A derived relations analysis of the aetiology, maintenance and treatment of fear and anxiety in human participants

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Abstract

In the present thesis a literature review revealed that further investigation is required into cases where clinical fears and anxiety exist but cannot be traced to a specific conditioning event in a person's life. The processes of stimulus equivalence, derived relational responding and the derived transfer of functions effect in particular, were identified as having significant potential for the explanation of such "unconditioned" clinical anxiety. Whilst early studies dealt with anxiety as mere avoidance, this idea was eventually challenged. It was since proposed that avoidance only becomes problematic when it eliminates contact with appetitive events and/or puts the individual in contact with aversive events. In other words, avoidance is problematic when conflicting contingencies supporting one or both of these consequences are present. The current research aimed to generate a procedure to investigate precisely this conflicting contingency phenomenon, i.e., approach-avoidance conflicts in the laboratory through eight computer-based experiments. The procedures presented in Chapter 2 (Experiments 1, 2 and 3) outlined three experiments that attempted to generate conflicting approach contingencies through derived relations, produced response variability across participants and reaction time delays within participants and provided a means with which to analyse more ecologically valid approach-avoidance conflicts. Chapter 3 outlined two experiments (Experiments 4 and 5) which attempted to generate response disruption similar to that reported in Chapter 2, using competing approach and avoidance contingencies in place of competing approach contingencies. Response variability across, but not typically within, participants was observed during both experiments and delayed reaction times were observed during Experiment 5. The two experiments outlined in Chapter 4 (Experiments 6 and 7) produced approach-avoidance conflicts using mild

electric shocks and small amounts of money during which conflicts were generated with greater appetitive and aversive salience than those presented during previous experiments. As reported during previous chapters, response variability was observed across participants but not typically within and reaction time delays were produced during conflict trials. Self-report anxiety ratings revealed greater anxiety during conflict than non-conflict trials during Experiment 6 but not 7. The experiment presented during Chapter 5 (Experiment 8) aimed to address the issue of response consistency observed within-participants during previous experiments by varying the amount of money on offer during approach-avoidance conflicts on a trial-by-trial basis. Again, response variability across, but not within participants, was observed. Skin resistance responses did not reveal higher rates of arousal during conflict trials than non-conflict trials and the findings are covered in detail. Finally, Chapter 6 provides a summary of the entire research programme presented in this thesis, and reviews the development of a procedure to generate laboratory-based approach-avoidance conflicts by derived stimulus relations. The relationship of the current research to the relevant literature, future research suggestions and clinical implications are discussed.

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CHAPTER 1: INTRODUCTION

Avoidance has been studied extensively by behaviour analysts over the past half century. However, recent developments in the analysis of derived relational responding and related effects have allowed for considerable extensions to the traditional approach to fear and avoidance with behaviour analysis. These developments not only extend upon the basic fear conditioning literature in exciting ways but also provide research opportunities to study complex forms of fear and avoidance that may be more characteristic of the anxiety condition in the world outside of the laboratory (see Dymond & Roche, 2009). In order to appreciate these recent developments, it is first necessary to briefly review some core concepts and principles from the avoidance conditioning literature.

1.1 Avoidance Behaviour

Avoidance itself, has been characterized as negatively reinforced behaviour in which a response prevents the beginning of an aversive stimulus, and therefore, becomes more likely to occur again (Catania, 1998). In discriminated, discrete-trials or signalled avoidance, an exteroceptive stimulus (also called a warning stimulus) occurs before the aversive stimulus; a response during this stimulus prevents the onset of an aversive stimulus on that particular trial. If no response occurs at all and the aversive stimulus is presented, escaping it usually depends on the same response that is effective for avoidance.

In deletion procedures, a response inhibits the presentation of an aversive stimulus. A simple example is of swatting away a wasp before it approaches a person. Once the wasp has been swatted, it has been permanently prevented from stinging that person. In experimental terms, deletion procedures can be understood more clearly when the following laboratory preparation is considered. A rat is placed in a chamber

with a lever and a floor grid through which short shocks are administered at a schedule of one shock per minute. If the rat presses the lever before the shock is due, that shock is cancelled. In other words, in such a situation, the rat can avoid the shock completely by pressing the lever at least once a minute.

Similarly, in postponement procedures, the response only delays the onset of an aversive stimulus. Consider the case of a person putting coins in a parking meter. As long as they put coins in to reset the meter they will not violate any parking laws. However, once they cease to put in coins, the meter will eventually run out. Sidman avoidance (or continuous, free-operant avoidance) is an example of a postponement procedure. In Sidman avoidance, no warning stimulus is arranged and, typically, there is no method of escape (Sidman, 1962). Each response postpones the aversive stimulus (in most cases, a brief shock) for a fixed period called the response-shock (RS) interval. If the participant does not respond, shocks are delivered regularly according to a shock-shock (SS) interval (Catania, 1998).

Pavlovian conditioning (also known as classical or respondent conditioning) has been described as an instance of stimulus control applied to stimulus-presentation operations instead of the contingencies of consequential operations (Catania, 1998). More simply, a stimulus signals the presentation of another stimulus rather than the consequence of responding. For example, when a bell repeatedly and reliably signalled food to be put in the mouth of a hungry dog, salivation began to be elicited by the bell in addition to the food itself. From a Pavlovian perspective, therefore, avoidance may be viewed as follows. When a previously neutral stimulus is associated with an unconditioned stimulus (UCS) which elicits an unconditioned response (UR), it will eventually function as a conditioned stimulus (CS) which elicits

a conditioned response (CR) – anxiety or fear – similar to that of the UR (Wolpe & Rachman, 1960).

According to Mowrer's two-factor theory (1947), fear is acquired through classical conditioning and then maintained through operant conditioning. Initially, Pavlovian conditioning is involved as a result of the warning signal functioning as a CS due to its previous pairing with the US (when the avoidance response did not occur). At this point, the CS elicits fear which is held to mediate avoidance responses produced in its presence. Then, operant conditioning occurs when the organism emits the avoidance response in the presence of the CS. According to the two-factor theory, the avoidance response is maintained by escape from the CS and by an immediate reduction in its fear-eliciting properties. One limitation of the theory relates to the empirical observation that avoidance responding may still be acquired when responding does not terminate the warning signal but instead averts the occurrence of a shock in the future (Herrnstein, 1969). The theory predicts that the absence of a reduction in the fear eliciting properties of the warning signal should reduce or prevent the acquisition of avoidance. However, research has consistently shown that it does not (Mineka, 1979).

In recent years behaviour analysts have begun to pay more attention to instances of fear and avoidance. Behaviour analysis emphasises the manipulation of antecedent and consequence events (e.g., in the clinical setting, in token economies and so forth) and methodogically involves single subject designs, repeated measurement, observations and graphical analysis (Hayes, 1978). Examples of concepts that feature prominently include reinforcement, punishment and generalisation. Behaviour analysis has a view of "cause" as selective rather than linear and philosophically is linked to materialism and functionalism. The radical

behaviourism of B.F. Skinner's (e.g., Skinner. 1974) which has close ties to analytic philosophy (Day, 1969) has particular influence.

Specifically, behaviour analysts have increased focus on cases where there appears to be no direct history of respondent or operant conditioning. Even pioneers of classical conditioning theories had come to the view decades ago that basic conditioning models of anxiety left room for expansion in cases where it is not possible to link the acquisition and maintenance of clinical fears to a specific recognisable environmental event (e.g., Rachman, 1977, 1991). As argued by Rachman (1977):

….. there is little doubt about the facility with which fear reactions can be conditioned, at least in animals tested under laboratory constraints... however, there are grounds for doubting whether the laboratory process of fear acquisition provides an adequate foundation for theorizing about fear acquisition in non-laboratory conditions, and in human participants in or out of the laboratory...Fears which emerge in the absence of any identifiable learning experience present notable difficulties for the theory. (p. 377).

1.2 Verbal Behaviour

Other researchers have raised concerns over behaviour analysts' conceptual approach to anxiety. Over a decade ago now, Friman, Hayes & Wilson (1998) critiqued the traditional literature on anxiety as dealing with it as an insignificant subject in behaviour analysis. This is largely due to the fact that anxiety itself is a vague metaphoric term. These authors asserted that a more refined model of behaviour analysis of anxiety is critical in the understanding of fear, avoidance and emotion more generally. Specifically, the authors argued that crucial to developing this more sophisticated analysis is the observation that verbally-able humans have the

ability to derive relations between events and that neutral stimuli can gain discriminative functions indirectly without direct training and with little difficulty. Moreover, as a result of this same process, private events can easily obtain discriminative functions. In their view, anxiety disorders would appear to sometimes occur in the absence of direct learning and that when direct learning is involved it is often minimal compared with the level of responding involved. Indeed, many researchers have echoed this view that verbal processes are critical in explaining avoidance where an aversive event is very unlikely or only experienced indirectly (Dougher, Augustson, Markham, Greenway, & Wulfert 1994; Dymond, Roche, Forsyth, Whelan, & Rhoden 2007; Dymond, Roche, Forsyth, Whelan, & Rhoden, 2008; Forsyth, Eifert, & Barrios, 2006; Hayes, 2004), thereby responding to what are widely considered to be the damning criticisms of Marks (1981, 1987) and Rachman (1977, 1991).

