finally, participants were informed that pressing the “d” key would select the response at the bottom left and pressing the “k” would select the response option at the bottom right of the screen.

After the basic details of the task had been outlined participants were advised to try to avoid the red X. They were told that selecting the correct response option would allow them to progress to the next screen while selecting an incorrect response would produce a red X. At this point participants were encouraged to press the spacebar and interact with the task, being told that all they could do on the first screen was guess what the correct response was. If they emitted a response deemed incorrect according to the program (i.e., the response produced a

red X), participants were advised that pressing the opposite key would allow them to continue through the task. The aim of the prompting procedure was to ensure participants attained the latency and accuracy criteria required on the IRAP without employing an explicit rule or instruction presented by the experimenter or the IRAP program (e.g., “Please respond as if furniture is furniture and vehicles are vehicles”).

Participants were required to achieve two performance criteria (see below) to complete one pair of practice blocks. Participants were allowed to attempt three practice-block pairs; if a participant was unsuccessful after the three pairs the program did not progress onto the test blocks and a message appeared that read “*Please contact the researcher*”. Participants were then debriefed and thanked for their time. The criteria for advancement to the test blocks required participants to produce >80% accuracy while maintaining < 2000ms average latency for each practice block within a pair.

**Fear-IRAP.** In this IRAP, on blocks of trials that were deemed consistent with pre-experimental history, participants were required respond in a manner that coordinated pictures of spiders with fear-related words and pictures of pets with positively-valenced words (hereafter referred to as anti-spider blocks). On blocks of trials that were deemed inconsistent with pre-experimental history, the opposite response pattern was required. That is, coordinating spiders with positively valenced words and pets with fear-related words (hereafter referred to as pro-spider blocks). Similar to the Practice-IRAP, no instructions were provided to participants during the Fear-IRAP. The order in which the two types of blocks were presented was counterbalanced across participants. For half of the participants, therefore, all odd numbered blocks required anti-spider responses and all even-numbered blocks required pro-spider responses; the opposite was the case for the remaining half of the participants.

Participants were exposed to a maximum number of three pairs of practice blocks, on which they could reach the performance criteria of 80% and  $\leq 2000$  ms. Once participants achieved these criteria they automatically advanced to the test blocks. No performance criteria were applied for progression through the test blocks, but performance feedback, detailed below, was presented at the end of each block to encourage participants to maintain the practice-block criteria ( $> 80\%$  correct and  $\leq 2000$ ms latency).

Each practice block and each test block consisted of 32 trials composed of four trial-types, each presented eight times within a block. The four trial-types were defined in terms of a 2x2 combination of the two label stimuli with the two types of target stimuli: *Pet-Pleasant*; *Pet-Fear*; *Spider-Pleasant*; *Spider-Fear*. Examples of these four trial-types are as follows; (i) Pet Picture/“Makes me smile”; (ii) Pet Picture/“Terrifies me”; (iii) Spider Picture/“I like it”; (iv) Spider Picture/“Scares me”. The four trial-types were presented in a quasi-random order, such that each trial-type was presented once every four trials (the same trial-type was never presented twice in succession).

On each trial, an image of either a spider or a pet (puppy or kitten) appeared in the upper centre of the screen. Below this, in the centre of the screen a target stimulus appeared (i.e., a phrase related to either fear or pleasant). In the bottom third of the screen, the response options were presented (“Yes” and “No”). One response was presented on the bottom right corner; the other was presented on the bottom left corner. These response options alternated randomly across trials with the software ensuring that they did not appear in the same positions for more than three successive trials.

On anti-spider blocks of trials, participants were required to press the “Yes” key if spiders were presented with a negative appraisal, and to press the “No” key if spiders were presented with a positive appraisal. For example, responding “Yes” was deemed correct when presented with a picture of a spider and a fear appraisal phrase (e.g., “Scares me” or “Terrifies



me”), or when a picture of a pet was presented with a pleasant appraisal (e.g., “I like it” or “Makes me smile”); responding “No” was deemed correct when presented with a picture of a spider and a pleasant appraisal, or when a picture of a pet was presented with a fear appraisal. On pro-spider blocks of trials, the opposite pattern of responding was required. That is, responding “No” when presented with a spider and negative appraisal, or when presented with a pet and a pleasant appraisal; and responding “Yes” when presented with a spider and a pleasant appraisal, or a pet and a negative appraisal.

