Using the Implicit Relational Assessment Procedure (IRAP) as a Measure of Spider Fear, Approach and Avoidance.

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Abstract

The current thesis examined the use of the Implicit Relational Assessment Procedure (IRAP) as a measure of spider fear, approach, and avoidance. Participants were drawn from a normative sample of university undergraduates. Study 1employed The Fear of Spiders Questionnaire (FSQ), a Behavioral Approach Task (BAT) using a spider moult, and a Rule Focussed IRAP (RF-IRAP). Both spider fear and approach/avoidance were measured simultaneously. Overall, patterns of responding revealed predictable IRAP effects with an implicit negative bias recorded for spider fear and also spider approach. However, the RF-IRAP had limited predictive validity in terms of the self-report measure and also in terms of the BAT. The next two studies therefore employed the traditional IRAP.

Study 2 employed two IRAPs, one targeting spider fear, the other targeting spider approach/avoidance. The Fear of Spiders Questionnaire (FSQ) and a Behavioral Approach Task (BAT) using a spider moult were also employed. Negative response biases for spider fear and avoidance, but not for approach, were recorded. The bias for fear was significantly stronger than for avoidance and approach. Both IRAPs failed to provide evidence for the predicative validity of the IRAP in terms of the BAT.

Study 3 was a partial replication of Study 2 but using a live house spider instead of a moult for the BAT. A similar pattern of results was obtained across the two IRAPs but one specific trial-type (*Spider-Approach*) predicted approach responses on the BAT. The research thus replicated a previously published study by Nicholson and Barnes-Holmes (2012), thus supporting the predictive validity of the IRAP but, at a level of precision not provided in the earlier studies. Implications for applied research are considered

Chapter 1

A Brief Introduction

The current thesis examined the use of the Implicit Relational Assessment Procedure (IRAP) as a measure of spider fear, approach and avoidance. The research programme comprised of 3 studies. Chapter 1 provides a brief introduction to the current research programme. Chapter 2 commences with a review of experimental research on fear and avoidance with a focus on spider fear and the use of implicit measures. The chapter focuses in particular on the implicit relational assessment procedure (IRAP), including its conceptual background in behaviour analysis and relational frame theory. It is noted that only one published study has used the IRAP in the investigation of spider fear and approach/avoidance (i.e. Nicholson & Barnes-Holmes, 2012). The research reported in the current thesis therefore aimed to replicate and extend the key findings from the previously published study.

Chapter 3 presents a study that employed a modified IRAP called the Rule-Focussed IRAP (RF-IRAP). This modified version of the IRAP relied more heavily on the delivery of specific rules for responding on the IRAP than the use of traditional response options, such as True and False. Both spider fear and approach/avoidance were measured simultaneously in Study 1 using stimuli similar to those used in the previously published study. Participants were also required to complete the Fear of Spiders Questionnaire (FSQ) and a Behavioural Approach Task (BAT) involving a spider moult.

Chapter 4 presents a study that employed two IRAPs, one targeting spider fear, the other targeting spider approach/avoidance. The FSQ and BAT were also employed similar to those used in Study 1.

Chapter 5 presents the final study in the current research programme. Similar to Study 2, two IRAPs were employed, one targeting spider fear and the other targeting spider approach/avoidance. The FSQ was also employed along with the BAT, but for this study a live Irish common house spider was used rather than a moult. A minor procedural flaw was also corrected in this final study.

The final Chapter provides a summary of the findings reported in the current thesis and considers a range of specific conceptual issues arising from the research, highlighting directions for future research.

Chapter 2

General Introduction

Chapter 2

2. General Introduction

The current thesis focuses on the use of one particular implicit measure, the Implicit Relational Assessment Procedure (IRAP) as only one published study has used this in the investigation of spider fear and avoidance. Furthermore, the use of this measure appears to allow for the separate analysis of fear and avoidance at an implicit level. Before considering the topic of implicit cognition, we will begin with a brief review of the relationship between fear and avoidance.

2.2 Fear and Avoidance: A Brief Historical Overview

2.2.1. Research on Fear and Disgust. Fear is an aversive emotion that generally serves a protective purpose by signalling danger and preparing an organism to deal with that danger. Fear is related to the presence or anticipation of a particular stimulus or situation (Pflugshaupt, Mossimann, von Wartburg, Wolfgang, & Nyffler, 2005). There is disagreement in the literature as to the acquisition of fear in relation to phobias, with some arguing it is as a result of direct conditioning (Rachman, 1977) whilst others maintain fear acquisition occurs based on biological predisposition of preparedness (Seligman, 1970). The conditioning theory of fear acquisition assumes that fear is acquired through some form of learning process. The basic model is that neutral stimuli are paired with fear evoking qualities, and thus those neutral stimuli develop fearful qualities and become conditioned stimuli (Rachman, 1977). The strength of the relationship between the conditioned stimuli and the individuals fear levels are seen as being determined largely by the number of repetitions of the pairing and also the intensity of the fear/pain experienced by the individual. Additionally, once an object or situation has developed fear provoking qualities, behaviour patterns emerge in the form of avoidance (Rachman & Crespigny, 1977).

The conditioning theory of fear acquisition received empirical support from laboratory experiments involving animals and the induction of fear in small children. It was relatively easy to generate fear reactions in animals by exposing them to a neutral stimulus paired with an aversive stimulus, usually an electric shock, which resulted in avoidant behaviour. The classic experiment on the induction of fear in Albert. B conducted by Watson and Rayner (1920) provided evidence for the conditioning theory of fear acquisition, by illustrating the applicability of classical conditioning to the development of human emotional behaviour (Harris, 1979). The conditioning theory of fear acquisition has been widely criticised, however. One key criticism is that fear and avoidance is driven, in part, by evolutionary processes that prepare an organism to find certain stimuli aversive or fear-inducing.

Indeed, Seligman (1971) proposed the theory of *preparedness*, which claims that evolutionary pressures selected for an adaptive predisposition to associate pre-technologically dangerous stimuli, such as snakes and spiders (rather than guns and electrical sockets) with aversive consequences (Davey, 1992). The theory of *preparedness* implies that individuals acquire learned fears by associating them with aversive consequences. In addition, the rate of learning an adaptive fear response to the perceived threat is learned rapidly and is slow to extinguish. Thus, based on Seligman's theory, individuals with spider phobia automatically assume that contact with spiders will result in negative consequences (Davey, 1994). Indeed, despite the low mortality risk from spider bites, spider fear is said to be the most common phobia in western cultures. Spider phobics have reported perceiving spiders to be dangerous, uncontrollable and unpredictable (Armfield & Mattiske, 1996). The overestimation of the relation between the threat relevant stimuli and aversive outcomes is referred to as expectancy bias (Olatunji, Cisler, Meunier, Connolly, & Lohr, 2008). That is, individuals with spider phobia often overestimate the amount of fear they will experience as a result of being confronted with a spider, and this is seen as supporting Seligman's theory that spider-fear/avoidance emerges in part from being *prepared* to develop such reactions through evolutionary processes.

Seligman received support for his theory of *preparedness* from laboratory-based fear conditioning experiments where fear relevant (i.e. snakes and spiders) and fear irrelevant (flowers and houses) stimuli were used as conditioned stimuli (CS) and an aversive stimulus (i.e. mild shock) was used as an unconditioned stimulus (UCS). Supportive evidence was obtained when it was shown, for example, that resistance to extinction of conditioned fear responses occurred for the likes of snakes and spiders but not for fear-irrelevant stimuli (Davey, 1992). Furthermore, spider phobic individuals' display inflated expectancy biases that aversive consequences (i.e. electric shock) will follow threat-relevant stimuli, such as images of a spider (Davey, 1992). It has also been found that pairing of an unconditioned aversive stimulus with a phobic-relevant stimulus leads to rapid acquisition of phobic responding and relatively strong resistance to extinction (Davey, 1992). Expectancy bias has also been demonstrated using thought experiments. Specifically, participants are required to imagine they are in a study and are asked to rate how often they expected a specific category of either fear-relevant (e.g. spider) or fear-irrelevant (e.g. flower) stimuli to be followed by a specific outcome, either aversive (e.g. electric shock) or neutral (Cavanagh & Davey, 2000). Critically, spider phobics reported higher expectancy for an aversive consequence following the occurrence of a spider compared to non-phobics.

The fear of spiders has also been linked with disgust and fear of contamination. Evidence for the link between disgust and spider phobia has been reported using self-report measures such as the Disgust Questionnaire (DQ; Rozin, Fallon & Mandell, 1984), as well as the Disgust Scale (DS; Haidt, McCauley & Rozin, 1994). The disgust hypothesis maintains that emotional responses are culturally transmitted since spiders were associated with disease and infection. Although fear is the dominant emotion is spider phobia, the disease avoidant conceptualisation maintains that the focus of fear is unwanted physical contact with the stimulus rather than perceived physical harm (van Overveld, de Jong, Peters, Cavanagh, & Davey, 2006). Matchett and Davey (1991) proposed a "disease-avoidant" model that claimed that the etiology and maintenance of spider fear is associated with the fact that spiders are typically found in dirty places such as drains, sewers and sinks, and with the spreading of disease and contamination. Thus, the aversion to spiders is an expression of disgust rather than fear of harm (Mulkens, Jong, & Merckelbach, 1996).

Evidence in support of the disease-avoidant model has been provided in studies where spider phobic's report both fear and disgust when viewing pictures of spiders (Olatunji, 2006). Additional evidence for the link between spider fear and disgust was reported by Mulken and colleagues (1996) who reported that spider phobic individuals displayed stronger disgust sensitivity to spiders. Additionally, spiders were found to have disgust evoking properties related to the individual's fear of spiders. Specifically, participants engaged in a behavioural task where they were required to report on their preference of eating a cookie prior to coming into contact with a spider and after the spider had walked across the cookie. Phobic individuals displayed a stronger reluctance in their motivation to eat the cookie after the spider had touched it. These results support the disease-avoidant model of spider phobia, which places disgust and fear of contamination as having a central role in the maintenance of spider phobia (Mulkens et al., 1996). However, the role disgust plays in the etiology and maintenance of spider fear is not without criticism. Thorpe and Salkovskis (1998) conducted a number of studies investigating the role of disgust in the acquisition and maintenance of specific phobias. Findings suggested that it is unlikely that disgust plays a role in spider phobia and the authors proposed that when stimuli that are normally associated with disgust become the focus of phobic anxiety, then a disgust response may simply be amplified (Thorpe & Salkovskis, 1998).

2.2.2 Avoidance. In addition to phobic individuals experiencing fear to perceived threatening stimuli, phobic behaviour typically includes avoidance of those stimuli. Avoidance generally serves two purposes; (1) it allows the individual to relieve the anxiety experienced in the presence of the feared stimuli, and (2) it reinforces and maintains the phobia in that it typically prevents the individual from experiencing habituation with respect to the feared stimuli (Pflugshaupt, et al., 2005). In pre-technological times, the ability to learn to avoid provided great survival value for both non-human animals and humans (Bolles, 1970). In simple terms, if a stimulus or event in the environment induced fear in an organism some form of response that involved avoiding further contact with that stimulus would be expected. In other words, with fear comes immediate avoidance.

Many studies have reported that individuals tend to avoid stimuli that are perceived to be threatening in some way. For example, Rinck and Becker (2007) showed that humans usually show a spontaneous avoidance reaction to unpleasant threatening stimuli and a spontaneous approach reaction to pleasant non-threatening stimuli. In their research they used a method for observing avoidant-approach behaviour through body movements (i.e. using ones arm to push away threatening stimuli, or pulling pleasant stimuli closer). This was demonstrated in a laboratory setting where participants were required to respond to pictures of spiders or nature elements, by pulling a joystick towards them or pushing it away. Results revealed that spider fearful individuals responded more quickly, by pushing rather than pulling, when an image of a spider was presented, compared to non-fearful participants. In another study conducted by Cochrane, Barnes-Holmes, and Barnes-Holmes (2008) participants were required to complete an automated 8 step perceived threat behavioural approach test. This test involved measuring participant’s willingness to place their hand into a number of jars with an incrementally increasing risk of contact with a spider. The task successfully discriminated between high, mid and low level spider fearful individuals.

2.2.3 Fear and Avoidance: The Conditioning and Extinction Paradigm. As mentioned previously, the repetitive pairing of a neutral stimulus with an aversive stimulus often results in a fear conditioned response. A fear conditioned response may then be emitted in the presence of the newly conditioned stimulus (Cameron, Roche, Schlund, & Dymond, 2015), along with an avoidance response that serves to prevent contact or exposure to that stimulus. This fear conditioning paradigm has been used to facilitate the investigation of behavioural processes that may underpin anxiety responses related to phobias (Beckers, Krypotos, Boddez, Effting, & Kindt, 2013). Indeed, conditioning based approaches to fear acquisition and avoidance behaviour led to the design of exposure techniques used in behaviour therapy (Wolpe, 1968).

Exposure therapy assumes that repeated exposure to a feared object/situation will result in the reduction of and ultimately the extinction of the fear conditioned response and therefore a reduction in avoidant behaviour. That is, if fear is removed or extinguished then related avoidance responding will also cease or at least be much reduced. On balance, the relationship between fear and avoidance within a conditioning paradigm should not be seen as uni-directional or overly simplistic. For example, exposure therapy, and extinction techniques generally, involve encouraging fearful individuals to approach (i.e., not avoid) the feared stimulus as a means of extinguishing the fear response. The basic idea is that in doing so the aversive consequences associated with the stimulus do not actually occur and the fear thus subsides and the basis for avoidance dissipates. In other words, the relationship between fear and avoidance is seen to be dynamic and bi-directional. Nevertheless, fear and avoidance are often considered to be closely interlinked, such that the presence of one implies the presence of the other, and there is a considerable body of evidence to support this assumption (e.g. Mowrer, 1951; Rachman & Hodgson, 1974; Mineka, 1979; Maia, 2010). On balance, very recent evidence within the behaviour-analytic literature suggests that the relationship between fear and avoidance is not so clear cut, at least in verbally sophisticated humans. Specifically, it appears that avoidance responding may persist following extinction of the relevant fear, and furthermore avoidance may dissipate in the presence of on-going fear. In short, it may be a mistake to assume that fear and avoidance always accompany each other and thus they should be analysed as two functionally independent behavioural repertoires. Before pursuing this idea further, however, we first need to consider the other core focus of the current research programme, the study of implicit cognition.