Over the years, the explanation of behaviour which occurs in the absence of overt reinforcement, or where reinforcement occurs minimally, has challenged behavioural accounts of complex behaviour. In spite of this, behaviour analysis has, for the most part, taken pride in its exclusive approach to understanding behaviour in terms of both direct-acting contingencies and changes induced through systematic and subtle manipulations of the formal features of stimuli and their evoked responses. From this tradition a vast array of, although not all, behaviour patterns were shown to be open to a direct-acting behaviour analysis. Nevertheless, certain aspects of complex behaviour have proven difficult to address with a direct, contingency-based account- most notably, the novel and generative features of human language and cognition. Thus, while traditional behavioural approaches have added a great deal to our knowledge, they are also restricted in their applications. Indeed, some have

argued that the direct contingency approach has reached its limits (Barnes-Holmes, Hayes, & Roche, 2001; Hayes & Barnes, 1997; Hayes, Fox, Gifford, Wilson, Barnes-Holmes, & Healy 2001; Rachman, 1977, 1991).

Researchers outside of the field of behaviour analysis have turned to mentalistic mediated learning accounts to pursue satisfactory explanations (e.g., Field, 2006; Lovibond, 2006; Mineka & Zinbarg, 2006). The term mentalism refers to the explanation of behaviour by appealing to independent variables that are assumed from the behaviour explained (Hayes & Brownstein, 1986; Skinner, 1969). In relation to anxiety specifically, Beck and Emery (1985) assert that anxiety disorders are the result of an ‘‘upset in the cognitive system’’ (p. 86). As an example, the most frequently occurring features of generalized anxiety disorder (GAD) are outlined and described, some of which involve upsets in the cognitive system (e.g., problems while concentrating, fear of losing control, etc.). The occurrence of these features is then offered as evidence of the causal status of cognitive deficiency. However, Friman et al (1998), point out that if such cognitive upsets are a core aspect of GAD, applying them to explain it is mentalistic because the upsets themselves are not accurately explained.

In addition to the traditional models of fear acquisition discussed, contemporary associative learning theorists have adapted to incorporate instances of fear in the absence of a direct conditioning event (Field, 2006; Lovibond, 2006; Mineka & Zinbarg, 2006). For example, Field (2006) acknowledged that processes other than direct classical conditioning alone may have a role in the acquisition of a conditioned fear response. These processes, referred to as “pathways to fear” (p.867) interestingly incorporate observational learning (vicarious) and “verbal information” (instructions). Mineka and Zinbarg (2006) also view other factors as having influence

over the CS-US relationship during conditioning, including how controllable and predictable stressful events are perceived, the properties of the CS itself (i.e., how relevant its fear is, how long before a stressful event is due to occur and so on) and vulnerabilities such as disposition and social and cultural learning history. In relation to the present thesis, it worth noting that accounts such as Field (2006) do not provide a functional definition of what is specifically referred to as "verbal" or "language". According to Field's account, verbal information is assumed to have effect through associative learning and Mineka and Zinbarg's (2006) account also relies largely on basic conditioning processes.

According to Lovibond's (2006) expectancy-based account, the warning signal will elicit fear through pairings with the US because participants have gained prepositional knowledge that the US will be presented after the warning signal. Operant responses are learned based on the expectancy of the relationship between the avoidance response and the absence of the US. Finally, participants produce an avoidance response in the presence of the warning signal by evaluating the expectancies for the consequences of producing responses and not producing responses (see also, Lovibond & Shanks, 2002; Lovibond, Saunders, Weidemann & Mitchell, 2008). Of course, such an approach is considered mentalistic within the tradition of behaviour analysis, but its appeal largely arises from the absence of superior alternative non-mentalistic accounts.

However, Lovbond's (2006) account has received some support (Declercq & De Houwer, 2008, 2009a, 2009b, 2011; Lovibond, Mitchell, Minard, Brady, & Menzies, 2009; Lovibond, Saunders, Weidemann, & Mitchell, 2008; Ly & Roelofs, 2009). For example, Declercq and De Houwer (2009b) used a sensory pre-conditioning procedure examining indirect avoidance where participants were initially

presented with with two neutral stimuli, A and B, which were paired with two other neutral stimuli, K and L. Next, A and B were followed by either a red 'X' or a red 'Y' (i.e., US for A and B, respectively. These presentations were followed by the loss of money. During avoidance learning, participants were trained to make a particular avoidance response in the presence of A and to make a different avoidance response in the presence of B, with each resulting in the omission of the respective US. Finally, participants were presented with K and L stimuli, control stimuli, were invited to produce either of the avoidance responses learned previously and also asked to rate the likelihood of the presentation of the US. According to the authors, sensory pre-conditioning had an influence over the selection of avoidance responses produced during the presentation of warning signals that were not directly paired with aversive events during the procedure. It was reported that participants produced avoidance responses and formed expectancies as a result of the integration of knowledge relating to the US after presentations of K and L stimuli and the avoidance of the US by producing the applicable avoidance responses. For further consideration of the expectancy based account and the role of verbal behaviour see the General Discussion.

Still, others have turned to neuroscience for answers to questions regarding apparently unconditioned fear (e.g., Delgado, Olsson & Phelps, 2006; Olsson & Phelps, 2004). Such studies aim to examine whether brain processes will illuminate the unconditioned avoidance and fear phenomenon. However, this is also considered mentalistic in behaviour analysis if the final purpose of analysis is not to identify manipulable stimuli whose relationship to measurable response units is understood. If such measures are used only as dependent variables and not as explanatory concepts

then they can form an important feature of an experimental analysis of behaviour (e.g., Cochrane, Barnes-Holmes, Barnes-Holmes, Stewart, & Luciano, 2007).

The swift emergence and expansion of a literature base on human language and cognition that may help in the analysis of avoidance and anxiety has largely been motivated by the behavioural phenomenon of stimulus equivalence (Sidman 1971; 1994), which can be described in brief as follows. Presume that reinforcement is provided for selection of an arbitrary stimulus B in the presence of another stimulus A, and for selection of C in the presence of B, respectively. The majority of verbally-able humans will now readily reverse these explicitly reinforced stimulus relations without any further training. In other words, they will now select A given B, and B given C. These selections are in accordance with derived mutually entailed stimulus relations, referred to in the stimulus equivalence literature as symmetry. In addition, participants will now also choose C given A and A given C, in accordance with derived combinatorially entailed stimulus relations, in the absence of additional training. Such derived stimulus relations are referred to as transitive relations. When a participant can match a stimulus to itself (reflexivity), as well as respond to symmetrical and transitive relations, the stimuli are said to participate in an equivalence class (Sidman, 1994) or a relational frame of coordination under the rubric of Relational Frame Theory or RFT (Barnes, 1994; Hayes, Barnes-Holmes, & Roche, 2001). One of the most interesting aspects of derived equivalence relations is that the test outcomes are not readily predicted from the traditional behavioural concept of conditional discrimination. Specifically, with regard to A and C stimuli, neither has a direct history of differential reinforcement for selection with respect to each other, and as a result neither stimulus should control selection of the other.

1.3 The Derived Transformation of Functions

One particularly interesting aspect of stimulus equivalence is the transformation of functions effect. Specifically, when a single behavioural function is established for one of the stimuli in an equivalence relation, the function often transfers to the other class members in the absence of further direct training. For example, if stimulus C in the prior example is associated with an aversive stimulus such as electric shock, then B and A may also evoke similar responses. In place of using the specific term transfer to describe patterns of responding which indicate a transferring of functions through symmetry and equivalence relations alone, RFT (Hayes, et al, 2001) researchers apply the term transformation of stimulus functions as a generic substitute for transfer specifically and for derived relational responding in general. Because the transformation of function is a defining aspect of arbitrarily applicable responding and equivalence responding may indeed itself be considered to be a transformation of function, the word *transformation*, in place of *transfer*, will be used throughout the current thesis in accordance with other work conducted in this area (Barnes-Holmes, et al., 2001; Dymond & Barnes, 1995, 1996; Dymond & Rehfeldt, 2000; Dymond et al., 2007, 2008; Hayes et al. , 2001; Roche & Barnes, 1997, Steele & Hayes, 1991).