Responses deemed correct for a given block of trials cleared the label, target and response option stimuli; the next set of stimuli appeared 400ms later. Incorrect responses produced a red “X” below the target stimulus, which remained on screen (with the label and response option stimuli) until the correct response was emitted. If a participant did not emit a response before 2000ms on any trial, “Too Slow!” appeared directly below where the red X was presented for incorrect responses, and it remained on screen until a response (correct or incorrect) was emitted.

**Avoidance-IRAP.** All procedures of the Avoidance-IRAP were similar to the Fear-IRAP except the target stimuli presented were modified. Specifically, the target stimuli referred to approach and avoidance responses. In this IRAP, the four trial-types were defined in terms of a 2x2 combination of the two label stimuli with the two types of target stimuli: *Pet-Approach; Pet-Avoid; Spider-Approach; Spider-Avoid*. Examples of these four trial-types are as follows; (i) Pet Picture/“I can touch it”; (ii) Pet Picture/“I want to avoid”; (iii) Spider Picture/“I need to leave”; (iv) Spider Picture/“I can approach it”.

**Fear-Related Verbal Rehearsal Task.** Participants were then administered a second exposure of the Fear-Related Verbal Rehearsal Task.

**Behavioral Approach Task (BAT).** There were five steps involved in the BAT, which progressively asked participants to move physically closer to the live spider. This was scored from 0 to 5 as participants progressed through each step.

## Results

### Scoring the Fear-Related Verbal Rehearsal Task

Each correct response on the rehearsal task was awarded one point (points did not appear on screen). Only participants who achieved a minimum of 50 correct answers (i.e., 50 points) on each presentation of the rehearsal tasks were included in the analyses (i.e., participants were required to produce a minimum of 50/60 correct answers on each task). The data for 36 participants were removed on this basis.

### Validating the BAT

Consistent with previously published studies by Leech et al. (2016), and Nicholson and Barnes-Holmes (2012), the correlation between the FSQ and the BAT proved to be strong and significant ( $r = -.593, p < .0001$ ), indicating that higher reported levels of fear on the FSQ predicted fewer approach steps on the BAT.

### Scoring the IRAPs

The primary datum from the IRAPs was response latency, which was defined as the time in milliseconds that elapsed from the onset of a trial to the emission of a correct response. Consistent with previously published studies employing the traditional IRAP, the data were screened before being subject to statistical analyses. If a participant's accuracy fell below 75% or the median latency exceeded 2000ms during a test block, this was taken to indicate that the participant had not maintained performance at a level close to that required to pass the practice blocks. Consistent with Leech et al. (2016), if participants failed to maintain these criteria for one or both test blocks from a given pair (1 & 2, or 3 & 4, or 5 & 6), the data from those two blocks were excluded and the data from the remaining two test-block pairs

were analysed (this applied to 7 participants). If participants failed to maintain the criteria across two or more pairs of blocks on either of the two IRAPs, all of the data from that participant were excluded from further analysis. The data for 2 participants (in addition to the 36 from the rehearsal task) were removed on this basis. The latency data from the Fear-IRAP and Avoidance-IRAP were transformed into *D*-IRAP scores.

Given the forgoing transformation, a larger *D*-IRAP score indicated a greater difference in mean response latencies between the two types of blocks (pro- versus anti-spider blocks) for each trial-type. Positive scores on the Fear-IRAP thus indicated a bias towards fearing and not finding spiders pleasant, and a bias towards finding pets pleasant and not fearing them. In order to facilitate direct comparisons across the spider and pet trial-types, the signs for the *Spider-Fear* and *Spider-Pleasant* trial-types were inverted (i.e., + scores became negative, and – scores became positive). Positive *D*-IRAP scores now indicated a positive bias for both spiders and pets and negative scores indicated a negative bias for both types of stimuli. The raw data from the Avoidance-IRAP were subjected to the same scoring procedure as the Fear-IRAP, and thus positive *D*-IRAP scores indicated a positive bias (pro-approach/anti-avoidance) for both spiders and pets and negative scores indicated a negative bias (anti-approach/pro-avoidance) for both types of stimuli.