2.3 Implicit Cognition

To fully understand the behaviour of an individual, knowledge of the external situation in which the individual is present is required, but also the individual's internal psychological attributes (De Houwer, Teige-mocigemba, Spruyt, & Moores, 2009). An important feature of an individual's internal psychological world has been discussed and conceptualized using the broad concept of implicit cognition. This type of cognitive is often characterized as automatic, unconscious, outside voluntary control, lacking in reflection or deliberative processes. Irrespective of exactly how one defines so called implicit cognition, there has been a growing research in this area over the past 15 years or so where researchers have been attempting to measure individual differences at an implicit level in order to understand, control or predict human behaviour (De Houwer, 2006). Previously, measuring individual differences was done using self-report measures such as questionnaires; however, there were concerns to the limitation of these measures such as their vulnerability to socially desirable responding and that they only assess the individuals' conscious beliefs. The growing interest in implicit cognition has given rise to the development of implicit measures. One of the most widely used implicit measures is the Implicit Association Test (IAT) developed by Greenwald, McGhee and Schwartz (1998).

2.4 The Implicit Association Test (IAT).

The Implicit Association Test (IAT) is a well-established measure of implicit processes. The IAT procedure seeks to measure implicit biases by measuring an individual's underlying automatic evaluation of the stimuli presented (Greenwald, Mcghee, & Schwartz, 1998). The fundamental assumption of the IAT is that the speed and accuracy with which an individual can pair two concepts is a reflection of the extent to which these concepts are associated in memory. The IAT is a computer based task that requires participants to pair positively and negatively valenced stimuli under time pressure and according to opposing rules across blocks of trials (Greenwald et al., 1998). The first study that employed the IAT presented the names of flowers (e.g. tulip) and names of insects (e.g. wasp) with pleasant words (e.g. "Happy") and unpleasant words (e.g. "Ugly") (Greenwald et al., 1998). The data indicated that the IAT was effective in measuring the participants' implicit attitudes because response latencies were shorter when participants were presented with associatively compatible categories (e.g., flowers and pleasant words) compared to incompatible categories (e.g., flowers and unpleasant words).

The IAT has also been employed as a useful measure in examining memory structures related to fear (Teachman, Gregg, & Woody, 2001). For example, it has been successful in reflecting automatic response biases related to spider- and snake-fear/disgust. In this study participants were classified as either highly spider phobic with low snake fear, or highly snake phobic with low spider fear, based on self-report measures. Each participant completed four IATs, which required them to categorise pictorial stimuli (i.e. snakes or spiders) with descriptive words which were either positively valenced (i.e. "Safe") or negatively valenced (i.e. "Dangerous"). Some blocks of trials required participants to categorise snakes with positively valenced words and spiders with negatively valenced words. On other blocks of trials the opposite pattern of responding was required. Based on the response latencies and accuracies of responding, the IAT was successfully able to discriminate between spider phobic and snake phobic individuals. Specifically, the IAT effectively demonstrated that spider phobic individuals responded more quickly and accurately when categorising spiders with negative words and snakes with positive words, than vice versa (i.e., spiders-positive and snakes-negative); in contrast snake phobic individuals produced the opposite pattern of responding (increased speed and accuracy on snake-positive/spider-negative blocks than on snake-negative/spider-positive blocks). Since this seminal study the IAT has been used in many other studies to assess implicit fear responses (e.g. Teachman, & Woody, 2003)

Despite its wide and indeed successful use in the domain of implicit fear (and many other areas too) the IAT is not without limitations. A widely recognised weakness is that the IAT only provides a relative measure of implicit cognition (De Houwer, 2003). That is, the IAT can only provide a measure of the strength of an association between the target stimuli and concept stimuli relative to the strength of the opposing target and concept stimuli presented within the procedure. For example, in relation to the Teachman et al. (2001) study, responding more quickly to spider-negative and snake-positive stimuli (than spider-positive and snake-negative) could be interpreted in a number of ways; it could indicate that (a) snakes are liked and spiders are disliked, or (b) both are disliked but the former more so than the latter, or (c) both are liked but the latter is preferred over the former.

2.5 The Implicit Relational Assessment Procedure (IRAP)

In order to rectify some of the shortfalls of the IAT, alternative methods of measuring implicit attitudes have thus been offered, such as the Implicit Relational Assessment Procedure (IRAP; Barnes-Holmes et al, 2006). The IRAP was derived from a modern behaviour analytic account of human language and cognition called Relational Frame Theory (RFT). The basic assumption of RFT is that the fundamental components of human language and cognition are relational and thus, the IRAP focuses on assessing relations between stimuli (Hughes & Barnes-holmes & De Houwer, 2011). One of the key differences between the IAT and the IRAP is that the IAT produces a single metric of overall bias, whereas, the IRAP produces four separate metrics, one for each of the individual relational responses that are targeted by the IRAP (Hussey, Barnes-holmes, & Barnes-holmes, 2015). Additionally, the IRAP can measure the strength and directionality of relatively simple stimulus relations (e.g., Spider-Fear) and more complex relational networks (I fear spiders but I can approach them).

The IRAP is a computer based procedure 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 their previous learning histories. 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.

A simple example of the IRAP might involve presenting one of two label stimuli on each trial, one positively valenced (e.g., pictures of flowers) and the other negatively valenced (pictures of insects). On each trial a positively or negatively valenced word would also be presented (“Safe”, “Pleasant”, Peaceful” versus (“Dangerous”, “Harmful” “Bad”). Participants would then be required to choose between one of two response options (i.e. “True” or “False”) presented at the bottom of the screen. During a block of history-consistent trials, participants would be required to respond in a manner assumed to reflect prevailing verbal contingencies for insects (e.g., choosing “True” given a picture of an insect and the word “Dangerous”) and for flowers (e.g., choosing “True” given a picture of flowers and the word “Safe”). During history-inconsistent trials the opposite pattern of responding would be required (e.g., choosing

"False" given insects and positive words). In this particular example, responding should be quicker on history-consistent relative to history-inconsistent trials.

Typically, the IRAP consists of a minimum of two practice block pairs and three test block pairs. Each block pair consists of two blocks of trials (one history-consistent block and one history-inconsistent block). Each block presents the same number of trials, which is typically comprised of four different trial-types. The trial types are created using 2x2 crossovers of the label and target stimuli. Given the previous example, the trial-types would be as follows: *Insect-Positive*; *Insect-Negative*; *Flower-Positive;* and *Flower-Negative*. In order to successfully complete a block of trials, participants are generally required to maintain specific performance criteria of 80% accuracy of responding with a median response time of less than 2000ms.

2.6 The Conceptual Basis of the IRAP

The IRAP emerged from a behavioural theory of human language and cognition known as Relational Frame Theory (RFT; Hayes, Barnes-Holmes & Roche, 2001), which is considered an operant but post-Skinnerian approach to verbal behaviour. Skinner (1957) published what is considered to be the first substantive treatment of human language from a behaviour-analytic perspective. As such, it was based on a functional-analytic assumption that explaining language involves focusing on the interactions that occur between an organism and its environment. As is well known, Skinner's approach was criticised in a highly cited review by the linguist Noam Chomsky (1959). The core criticism was that Skinner's account failed to address the generative nature of human language and that it provided relatively weak explanations of advanced language phenomena, such as analogy and metaphor. Although some of Chomsky's criticisms failed to appreciate certain strengths in Skinner's work, in particular its potential for developing educational interventions for children with basic language deficits

(Sundberg & Partington, 1998; Greer & Ross, 2007; Dixon, Whiting & Rowsey, 2014), it has been recognised by many behavioural researchers that Skinner's account did in fact fail to address the generative nature of human language (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000).

It was not until Murray Sidman (1971) conducted the first study on equivalence class formation that the potential to address the generativity in human verbal behaviour, from a functional-analytic perspective, became apparent. Specifically, Sidman's seminal work across a period of 10 to 20 years revealed that the ability to form equivalence relations appears in the early developmental years of children and seems to provide a functional analysis of symbolic relations in natural language (see Sidman, 1994 for a book length treatment of the early research programme). The basic phenomenon of stimulus equivalence is characterized by the explicit or direct reinforcement of a small subset of stimulus relations followed by the emergence of derived or untaught relations that are consistent with the trained relations. Thus, for example, directly training or reinforcing the stimulus relations A-B and A-C in children with basic language skills frequently leads to the unreinforced relational responses, B-A, C-A, B-C, and C-B. When these latter responses emerge (without direct reinforcement), the three stimuli are said to form an equivalence class. The potential for equivalence class formation to provide a functional-analytic model of symbolic relations in natural language may be readily seen in the earliest work reported by Sidman. Specifically, he demonstrated that it was possible to establish equivalence relations composed of pictures of objects, and the spoken and written words for those objects, without having to train all of the individual stimulus relations. Training *picture-spoken word* and *picture-written word* spontaneously produced the unreinforced "reading" response in which an individual would utter the spoken-word when presented with the written word. In effect, equivalence class formation constituted a functional definition or treatment of what it means when we say that a word stands for or is a symbol for a particular object or event in the world (for a compelling rendition of this particular insight see the exchange between Sidman and Willard Day in Sidman’s (1994) text, *Equivalence Relations a Research Story.*

The research programme on stimulus equivalence played an early but pivotal role in the development of the post-Skinnerian attempt to develop a “grand” theory of human language and cognition, known as RFT, commencing in the mid to late 1980s, and leading to a book-length exposition 15 years later (Hayes, et al., 2001). The theory placed derived relational responding at the centre of the theory but also focused on multiple stimulus relations rather than just equivalence classes. Specifically, RFT maintains that the ability to form equivalence classes was based on prior exposure to operant contingencies provided largely by the wider verbal community. For example, learning to name, according to RFT, functions as a type of multiple-exemplar training in bi-directional relational responding, which is seen to be a defining element of equivalence class formation. Specifically, when learning to name, seeing an object and hearing the spoken name for that object predicts that if a child subsequently hears the name and then orients towards or identifies the object, social reinforcement will follow. When this occurs across a number of objects and related names, gradually the generalized operant of bi-directional relational responding emerges (e.g., Lipkens, Hayes, & Hayes, 1993). In effect, when the child now hears the name for an object, he or she may then spontaneously identify that object when hearing the name in the absence of explicit reinforcement, prompting or instruction for doing so. From the perspective of RFT a type of generalized type of relational responding has been created by the operant contingencies involved in naming and this provides the basis for what are called relational frames (i.e. the basic operant units of human verbal behaviour).

Critically, RFT also postulated that equivalence was only one of many such relational, frames allowing for the possibility of multiple relational frames. Thus progressing from Sidman’s seminal study on equivalence classes with learning disabled individuals, RFT focussed on children's early learning experiences as the basis for arbitrarily applicable relational responding (AARR). The ability to AARR, according to RFT, accounts for many features of human language and cognition, including generativity, analogy, metaphor, rule-following, problem solving, and even perspective-taking. Much of the empirical work in this area was initially focused on demonstrating that the key concepts were demonstrable in basic research studies and therefore focussed on conducting studies showing, for example, that complex patterns of AARR did in fact emerge given appropriate training in the minimal set of "baseline" relations. For example, if the relations "A more than B" and "B more than C" were trained, RFT predicted that "A more than C" and "C less than A" should emerge without direct reinforcement, provided that participants had an appropriate reinforcement history for deriving such relations in the past.

Another critical feature of RFT is referred to as the transformation of functions. Specifically, this concept refers to the prediction that when a specific psychological function is established for a stimulus and that stimulus participates in a relational frame the functions of the other stimuli within that frame will be changed or transformed based on the stimulus relations. Many of the basic studies in this area focused on transformations of function in accordance with frames of equivalence. For example, Smyth, Barnes-Holmes, and Forsyth (2006) showed that when a stimulus from an equivalence class was paired with film clips of spider attack scenes not only did the directly paired stimuli acquire fear functions, but so too did the other stimuli in the equivalence class, although they were never directly paired with the spider stimuli. Critically, the levels of fear that were involved in the transformation of function were moderated by the participants' self-reported levels of spider-fear. That is, participants who reported that they were highly spider-fearful indicated higher levels of spider fear based on the transformation of function relative to those participants who reported only low levels of spider fear.

This type of research, in which the transformation of fear functions in basic RFT studies was shown to be moderated by extra-experimental factors, such as level of spider fear, highlighted the need to develop procedures that could be used to explore the strength, persistence and indeed malleability of AARR that had been established in the natural environment rather than solely in the basic research laboratory. This question gave rise to the development of the Relational Elaboration and Coherence Model (REC) and the IRAP.

The Relational Elaboration and Coherence (REC) model. The REC model, which underpins the IRAP, was developed from a theoretical premise of RFT, that human language and cognition are relational. The REC model was developed in an attempt to provide an explanation for the type of effects that have typically been obtained with the IRAP (Barnes-Holmes, Barnes-holmes, Stewart, & Boles, 2010). Consider the earlier example involving four trial-types, *Insect-Positive*; *Insect-Negative*; *Flower-Positive;* and *Flower-Negative*. All things being equal, faster responses would be expected when participants are required to respond in a manner that is consistent rather than inconsistent with their prior verbal histories (e.g., responding *False* more rapidly than *True* on *Insect-Positive* trials). The REC model argues that when an individual is required to produce a response under time pressure, the response emitted is largely driven by brief and immediate relational responding (BIRR) that is congruent with the individual's history. If the response required is incongruent with the individual's history of responding, it will be emitted less quickly. In other words, BIRRs that overlap functionally with an individual's behavioural history tend to occur at a higher probability on the IRAP than those that do not overlap with that history. The difference in relative probabilities is revealed in the difference scores, in accuracy and latency, which has often been formalized as the *D*-IRAP effect.

Support for the REC model has been presented by Barnes-Holmes and colleagues (2010) demonstrating that reducing the practice latency criterion in the IRAP from 3000ms to

2000ms actually increased racial stereotyping effects suggesting that responding under time pressure moderates contamination impact from elaborative relational responding (Barnes-Holmes, et. al. 2010). The REC model received further support in its utility from Cullen and colleagues (2009), specifically where a negative bias toward old age on the IRAP was found to be malleable with appropriate exemplar training but not on explicit measures. The REC model assumes that the exemplar training would have a large impact immediate relational responding but a lesser impact on coherent/extended relational networks (Barnes-Holmes, et. al. 2010). The "Pro-Old" exemplars in the IRAP may have evoked "Old-Positive" immediate relational responding on the IRAP but these responses were then rejected on the explicit measures as they did not cohere with elaborated relational responding.