Equivalence relations are one form of many different types of derived relational responding. As highlighted by Dymond & Rehfeldt (2000), RFT acknowledges the distinction between transformation of functions as a general concept and specific forms of transformations, such as mutual entailment and combinatorial entailment. The generic term mutual entailment refers to relations that have intrinsic bidirectionality (e.g., if A is larger than B, then B is smaller than A) and combinatorial entailment refers to a combination of

relational responses (e.g., if relations are trained between X and Y and between Y and Z, in a specific context, these relations will combine to produce relations between X and Z and also between Z and X). As a result of the derived transformation of functions effect, if a particular stimulus in a mutual or combinatorially entailed relation is presented with a psychological function, the other stimuli in that relation may then acquire this function in accordance with the form of the derived relation established. Research conducted on multiple stimulus relations (and not just equivalence alone) has demonstrated that human participants can produce responses in accordance with contextually controlled relations such as Same, Opposite, Different, More than/Less than, and Before/After (e.g., Dougher, Hamilton, Fink & Harrington, 2007; Dymond & Barnes, 1995, 1996; ; Dymond et al. , 2007; Dymond et al., 2008; O'Hora, Roche, Barnes-Holmes, & Smeets, 2002; Roche, Barnes-Holmes, Smeets, Barnes-Holmes, & McGeady, 2000; Steele & Hayes, 1991).

The study of multiple stimulus relations with humans initially involves reinforcing particular contextual cues through the use of nonarbitrary stimuli related along formal dimensions, and subsequently using such cues to produce arbitrarily applicable relations among stimuli that do not have formal relations (see Barnes-Holmes, Hayes, Dymond & O'Hora, 2001). For example, an early demonstration of the using this approach in the study of multiple relations was conducted by Steele and Hayes (1991) and involved initially training participants to relate same stimuli (e.g., a short line with another short line) in the presence of a particular contextual cue and opposite stimuli (e.g., a short line with a long line) in the presence of a different contextual cue. Following

this, participants were trained with a series of conditional discriminations with each of the contextual cues involved during the initial training. In the interest of clarity, the two training trials presented during the study will be outlined as opposite/A1 [B1-*B2*] and opposite/A1 [C1-*C2*] in which reinforcement was provided for the selection of the italicised comparisons. When participants were presented with a test trial such as opposite/B2 [C1–C2] they had the option of responding in accordance with the equivalence relation or relational frame of co-ordination (i.e., sameness) by choosing C2 because C2 was selected with B2 in the presence the A1 sample. Conversely, should the opposite stimulus have functioned as a conditional discriminative stimulus (i.e., participants ignoring the sample stimulus) participants would select C2 because producing this response had been previously reinforced in the presence of the opposite cue. Overall, participants tended to select C1 indicating that the relational frame of opposition had been established.

The transformation of function effect has also been confirmed with a vast assortment of operant and respondent behaviour (e.g., Barnes & Keenan, 1993; Dougher, Augustson, Markham, Greenway, & Wulfert, 1994; Dougher, Perkins, Greenway, Koons, & Chiasson, 2002; Dymond et al. , 2007, Dymond et al., 2008; Hayes, Kohlenberg, & Hayes, 1991; Roche & Barnes, 1997; Roche et al., 2000; de Rose, McIlvane, Dube, Galpin, & Stoddard, 1988).

For example, Experiment 1 of two studies by Dougher et al. (1994) demonstrated differences in skin conductivity after two four-member equivalence relations (A1-B1-C1-D1 and A2-B2-C2-D2) were established and a mild electric shock to each participant's forearm was classically conditioned as an unconditional stimulus that followed presentations of the B1 stimulus. The B2 stimulus was

presented in the absence of the mild electric shock. The conditioned emotional responses of participants to both B stimuli were measured as SCRs (Skin Conductance Responses). Participants were then presented with all remaining members of both equivalence classes to test for the derived transfer of eliciting functions. It was found that five of the eight participants produced evidence of classical conditioning and a derived transfer of respondent eliciting functions. More recently, Experiment 2 of a study by Rodriguez Valverde, Luciano & Barnes-Holmes (2009) used a similar but modified procedure to Dougher et al. (1994) in which test trials for the derived transfer of functions were presented in a random order. Of the 30 participants, over 80% who produced differential conditioning also produced the predicted derived transfer of conditioning. The authors acknowledged that the extent to which their findings were of clinical relevance were arguable, especially when it is considered that from a behaviour analytic perspective, the key feature of the analysis of anxiety and related disorders is avoidance responding (e.g., Hayes, 1976).

Understanding the transformation of function effect may explain why people display avoidance in situations where there appears to be no history of direct conditioning for such behaviour (Barlow, 2002). For example, in one particularly well-cited study, Augustson and Dougher (1997) trained 8 participants in the development of two four-member equivalence classes. Next, an avoidance response was established for a discriminative stimulus that was, at the same time, a member of one of the equivalence classes. The avoidance response was demonstrated to transfer to the other members of that particular equivalence class, yet not to members of the other equivalence class. The above transfer of function across equivalence classes was used by the authors to aid in the partial explanation of the aetiologies of avoidance behaviours that would seem to have materialised without any overt history of

reinforcement for avoidance in the natural environment (see also Dougher et al., 1994; Friman, et al., 1998; Roche, et al., 2000).

An example of how this could occur outside of the laboratory was provided by Blackledge (2003). Consider a person who has had enough direct or indirect experience with snakes to have a fear of them but never encountered them in the woods. This person had previously enjoyed spending time in the woods and found their time there to be quite pleasant. However, after being told that wooded areas often contain snakes, a relationship has been established between snakes and woods which results in the transfer of the fear functions of the snake to the wooded area. Although at one time the woods were an enjoyable and pleasant place for recreation, the individual may now be afraid of them as result of their participation in the same equivalence class as snakes and the events and experiences that also participate in this class. The person in this example may wish to avoided wooded areas as a result of this transfer of functions.

An implication of this phenomenon for therapy was suggested by Roche, Kanter, Brown, Dymond and Fogarty (2008). This study found that derived extinction effects might indeed be more effective than direct extinction for targeted and related stimuli. It was suggested by the authors that rather than targeting the most likely discriminative stimulus for avoidance, it may be more effective for treatment to target the remote members of verbal relations which contain the relevant aversive stimuli. This would support the use of talk therapy techniques that seem to rely on processes involved in derived extinction, but the authors acknowledge that it is novel to suggest for therapy to target indirectly related stimuli in place of conditioned stimuli for avoidance because exposure techniques have been shown to be effective for many psychological problems (Barlow, 2002). However, it may help to address cases of a

resurgence of the problem in the future as the derived functions resurge and emerge again for the conditioned stimuli. No evidence of this latter process exists at the time of writing but it is a tenable conjecture given what is known about the derived transfer of functions effect. Dymond and Roche (2009) pointed out that knowledge gained from the procedures and findings from basic research may be shown to be very important in the understanding of the treatment implications of therapy techniques that focus on the derived extinction of avoidance functions (e.g., Lovibond, Davis & O'Flaherty, 2000; Wilson & Hayes, 1996).

The study by Dymond et al. (2007) employed a novel Relational Completion Procedure (RCP) to establish Same and Opposite relations among arbitrary, nonword stimuli. Participants were exposed to a relational pre-training procedure to establish the contextual functions of Same and Opposite for two arbitrary cues. These cues were then employed in the relational training tasks which consisted of matching stimuli in various ways in the presence of both cues. Using the RCP procedure, the following stimulus relations were trained; Same-A1-B1, Same-A1-C1, Opposite-A1-B2, Opposite-A1-C2. This led to the derived relations; Same B1-C1, Same B2-C2, Opposite B1-C2 and Opposite B2-C1 during testing. During a subsequent avoidance conditioning phase, responding to the stimulus B1 signalled the cancellation of a scheduled aversive image and sound. Participants were then shown to spontaneously respond in the same way (i.e., avoidance) to C1 but not to C2 (due to C1 being the same as B1), whereas C2 is the opposite (see also Dymond et al., 2007; 2008). Thus, these and the findings of the studies reported above support the idea that avoidance patterns can emerge in the absence of a direct history of conditioned avoidance or respondent conditioning using a stimulus as a discriminative or conditioned stimulus, respectively.

1.4 Approach-Avoidance Conflicts

These foregoing studies no doubt capture some complex features of real world anxiety (i.e., it is not always directly conditioned) that improve upon accounts offered by earlier purely Skinnerian accounts. However, they too fall short of capturing the multitude of stimulus functions present for anxiety provoking stimuli in the real world. More specifically, while early research characterised phobic anxiety as mere avoidance, this idea was eventually challenged and conflicting opinions were asserted (see Costello, 1970, 1971; Powell & Lumia, 1971; Wolpe, 1971). The main issue from the debate was summarised by Costello (1970) as follows:

> …the types of conditioned avoidance responses that have been regarded by behaviour therapists as providing adequate experimental analogues of phobic behaviour are dissimilar to such behaviours because (a) avoidance responses are adequate (coping) behaviours, and, (b) they do not involve conflict with approach behaviours, and such a conflict appears to be characteristic of clinical phobias (Costello, 1970, p. 252).