### **Between Group Analyses**

Preliminary analyses indicated that participants in the two verbal rehearsal conditions (accept- and reduce-fear) did not differ significantly on the FSQ, the DASS (including its three sub-scales), or the AAQII (*all ps* > .3). The mean *D*-IRAP scores for the two conditions on the two IRAPs are presented in Figure 1. The Fear-IRAP produced a strong positive bias on the *Pet-Pleasant* trial-type for both conditions, the larger of which was in the reduce-fear group. A similar effect was observed on the *Pet-Fear* trial-type, however, this effect was weaker. On the *Spider-Pleasant* trial-type, a negative bias was observed for both conditions,

but this was close to zero. And on the *Spider-Fear* trial-type, negative biases were also observed, the larger of which was in the reduce-fear group. In concrete terms, participants tended to respond “Yes” more quickly than “No” when presented with a picture of a spider and fear appraisal phrase or a picture of a pet and a pleasant appraisal. When presented with a picture of a pet and fear appraisal, participants showed a tendency to respond “No” rather than “Yes”. Finally when presented with a picture of a spider and a pleasant appraisal, participants produced a very weak tendency to respond “No” rather than “Yes”. Preliminary analyses indicated that the rehearsal manipulation did not interact significantly with the counterbalancing variables (e.g., consistent- versus inconsistent-first, IRAP-order). A mixed repeated measures analysis of variance (ANOVAs) conducted with trial-type as the within group variable and rehearsal condition as the between group variable indicated no main or interaction effects for rehearsal condition (all  $ps > .05$ ).

Insert Figure 1 Here

The Avoidance-IRAP produced a strong positive bias on the *Pet-Approach* trial-type for both conditions, the larger of which was in the reduce-fear group. A similar effect was observed on the *Pet-Avoid* trial-type, however no difference between conditions emerged. On the *Spider-Approach* trial-type, a negative bias was observed in the reduce-fear condition, but a positive bias was observed in the accept-fear condition, although these effects were close to zero. And on the *Spider-Avoid* trial-type, negative biases were also observed, the larger of which was in the reduce-fear group. Preliminary analyses indicated that the rehearsal manipulation did not interact significantly with the counterbalancing variables (e.g., consistent- versus inconsistent-first, IRAP-order). A mixed repeated measures ANOVA with trial-type as the within group variable and rehearsal condition as the between group variable indicated no main or interaction effects for rehearsal condition (all  $ps > .05$ ).

### **BAT Analyses**

An independent *t*-test comparing the total number of steps completed by each participant (accept-fear,  $M = 4.29$ ,  $SD = .76$ ; reduce-fear,  $M = 4.27$ ,  $SD = .72$  ) indicated no significant difference between the two rehearsal conditions on the BAT ( $p > 0.9$ ).

### **IRAP-FSQ/BAT Correlational Analyses**

Two correlation matrices, one for each IRAP, which were split by rehearsal condition, were calculated to determine if any of the eight trial-types predicted self-reported fear of spiders (FSQ) and approach responses on the BAT. The results of these correlations are presented in Table 4 (Fear-IRAP) and Table 5 (Avoidance-IRAP). Only one of the sixteen correlations was significant across the two IRAPs for the accept-fear condition (*Spider-Approach-FSQ*), whereas six of the correlations were significant in the reduce-fear condition (three involving the FSQ and three involving the BAT). In each case, the correlations were in the intuitively correct direction – for example, increased positive biases on the *Spider-Pleasant* and *Spider-Approach* trial-types predicted a higher number of approach responses on the BAT. In effect, it appears that the relationship between performance on the IRAP and other measures of spider fear was reasonably robust in the reduce-fear condition but not in the accept-fear condition.

Insert Table 4 Here

Insert Table 5 Here

### **Discussion**

One of the main aims of the current research was to partially replicate and extend the study reported by Leech et al. (2016). A simple verbal rehearsal task was included in the current research to determine if it would impact upon the IRAP performances and to determine the impact, if any, on actual approach behavior towards a live spider. A normative sample of participants were randomly assigned to one of two conditions; reduce or accept-fear. No significant differences between the two conditions emerged on the IRAPs, BAT, or

explicit self-report measures. However, the overall pattern of effects on the two IRAPs reported by Leech, et al. were observed again here, thus replicating the basic findings. Interestingly, the correlations between the IRAPs, and the BAT and self-report measures appeared to differ across the two verbal rehearsal conditions. Specifically, the IRAP performances correlated more often with the other measures in the reduce-fear than in the accept-fear condition.