The following section outlines how the IRAP has been used in the study of spider fear and avoidance, but as we will see fear and avoidance were not separated in this IRAP research. However, two recent studies on the derived transformation of fear and avoidance have highlighted that it may be useful to analyse the functional independence of these two behaviours.

2.7 The functional independence of fear and avoidance.

As noted earlier in the current chapter, very recent behaviour-analytic research has examined the relationship between fear and avoidance, and as will become clear this is directly relevant to the present research programme. Specifically, as noted by Auguston and Dougher (1997), "the clinical significance of a stimulus is not always its particular emotional function (e.g. fear) but rather the extent to which it engenders avoidance behaviour" (p. 183). Critically, two studies reported by Luciano and colleagues (2013, 2014), which focused on the derived transformation of fear and avoidance responses, highlighted the extent to which these behaviours may function independently. Specifically, the first study by Luciano, et al (2013) established a fear response for a stimulus using a respondent conditioning paradigm and electric shock as a UCS, and then demonstrated the derived transformation of that function to other members of an equivalence class. Subsequently, the fear response was extinguished for both the respondently conditioned stimuli, and the other members of the equivalence class, by presenting the directly conditioned stimuli in the absence of shock. Critically, however, participants continued to engage in avoidance responding even though the fear had been extinguished (i.e., as measured by skin conductance). In effect, avoidance continued in the apparent absence of fear.

In a broadly similar study, Luciano et al. (2014) demonstrated again that it was possible to establish a derived transformation of fear and avoidance functions via equivalence relations, but this time they did not employ an extinction procedure. Rather they presented an analogue intervention based on acceptance and commitment therapy, which they labelled a defusion protocol. Participants exposed to this protocol continued to show fear responses (as measured using skin conductance) but avoidance responses dropped to near zero. In this second study, therefore, fear continued in the absence of avoidance. Taken together, therefore, the two studies demonstrated the functional independence of fear and avoidance using the derived relations (and transformation of functions) paradigm. As will be described subsequently this provides the core focus of the research reported in the current thesis but examined through the lens of so called implicit measures and cognition and in particular the IRAP.

2.8 The IRAP and Spider Fear/Avoidance

There has been an increasing body of research with regard to using the IRAP in a range of psychological domains including, for example, racial bias (Barnes-Holmes, Murphy, Barnes-Holmes, & Stewart, 2010), depression (Hussey & Barnes-Holmes, 2012), and obsessive compulsive disorder (OCD, Nicholson, Dempsey, & Barnes-Holmes, 2014). One area in which the IRAP has been applied is in the study of fear of spiders. Specifically, Nicholson and Barnes-Holmes (2012) conducted a study measuring anti-spider bias on the IRAP as a predictor of avoidant behaviour to a live spider. Participants were required to respond in a manner that was deemed either consistent with an anti-spider bias or inconsistent with that bias. For example, the IRAP required responses on some trials that either confirmed or denied that pictures of spiders were negatively valenced (e.g. Spider-Scares me-True versus Spider-Scares me-False). On other trials, the IRAP required responses that confirmed or denied that the participant could approach the spider pictures (e.g. Spider-I can approach-True/False). These spider trials were intermixed with an equal number of trials that presented pictures of nature scenes that were deemed to be relatively neutral and functioned as a contrast category. Examples of each of the four trial-types can be seen in Figure 1. Participants were required to respond in accordance with two pre-specified alternating rules. The anti-spider rule was *"Spiders are scary and I can approach nature"*, whereas the pro-spider rule was "I can approach spiders and nature is scary".

Results indicated that response latencies were faster for anti-spider blocks versus pro-spider blocks for participants who were rated highly fearful based on explicit self-report measures of spider fear as measured by the Fear of Spiders Questionnaire (FSQ; Szymanski & O'Donohue, 1995). Additionally, the IRAP successfully predicted avoidant behaviour on a Behavioural Approach Task (BAT), which involved approaching a live tarantula. Participants were given a series of steps that took them physically closer to the tarantula.

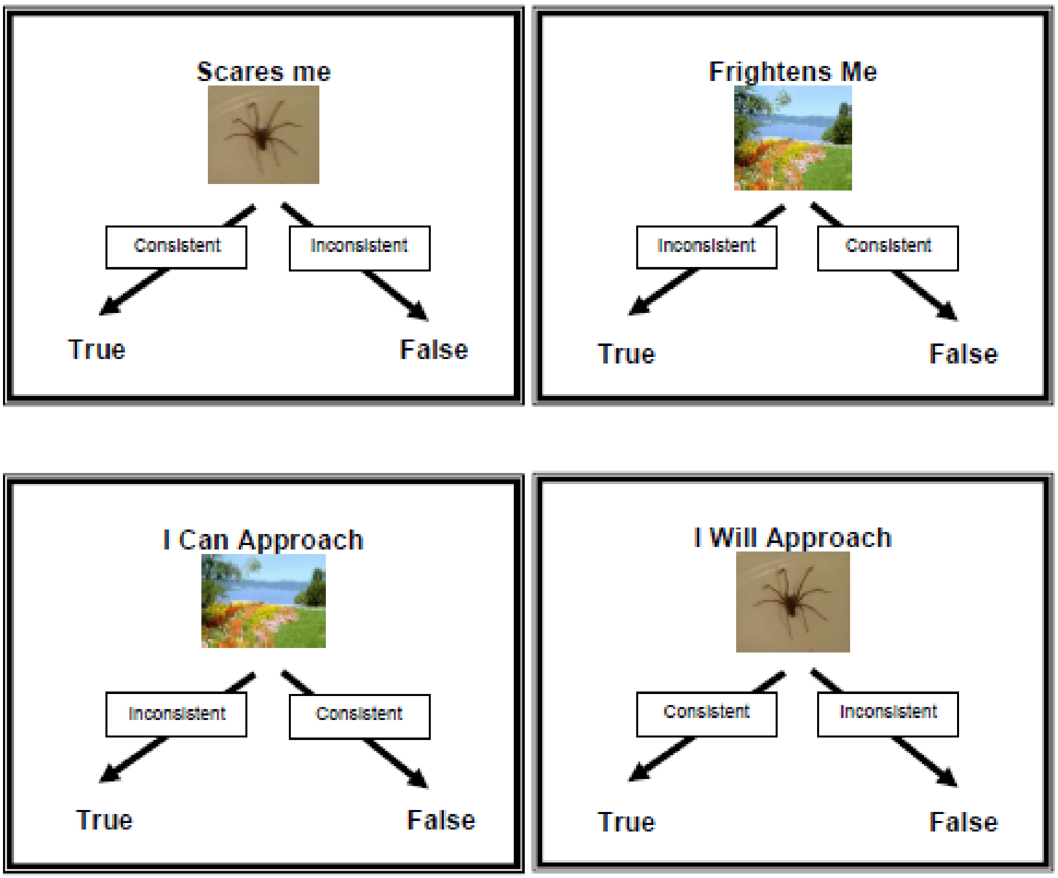


Figure 1: Examples of the four Trial-Types from Nicholson and Barnes-Holmes (2012).

One of the key limitations to the study reported by Nicholson and Barnes-Holmes (2012) is that the IRAP conflated the measurement of fear and approach/avoidance. That is, the IRAP effect that was used to capture fear of spiders involved combining the *D*-scores for trial-types that asked participants to confirm or deny that spiders were aversive (e.g., fear-inducing) with the trial-types that asked them to confirm or deny that they could approach spiders. As noted above, the IRAP performance on these trial-types predicted both self-reported fear and actual approach behaviour. However, 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 trial-type would be more predictive of self-reported fear whereas the spider-approach trial-type would be more predictive of performance on the BAT. The series of studies reported in the current thesis aimed to address this question.

Or more specifically, the current research sought to use the IRAP to separate the measurement of implicit fear of spiders from implicit spider approach/avoidance responses.

The current research sought to replicate the findings presented by Nicholson and Barnes-Holmes and to further investigate the role of spider fear and avoidance using the IRAP and a BAT. In conducting the current research two additional issues were also addressed. First, Nicholson and Barnes-Holmes (2012) employed a dichotomized sample in that participants were selected based on whether they were deemed to be high or low in spider-fear in terms of their scores of the Fear of Spiders Questionnaire (FSQ). In adopting this strategy it is possible that the correlational analyses may have been somewhat inflated, as indeed acknowledged by the authors (p. 271). Thus throughout the current programme of research the participants were sampled randomly with no effort to dichotomize high- from low-fear participants. Second, the research also commenced by testing a slightly modified version of the IRAP that removed the traditional response options (e.g., True versus False) and relied more heavily on the provision of specific rules, which participants were required to follow while completing the IRAP.

Chapter 3

Measuring Spider Fear and Approach/Avoidance using a Rule-Focused IRAP

3. Study 1: Introduction

As noted at the end of the previous chapter, the current research commenced by testing a slightly modified version of the IRAP that removed the traditional response options (e.g., True versus False) and relied more heavily on the provision of specific rules. This modified version is described as a Rule-focused IRAP (hereby referred to as RF-IRAP). The rational for employing the RF-IRAP was to remove the positively and negatively valenced response options and determine if the RF-IRAP could identify anti-spider and pro-spider biases in a normative population based on participants' rule focused responding.

3.1 Method

3.1.1 Ethical Considerations. The three studies reported here were conducted in accordance with the ethical guidelines of Maynooth 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.

3.1.2 Participants. Forty three undergraduate students attending Maynooth University, Ireland, volunteered to participate in Experiment 1 (N = 43, 29 Females, 14 Males). No remuneration was offered for participation in this study. Prior to the experiment, participants read and signed a consent form informing them that they could withdraw from the study at any time. The mean age was 20.93 years (Standard Error [SE] = .548), with a range of 18 – 41 years. Four participants were eliminated due to their failure to achieve the necessary performance criteria (see "procedure" section) on the RF-IRAP, leaving 27 females and 12 males (N = 39), the results of whom were subject to analysis. The participants completed the study individually in the Department of Psychology at NUI Maynooth. Based on the recent meta-analysis of criterion effects for the IRAP conducted by Vahey, Nicholson and Barnes-

Holmes (2015), a sample size greater than 29 is required for first order correlations to achieve statistical power of .8 when testing criterion validity of clinically focussed IRAP effects.

3.1.3 Materials

3.1.3.1 Fear of Spiders Questionnaire. The Fear of Spiders' Questionnaire (FSQ; Szymanski & O'Donohue, 1995) 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; Symanski & O'Dononhue, 1995). All participants completed the FSQ.

3.1.3.2. Tarantula moult BAT. A tarantula moult approx 10cm in diameter was used as the stimulus for a BAT in the study. A tarantula moult is the skin that remains after a spider has shed/moulted. It is an exact mould of the spider with fine details including hair. The moult was kept in a small plastic transparent container with a closed lid. 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.

3.1.3.3. RF-IRAP. This measure is a modified version of the traditional IRAP. Similar to the traditional version, it is a computer based programme, which presents trials within a series of blocks. The RF-IRAP differs from the traditional version in a number of ways. First, during the RF-IRAP, the rule for responding remains on the screen throughout each block of trials. This allows participants to refer to the rule during each trial for responding. Second, the left and right response options in the RF-IRAP were removed and instead replaced with a statement informing participants which keys to press in order to respond in accordance with the rule presented on the screen. Participants are required to respond accurately and quickly to the blocks. The primary datum is response latency measured in milliseconds. The RF-IRAP software was used to present instructions and stimuli and to record participant's responses. Each trial type presented one of two types of category label, either fear (e.g. "Scares me"), or approach (e.g. "I could approach"). One of eight target stimuli was also presented, which consisted of four spider images and four natural scene images. These images were obtained from, and identical to, those used in the study conducted by Nicholson and Barnes-Holmes (2012). Response instructions were also presented (see "Procedure" section for full RF-IRAP description).

3.2 Procedure

All participants first completed the FSQ, followed by the Traditional IRAP and RF-IRAP, and then the BAT.

3.2.1 RF-IRAP

3.2.1.1 Instructions. The instructions for the RF-IRAP were presented visually to participants. All screens displayed a black background with coloured text. Before commencing practice or test blocks, participants were presented with the following instructions in white text:

> *"This task will determine what makes 'intuitive sense' to you by seeing what rules you find easy and hard to follow. You'll pair words*

according to a rule using the D and K keys.[1] *You'll be told the rule, and when it changes. If you make a mistake you'll see a red X. Provide the correct response to continue. Learn to respond accurately according to the rule. When you've learned to be accurate (>80%) you'll naturally speed up too. Going quickly without being accurate will not provide meaningful data. Press space to continue."*

Once participants pressed the space bar, they were next presented with either an anti-spider or pro-spider rule on screen. The former rule read "Spiders are scary; I can approach nature" whereas the latter rule read "I can approach spiders; nature is scary". The rule was presented on the top third of the screen. The rules presented to participants were colour coded. The first rule presented was colour coded blue and the second rule presented was colour coded yellow. The order in which these rules were presented was counterbalanced across participants. That is, for half of the participants the first block of the IRAP and every odd numbered block thereafter presented the anti-spider rule, with the pro-spider rule presented on every even numbered block. For the remaining participants, all odd numbered blocks presented the pro-spider rule and all even numbered blocks presented the anti-spider rule. Subsequent data analyses indicated that this procedural variable had no significant impact on IRAP performance and thus no further reference will be made to it.

Below the rule was a white boarder box containing the instructions for the block of trials that was about to be presented. The instructions appeared in the top half of the boarder box and were also colour coded identical to the rule (e.g. if the rule was blue the instruction was also blue). The first instruction presented was colour coded blue and read "*Respond*

[1] Due to an oversight in programming the RF-IRAP, the instruction referred to the "D" and "K" keys rather than the "E" and "I" keys; the latter keys were actually used as the response keys with the RF-IRAP. Note, however, that the correct keys (i.e., E and I) were specified in all subsequent instructions provided by the IRAP program and anecdotal reports from participants indicated that the single incorrect instruction provided above had minimal impact on their understanding and performance on the RF-IRAP.

according to the blue rule above". The second instruction presented was colour coded yellow and read "*Respond according to the yellow rule above".* In the bottom of the boarder box, white coloured text appeared stating whether the next block was a practice block or test block (e.g. "Practice Block A"). Finally, just beneath the border box, green text appeared; before each block of trials commenced the text read, *"Press space to continue"* (see Figure. 2).