Others have also made the case that in real world anxiety approach and avoidance contingencies work in parallel and even in combination with each other (Hayes, 1976; Forsyth, Eifert and Barrios, 2006). In other words, many people in therapy for acute or chronic anxiety are in conflict situations – not just avoidance situations. More specifically, fear learning and avoidance across the anxiety disorders in general are associated with costs in terms of competing approach contingencies (cf. Hayes, 1976). These same contingencies are shown in the reasons clients suffering from anxiety seek treatment (e.g., “My fear of driving is driving my husband crazy,” or “I can’t drive to work because I might panic”). This dual-component view of anxiety (Hayes, 1976) proposes that fear learning becomes problematic only when it

(a) eliminates contact with reinforcing events, and/or (b) places the individual in direct contact with aversive events. Hayes (1976) argued that the avoidance that follows is troublesome when competing contingencies supporting (a) and/or (b) are present. For example, a pedestrian who hears the horn blare of an approaching car and jumps out of the way would likely experience fear, some conditioning, and obviously displays avoidance behaviour. However, this person would not be deemed phobic, partly because there are few or no approach contingencies (Hayes, 1976). In reality, approach (running into the street) would be enormously punishing. This situation is analogous to avoidance learning paradigms where a signal is followed by the emission of an avoidance response or else the onset of an aversive stimulus. Such behaviours are not phobic because there is no competing approach factor in the situation. If there are no approach contingencies in the situation (i.e., approach-avoidance conflict), then fear learning is just fear learning and avoidance is simply avoidance, not an anxiety disorder (Forsyth, et al. 2006).

As noted by Forsyth et al. (2006), the implications of the dual component model have yet to be fully examined in humans. However, Hayes, Lattal and Myerson (1979) generated data in support of this model in an animal experiment in which 20 male hooded rats were pre-trained to nose-poke at a high rate for food and were given passive avoidance training to a criterion set at 1 of 2 body weights. They were then examined under the pre-training arrangements. It was found that the rate of responding at 70% body weight was higher during passive avoidance. Furthermore, during assessment those rats at 70% free feeding weight showed stronger passive avoidance than the 90% free feeding weight group.

Of course, modern behaviour analysts are not the first to note the relevance of approach-avoidance conflicts to our understanding of fear conditioning. Specifically,

Lewin (1935) suggested that a fear-approach conflict could be understood as the uncertainty that surrounds a goal that embodies both positive and negative characteristics. An increase in the proximity to this goal, in terms of either time or space, will promote both the approach and avoidance tendencies of that particular person (Miller, 1959).

One of the most widely used experimental models in animal studies of anxiety is the elevated plus maze, which consists of a plus-shaped maze elevated from the floor with two open and two closed arms. In this model, the motivation of the animal (usually a rat or mouse) to investigate the new environment is opposed to its desire to remain in a safe place. With rats, this conflict typically results in the following behaviour: greater exploration of the closed arms and less exploration of the open arms. This model is derived from the research conducted by Montgomery (1955) which examined the relationship between fear and exploratory drives in rats. This research, in turn, was based on the idea that environmental novelty evokes both fear and curiosity and thereby creates a typical approach-avoidance conflict situation. Using a Y-maze, Montgomery concluded that the intensity of this conflict induced following the rat's exposure to an open alley was greater than when it was exposed to enclosed alleys. This model has since been validated as a behavioural, physiological and pharmacological model of anxiety. (Lister, 1987; Pellow, Chopin, File & Briley, 1985; Salum, Morato, Roque-de-Silva, 2000).

Of course, the responding produced to an approach-avoidance conflict for humans may not be the same as the responding produced by nonhumans or nonverbally-able humans. Features of verbal behaviour such as stimulus equivalence and the derived transformation of functions may present humans with a different experience of an approach-avoidance conflict than a non-human. Although it has been

suggested that the absence of demonstrations of nonhumans producing derived stimulus relations is the result of inaccurate procedural issues (see McIlvane, Serna, Dube and Stromer, 2000), the generation of stimulus equivalence itself has still not been shown unequivocally by non-verbal humans or nonhumans (Barnes, McCullagh & Keenan, 1990; Hayes, 1989; Dugdale & Lowe, 2000; Lionello-DeNolf & Urcuioli, 2002). Indeed, it has been argued that a person's naming skills are required and may suffice to meet testing criteria for stimulus equivalence and therefore, non-verbal humans do not possess such an ability and consequently will not show evidence of equivalence (Horne & Lowe, 1996). Horne and Lowe even assert that should nonhumans be shown to explicitly demonstrate equivalence then the results would have little benefit to the study of human behaviour as the procedures involved would be more contingency-shaped than verbally-governed (p.224). The RFT (Hayes et al, 2001) position is that continuity between humans and nonhumans in terms of derived relational responding may or may not occur but this is not a primary focus for the theory. Research in this area embraces humans, nonhumans and computational models (Barnes & Hampson, 1997) in order to further advance the understanding of human language and cognition (Dymond, Roche and Barnes-Holmes, 2003).

Researchers have also attempted to study approach-avoidance conflicts in humans. For instance, Approach-avoidance conflicts have also been studied in terms of what is known as regulatory focus. According to regulatory focus theory (Higgins, 1997, Higgins, Roney, Crowe, and Hymes, 1994; Shah, Higgins and Friedman, 1998), people have two distinct and independent directions: prevention and promotion. A focus of prevention prioritises safety, security and so on. From this point of view, there is strategic importance on approaching non-losses and avoiding loses. Promotion focus has emphasis on hopes, accomplishments and so on. From this

perspective, there is a strategic concern on approaching positives and avoiding absences of positives. In other words, regulatory focus differentiates between goals that fall into the promotion focus bracket and prevention bracket. The theory predicts that momentary situations can induce either a promotion focus or prevention focus on a temporary basis.

Also, two particularly well-cited studies examined the approach-avoidance conflicts encountered by parachute jumpers (Epstein & Fenz, 1962; Fenz & Epstein, 1967). The first study (Epstein & Fenz, 1962) reported both beginners' (n=33) and experienced jumpers' (n=33) self-report levels of approach (i.e., looking forward to the jump and wanting to proceed) and avoidance (i.e., fear, not wanting to jump, wishing to cancel the jump). For the novice jumpers, the greatest fear was experienced just before the signal to jump (i.e., the Sd for both approach and avoidance) was given and experienced jumpers reported their fear was at the highest level the morning of the jump. The second study (Fenz & Epstein, 1967) examined the heart rate, respiration rate and skin conductance of ten experienced and ten inexperienced jumpers. The authors stated that the beginners showed increasing fear until the plane reached its maximum altitude and then their fear began to decrease. The experienced jumpers also reported of increasing fear until take-off but a decrease thereafter. Studies of this nature tend to focus specifically on the generated approach-avoidance conflict itself, rather than the associated anxiety.

According to Augustson and Dougher (1997) and Dymond et al. (2007, 2008), it is the robustness of an avoidance response repertoire, rather than fear per se, that more typically defines anxiety or phobia. That is, phobic individuals generally opt for treatment when their avoidance of feared situations interferes with their existing approach contingencies and not because of the intensity or frequency of fear itself.

While in general agreement with this formulation, the current research aims to extend this view by empirically examining the potentially important role of approach contingencies in the development of distress associated with avoidance. Specifically, it may be the concurrent control of both approach and avoidance behaviours that best characterises the clinical condition known as "anxiety". If this idea turns out to have merit following empirical investigation, this finding will have implications for how therapists approach the treatment of anxiety. More specifically, they may do well to consider both approach contingencies and avoidance contingencies in the lives of their clients, as well as how these contingencies may be conflicting. As suggested above, some of a given client's distress may be explicable more by the approach-avoidance conflicts than by states of anxiety or patterns of avoidance, per se. Of course, the therapist has no reliable way of knowing the impact of approach–avoidance conflicts on the client without conducting a functional analysis. For many clients, a functional analysis may show a preponderance of approach behaviours in the repertoire that are associated with the very avoidance behaviours that brought them in to therapy (e.g., "I want to go to work even though I am afraid to leave the house").

Given the foregoing suggestion, the problem for many anxious clients may be conceived as a problem of competing goals and of being unable to attain a sufficient number of reinforcers in order to feel satisfied with life. Some behaviour therapists have begun to approach this problem of contingency conflict in terms of goal-setting strategies and an attempt to identify and prioritise personal goals and values. For instance, according to ACT (Hayes, Stroshal & Wilson, 1999), many therapeutic clients have difficulty identifying their personal goals and values. With the help of the therapist the client can identify their personal goals and the avoidance repertoires that

militate against reaching them. As an example, consider a man who highly values having a wife but also has a social phobia, which is characterised by avoiding social situations involving women. Clearly, for such an individual, the approach contingencies presented by potential female companions in social situations are in conflict with avoidance in the same social situation. If this situation persists and leads to distress and eventual contact with a therapist, the individual may be described as stuck in a trap of emotional control and avoidance (Hayes & Strosahl, 2004). According to Hayes and Strosahl, this causes the client to gradually lose the "guidance mechanism" that leads to more fulfilling behaviour. When this occurs their behaviour becomes increasingly focussed on controlling and eliminating unpleasant private events. ACT aims to recover the individual's sense of life direction that is consistent with their values and then to help them instigate behaviour, which is also consistent with their values. Therefore, when in such a situation, the client may appear trapped in an approach-avoidance conflict in which the negative reinforcement by avoiding is offset by the loss of positive reinforcement for approaching, leaving the individual dissatisfied and even distressed.