The absence of a clear effect for the verbal rehearsal task on the IRAPs (and the BATs) could be seen as inconsistent with the recent findings reported by Ritzert et al. (2015). Specifically, they reported a larger reduction in the spider-fear IRAP effects for participants who were exposed to a defusion intervention relative to those in both distraction and control conditions. On balance, as noted previously, the current study employed a very simple computerized verbal rehearsal task, whereas Ritzert et al. applied an established ACT-based intervention, including an experiential exercise, that had been shown to be effective in previous research (Masuda, et al., 2010; Masuda, Hayes, Sackett, & Twohig, 2004). In addition, the current study employed a normative sample, whereas Ritzert et al. selected a “clinical analog” sample who reported high levels of spider fear. The different outcomes across the current and previous study in terms basic impact on IRAP effect sizes is perhaps therefore not that surprising. It will be important, however, for future research to determine to what extent our simple verbal rehearsal task would need to be developed or enhanced to produce the types of effects reported by Ritzert et al. For example, is the inclusion of an experiential exercise a critical variable, or is some other feature more or less active in shifting IRAP and BAT performances specific to fear-related stimuli (see Kehoe et al., 2014; McMullen et al., 2008)? Indeed, there are potentially many different ways in which the verbal rehearsal task could be modified in future research. It may be useful to include some form of feedback for performance on the task. In addition, perhaps the task would have a greater

impact if participants were assigned to a task that reflected their pre-existing coping tendencies.

Although the current study did not find a significant effect for the verbal rehearsal task in terms of modifying the IRAP and BAT performances, the differential pattern of correlations between the measures across the two tasks could be important. Critically, the IRAP performances correlated with the BATs and explicit measures in the reduce-fear condition but with one exception failed to do so in the accept-fear condition. Furthermore, the correlations were generally consistent with “common-sense” expectation. For example, higher levels of pro-spider bias on both IRAPs predicted a greater number of approach steps on the BAT. The differential pattern of correlations could be seen as revealing the impact of the verbal rehearsal task on a behavior-behavior relation (see Barnes, 1989; Hayes & Brownstein, 1986) that is directly relevant to the concept of defusion in the ACT literature (Hayes et al., 1999). On the one hand, the reduce-fear task may have served to strengthen the causal relations between statements about one’s own fear and actual fear-relevant behavior (because participants were required to confirm that they should reduce or control their fear as a strategy for success or achievement). On the other hand, the accept-fear verbal rehearsal task may have served to “loosen” or undermine the causal relations (because participants were required to confirm that they could be successful while also experiencing fear). In other words, the correlations observed in the reduce-fear condition task could indicate that the task supported or increased fusion between the IRAP and the BAT; in contrast, the absence of any correlations in the accept-fear condition could indicate that it “defused” the “fusion” between the behaviors observed in these two contexts.

Of course, without a control condition it is not possible to determine if one or both tasks changed the “default” level of fusion (that may exist in a normative sample). However, Experiment 2 from the previously published study reported by Leech et al. (2016) could be

seen as a type of control condition because no verbal rehearsal task was employed. As noted previously, in that study a correlation between one of the trial-types on the Avoidance-IRAP and the BAT was recorded. This suggests, if only very tentatively, that in the absence of any verbal rehearsal task the level of “fusion” between the IRAP and BAT performances lies somewhere in between the levels created by the accept-fear versus control-fear “interventions”. Nevertheless, it will be important for a future study to employ an experimental design that would clearly demonstrate that the accept-fear verbal rehearsal task was responsible for undermining the correlations between the IRAP and the BAT.

In making the foregoing argument, we are not suggesting the current findings provide a complete experimental analysis of the concept of defusion (or fusion for that matter). Indeed, the concept of fusion/defusion remains at present a middle-level term in the ACT literature and thus lacks the level of precision typically required to yield to a basic experimental analysis (see Barnes-Holmes, Hussey, McEnteggart, Barnes-Holmes & Foody, 2015). Nevertheless, middle-level terms can be useful in helping researchers to see perhaps important connections between their work and its potential application in therapeutic settings. And we have drawn on the concept of fusion/defusion entirely in that spirit in the current context.