Figure 2: RF-IRAP instructions presented prior to each anti-spider and pro-spider block of trials.

3.2.1.2 Practice Blocks. Once participants pressed the space bar the first trial was presented. During practice blocks the rule remained at the top of the screen. For each trial, a target stimulus was presented within the boarder box, which consisted of a statement and a picture. Thus, for example, the statement, "Creeps me out" may have appeared with a picture of a spider presented directly below the statement. Below the boarder box containing the target stimuli were instructions for responding that read *"Press I if it follows the rule or E if it doesn't*". The task for the participant was to press the "I" key if the statement followed the rule or to press the "E" key if it did not. In the current example, pressing the "I" key was deemed correct if the anti-spider rule was presented (i.e. *"Spiders scare me; I can approach nature")* (see Figure.3), whereas pressing the “E” key was correct if the pro-spider rule was presented (i.e. *“I can approach spiders; nature scares me”).* Correct responses cleared the stimuli (the statement and the picture) and the next stimulus pair appeared 400ms later. Incorrect responses produced a red “X” below the picture within the boarder box, which remained on screen until the participant pressed the correct key. Upon completion of each practice block, participants were presented with a screen displaying feedback on their performance (see “Feedback” section).

Each practice block consisted of 32 trials composed of four trial-types, each presented eight times within the block. The four trial-types were defined in terms of the combination of the two label stimuli with the two types of target stimuli: *Spider-Fear; Nature-Fear; Spider-Approach; Nature-Approach.* Examples of these four trial-type are as follows; (i) Creeps Me Out / Spider Picture; (ii) Creeps Me Out / Nature Picture; (iii) I Can Approach / Spider Picture; (iv) I Can Approach / Nature Picture. 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).

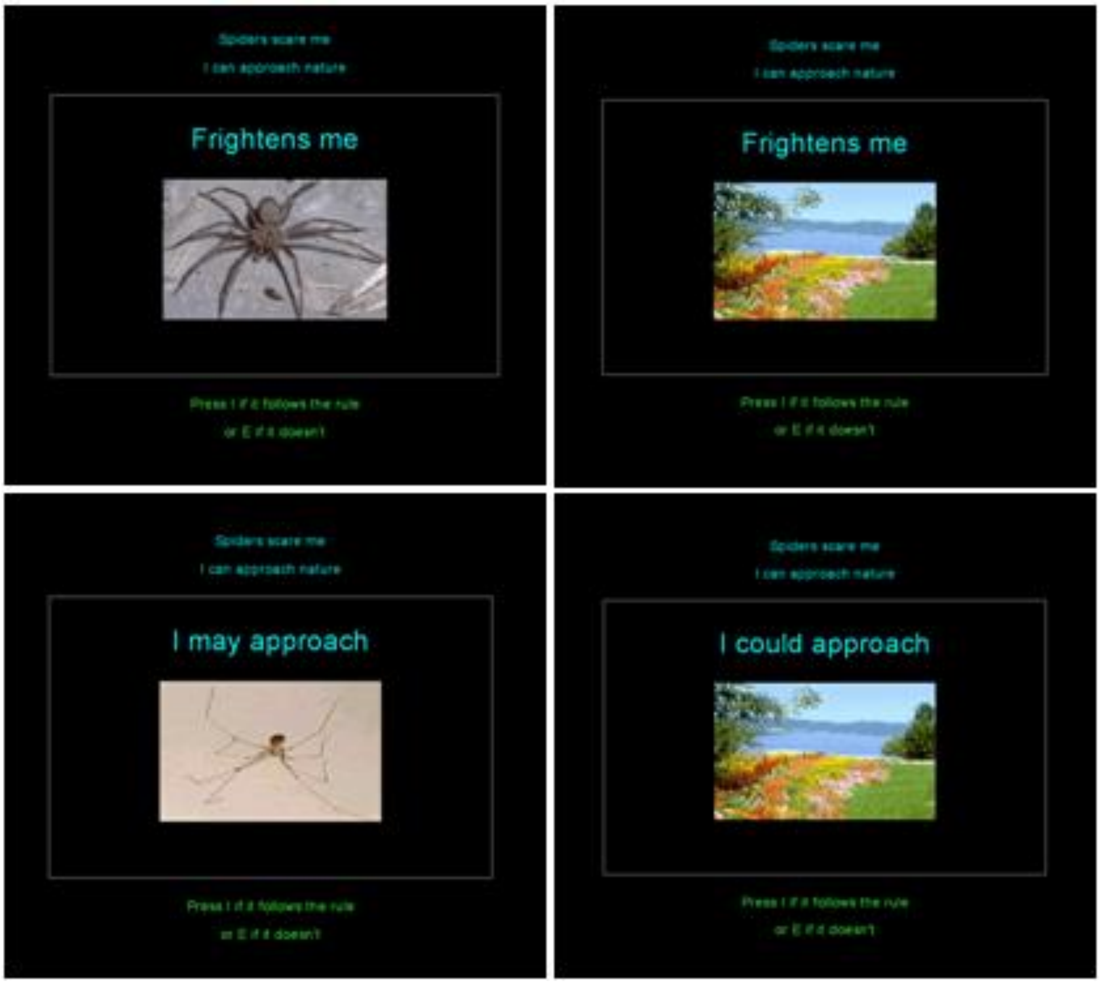


Figure 3: Examples of each Trial-Type presented during practice blocks on the RF-IRAP.

3.2.1.3 Test blocks. Once participants successfully completed the practice blocks they progressed to the test blocks. Participants were presented with the anti-spider rule screen or pro-spider rule screen identical to that presented in the practice blocks. Once participants pressed the space bar, the first trial of that test block appeared. The trial screen presented was similar to those used for the practice blocks seen in Figure 3, except that the rule no longer appeared on the top of the screen. The test blocks were similar to the practice blocks (32 trials, composed of four different trial-types, with the blocks alternating between anti-spider and pro-spider rules across each successive block), with some very minor differences, detailed below. Upon completion of each test block, participants were presented with a feedback screen (also described below). Once participants completed 6 test blocks, a screen displaying the following message appeared *"Thank you. The task is now complete. Press return to end."*

3.2.1.4 Mastery criteria. Participants were required to successfully complete one practice block pair to progress to the test blocks. Participants were allowed to attempt three practice block pairs. If unsuccessful after three, they did not proceed to the test blocks and a message appeared that read *"Thank you. The task is now complete. Press return to end."* Participants were then debriefed and thanked for their time. The criterion for advancement to the test blocks required that participants produce > 80% correct with < 2000 ms average latency across each of the practice blocks within that block pair. Once these criteria were achieved participants were then presented immediately with a rule screen that was similar to that presented for the odd numbered practice blocks, except the message "Practice Block A" was replaced with "Test Block 1 of 6" (this message was numerically increased for each subsequent test block; ("Test Block 2 of 6", "Test Block 3 of 6", etc.). Once participants pressed the space bar the first trial of the test block began. As noted above, the test blocks were similar to the practice blocks. The first test block and all subsequent odd numbered blocks presented one type of rule (e.g., the anti-spider rule) and the second block and all subsequent even number blocks presented the orthogonal rule (i.e., in this example the pro-spider rule). There were no criteria for progressing through the test blocks but feedback messages were presented at the end of each block to encourage participants to maintain accuracy and latency criteria (see next section).

3.2.1.5 Feedback. The feedback screen appeared at the end of each of the practice and the test blocks. The feedback screen contained a white boarder box, within which, three messages appeared. The first message appeared in the top of the boarder box in white text, and relayed participants' performance on the block giving accuracy scores in a percentage and the time they took on average on each trial (e.g. Last Block: 90% and 1.03 seconds on average"). Beneath this, in the middle of the boarder box in white text, a second message appeared reminding participants the criteria required to complete each block (e.g. Goal: > 80% and < 2 seconds). At the bottom of the boarder box in red text, a message of encouragement appeared. Depending on the participants' performance during the previous block, four different messages of encouragement were delivered. Participants who were successful in maintaining the mastery criteria received the following message; *"Continue responding both as accurately and quickly as you can".* If participants' accuracy fell below the > 80% correct response criterion, the following message appeared; *"Slow down slightly until you have learned to accurately follow the rule".* Participants', whose average latency scores were greater than 2000ms, received a message that read *"Continue responding as accurately as you can. You'll naturally get faster with practice".* If participants failed to meet both accuracy and average latency criteria, the following message appeared *"Learn to accurately follow the rule. You'll naturally get faster with time".* Once all 6 of the test blocks were completed, the experiment was over and the final feedback screen displayed the message *"Thank you. The task is now complete. Press return to end."*

3.3 Results and Discussion

3.3.1 Descriptive Statistics and Validating the BAT. Descriptive statistic for the FSQ and the BAT include a mean of 49.87 (*SD* = 28.75, *Min* = 18, *Max* = 122) and a mean of 3.51 (*SD* = 1.55, *Min* = 0, *Max* = 5) respectively. The Spider Moult BAT was adapted from the Nicholson and Barnes-Holmes (2012) study in which a live tarantula was used. As such, it was deemed important to determine if approach behaviours on the task correlated with the FSQ. The correlation proved to be relatively strong and significant ($r = -.630$, $p < .0001$), indicating that higher reported levels of fear on the FSQ predicted fewer approach steps on the BAT.

3.3.2 Scoring the IRAP. The primary datum from the RF-IRAP 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 subjected to statistical analyses. If accuracy fell below 78% 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 Nicholson and Barnes-Holmes (2012), 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 blocks were analysed. If participants failed to maintain the criteria across two or more pairs of blocks all of the data from that participant was excluded from further analysis. The data for four participants were removed on this basis. The latency data from the RF-IRAP were transformed into *D*-IRAP scores (see Barnes-Holmes, Barnes-Holmes, & Stewart, 2010) in the same manner as for a traditional IRAP (see Table 1). The D-*algorithm* is used to minimise the impact of extraneous factors such as age, motor skills, and/or cognitive ability (Nosek, Greenwald & Banji, 2007).

Table 1

Method for Converting the Response Latencies from Each Participant into D-IRAP Scores

1	The response latencies from only the six test blocks were utilised for the data analysis.
2	Any latency that exceeded 10,000 ms was removed from the data set.
3	If the data of a participant contained response latencies of less than 300 ms in more than 10% of test block trials, the participant was removed from the data set.
4	Standard deviations were calculated for each of the four trial types per pair of test blocks: four from the response latencies from the first and second test blocks, four from the response latencies from the third and fourth test blocks, and four from the response latencies from the fifth and sixth test blocks.**
5	A mean latency score was calculated for each of the four trial types in each test block. This resulted in 24 mean latencies for the four trial types over the six test blocks.
6	A difference score was calculated for each of the four trial types in each test block. This was done by subtracting the latency of the anti-spider test block from the corresponding pro-spider test block.
7	Each difference score was divided by its corresponding standard deviation (Calculated in step 4) which yielded 12 *D*-IRAP scores, one for each trial type for each pair of test blocks.
8	Four overall *D*-IRAP scores were calculated for each trial type. This was done by averaging the scores for each of the four trial types across each of the three pairs of test blocks.

Given the forgoing transformation, a larger *D*-IRAP score indicated a greater difference in mean response latencies between the two types of rules for each trial-type. Positive scores thus indicate a bias towards fearing and not approaching spiders and a bias towards approaching and not fearing nature. In order to facilitate direct comparisons across the spider and nature trial types, the signs for the *Spider-Fear* and *Spider-Approach* trial-types were reversed (i.e. positive scores became negative and negative scores became positive for those trial types). Positive *D*-IRAP scores now indicated positive bias for both spiders and nature and negative scores indicated negative bias for both types of stimuli.

A preliminary two-way mixed between-within analysis of variance (ANOVA) was conducted with RF-IRAP trial type as the repeated measure and block order as the between group variable. Neither the main effect for block order nor the interaction were significant (*ps* > .08) and thus block order was removed from all subsequent analyses.

3.3.3. Mean Scores Analyses. The four resulting *D*-IRAP scores are presented in Figure 4 and show a negative bias for the *Spider-Fear* trial-type but positive biases for the remaining three trial-types. Thus participants tended to respond more quickly when presented with a spider-fear/nature-approach rule, than the opposing rule (*Spider-Approach/Nature-Fear*), and a picture of a spider and statement that indicated a negative reaction (e.g., creeps me out). Or more informally, participants found it easier to follow a rule that specified spider-fear over spider-approach. Interestingly, however, this bias was reversed when the pictures of spiders were presented with statements that indicated approach – that is, participants responded more quickly when following the spider-approach/nature-fear rule than when following the spider-fear/nature-approach rule.

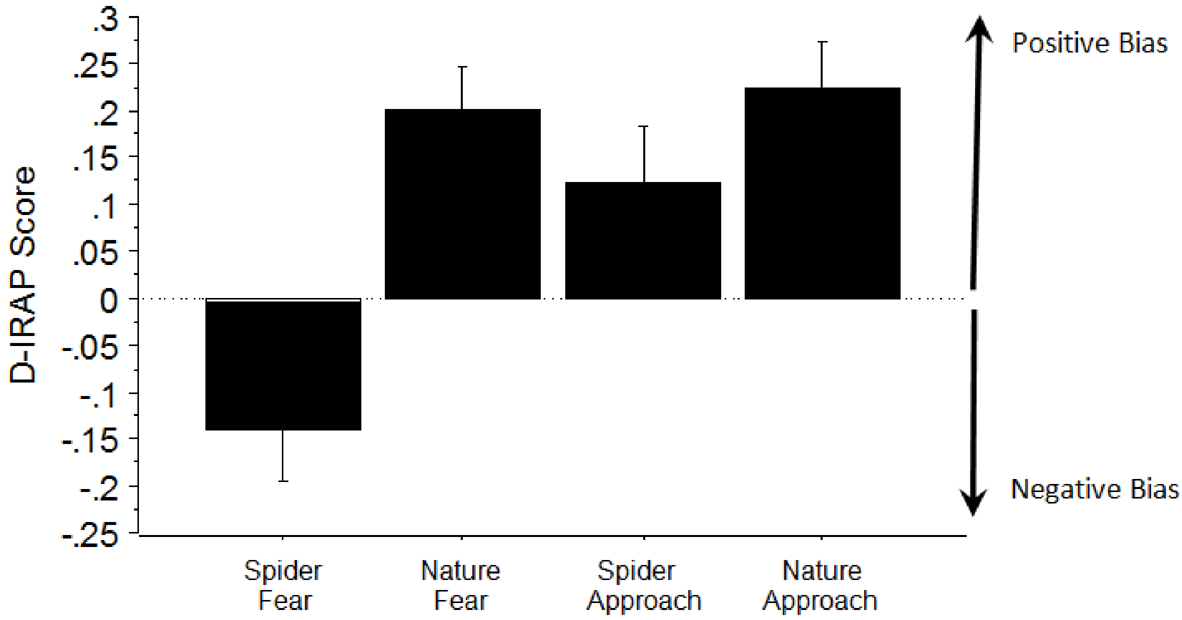


Figure 4: Four mean *D*-IRAP trial-type scores for the RF-IRAP.