In ACT terms, the pattern of avoidance behaviour shown by the man in the scenario above is in conflict with his values. However, the method of treatment ACT or any other approach chooses to employ in treating this problem is not relevant here. The important point is that understanding such dilemmas in terms of conflicting approach and avoidance contingencies may provide a more complete picture of the controlling conditions for chronic and acute anxiety. In addition, a further core interest of the current thesis is to examine whether or not approach-avoidance conflicts can be generated in accordance with derived stimulus relations.

1.5 The Present Study

No experimental research to date has directly identified the core behavioural processes at work when avoidance contingencies are thought to be in conflict with reinforcement contingencies (i.e., verbally stated goals) from the perspective of a therapist. Such work is difficult to conduct in vivo in the therapy setting. Nevertheless, the process of elucidating one's goals and values might be considered conceptually for present purposes as a process of identifying competing approach and avoidance contingencies. Furthermore, the current research will speak to those interested in identifying core processes at work in the development and treatment of anxiety using behavioural methods. For instance, as noted above, the ACT literature suggests that being "stuck" can be characterised as being in the trap of emotional control and avoidance (Hayes & Strosahl, 2004). However, while all forms of psychological "stuckness" may be characterised in this way, it does not necessarily follow that all approach-avoidance conflicts lead to a form of psychological "stuckness" or non-responding. While such questions regarding the relationship between process and outcome are important conceptual questions, they may also be addressed empirically. The current thesis will attempt to address precisely such questions.

The present thesis reports on an empirical research programme into approach-avoidance contingencies in humans conducted within a derived relations paradigm. The basic phenomenon of interest is described in the following scenario. Imagine that an approach function is established for an arbitrary stimulus A, and an avoidance function is established for an arbitrary stimulus C. Next, an equivalence class containing the A and C stimuli is trained and tested using a linear training protocol (i.e., A is matched with B and B is matched with C). Given the wealth of knowledge now centred on the phenomenon of the derived transfer of functions, it is uncertain

how human participants would respond when presented with the B stimulus in this preparation. They may produce an avoidance response based on the functions of C, or an approach response based on the functions of A. Alternatively, they may fail to respond due to the intense behavioural competition. It has yet to be seen, therefore, if a verbally able organism would respond any differently in these conflict situations than animals typically do. Furthermore, it is not yet known if these approach-avoidance conflicts can be generated via derived relational responding processes. A series of experiments reported in the following chapters aimed to both answer these questions and further questions arose in attempting to empirically demonstrate approach-avoidance conflicts under laboratory conditions.

CHAPTER TWO: EXPERIMENTS 1, 2 AND 3: APPROACH-APPROACH CONFLICTS 1, 2 AND 3

The first three experiments aimed to establish a procedure that would generate laboratory-based conflicts of competing approach contingencies. These three computer-based experiments investigated response disruption in terms of changes in reaction time and alterations in response patterns under the conditions of a derived approach-approach conflict. Specifically, Experiment 1 (Approach-Approach Conflicts 1) consisted of four phases. Phase 1 involved establishing four arbitrary nonsense stimuli (B1, C1, B2 and C2) as discriminative stimuli for clicking four separate coloured boxes presented on a computer screen. Phases 2 and 3 involved training and testing two three-member equivalence classes (A1-B1-C1 and A2-B2-C2), respectively, using a one-to-many training protocol (i.e., A-B, A-C). Both classes contained two discriminative stimuli established during Phase 1 (i.e., 'B' and 'C' stimuli). During Phase 4, 'A' stimuli (which were expected to acquire the derived response functions of both 'B' and 'C' stimuli) were presented along with the response options associated with 'B' and 'C' stimuli. This in effect constituted an approach-approach conflict insofar as two incompatible approach responses were expected given 'A' stimuli. Participants' responses (i.e., which coloured box was clicked and reaction times) were observed and analysed. Experiment 2 (Approach-Approach Conflicts 2) further investigated similar derived approach-approach conflicts by providing participants with a history of more than one box-click per trial across phases and the inclusion of an opt-out response. These modifications allowed participants to respond to both derived functions of the conflict or to not emit a response on a particular trial. The probe phase of Experiment 3 (Approach-Approach Conflicts 3) consisted of the simultaneous presentation of two stimuli per trial with

the option of an opt-out response. Presenting both stimuli onscreen simultaneously resulted in a more salient conflict and it was not known how participants would respond. Each experiment attempted to establish a point of equilibrium between derived response functions that would generate response disruption.

During this early stage of the research programme, competing approach contingencies were established and presented to examine how to produce a procedure to investigate contingencies in conflict for future study. It is important to note that none of the first three experiments actually placed approach and avoidance contingencies in direct competition with each other. Nevertheless, behavioural competition was established by the presentation of stimuli that required participants to respond in accordance with one set of contingencies or another (i.e., approach-approach). While later experiments will examine approach-avoidance contingency conflicts more explicitly, these initial experiments served the purpose of exploring the utility of potential procedures to that end and to assess the minimal conditions for contingency conflicts. That is, it is important to know if such conflicts can be generated with even simple procedures using arbitrary stimuli devoid of salient emotional (i.e., aversive or appetitive) response functions. Once a procedure could be shown to reliably demonstrate the conflict of approach contingencies, a similar procedure should, in theory at least, allow for the presentation of approach-avoidance conflicts with the inclusion of appetitive and aversive functions are of very similar or equal value. This would then allow for a more functional investigation of conflicting contingencies with equal positive and negative consequences (i.e., approach-avoidance conflicts) and may provide valuable insights into the study of anxiety from a derived relations perspective due to the role of verbal behaviour as discussed during the previous chapter.

Experiment 1 (Approach-Approach Conflicts 1)

2.1.1 Method

2.1.1.1 Participants

Nineteen unpaid volunteers were recruited from personal contacts. All participants were first presented with Phase 1 (Operant Conditioning) and proceeded to a series of subsequent phases (see General Experimental Sequence below) on condition that their performances met pre-determined criteria for each phase. Of the 19 participants, 10 (6 males and 4 females) met the pre-set criteria for each phase of the experiment and were presented with the final critical test phase. Only the data for the 10 participants who completed the study will be discussed here. The 10 participants' ages ranged from 18 to 22 years, and the mean age was 20 years.

2.1.1.2 Ethical Considerations

Participants provided their informed consent to take part (see Appendix 1a). Each participant was informed that their participation would be confidential and that they were free to withdraw from the experiment at any time. An extinction phase was included at the end of the experiment to reduce the possibility of any post-experimental effects. All participants were fully debriefed after the experiment.

2.1.1.3 Apparatus and Stimuli

The experiment was conducted in a research laboratory in the Department of Psychology at the National University of Ireland, Maynooth. The small experimental room (1.5 x 1.5 meters) contained a personal computer. A computer program written in Microsoft Visual Basic ® 6.0 controlled all stimulus presentations on a personal computer. This software also controlled the recording of reaction times.

Four stimuli in Arial font (size 48) were used as discriminative stimuli during Phase 1 conditioning. Six nonsense syllables were utilized as sample and comparison stimuli during the training and testing stages of the experiment (i.e., CUG, VEK, JOM, ROG, MAU and LER). In the interest of clarity, these will be labelled using the alphanumerics A1, B1, C1, A2, B2 and C2 (see Appendix 7).

2.1.1.4 General experimental sequence

Each participant signed a consent form prior to commencing the experiment (Appendix 1a). This form also assured the participants that they were free to withdraw from the study at any time without penalty. All participants were exposed individually to the experimental procedures, and times were arranged so that participants did not meet each other in the vicinity of the laboratory. Upon entering the laboratory participants were seated comfortably at a desk facing a computer screen. All instructions were presented on the screen at the start of each phase.

2.1.2.1 Phase l: Operant conditioning

Before beginning this phase the following instructions appeared on the screen:

> Thank you for agreeing to participate. This research involves examining human learning on a series of simple problem-solving tasks. IT IS VERY IMPORTANT YOU PAY ATTENTION TO THE SCREEN AT ALL TIMES. When you are ready to start please click ‘Begin’ below.