At this point, it seems important to note a number of issues when comparing the current study with the previously published work of Leech et al. (2016). First, both the previous and current studies obtained correlations between measures of spider fear and performance on the pet trial-types from the Avoidance-IRAP. That is, positive response biases towards puppies and kittens predicted greater negativity towards spiders (but only in the reduce-fear condition). Once again this finding suggests that the reactions to the two classes of stimuli employed in the IRAPs were not entirely functionally independent. One explanation for this finding is that participants who are relatively positive about “cute” and “cuddly” pets, such as puppies and kittens, tend to be less positive or more negative about “exotic” pets such as



spiders or snakes. Given that this finding has now been obtained across two separate studies, it may be an effect that is worthy of further investigation in future studies. For example, Nicholson and Barnes-Holmes (2012) used relatively neutral pictures of nature scenes (in terms of emotional valence) in their IRAP study of spider fear. If such scenes were employed in a partial replication of the current study, would we observe the same correlations for the contrast category (i.e., nature scenes)? If there is an inverse correlation between fear of spiders and general positivity towards more “traditional” pets then no such correlation should be observed when the contrast is nature scenes. On balance, if the correlations with the contrast category are a type of artefact specific to the IRAP then those correlations should again be recorded for the nature scenes.

A second issue that arises when comparing the current study with Leech et al. (2016) is that the general pattern of results for the IRAPs as measures of spider fear were replicated relatively closely even though there were a number of potentially important differences across the two studies. The earlier study was conducted in an Irish university with an English speaking population, whereas the current study was conducted in a different university with a sample of Flemish speaking participants (the experimental materials were translated into Dutch). Furthermore, a different method for introducing participants to the IRAP was used across the two studies. Recent evidence has indicated that the use of different types of rules for instructing response patterns on the IRAP may influence performance on the measure (Finn, Barnes-Holmes, Hussey, & Graddy, 2016). In the earlier study reported by Leech et al., participants were provided with “specific” rules for responding on each block of trials on the IRAPs, but in the current study no such rules were employed, with participants simply being prompted to respond to the feedback contingencies during the initial exposure to the first two practice blocks. As far as we can tell, this difference had minimal impact on the patterns of IRAP effects observed across the two studies. Overall, therefore, the findings of the current

study indicate that the fear and avoidance IRAPs that we have developed here produce relatively robust effects that replicate across different populations, languages and relatively minor procedural modifications.

The results of Leech, et al. (2016), and those reported in the current study, support the predictive validity of the Fear- and Avoidance- IRAPs. Although the verbal rehearsal tasks in the current research did not alter responding on the IRAP or BAT in an absolute sense, the data do suggest that the behavior-behavior relations between the IRAP and BAT were moderated by the type of verbal rehearsal that participants completed. Although the latter conclusion must remain a post-hoc interpretation, it provides the basis for a relatively precise experimental analysis of behavior directly relevant to the widely used concept of defusion in the ACT literature.

### **Compliance with Ethical Standards**

**Conflict of Interest:** Aileen Leech declares that she has no conflict of interest. Dermot Barnes-Holmes declares that he has no conflict of interest. Ciara McEnteggart declares that she has no conflict of interest.

**Ethical Approval:** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent:** Informed consent was obtained from all individual participants included in the study.

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*Table 1 Fear-Related Verbal Rehearsal Statements*

| Accept-Fear Condition                               | Reduce-Fear Condition                                |
|---|--|
| I am in control of my actions even when I am afraid | When I eliminate my fear then I can achieve anything |
| When I'm afraid I can still keep going              | When I overcome my fear I succeed                    |
| I succeed in spite of my fear                       | When I conquer my fear I achieve my goals            |
| Being frightened will never stop me                 | Controlling my fear is essential for success         |
| Even when I am fearful I can still succeed          | I must suppress my fear to succeed                   |

*Table 2 Target Stimuli for Fear-IRAP*

| Target Stimuli - Fear  | Target Stimuli - Pleasant |
|------------------------|---------------------------|
| Scares me              | Calms me                  |
| Makes me uncomfortable | Gives me warm feelings    |
| Frightens me           | Let's me feel happy       |
| Makes me anxious       | Makes me happy            |
| I hate it              | I like it                 |
| Gives me stress        | Relaxes me                |
| Gives me shivers       | Makes me smile            |
| I find it annoying     | Reassures me              |

*Table 3 Target Stimuli for Avoidance-IRAP*

| Target Stimuli - Avoid | Target Stimuli - Approach |
|------------------------|---------------------------|
| I escape               | I stay                    |
| I leave                | I touch it                |
| I flee                 | I pick it up              |
| I run away             | I approach it             |
| I retreat              | I play with it            |
| I avoid it             | I carry it                |
| I jump away            | I hold it                 |
| I get away             | I look at it              |