As indicated above, for the Nature trial-types there was no divergence in the two response biases. For the *Nature-Approach* trial-type participants responded more quickly when pictures of nature were presented with approach statements and a rule that indicated approach rather than fear; for the *Nature-Fear* trial-type, however, participants *failed* to respond more quickly when presented with a rule that specified fear of nature. Overall, therefore, participants indicated both implicit fear and approach towards spiders, but approach and absence of fear with respect to nature.

A one way repeated measures analysis of variance (ANOVA) was conducted with RF-IRAP trial type as the repeated measure and this proved to be significant, (F (3, 38) = 10.333, p < .001, η_p^2 = 0.21). Post-hoc comparisons using Fisher's PLSD tests indicated that the mean score for the *Spider-Fear* trial type *(M = -.141, SE = .05)* was significantly different from the scores for the other three trial-types (*ps* < .0006), *Nature-Fear (M =.20, SE = .05); Spider-Approach (M = .12, SE = .06)*; and *Nature-Approach (M =.22, SE = .05)*. The scores for latter three trial-types did not differ significantly from each other. Four one-sample t-tests confirmed that each of the four trial-type scores was significantly different from zero (*ps* > .05). The inferential statistics therefore confirmed the descriptive statistics presented in Figure 4

3.3.4 Implicit-Explicit/BAT Correlational Analyses. A correlation matrix was calculated to examine the relationships between the RF-IRAP trial types and the FSQ scores and performance on the BAT. The only significant correlation between the IRAP and FSQ was recorded for the *Nature-Approach* trial-type ($r = -.321$, $p = .046$), indicating that a stronger bias towards approaching nature predicted lower self-reported fear towards spiders. Interestingly, the *Spider-Fear* and *Spider-Approach* trial-types correlated positively ($r = .419$, $p = .007$), indicating reduced levels of implicit fear predicted increased levels of approach towards spiders.

3.3.5. Summary and Conclusion. Consistent with previous IRAP studies on spider-fear – a negative bias for spiders was recorded. However, interestingly this was observed only for the fear trial-type rather than the approach trial-type. This might be explained by the fact that participants were normative and therefore although spiders might not be positively valenced, they would not necessarily evoke strong avoidance responses. The fact that participants showed positive bias for both fear and approach responses to the nature scenes supports this conclusion (i.e., critically, we did not record a general bias towards confirming fear on the IRAP).

On balance, the correlational analyses did not provide strong evidence that fear and approach responses towards pictures of spiders predicted self-reported fear on the FSQ or actual approach behaviour on the BAT. Given that previous IRAP studies using spider pictures did correlate with FSQ scores and a BAT this placed a possible question-mark over the use of the RF-IRAP that was employed for the first time in the current study. At this point in the research programme, therefore, it seemed important to revert back to a traditional IRAP in the investigation of spider fear and approach/avoidance.

Chapter 4

Separating Fear and Approach/Avoidance Using Two Separate Traditional IRAPs

4. Study 2: Introduction

As noted at the end of the previous chapter, it was decided that the next study would employ the traditional IRAP because previous studies with this method had reported significant correlations between spider trial-types and both FSQ scores and BAT performances. In conducting this second study it seemed important to use two separate IRAPs with one designed to target fear responses and the second approach/avoidance responses. Although there was little empirical basis for doing so, given that one of the main aims of the current research programme was to separate spider fear and approach/avoidance at the implicit level, using two separate IRAPs seemed strategically wise. The current study also involved using a different contrast category from Study 1, which employed pictures of natural scenes. Upon reflection perhaps such scenes may have evoked some of the psychological properties of spiders (e.g., one frequently finds spiders in gardens or forests, and so on). In the current study participants were asked to indicate their preference for dogs versus cats and their preferred category of animal was then inserted into the IRAP as a contrast category for spiders. The aim here was to present an IRAP with a relatively strong positively valenced stimulus category against which responses to spiders could be assessed.

4.1 Method

4.1.1 Ethical Considerations. The three studies reported here were conducted in accordance with the ethical guidelines of Maynooth 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.

4.1.2 Participants. Fifty seven undergraduate students attending Maynooth University, Ireland, volunteered to participate in this study (*N=57*, 27 Females, 30 Males). No remuneration was offered for participation in this study. All participants completed a brief pre-screening questionnaire, which asked for some demographic details, levels of self-reported spider fear and participants preference for dogs or cats. Prior to the experiment, participants read and signed a consent form informing them that they could withdraw from the study at any time. The mean age was 21.29 years (Standard Error [SE] = .352) with an age range of 18 - 38 years. Twelve participants were eliminated due to their failure to achieve the necessary performance criteria (see "procedure" section), leaving 21 females and 24 males (*N* = 45), the results of whom were subject to analysis. The mean age was 21.5 years (Standard Error [SE] = .419), with a range of 18 – 38 years. The participants completed the study individually in the Department of Psychology at Maynooth University. Upon completion, participants were fully debriefed. Based on the recent meta-analysis of criterion effects for the IRAP conducted by Vahey, et. al., (2015), a sample size greater than 29 is required for first order correlations to achieve statistical power of .8 when testing criterion validity of clinically focussed IRAP effects.

4.1.3 Materials. The FSQ was also employed in the Study 2. The same BAT that was employed in Study 1 was employed in the current experiment (e.g. a spider moult was used).

4.1.3.1 Implicit Measures

4.1.3.1.1 Photographic images. The label stimuli for the F-IRAP and A-IRAP consisted of one of twelve images: six were colour images of various spiders, the other six were various images of either puppies or kittens. Some of the spider images were taken from the Nicholson and Barnes-Holmes (2012) study on High/Low spider fear. The remainder of the images were sourced freely on Google. In the case of the spider images, the pictorial stimuli were chosen because they reflected a range of both familiar and unfamiliar 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 which would appeal to participants. Label stimuli for F-IRAP and A-IRAP can be found in Appendix C.

4.1.3.1.2.The Implicit Relational Assessment Procedure (IRAP). As noted previously, the current study employed the traditional IRAP (rather than the RF-IRAP employed in the study reported in Chapter 2). Given the unique nature of the RF-IRAP and the many ways in which it differed from the traditional version a relatively complete description of the latter version will be presented here (initial attempts to write a brief description of the traditional IRAP based on the RF version quickly became quite cumbersome and unwieldy).

The (traditional) IRAP is a computer based programme that requires participants to respond quickly and accurately to specific stimuli that are deemed either consistent or inconsistent with their prior learning histories and/or response biases. The stimuli are presented in the forms of trials within a series of blocks. The fundamental hypothesis of the IRAP is that relational responding should be quicker and more accurate across blocks of trials that require responding that is consistent with the participant's learning history and/or response biases than on blocks that require responding in a manner that is inconsistent with that history and/or response biases. The primary datum from the IRAP is response latency, which is measured in milliseconds, and defined as the time that elapses from the onset of stimuli in each trial to the emission of a correct response. In the current study, 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 two separate IRAPs, one targeting Fear (i.e. F-IRAP) and another targeting avoidance (i.e. A-IRAP).

4.2 Procedure

All participants first completed a pre-screening questionnaire similar to that employed in Study 1. In addition, participants completed two traditional IRAPs (F-IRAP and A-IRAP), the FSQ and a BAT, the order of which, were counterbalanced across all participants.

4.2.1 F-IRAP. In this IRAP, participants were required to complete some blocks of trials that required responding in a manner that coordinated pictures of spiders with fear-related words and pictures of pets with positively-valanced words (hereafter referred to as anti-spider blocks). On other blocks of trials the opposite response pattern was required – coordinating spiders with positively valenced words and pets with fear-related words (hereafter referred to as pro-spider blocks). At the beginning of each anti-spider block participants were presented with the rule; *"Please respond as if, Spiders are Scary and Puppies [or Kittens] are Pleasant. Please try to avoid the red X"*, and at the beginning of each pro-spider block participants were presented with the rule; *"Please respond as if, Spiders are Pleasant and Puppies [or Kittens] are Scary`. Please try to avoid the red X."*. A message of encouragement appeared below the rule in red text that read *"Try to get as many as possible 'right' according to the rule above"*. Instructions for beginning each block of trials were presented beneath the rule and read "*Press space to continue"*. 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.

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: *Spider-Fear; Pet-Pleasant; Spiders-Pleasant; Pet-Fear*. Examples of these four trial types are as follows; (i)

Spider Picture/Scares me; (ii) Pet Picture/Makes me smile; (iii) Spider Picture/I like it; (iv) Pet Picture/Terrifies 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). Target Stimuli for the F-IRAP can be found in Table 3.

Table 3. The target stimuli in the current study were generated by searching for synonyms, antonyms and commonly used phrases relating to fear and pleasant for the F-IRAP, and avoid and approach for the A-IRAP.

Target Stimuli for F-IRAP for Fear and Pleasant responding

Target Stimuli - Fear	Target Stimuli - Pleasant
Scares me	Calms me
Terrifies me	Comforts me
Frightens me	Cheers me up
Worries me	Makes me happy
Creeps me out	I like it
Horrifies me	Relaxes me
Panics me	Makes me smile
Alarms me	Pleases me

Participants were required to successfully complete one pair of practice blocks (i.e. one anti-spider block and one pro-spider block) to progress onto the test 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 whilst maintaining < 2000ms average latency for each practice block within a pair. Once participants achieved these criteria they were automatically advanced to the test blocks. No performance criteria were applied for progression through the test blocks, but the performance feedback was presented at the end of each block to encourage participants to maintain the practice-block criteria (> 80% correct and <= 2000ms latency).

As noted above, participants commenced each block of trials by pressing the space-bar. 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. The response options allowed participants to appraise the relational network in which the images and target stimuli participated as either relationally coherent or incoherent with the rule presented at the beginning of the block.

As noted above, each block commenced with the presentation of either an anti-spider or pro-spider rule. When the anti-spider rule was presented the task for the participant was to press the "*Yes*" key if the stimulus pair were consistent with the rule and to press the "*No*" key if the stimulus pair were inconsistent with the rule. 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. When a pro-spider rule was presented at the beginning of a block the opposite pattern of responding was required. That is, responding "*No"* when presented with a spider and fear 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 fear 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, a red exclamation mark 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. To avoid "over-loading" the participants when they first began the IRAP, the latency-prompt (the exclamation mark) was not presented during the first pair of practice blocks; but it was presented during all subsequent practice (and test) blocks. An additional message appeared on screen before each such block that read *"If you go over time on any trial '!' will appear"* in red text.

Upon completion of each block, participants were presented with a screen displaying performance feedback for that block. Following completion of the first practice block, a message displaying accuracy for the previous block appeared in black coloured text (i.e. Your scores on the previous block: Accuracy: 91%). Below this, in red coloured text, the target for the next block was displayed (i.e. Your targets for the next block: Accuracy: More than 80%). On completion of the second practice block*, and every block thereafter,* the participant's accuracy scores and their speed scores were displayed in black coloured text (i.e. Your scores on the previous block: Accuracy 91%, Speed: 1100 milliseconds). Below this in red text, a message describing the participants target for the next block appeared (i.e. Accuracy: More than 80%, Speed: Less than 2000 milliseconds). After each pair of practice blocks (one anti-spider and one pro-spider) a screen appeared displaying two messages. The first was a message of encouragement that read *"Keep practicing until your accuracies are at least 80% correct and your speeds are less than 2000 milliseconds".* The second message displayed performance on each block within that block pair, for example; *"Your scores on the previous pair of blocks:*

Accuracies: 91% and 91%. Speeds: 1100 and 1280 milliseconds". Similar performance feedback was presented after each test block (the second message providing feedback after each pair of test blocks was not presented). Once all test blocks were completed, a blue screen appeared with the following text "*Please contact the researcher"*.

4.2.2. A-IRAP. The procedure for the A-IRAP was similar to the F-IRAP except the target stimuli and the rules presented at the beginning of each block were modified. Specifically, the target stimuli referred to approach and avoidance responses (see Table 4), and the two rules were as follows: anti-spider rule, *"Please respond as if, Spiders are Distressing and Puppies [or Kittens] are Pleasant. Please try to avoid the red X"* and pro-spider rule, *"Please respond as if, Spiders are Pleasant and Puppies [or Kittens] are Distressing. Please try to avoid the red X".*

Table 4

Target Stimuli for A-IRAP for Avoidant and Approach responding -

Target Stimuli - Avoid	Target Stimuli - Approach
I need to escape	I can stay
I need to run away	I can touch it
I need to get out	I can pick it up
I need to avoid it	I can approach it
I need it removed	I can play with it
I need to get away	I can carry it
I need to leave	I can hold it
I need to retreat	I can face it

4.3 Results and Discussion

4.3.1 Descriptive Statistics and Validating the BAT. Descriptive statistic for the FSQ and the BAT include a mean of 44.18 (*SD* = 28.08, *Min* = 18, *Max* = 118) and a mean of 4.31 (*SD* = 0.97, *Min* = 2, *Max* = 5) respectively. As in Study 1, the correlation between the FSQ and the BAT proved to be relatively strong and significant ($r = -.481$, $p = .0007$) indicating that higher reported levels of fear on the FSQ predicted fewer approach steps on the BAT.