When the participant clicked the onscreen ‘Begin’ button directly below the instructions in the centre of the screen, the next set of instructions appeared:

> In a moment some words and coloured boxes will appear on this screen. Your task is to look at the word at the top of the screen and choose one of the boxes at the bottom of the screen by "clicking on it" using the computer mouse and cursor. During this stage the computer will provide you with feedback on your

performance. You should try to get as many correct answers as possible.

If you have any questions please ask them now.

When you are ready to begin please click 'Continue' below.

Clicking the 'Continue' button resulted in the presentation of the first trial of this phase. A discriminative stimulus in black Arial font (size 48) was presented on its own in the top-middle of the screen for 1.5 seconds and then four coloured boxes (red, green, purple, yellow) appeared underneath. The four coloured boxes were positioned on the screen in a quasi-random order across trials. Each box was 8cm in length and 5cm wide and the positions of the boxes were randomized across trials during training and testing (Figure 1). Clicking any of the four boxes caused all the boxes and the nonsense syllable to disappear. If the correct box was clicked the word "Correct" appeared immediately in green font (size 48) in the centre of the screen for 1.5 seconds. If an incorrect box was clicked the word "Wrong" appeared immediately in red font (size 48) in the centre of the screen for 1.5 seconds. When the feedback disappeared, the computer screen remained blank for an inter-trial interval of 500ms after which the next trial was presented.

In the presence of the B1 stimulus clicking the red box was reinforced. In the presence of the C1 stimulus clicking the green box was reinforced. In the presence of the B2 stimulus clicking the purple box was reinforced and in the presence of the C2 stimulus clicking the yellow box was reinforced.

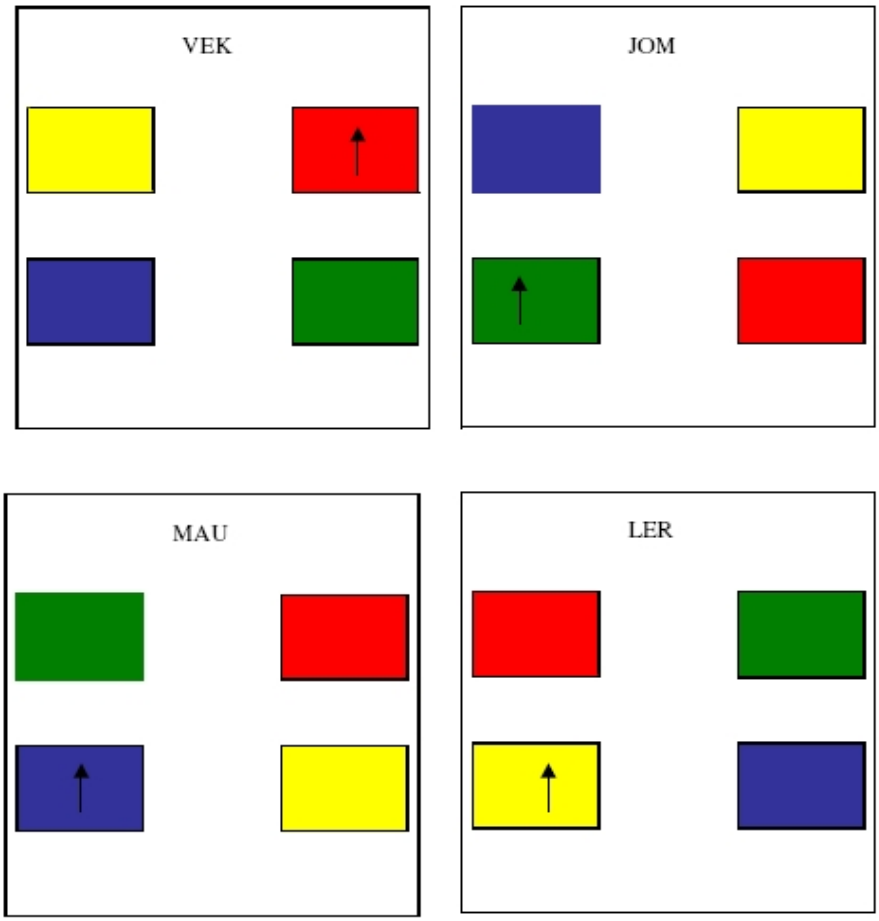


Figure 1. *The four tasks presented during Phase 1.* VEK= B1 Stimulus, JOM= C1 Stimulus, MAU= B2 Stimulus and LER= C2 Stimulus. The ↑ symbol refers to the reinforced response for each trial.

This phase consisted of a block of the four tasks presented five times in quasi-random order until 20 trials were administered. If the participant produced less than 19/20 correct responses they were immediately presented with instructions for this phase again and were re-exposed to this phase. If the participant did not meet the correct response criterion on the fourth exposure the experiment ended. However, if a total correct response rate of 19/20 or 20/20 was produced within four exposures to this phase, the participant was presented with instructions for the next phase.

2.2.2.2 Phase 2: Equivalence training

Before beginning this phase the following instructions appeared on the screen:

In a moment some words will appear on this screen. Your task is to look at the word at the top of the screen and choose one of the two words at the bottom of the screen by "clicking on it" using the computer mouse and cursor. During this stage the computer will provide you with feedback on your performance. You should try to get as many correct answers as possible.

If you have any questions please ask them now.

When you are ready to begin please click 'Continue' below.

Clicking the mouse on the onscreen 'Continue' button led to the first trial of this phase. A stimulus in black coloured Arial font (size 48) was presented on its own in the top centre of the screen for 1.5 seconds and then two comparison stimuli (also in black Arial font and size 48) appeared in the bottom left and right of the screen. Stimuli remained on the screen until the participant clicked on one of the comparisons. If the correct comparison stimulus was clicked, the word "Correct" appeared immediately in green font (size 48) in the centre of the screen for 1.5 seconds. If the incorrect comparison stimulus was clicked the word "Wrong" appeared immediately in red font (size 48) in the centre of the screen for 1.5 seconds. When the feedback disappeared, the computer screen remained blank for an inter-trial interval of 500ms, after which the next trial was presented. The position of both comparison stimuli was randomized across trials, in order to allow the correct comparison to appear with equal probability in the bottom left side or bottom right side of the screen.

Two three-member equivalence relations were trained during this phase. Training was conducted in a blocked one-to-many fashion. That is, A-B relations were trained to criterion before A-C relations. Specifically, in the presence of A1

selection of B1 was reinforced and selection of B2 was punished. Similarly, when A2 was presented, B2 was reinforced and B1 was punished. In the same way the A-C relations were trained. In effect the trained relations were: A1-B1, A1-C1, A2-B2 and A2-C2.

A-B training (which will also be referred to as Phase 2a) consisted of two tasks: A1-B1 [B2] and A2-B2 [B1], where alphanumerics in square brackets indicate incorrect choices (see Figure 2). These tasks were presented once each in a block of two trials in a quasi-random order that was in turn presented 10 times (i.e., 20 trials in total). Thus, no one task was presented more than two times in succession. If the participant failed to make 19 correct responses out of 20 trials they were exposed to the training block again, up to a maximum of three times. If the participant failed to make 19 correct responses out of 20 within four exposures to the block of 20 trials, this signalled the end of their participation and they were asked to report to the experimenter. If the participant responded correctly to 19 trials out of 20 they proceeded to the next stage of the experiment. When participants passed this A-B training they were then presented with A-C training (Phase 2b). The tasks A1-C1 [C2] and A2-C2 [C1] were presented in an identical fashion. Following Phase 2b, tasks from Phase 2c (Mixed Training) were presented. Phase 2c consisted of the each task presented during Phases 2a and 2b in a quasi-random order for 30 trials with a maximum of four exposures. When participants passed Phase 2c they were presented with instructions for Phase 3 (Equivalence Test).