*Table 4 Correlation Matrix for Fear-IRAP and Explicit Measures*

| Fear-IRAP Correlation Matrix |              |          |                 |             |              |          |                 |             |
|------------------------------|--------------|----------|-----------------|-------------|--------------|----------|-----------------|-------------|
|                              | Accept-Fear  |          |                 |             | Reduce-Fear  |          |                 |             |
|                              | Pet Pleasant | Pet Fear | Spider Pleasant | Spider Fear | Pet Pleasant | Pet Fear | Spider Pleasant | Spider Fear |
| BAT                          | -.205        | -.193    | .269            | -.004       | -.181        | -.054    | .468*           | .074        |
| FSQ                          | .069         | .173     | -.289           | -.328#      | .061         | .266     | -.471*          | -.015       |

*Table 5 Correlation Matrix for Avoidance-IRAP and Explicit Measures*

| Avoidance-IRAP Correlation Matrix |              |           |                 |              |              |           |                 |              |
|-----------------------------------|--------------|-----------|-----------------|--------------|--------------|-----------|-----------------|--------------|
|                                   | Accept-Fear  |           |                 |              | Reduce-Fear  |           |                 |              |
|                                   | Pet Approach | Pet Avoid | Spider Approach | Spider Avoid | Pet Approach | Pet Avoid | Spider Approach | Spider Avoid |
| BAT                               | -.086        | -.084     | .338#           | .244         | .130         | -.351*    | .416*           | .284         |
| FSQ                               | .135         | .290      | -.386*          | -.337#       | .258         | .540*     | -.235           | -.357*       |

\* $p < .05$  #  $p \geq .05$

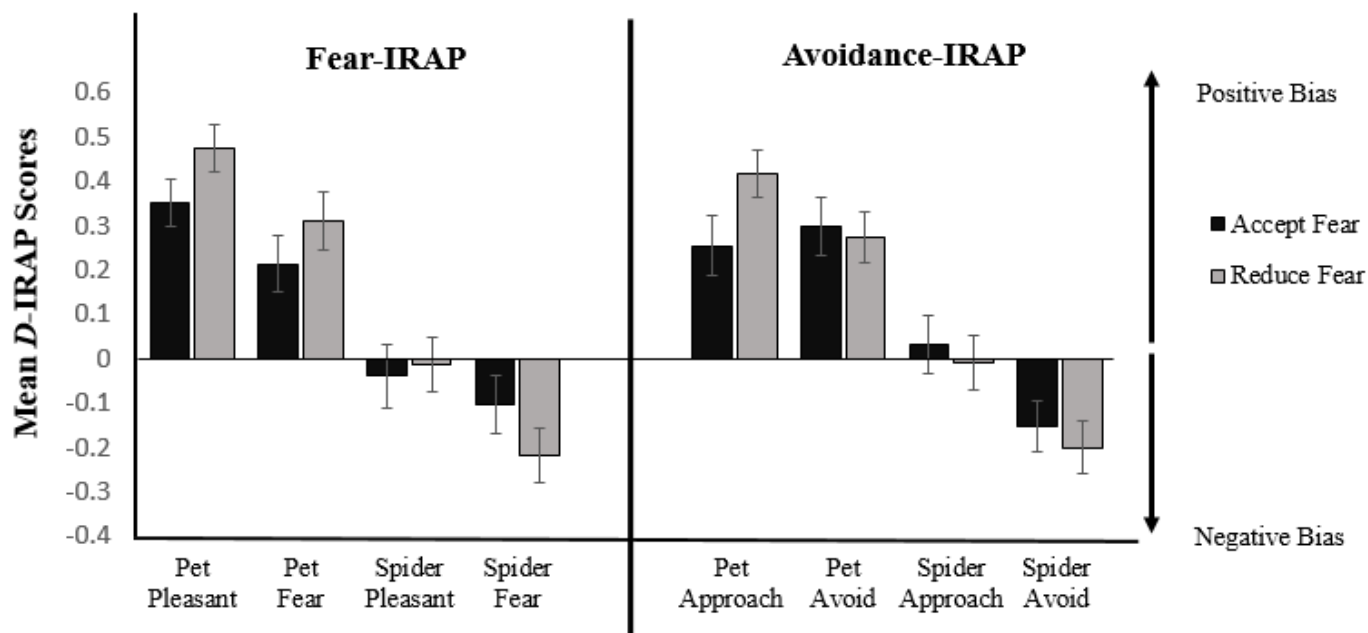


Figure 1: Eight mean D-IRAP scores for the Fear-IRAP and Avoidance-IRAP.