4.3.2 Scoring the IRAPs. The primary datum from the F-IRAP and A-IRAP 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 Study 1, and previously published studies employing the traditional IRAP, the data were screened before being subject to statistical analyses. Similar to Study 1, the exclusion criteria based on participant performance on the RF-IRAP was employed in the current study. That is, if the participant's accuracy fell below 78% 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 Nicholson and Barnes-Holmes (2012), 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. If participants failed to maintain the criteria across two or more pairs of blocks all of the data from that participant was excluded from further analysis. The data for ten participants were removed on this basis. The latency data from the F-IRAP and A-IRAP were transformed into *D*-IRAP scores as per Table 1 in Chapter 2.

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 F-IRAP thus indicate 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 reversed (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.

Similar to the F-IRAP, a larger *D*-IRAP score indicated a greater difference in mean response latencies between the two types of rules for each trial-type. Positive scores on the A-IRAP thus indicate a bias towards avoiding and not approaching spiders and a bias towards approaching and not avoiding pets. In order to facilitate direct comparisons across the spider and pet trial types, the signs for the *Spider-Avoid* and *Spider-Approach* trial-types were reversed (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.

4.3.3 Mean Scores Analyses. The eight *D*-IRAP scores, four for the F-IRAP and four for the A-IRAP, are presented in Figure 5. The F-IRAP produced a strong negative bias for the *Spider-Fear* trial-type but positive biases for the remaining three trial types, although the effect the *Spider-Pleasant* trial-type was close to zero. 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 strong 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 “Yes” rather than “No”.

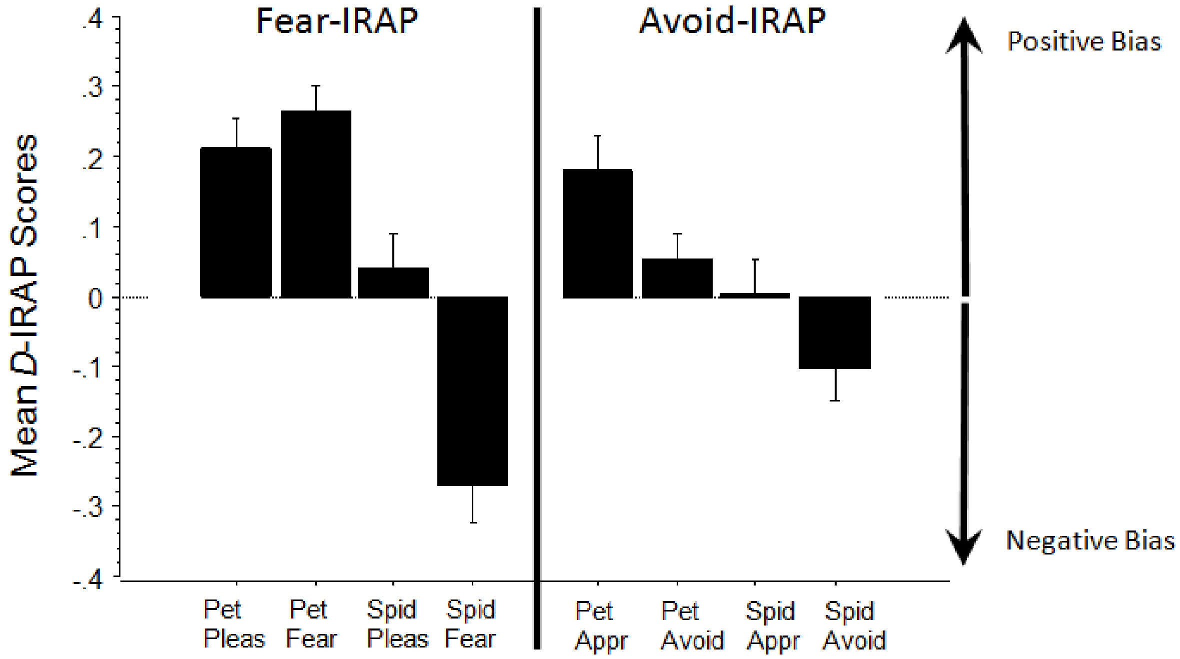


Figure 5: Eight mean *D*-IRAP scores for the F-IRAP and A-IRAP.

The A-IRAP produced a negative bias for the *Spider-Avoidance* trial-type but positive biases for the remaining three trial types, although the effect the *Spider-Approach* trial-type was almost zero. In concrete terms, participants tended to respond "Yes" more quickly than "No" when presented with a picture of a spider and an avoidance phrase or a picture of a pet and an approach phrase. When presented with a picture of a pet and an avoidance phrase, participants showed a weak tendency to respond "No" rather than "Yes". Finally when presented with a picture of a spider and an approach phrase, participants responded "Yes" and "No" with almost equal bias.

The eight *D*-IRAP scores for each participant were entered into a 2x4 repeated measures analyses of variance (ANOVA) with IRAP type (F-IRAP and A-IRAP) and each of the four trial-types as repeated measures. The main effect for trial-type was significant, (F (3, 132) = 25.764, $p < .0001$, $\eta_p^2 = .37$), but the effect for IRAP type was not ($p > .3$). Critically, however, the interaction effect was significant, (F (3, 132) = 5.984, $p = .0007$, $\eta_p^2 = .12$). To better understand the nature of this interaction, the data from each IRAP were first analysed separately; between-IRAP comparisons are presented thereafter.

The F-IRAP. A one way repeated measures analysis of variance (ANOVA) was conducted with trial type as the repeated measure and this proved to be significant, (F (3,44) = 25.794, p <.0001, η_p^2 = .37). Post-hoc comparisons using Fisher's PLSD tests indicated that the mean score for the *Spider-Pleasant* trial type (M = -.04, SE = .05) was significantly different from the scores for the other three trial types (ps < .0001), *Spider-Fear* (M = .27, SE = .05); *Pet-Fear* (M = .26, SE = .04); *Pet-Pleasant* (M = .21, SE = .04). In addition, the mean scores for the *Spider-Fear* trial type were significantly different from the *Pet-Fear* and *Pet-Pleasant* trial types (ps <.0001). Four one-sample t-tests indicated that the *Pet-Pleasant, Pet-Fear and Spider-Fear* trial-type effects were each significantly different from zero (ps < .0001), but the effect for *Spider-Pleasant* was not (p = .4). The inferential statistics for the Fear-IRAP therefore confirmed the descriptive statistics presented in Figure 5.

The A-IRAP. The one way repeated measures analysis of variance (ANOVA) was conducted with A-IRAP trial type as the repeated measure and this proved to be significant, (F (3,44) = 6.677, p =.0003, η_p^2 = .132). Post-hoc comparisons using Fisher's PLSD tests indicated that the mean score for *Pet-Approach* trial type (M = .18, SE = .05) was significantly different from the scores from the other three trial types *Pet-Avoid* (M = .05, SE =.04) and *Spider-Approach* *(*M = .006, SE = .05) and *Spider-Avoid* (M = -.102, SE = .05). The Mean score for *Pet-Avoid* was also significantly different from the *Spider-Avoid* trial type (p = .016). Four one-sample t-tests indicated that the *Pet-Approach* and *Spider-Avoid* trial types were significantly different from zero (p < .028) but the effect for the *Pet-Avoid* and *Spider-Approach* trial-types were not. The inferential statistics therefore confirmed the descriptive statistics presented in Figure 5.

Between-IRAP Analyses. Four separate paired t-tests were used to examine the differences between the corresponding trial-types from each IRAP (i.e. 1. *Pet-Pleasant* vs. *Pet-*

Approach; 2. *Pet-Fear* vs. *Pet-Avoid;* 3. *Spider-Pleasant* vs. *Spider-Approach;* 4. *Spider-Fear* vs. *Spider-Avoid*). The differences for the second and fourth comparisons, respectively, proved to be significant, (t = 4.183, p < .0001; t = -2.648, p = .011), but the remaining two did not (*ps* > .5).

Overall, therefore, the interaction effect between the two IRAPs and their respective trial-types appeared to be driven by larger *D*-IRAP effects for the *Pet-Fear* and *Spider-Fear* relative to the *Pet-Avoid* and *Spider-Avoid* trial-types.

4.3.4 Implicit-Explicit/BAT Correlational Analyses. A correlation matrix was calculated to determine if any of the eight trial-types from the two IRAPs predicted self-reported fear of spiders (on the FSQ) and approach responses on the BAT. The only significant correlation between the IRAP and the explicit/BAT measures were recorded for the *Spider-Fear* trial type in the F-IRAP and the FSQ (r = -.329, p = .027), indicating that increasing implicit fear of spiders predicted higher self-reported fear of spiders. The negative correlation between the *Spider-Approach* trial-type and the FSQ failed to reach significance (p = .07).

Table 5

Correlation Matrix for F-IRAP, A-IRAP and Explicit Measures

F-IRAP Correlation Matrix					A-IRAP Correlation Matrix			
	Pet Pleasant	Pet Fear	Spider Pleasant	Spider Fear	Pet Approach	Pet Avoid	Spider Approach	Spider Avoid
BAT	.14	.167	-.178	.128	.062	.081	.014	.214
FSQ	-.105	.023	.214	-.329*	.184	.019	-.265	-.201

*p < .05

4.3.5 Summary and Conclusion. Consistent with Study 1, and the previously published study employing a traditional IRAP investigating spider fear (Nicholson & Barnes-Holmes, 2012), a negative bias for spiders was recorded. Unlike the previous study, and the findings reported by Nicholson and Barnes-Holmes, two separate IRAPs were employed one targeting fear and one targeting approach/avoidance, and both IRAPs revealed significant negative biases. The negative biases for each IRAP were recorded with one specific trial-type in each case (*Spider-Fear* and *Spider-Avoid*), although the strength of the negative bias was stronger for implicit fear than for implicit avoidance. This is the first study, therefore, that has provided evidence that fear and avoidance of spiders, at the implicit level, may be measured separately.

The correlational analyses indicated that implicit spider fear predicted self-reported fear levels.. Similar to Study 1, however, the correlational analyses failed to provide evidence that implicit fear or approach/avoidance biases predicted behaviour on the BAT. Thus, the current study yielded some evidence to support the predictive validity of the IRAPs in terms of predicting self-reported fear levels but little if any evidence that they predicted actual behaviour. Critically, the previously published study by Nicholson and Barnes-Holmes (2012) on spider fear using an IRAP reported a medium correlation (r = -.41) between implicit responses to spiders and number of steps completed on a BAT. At this point in the research programme, therefore, we had twice failed to replicate the finding that performance on a spider-related IRAP predicts actual approach behaviour. Given that a recent meta-analysis of the IRAP in clinically-relevant domains had reported relatively high predictive validity for first-order correlations (r = .45), the failure to replicate forced us to reconsider the nature of the BAT we had employed in these first two studies. Specifically, unlike the previously published spider-IRAP study a spider moult was employed in the BAT rather than a live tarantula. Although somewhat speculative, we reasoned that it may be important to use a live spider in a BAT rather than a moult. Indeed, anecdotally, many of the participants reported that the moult was “not a real spider”, either during the actual BAT itself or during de-briefing. In the third and final study, therefore, a live Irish house spider was employed in the BAT. Another issue that we felt required attention related to the anti- and pro-spider rules that were employed with the A-IRAP. Specifically, the pre-block rules asked participants to respond as if spiders are distressing (and pets are pleasant) and vice versa, rather than referring directly to approach and avoidance responses, per se. This was rectified in the next study.

Chapter 5

Separating Fear and Approach/Avoidance Using Two IRAPs and a Live-Spider BAT

5. Study 3: Introduction

As noted at the end of the previous chapter, it was decided that the next study would employ the F-IRAP and an A-IRAP similar to that employed previously. In addition, the FSQ was used again given that it did yield some evidence to support the predictive validity of the IRAPs (e.g., it correlated with the Spider-Fear trial-type). As noted in the previous chapter, the BAT, which employed the use of a spider moult, raised questions of its utility and reliability as a measure of spider approach behaviour. It was therefore deemed important to use a live Irish house spider in the current study. Finally, the pre-block rules presented in the A-IRAP required participants to respond as if spiders are distressing (and pets are pleasant) and vice versa, rather than referring directly to approach and avoidance responses. It was therefore deemed important to revise the rules to directly state that approach and avoidant responding is required.

5.1 Method

5.1.1. Ethical Considerations. The three studies reported here were conducted in accordance with the ethical guidelines of Maynooth 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.

5.1.2 Participants. Thirty four undergraduate students attending Maynooth University, Ireland, volunteered to participate in this study (*N* = 34, 21 Females, 13 Males) . No remuneration was offered for participation in this study. Prior to the experiment, participants read and signed a consent form informing them that they could withdraw from the study at any time. Three participants were eliminated due to their failure to achieve the necessary performance criteria (see “procedure” section), leaving 18 females and 13 males (*N* = 31), the results of whom were subject to analysis. The mean age was 21.68 years (SE = 1.27), with a range of 17 – 55 years. The participants completed the study individually in the Department of Psychology at Maynooth University. Upon completion, participants were fully debriefed. Based on the recent meta-analysis of criterion effects for the IRAP conducted by Vahey, et. al., (2015), a sample size greater than 29 is required for first order correlations to achieve statistical power of .8 when testing criterion validity of clinically focussed IRAP effects.

5.1.3. Materials. The FSQ was employed in the current study. The BAT for the current study employed the use of a live Irish common house spider (*Eratigena atrica*) approximately 7cm in diameter. Completing and scoring of the BAT was similar to the previous two studies. Given that the spider was a live specimen, on occasion it would move when touched (gently) by participants before the 10 second requirement had been met. When this occurred they were invited to touch the spider again for a full 10 seconds to complete the BAT. If the spider moved again when touched before 10 seconds lapsed, the full 5-steps of the BAT were recorded because the participant had clearly demonstrated a strong approach response and we wished to avoid distressing the spider unnecessarily. 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 current study, the spider was released.

5.2 Procedure

Apart from a change to the Avoidance IRAP, described below, all other procedural features of Study 3 were similar to those described for Study 2.

5.2.1 Implicit measures

5.2.1.1 The Implicit Relational Assessment Procedure (IRAP). As described in the previous chapter, the traditional IRAP is a computer based programme that requires participants to respond quickly and accurately to specific stimuli that are deemed either consistent or inconsistent with their prior learning histories and/or response biases. Similar to the previous study, 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 two separate IRAPs, one targeting Fear (i.e. F-IRAP) and another targeting approach/avoidance (i.e. A-IRAP). The F-IRAP was the same, in all respects, to that employed in Study 2.