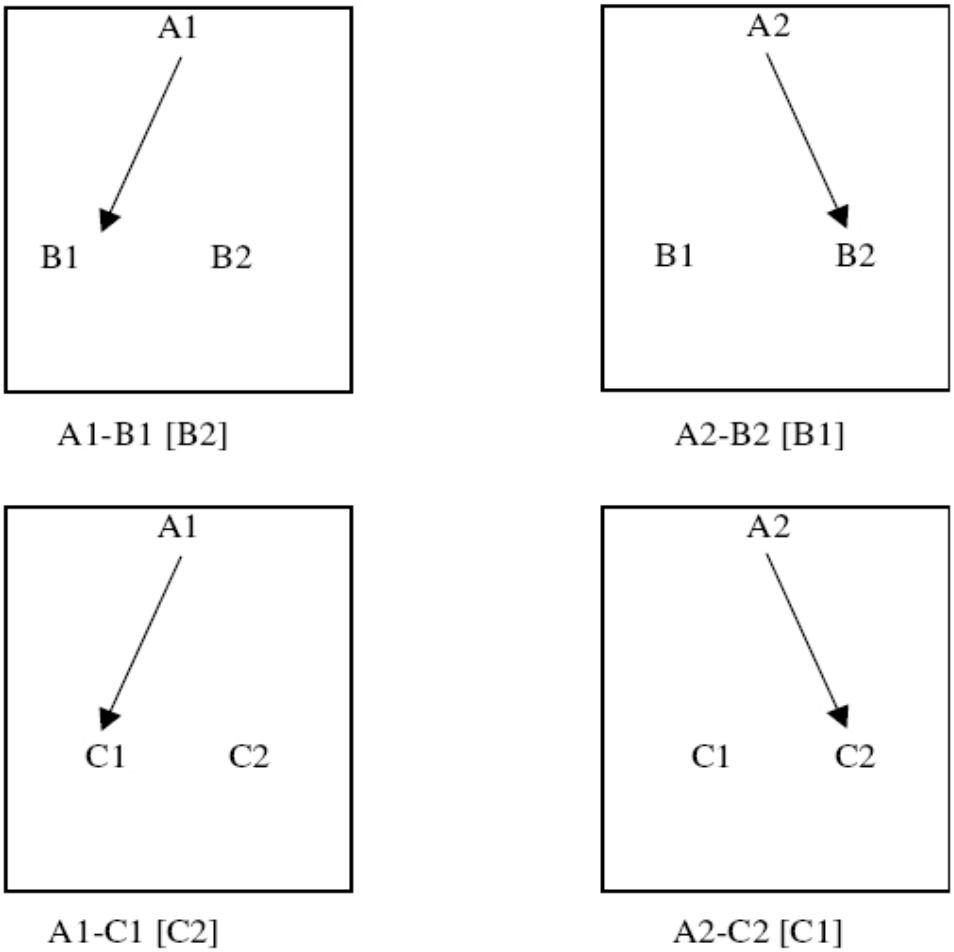


Figure 2. ***The four tasks presented during Phase 2.*** **A-B training tasks were presented during Phase 2a and A-C training tasks were presented during Phase 2b. Both A-B and A-C training tasks were presented on interspersed trials during Phase 2c. Alphanumerics in square brackets indicate incorrect responses for each task.**

2.2.2.3 Phase 3: Equivalence test

Before beginning this phase the following instructions appeared on the screen: In a moment some words will appear on this screen. Your task is to look at the word at the top of the screen and choose one of the two words at the bottom of the screen by "clicking on it" using the computer mouse and cursor. During this stage the computer WILL NOT PROVIDE YOU WITH FEEDBACK on your performance. You should try to get as many correct answers as possible. It might help you to use what you learned in the previous phase to make correct choices in this phase.

This phase has no particular time limit but will continue until you are making

consistently correct choices.

If you have any questions please ask them now.

When you are ready to begin please click ‘Continue’ below.

Clicking the mouse on the onscreen ‘Continue’ button led to the first trial of this phase. The equivalence test probed for the formation of the derived relations; B1-C1, B2-C2, C1-B1 and C2-B2 (see Figure 3 below). Each task was presented once in a block of four trials in a quasi-random order. The block was cycled five times. In effect, no one task was presented more than two times in succession. The blocks of 20 were presented until the participant responded correctly on all of the trials within a particular block (up to a maximum of four blocks).

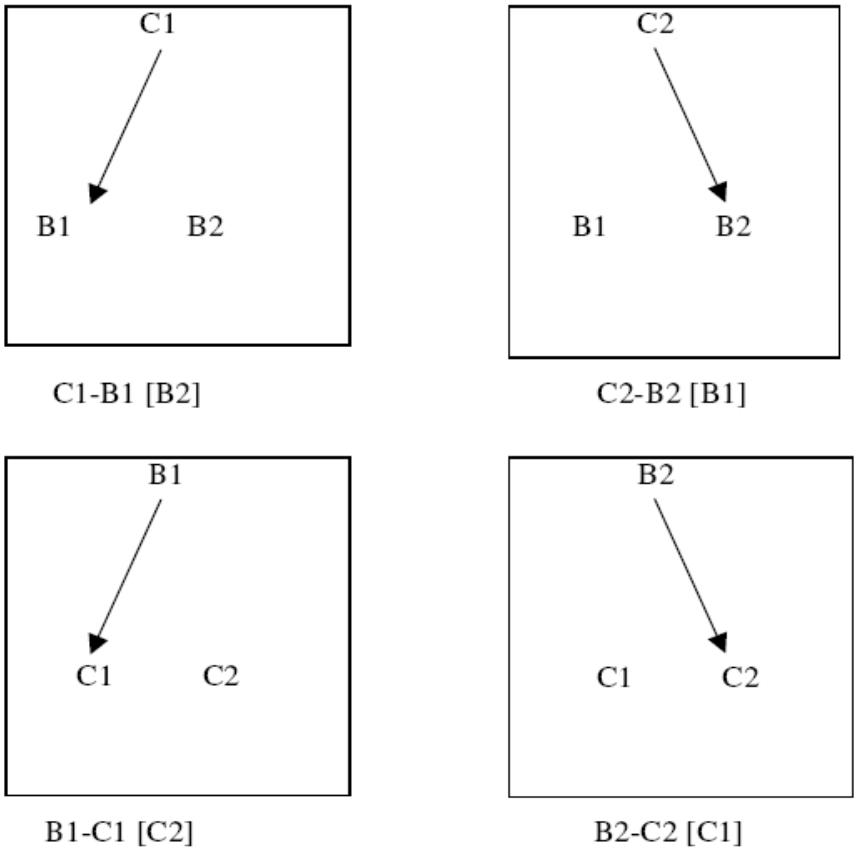


Figure 3. ***The four tasks presented during Phase 3.*** **The relations tested for were C1-B1 [B2], C2-B2 [B1], B1-C1 [C2] and B2-C2 [C1]. Alphanumerics in square brackets indicate incorrect responses for each task**.

All feedback (i.e. "Correct" or "Wrong") was omitted during the relational testing tasks; responses were followed by the regular inter-trial interval only. Participants were required to respond correctly on 20 trials out of 20 (100% correct) to complete testing. If they failed to make 20 correct responses in a block of 20 the block of testing was automatically re-administered with a re-exposure to the instructions. If a participant failed to respond correctly 20 times out of 20 trials within four consecutive testing blocks, the experiment was terminated. When participants responded correctly 20 times in a block, they were presented with the instructions for the next stage of the experiment.

The equivalence test probed for the formation of the predicted equivalence relations A-B1-C1 and A2-B2-C2. It should be noted that the established equivalence relations contained pairs of stimuli with different response functions. Specifically, the A1-B1-C1 class contained stimuli that were discriminative for clicking on a red box (i.e., the B1 Stimulus) and a green box (i.e., the C1 Stimulus). Similarly, the B2 and C2 stimuli controlled purple and yellow box clicking, respectively.

2.2.2.4 Phase 4: Critical test phase: Conflicting contingencies test

Before beginning this phase the following instructions appeared on the screen:

In a moment some words and coloured boxes will appear on this screen. Your task is to look at the word at the top of the screen and choose one of the boxes at the bottom of the screen by "clicking on it" using the computer mouse and cursor. During this stage the computer WILL NOT PROVIDE YOU WITH FEEDBACK on your performance. You should try to get as many correct answers as possible.

It might help you to use what you learned in the previous phase to make correct choices in this phase. It is important that you continue to concentrate

and try to get as many correct answers as possible.

If you have any questions please ask them now.

When you are ready to begin please click ‘Continue’.

The purpose of this phase was to record the responses made by participants in the presence of the ‘A’ stimuli. It was predicted that the ‘A’ stimuli should exhibit the response functions of all class members. Given the class structures trained and tested during Phases 2 and 3, the A1 stimulus should produce both red and green box-clicks, due to its derived relation to both B1 and C1. In contrast, the A2 stimulus should produce both purple and yellow box-clicks, due to its derived relation to both B2 and C2. However, only one response per trial was permitted during this phase. That is, from the participants’ point of view, one response was acknowledged by the computer software by the removal of all stimuli from the screen and the presentation of the next trial. If participants attempted to produce more than one response on a given trial, the computer program nevertheless recorded both responses and their respective response times. Immediately upon a first response on a given trial, the screen cleared and the next trial was presented after an inter-trial interval of 1.5s.

Clicking the mouse on the onscreen ‘Continue’ button during the presentation of the instructions led to the first trial of this phase. This phase was similar to Phase 1, with the exception that ‘A’ stimuli were presented in place of ‘B’ and ‘C’ stimuli. A1 and A2 stimuli were both presented once in a block of two trials in a quasi-random order (i.e., once each), which was in turn presented ten times (i.e., 20 trials in total). In addition, no feedback followed any responses made during this phase. The font size, colour, positions of stimuli and coloured boxes and inter-trial interval were all identical to Phase 1.

At the end of the test, the participant was presented with the following instructions:

This is the end of the experiment. Please contact the experimenter.

Thank you for your participation.