The Avoidance IRAP (hereafter referred to as A2-IRAP) was similar to that employed in Study 2 but with a number of key differences. First, in Study 2 the *anti-spider* and *pro-spider* rules presented to participants at the beginning of each block of trials did not specify avoidant and approach responding. The anti-spider rule read; *"Please respond as if, Spiders are Distressing and Puppies [or Kittens] are Pleasant. Please try to avoid the red X"*. The pro-spider rule read; *"Please respond as if, Spiders are Pleasant and Puppies [or Kittens] are Distressing. Please try to avoid the red X".* These rules were adapted in order to clearly state to participants that avoidant and approach responding was required. Specifically, the *anti-spider* rule now read *"Please respond as if, you want to Avoid Spiders and you want to Approach Puppies [or Kittens]. Please try to avoid the red X"*. The *pro-spider* rule read, *"Please respond as if, you want to Approach Spiders and you want to Avoid Puppies [or Kittens]. Please try to avoid the red X"*. All other criteria employed in the A2-IRAP replicated the A-IRAP in Study 2 including all mastery criteria and feedback.

5.3. Results and Discussion

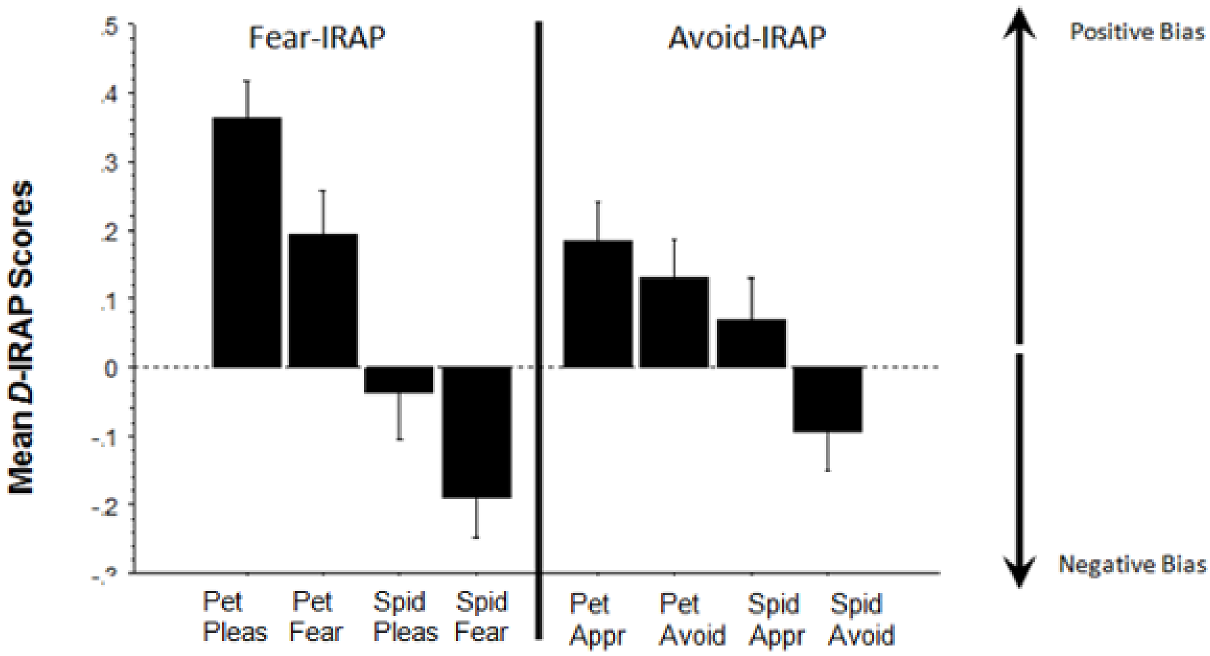
5.3.1 Descriptive Statistics and Validating the BAT. Descriptive statistic for the FSQ and the BAT include a mean of 51.68 (*SD* = 28.65, *Min* = 18, *Max* = 112) and a mean of 4.03 (*SD* = 1.05, *Min* = 1, *Max* = 5) respectively. Consistent with the previous two studies, the correlation between the FSQ and the BAT proved to be strong and significant ($r = -.819$, $p < .0001$) indicating that higher reported levels of fear on the FSQ predicted fewer approach steps on the BAT.

5.3.2. Scoring the IRAPs. As in the previous two studies, the primary datum from the F-IRAP and the A2-IRAP 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. All data were screened prior to statistical analyses. The exclusion criteria based on participant performance on the two IRAPs in the current study were similar to Study 2. That is, if the participant's accuracy fell below 78% 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. If participants failed to maintain these criteria for one or both test blocks from a given pair, the data from that participant were excluded and the data from the remaining two test block pairs were analysed. If participants failed to maintain the criteria across two or more pairs of blocks all of the data from that participant were excluded from further analysis. The data for three participants were removed on this basis. The latency data from the F-IRAP and A2-IRAP were transformed into *D*-IRAP scores as per Table 1 in Chapter 2.

Given the forgoing transformations, 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. Similar to Study 2, positive scores on the F-IRAP thus indicate 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 reversed (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 same transformations were conducted for the A2-IRAP and similar to Study 2, positive scores on the A2-IRAP thus indicate a bias towards avoiding and not approaching spiders and a bias towards approaching and not avoiding pets. Again, in order to facilitate direct comparisons across the spider and pet trial types, the signs for the *Spider-Avoid* and *Spider-Approach* trial-types were reversed (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.

5.3.3. Mean Scores Analyses. The eight *D*-IRAP scores, four for the F-IRAP and four for the A2-IRAP, are presented in Figure 6. The F-IRAP produced a strong negative bias for the *Spider-Fear* trial-type. The *Spider-Pleasant* trial type also produced a negative bias but was close to zero. The pet trial-types produced medium to strong positive biases. 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 strong 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".



The D-IRAP effects produced on A2-IRAP revealed a negative bias for the *Spider-Avoidance* trial-type but positive biases for the remaining three trial types. Participants tended to respond "Yes" more quickly than "No" when presented with a picture of a spider and an avoidance phrase or a picture of a pet and an approach phrase. When presented with a picture of a pet and an avoidance phrase, participants tended to respond "No" more quickly than "Yes". Finally, when presented with a picture of a spider and an approach phrase, participants showed a weak tendency to respond "Yes" rather than "No".

The eight *D*-IRAP scores for each participant were entered into a 2x4 repeated measures analyses of variance (ANOVA) with IRAP type (F-IRAP and A2-IRAP) and each of the four trial types as repeated measures. The main effect for trial-type was significant, (F (3, 90) = 13.182, $p < .0001$, $\eta_p^2 = .31$), but the effect for IRAP type was not ($p > .7$). Critically, however, the interaction effect was significant, (F (3, 90) = 3.341, $p = .023$, $\eta_p^2 = .1$). To better understand the nature of this interaction, the data from each IRAP were first analysed separately; between-IRAP comparisons are presented thereafter.

The F-IRAP. A one way repeated measures analysis of variance (ANOVA) was conducted with trial type as the repeated measure and this proved to be significant, (F (3,30) = 14.38, p < .0001, η_p^2 = .32). Post hoc comparisons using Fisher's PLSD tests indicated that the mean scores for the *Pet-Pleasant* (M = .365, SE = .052) and *Pet-Fear* trial-types (M = .194, SE = .063) were significantly different from the scores for the *Spider-Pleasant* (M =.-.038, SE = .065) and *Spider-Fear* (M = -.188, SE = .061) trial types. Four one-sample t-tests indicated that the *Pet-Pleasant, Pet-Fear and Spider-Fear* trial-type effects were each significantly different from zero (ps < .005), but the effect for *Spider-Pleasant* was not (p = .6). The inferential statistics for the Fear-IRAP therefore confirmed the descriptive statistics presented in Figure 6

The A2-IRAP. The one way repeated measures ANOVA proved to be significant, (F (3, 30) = 4.033, p =.0097, η_p^2 = .118). Post-hoc comparisons using Fisher's PLSD tests indicated that the mean score for the *Spider-Avoid* (M = -.093, SE = .056) trial-type was significantly different from the *Pet-Approach* (M = .184, SE = .056) and *Pet-Avoid* (M = .132, SE = .056). Four one-sample t-tests indicated that the *Pet-Approach* and *Pet-Avoid* trial types were significantly different from zero (ps < .025) but the effects for the *Spider-Avoid* and *Spider-Approach* trial-types were not (ps > .1). The inferential statistics therefore confirmed the descriptive statistics presented in Figure 6.

Between-IRAP Analyses. Four separate paired t-tests were used to examine the differences between the corresponding trial-types from each IRAP (i.e. 1. *Pet-Pleasant* vs. *Pet-Approach;* 2. *Pet-Fear* vs. *Pet-Avoid;* 3. *Spider-Pleasant* vs. *Spider-Approach;* 4. *Spider-Fear* vs. *Spider-Avoid*). The difference for the first comparison proved to be significant, (t = 2.881, p =.0073), but the remaining three differences did not (ps > .1).

Overall, therefore, the interaction effect between the two IRAPs and their respective trial-types appeared to be driven by larger *D*-IRAP effects for the *Pet-Pleasant* trial-type relative to *Pet-Approach.*

5.3.4. Implicit-Explicit/BAT Correlational Analyses. A correlation matrix was calculated to determine if any of the eight trial-types from the two IRAPs predicted self-reported fear of spiders (FSQ) and approach responses on the BAT. A significant correlation was recorded between the *Spider-Approach* trial-type and the BAT (r = .377, p = .036), indicating that increasing implicit approach of spiders predicted actual approach behaviour on the BAT. The negative correlation between the *Spider-Approach* trial-type and the FSQ approached significance (p = .052) suggesting that decreasing implicit approach towards spiders predicted higher self-reported fear. The *Pet-Pleasant* trial-type positively correlated with the FSQ (r = .373, p = .038) indicating that increasing implicit bias towards pets as pleasant predicted higher self-reported fear of spiders. The negative correlation between the *Pet-Pleasant* trial-type and the BAT did not reach significance (p = .069), The negative correlation between the *Pet-Avoid* trial-type and the BAT did not reach significance, (p = .076).Additionally, the positive correlation between the *Pet-Avoid* trial-type and the FSQ bordered significance, (p = .058), suggesting that negative bias towards pets predicted higher self-reported fear of spiders.

Table 6

Correlation Matrix for F-IRAP, A2-IRAPand Explicit Measures

F-IRAP Correlation Matrix					A2-IRAP Correlation Matrix			
	Pet Pleasant	Pet Fear	Spider Pleasant	Spider Fear	Pet Approach	Pet Avoid	Spider Approach	Spider Avoid
BAT	-.331	-.051	.08	-.166	.137	-.323	.377*	.174
FSQ	.373*	.091	.070	.015	-.077	.344	-.352	-.176

*p < .05

5.3.5. Summary and Conclusion. Consistent with the previous two studies, and the previously published study employing a traditional IRAP investigating spider fear (Nicholson & Barnes-Holmes, 2012), a negative bias for spiders was recorded. Unlike the previous study, however, the difference between the *Spider-Fear* and *Spider-Avoid* trial-types was not significant. On balance, the effect for the former trial-type was significantly different from zero, whereas the latter effect was not. Thus, the same general pattern was observed across the two studies. The correlational analyses suggested that spider approach bias predicted self-reported levels of fear.. Additionally, spider approach bias predicted actual approach behaviour on the BAT. This finding supports the view that the spider moult did not have the functional properties of a live spider and supports the rationale for using a live spider. Thus, the current study has provided evidence to support the predictive validity of the IRAP in terms of predicting actual behaviour. A number of other correlations were also recorded in the current study between the two IRAPs and the BAT and explicit measures, but we will consider these in the context of the General Discussion.

Chapter 6

General Discussion

6. General Discussion

6.1 Summary of the Findings

In the current programme of research, three studies were conducted investigating spider fear and spider approach/avoidance at implicit, explicit and behavioural levels. The first study employed a rule-focused IRAP (RF-IRAP), as a modified version of the traditional measure. As noted previously, the use of this IRAP was largely exploratory and did not emerge as an important feature of the current research. Results revealed a negative bias for spiders, which was generally consistent with the previously published study by Nicholson and Barnes-Holmes (2012) on spider fear. Specifically, a negative bias was recorded for the spider-fear trial-type rather than the spider-approach trial-type on the RF-IRAP. This finding supported the view that the RF-IRAP successfully discriminated spider fear from approach/avoidance. The precision of the RF-IRAP was also highlighted by the fact that participants demonstrated positive biases for nature scenes on *both* fear and approach trial-types.

On balance, correlational analyses with the RF-IRAP failed to provide supportive evidence that fear and approach responses towards pictures of spiders predicted self-report fear on the FSQ or actual approach behaviour on the BAT. In contrast, the previous IRAP study that targeted spider-fear and approach/avoidance yielded correlations with FSQ scores and a BAT (Nicholson & Barnes-Holmes, 2012). The failure to replicate previously published findings placed a possible question mark over the utility of the RF-IRAP and thus the next study reverted to the use of the traditional procedure. In addition, spider-fear and spider approach/avoidance were targeted in a single RF-IRAP. We reasoned that in order to measure implicit fear versus approach/avoidance, it might be wise to employ two separate (traditional) IRAPs, one targeting one response domain, a Fear-IRAP (F-IRAP), and the other targeting the other domain, an Avoidance-IRAP (A-IRAP).

Study 2 recorded negative biases for spiders were recorded on both IRAPs, but only on one particular trial-type in each IRAP (i.e., the *Spider-Fear* trial-type on the F-IRAP and the *Spider-Avoid* trial-type on the A-IRAP). As such, the study clearly demonstrated, unlike Nicholson and Barnes-Holmes (2012), that spider-fear and spider approach/avoidance effects may be measured separately at an implicit level. Furthermore, correlational analyses indicated that increasing negative bias on the *Spider-Fear* and *Spider-Approach* trial-types predicted increased levels of self-reported fear on the FSQ, again supporting the separate measurement of these two response domains. On balance, however, none of the trial-types from either IRAP correlated significantly with performance on the BAT, thus failing to replicate a key finding for the predictive validity of the IRAP reported by Nicholson and Barnes-Holmes.

At this point in the research programme, therefore, we had failed twice to replicate a key finding from a previously published study from within our own laboratory (i.e., a medium to moderate, r = -.41, between the IRAP spider trial-types and number of steps taken on the BAT). As noted previously, anecdotal evidence suggested that the use of a spider moult in Studies 1 and 2, as opposed to a live specimen, might have played a role in our failure to replicate. In the third and final study, therefore, a live spider was employed in the BAT. In addition, we also corrected a potential flaw in the instructions that were delivered to the participants before each block of trials on the A-IRAP (i.e., in Study 3 the instructions specified approach and avoidance responses on the A2-IRAP rather than levels of distress).

Consistent with the results from Studies 1 and 2, negative biases for spiders were recorded on the spider-fear trial-type on the F-IRAP and the spider-avoid trial-type on the A2-IRAP. The difference between the two negative biases did not reach statistical significance (as in Study 2), but the trend was similar. Furthermore, the effect for the fear bias was significantly different from zero but this was not the case for the avoidance bias. Overall, therefore, the pattern of IRAP effects was similar across the two studies. The correlational analyses failed to indicate any predictive relationships between the spider trial-types on the F-IRAP and the FSQ or the BAT. Interestingly, the spider-approach trial-type (but not spider-avoid) on the A2-IRAP predicted performance on the BAT. This was the first study, therefore, in the current thesis which successfully replicated the key finding from the Nicholson and Barnes-Holmes (2012) study. That is, implicit *Spider-Approach* responding predicated actual approach behaviour on the BAT (with a live spider, rather than a moult). The current study thus provided evidence to support the predictive validity of the IRAP in terms of predicting actual approach behaviour in a normative population.

6.2 Specific Issues

6.2.1 Spider Moult versus a live Specimen. One of the main aims of the current research programme was to replicate a key finding from the previously published study by Nicholson and Barnes-Holmes (2012). That is, to produce a significant correlation between the IRAP and the BAT, thus supporting the predictive validity of the IRAP in terms of predicting overt behaviour. The BAT from the previously published study employed a live Chilean rose tarantula, which would be considered exotic or unusual in Ireland. For the BAT in Studies 1 and 2 of the current research programme, we used the moult of a tarantula. As described previously, a tarantula moult is the “skin” that remains after the spider has shed/moulted, and provides an exact mould of the spider with fine details including hair. We reasoned that given that the moult was almost identical to a live specimen, its functions would therefore be similar and thus would evoke fear and approach/avoidant responding. In the event, however, this assumption was not entirely up-held, given that (anecdotally) many of the participants reported that the moult was “not a real spider”, either during the actual BAT itself or during de-briefing. A possible explanation for the failure to replicate the findings published by Nicholson and Barnes-Holmes (2012) may be related to the “disease avoidant” model proposed by Matchet and Davey (1991). Aversion to the spider moult may have been an expression of disgust rather than fear itself. Participants may have felt the need to avoid the spreading of disease and contamination, thus, influencing their willingness to approach the moult.

As a result, for the final study a live common Irish house spider was employed in the BAT, and it was only in this study that a significant correlation between a spider trial-type, (i.e. *Spider-Approach)* and the BAT was recorded. Although not definitive, this supports the argument that the live spider was critical in replicating the key finding in the previously published study. Although the use of a live common house spider differs from the tarantula used in the Nicholson and Barnes-Holmes study, we reason that the use of a common live house spider was more advantageous to study approach and avoidant behaviour given that participants would normally be exposed to such spiders in their everyday life. Thus the BAT employing a common live house spider would reflect a more realistic encounter with a spider which would then in turn yield a behavioural response similar to that in an everyday setting.

6.2.2. Correlational Analyses and Pet Trial-Types. Correlational analyses from Study 3 with the F-IRAP produced a significant positive correlation between the *Pet-Pleasant* trial-type and the FSQ, indicating that increasing implicit confirmation that pets are pleasant predicted higher self-reported fear of spiders.

This finding may be seen as challenging the claim that the IRAP provides a non-relative measure of implicit response biases because responses to the contrast category (in this case puppies and kittens) also predicted, in some cases, reactions (self-report and approach responses) to spiders. On balance, it is possible that reactions to the two classes of stimuli employed in the IRAPs were not entirely functionally independent of each other. It may well be, for example, that strongly positive reactions to "cute" and "cuddly" pets is inversely correlated with positive reactions to the more exotic variety, such as spiders, snakes, and reptiles (cf. Archer, 1997). Insofar as this is the case, then the correlation between the *Pet-*

Pleasant trial-type and the FSQ obtained in Study 3 would be expected. Future research might test this post-hoc explanation. For example, it might be interesting to determine if pictures of adult dogs and cats that were rated as not particularly cute or cuddly, would fail to produce the inverse correlations with the spider stimuli recorded in the current research.

Another possible explanation, from a theoretical perspective, for the correlations found in the current research may be related to Seligman's theory of preparedness. Anecdotally, it is widely accepted in western cultures that dogs and cats are domestic animals and spiders are generally not. Although exotic spiders may be kept as pets, it is very uncommon to keep a house spider as a pet. With this in mind, it may be possible that the findings in the current research support Seligman's theory of preparedness, which, as mentioned previously, claims that evolutionary pressures selected for an adaptive predisposition to associate pre-technologically dangerous stimuli, such as spiders, with aversive consequences (Davey, 1992). It is important to note that this explanation is speculation and laboratory based research would need to be conducted to provide evidence for this possible explanation.

6.2.3. The Precision of the Final IRAPs. Based on the evidence provided in the current research programme, the IRAP has demonstrated its utility in separating spider fear from spider approach/avoidance at the implicit level. For example, in Study 1 a negative bias was recorded for the spider-fear trial-type but not for the spider approach trial-type. Given that a normative sample was employed this finding may reflect that many individuals have a mildly negative reaction to spiders but are able to approach them, for example when removing a house spider from the bath. Indeed, even in Study 2, when fear and approach/avoidance were measured using separate IRAPs, the negative fear bias was considerably stronger than the negative avoidance bias; this was replicated in Study 3 although the difference was not significant (but the *n* was lower). A further test of the precision of the IRAP would be to employ a sample of high spider fear individuals (who actively avoid or certainly do not approach spiders in the natural environment) to determine if they produce stronger negative approach/avoidance biases on the IRAP than those observed in the current study. If such a result emerged this would further bolster the validity of the IRAP as a measure of "real-world" clinically-relevant behaviours.

An unexpected level of (potential) precision for the IRAP emerged in Study 3 of the current research. Specifically, the *spider-approach* trial-type on the A-IRAP predicted performance on the BAT, but the *spider-avoidance* trial-type did not. It appears, therefore, that not only did the current research provide evidence for the functional independence of implicit fear and avoidance, it also suggests that avoidance may be functionally independent from approach. Of course, it will be important to replicate this finding in future studies, but the functional independence of these two repertoires is consistent with the fact that the direction of the approach and avoidance biases observed in Studies 2 and 3 were in opposite directions. In one sense, this finding makes intuitive sense in that most individuals in a normative sample may prefer to avoid direct contact with spiders but, as noted previously, can approach a specimen if required to do so. In any case, perhaps a future study could employ a task that involves an active avoidance component (rather than approach). For example, a task could be devised in which participants have the opportunity to push a joystick away from them to reduce the size of a picture of a spider on screen. Would performance on this task correlate with the avoidance trial-type but not the approach trial-type on the IRAP?

At this point it is worth noting that developing the IRAP into a measure that could offer high levels of precision in separating fear, avoidance, and approach could be extremely useful in helping applied researchers to determine exactly how different treatments or interventions impact upon irrational fears. For example, it may be possible to determine if different types of therapy (e.g. traditional cognitive behaviour therapy versus acceptance and commitment therapy) have similar or differential effects on implicit fear, avoidance and approach responses.

And more importantly, perhaps, if differential outcomes are revealed, would these outcomes predict the longer-term success or failure of the therapy in the natural environment?

6.3 Lessons Learned and Future Directions

In reflecting upon the research reported in the current thesis, a number of issues seem important to note. First, the use of a spider moult, rather than a live specimen, may impact upon the correlations obtained between implicit and behavioural approach measures. It is possible; for example, that the use of a moult serves to elicit so called "disgust" rather than "fear" responding in participants, and this may then impact upon how actual approach behaviour correlates with the implicit measure. The second issue concerns the use of the RF-IRAP in Study 1, which was abandoned because it failed to correlate with the BAT. However, in Study 2 we again failed to replicate the correlation previously reported by Nicolson and Barnes-Holmes (2012), and it was only when a live house spider was used, in Study 3, that a significant correlation was recorded. Perhaps, therefore, we "rejected" the RF-IRAP prematurely, and it would be wise in a future study to try this modified version again but using a live spider for the BAT. The third issue that seems worthy of note is that no "standard" physiological or other measures of fear were taken during the current research programme. In future research, therefore, it may be useful to record skin conductance responses (SCRs) and/or electromyography (EMG) reactions to the relevant stimuli as another means by which to test the predictive validity and relative precision of the IRAPs. For example, would an IRAP that targeted fear rather than approach/avoidance better predict SCR and EMG measures? Previous research in the domain of body-size bias has already demonstrated that IRAP performances may correlate with EMG (Roddy, Stewart, & Barnes-Holmes, 2011) and thus the use of such measures is certainly a direction worth pursuing in future IRAP research in the context of fear and approach/avoidance.

6.4 Conclusion

As noted in the opening paragraph of the current thesis, the IRAP appears to allow for the separate analysis of fear and avoidance at an implicit level. The primary purpose of the research reported herein was to begin a programme of studies that will subject this potential use of the IRAP to appropriate empirical inquiry. The results have provided a solid foundation for optimism in this regard, and indeed have highlighted a level of precision that was not anticipated initially – a potential separation between implicit approach and avoidance response repertoires. Furthermore, the role of the stimulus employed in the BAT may be critical in determining the precision of the IRAP in predicting actual behaviour, and provides a basis for reconsidering the use of modified versions of the standard or traditional IRAP. Overall, therefore, the current research programme provides a strong starting point to continue with a systematic analysis of fear, approach and avoidance responses at the implicit level and how they predict both self-reports and relevant real-world behaviours, including psycho-physiological reactions. In so doing, it is hoped that the development of the IRAP in this regard may allow for experimental analyses that serve to inform intervention-research in more directly applied domains.

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Appendices

Appendix A:

Participant Consent Form

In agreeing to participate in this study I understand the following:

The study is entitled "*The Implicit Relational Assessment Procedure (IRAP) as a Measure of Spider Fear and Approach/Avoidance*". It is being conducted by Aileen Leech, a postgraduate student in the Department of Psychology (AILEEN.LEECH.2012@nuim.ie), under the supervision of Prof. Dermot Barnes-Holmes (Dermot.Barnes-Holmes@nuim.ie, (01) 708-4786/4765).

The purpose of the study is to use the Implicit Relational Assessment Procedure to determine an individual's emotional reactions to specific stimuli. Thus, I will be required to complete two IRAPs, a series of self-report questionnaires and a behavioural approach task. The behavioural approach tasks may induce a small amount of discomfort as it may involve a live house spider; however, at no point will I be required to even look at the spider if I do not wish to do so.

I am aware that no outside individuals except the experimenters will have access to the data at any time nor will my name be attached to my dataset. I understand that data will be pseudo-anonymised and will be available for me to retrieve at my own discretion. The results from each participant from the study will be retained until combined, analysed, and submitted to an international journal and will be presented at relevant national and international conferences.

I understand that I have the right to withdraw from the study at any time and may withdraw my dataset at any point up until the data is published.

Any questions I might have at the conclusion of my participation in the study will be fully addressed.

If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process please contact the Secretary of the National University of Ireland Maynooth Ethics Committee at research.ethics@nuim.ie. Please be assured that your concerns will be dealt with in a sensitive manner.

Signed:

___________________Participant

___________________ Researcher

_____________ Date

Appendix B:

Fear of Spiders Questionaire FSQ

Please rate the following statements from 1 (strongly disagree) to 7 (strongly agree)

1. If I came across a spider now, I would get help from someone else to remove it.
2. Currently, I am sometimes on the lookout for spiders.
3. If I saw a spider now, I would think it will harm me.
4. I now think a lot about spiders.
5. I would be somewhat afraid to enter a room now, where I have seen a spider before.
6. I now would do anything to try to avoid a spider.
7. Currently, I sometimes think about getting bit by a spider.
8. If I encountered a spider now, I wouldn't be able to deal effectively with it.
9. If I encountered a spider now, it would take a long time to get it out of my mind.
10. If I came across a spider now, I would leave the room.
11. If I saw a spider now, I would think it will try to jump on me.
12. If I saw a spider now, I would ask someone else to kill it.
13. If I encountered a spider now, I would have images of it trying to get me.
14. If I saw a spider now I would be afraid of it.
15. If I saw a spider now, I would feel very panicky.
16. Spiders are one of my worst fears.
17. I would feel very nervous if I saw a spider now.
18. If I saw a spider now I would probably break out in a sweat and my heart would beat faster.

Seven-point Likert-scale

1 – Strongly disagree

2 – Disagree

3 – Somewhat disagree

4 – Neither agree nor disagree

5 – Somewhat agree

6 – Agree

7 – Strongly agree

Appendix C:

List of Label Stimuli used in RF-IRAP, F-IRAP, A-IRAP and A2-IRAP

Label Stimuli for RF-IRAP	
Label Stimuli-Spiders	Label Stimuli-Nature
	
	
	
	

Label Stimuli for F-IRAP, A-IRAP & A2-IRAP		
Label Stimuli - Spiders	Label Stimuli - Puppies	Label Stimuli - Kittens
		
		
		
		
		
		

Appendix D:

Behavioural Approach Task Scoring Sheet

Prompt: The following task is designed to assess how willing you are to approach a spider. I am going to ask you if you are willing to complete a number of tasks and if you are willing, I will then ask you to complete this task.

There is a spider in a container on the table in the next room. Would you be.....

Scoring

Enter the individuals BAT score below, where:

0 = completed no steps

1 = willing to open the door and look

2 = willing to enter the room

3 = willing to touch the box

4 = willing to open the box

5 = willing to touch the spider for 10 seconds