2.1.3 Results and Discussion

Of the nineteen volunteers, ten (i.e., Participants 5, 8, 9, 10, 13, 14, 16, 17, 18 and 19) successfully completed Phases 1, 2, 3 and 4. Only the results of these ten participants are discussed here.

2.1.3.1 Phase 1: Operant conditioning

All 19 participants initially recruited were presented with this phase. Participant 14 produced a total correct response rate of 20/20 during their first exposure. Participants 9, 10 and 19 produced correct response rates of 19/20, 20/20 and 19/20, respectively, on their second exposures to this phase. Participants 8, 16 and 18 reached the criterion after three training blocks and each produced a correct response rate of 20/20 on their third exposure. Three of the participants (Participants 5, 13, 17) were exposed to this phase four times in order to reach the criterion and produced correct response rates of 20/20, 20/20 and 19/20, respectively. Participants 2, 3, 7, 12 and 15 did not produce correct response rates that met the criterion during the four presentations of this phase and were terminated from the experiment.

2.1.3.2 Phases 2 and 3: Equivalence training and testing

Participants 8, 10, 17 and 19 required only one exposure to Phases 2a, 2b, 2c and 3 by producing correct response rates which met the pre-set criterion and permitted them to progress to the next stage of the experiment (see Table 1). Participants 9 and 18 required two exposures to Phase 2a, but only one exposure to each of the other phases to proceed with the experiment. Participant 5 required two exposures to Phase 2a and three exposures to Phase 3 but only one exposure to each other phase. Participant 13 required two exposures to Phases 2b and 3. Participant 14 required one exposure to each phase, with the exception of Phase 3. Participant 16

produced a similar pattern where two exposures to Phase 2c were required but only one exposure to each other phase.

Table 1: Each participant's correct response rate produced during Phases 2 and 3.

P. No.	Phase 2a	Phase 2b	Phase 2c	Phase 3
05	17/20 19/20	20/20	20/20	16/20 16/20 20/20
08	20/20	19/20	20/20	20/20
09	18/20 20/20	19/20	20/20	20/20
10	20/20	20/20	19/20	20/20
13	19/20	18/20 20/20	20/20	17/20 20/20
14	20/20	20/20	20/20	18/20 20/20
16	20/20	19/20	18/20 20/20	20/20
17	20/20	20/20	20/20	20/20
18	18/20 20/20	20/20	20/20	20/20
19	20/20	20/20	20/20	20/20

2.1.3.3 Phase 4: Conflicting contingencies test

Response patterns produced during Phase 4 were divided into two main categories: relationally consistent and relationally inconsistent. Relationally consistent responding was defined as responding in accordance with the functions established during Phase 1. In order for a participant's response pattern to be deemed consistent, they were required to produce a minimum of 18/20 responses of this type in a single block of Phase 4 testing. There were two relationally consistent responses possible for each of the Phase 4 probe trials. Consistent responding was in turn categorised as varying or stable. Stable responding refers to a pattern of identical and relationally

consistent responses across trials (i.e., pressing the same colour response key across all presentations of a given stimulus). Varying responding refers to a pattern of responding in which both of the two relationally consistent responses were observed in the presence of a given stimulus across trials. Relationally inconsistent responding was defined as responding that was incongruent with the functions established during Phase 1. This pattern of responding was also categorised as varying or stable.

Due to the functions established during Phase 1 (B1 was discriminative for a red box-click and C1 for a green box-click) and the derived transfer of functions effect, participants were expected to click either the red or green box in the presence of A1 during Phase 4. Similarly, given the response functions established during Phase 1 (i.e., B2 was discriminative for a purple box-click and C2 for a yellow box-click), participants were expected to click either the purple or yellow boxes in the presence of A2.

Table 2: Each participant's responses produced during Phase 4. The column titles, *Red*, *Green*, *Purple and Yellow,* refer to the corresponding coloured box clicked by participants in the presence of the 'A' stimuli.

P. No.	A1 Probes				A2 Probes			
	Red	Green	Purple	Yellow	Red	Green	Purple	Yellow
05	9			1		1		9
08			10		2			8
09	10							10
10	1	9			1		6	3
13			10			10		
14			10			10		
16	5	5					3	7
17	10							10
18		10						10
19			10				1	9

Table 3: Each participant's response pattern produced during Phase 4. The "*" indicates the response pattern produced by each participant. *Rel. Con. Stable* refers to a relationally consistent and stable response pattern. *Rel. Con. Varied* refers to a relationally consistent and varied response pattern. *Rel. Incon.* refers to a relationally inconsistent response pattern.

P.No	Response Pattern		
	Rel. Con. Stable	Rel. Con. Varied	Rel. Incon.
05	*		
08			*
09	*		
10		*	
13			*
14			*
16		*	
17	*		
18	*		
19			*

Participants 5, 9, 17 and 18 produced a relationally consistent and stable responding pattern (see Table 3). Participant 5 responded inconsistently on the first two trials (i.e., green box-click in the presence of A2 and yellow box-click in the presence of A1) but then settled into a relationally consistent and stable pattern of responding. This participant clicked the red box in the presence of A1 across the remaining trials and clicked the yellow box in the presence of A2 on the remaining trials. Participants 9 and 17 both clicked the red box in the presence of A1 on ten trials and clicked the yellow box in the presence of A2 on ten trials. Participant 18 clicked the green box in the presence of A1 on ten trials and clicked the yellow box in the presence of A2 on ten trials (see Table 2).

Participants 10 and 16 produced relationally consistent and varying response patterns. More specifically, Participant 10 clicked the red box in the presence of A1 on one trial and clicked the green box in the presence of A1 on nine trials. This

participant also clicked the red box on one trial in the presence of A2 (i.e., inconsistent with Phase 1) but, in addition, clicked the purple box six times and the yellow box three times (i.e., relationally consistent with Phase 1). Similarly, Participant 16 clicked the red and green boxes five times each in the presence of A1 and clicked the purple box three times and the yellow box seven times in the presence of A2.

Participants 8, 13, 14 and 19 responded in a pattern that was inconsistent with Phase 1 training but was nevertheless stable. For example, in the presence of A1, Participant 8 clicked the purple box on the ten trials in which A1 was presented. This participant also clicked the yellow box in the presence of A2 (in accordance with Phase 1 training) on eight trials and clicked the red box twice in the presence of A2 (inconsistent). Participants 13 and 14 both produced relationally inconsistent and stable response patterns by clicking the purple box in the presence of A1 on ten trials and clicking the green box in the presence of A2 on ten trials during this phase. Participant 19 produced a relationally inconsistent and stable responding pattern by clicking the purple box in the presence of A1 on ten trials. This participant clicked the purple box once in the presence of A2 and clicked the yellow box nine times in the presence of A2.

In summary, six of the ten participants responded to the contingency conflict probes in a relationally consistent (i.e., predicted) manner. Of those six participants, two varied their responses between the predicted options, while four participants responded in a predicted and stable pattern (see Table 3). Four participants produced a response pattern that was relationally inconsistent (i.e., not predicted) with Phase 1 training. Thus, the conflicting contingencies created by the presentation of the 'A'

stimuli appear to have produced a large amount of variance in responding both across and within participants.

2.1.4 Response latencies

Participants' mean reaction times (RTs) in seconds were also measured during Phases 1 and 4 (see Table 4) in order to allow for a comparison between RTs to directly established (i.e., B and C stimuli) and derived (i.e., A stimuli) discriminative stimuli. For the purposes of RT analysis, any response times that exceeded ten seconds were truncated to ten seconds. This was done to decrease the range of the data set and to increase the normality of the data set for statistical analyses.

Table 4: Each participant's mean reaction times during Phase 1 and Phase 4. SD indicates standard deviation.

P. No	Phase 1	Phase 4
05	4.14	3.76
08	5.48	4.43
09	7.18	3.74
10	3.94	3.57
13	3.53	2.96
14	4.06	3.67
16	2.93	5.90
17	5.87	5.31
18	4.39	3.75
19	5.55	4.60
Mean	4.71	4.17
SD	1.28	0.89

Table 4 shows that nine participants (5, 8, 9, 10, 13, 14, 17, 18 and 19) produced a higher mean RT during Phase 1 than Phase 4. That is, for these participants, there is no evidence of behavioural disruption by the conflicting

contingency probes as measured by response times. Participant 16 was the only participant to produce a larger mean RT during Phase 4 compared to Phase 1.

A Wilcoxon Signed Rank Test was conducted to compare the mean reaction times to all probes combined during Phase 1 and Phase 4 for all participants. The results indicated that there was no significant difference ($z=-1.886$, $p>.05$).

It should be noted that mean response times may not be the best index of response disruption, as it is likely this form of disruption only occurs on early trials during any phase. Thus, the effect of disruption may be masked in the mean statistic due to the effect of practice on reaction times across trials. Response times on first responses only were therefore examined across Phases 1 and 4 (Table 5).

Table 5: Each participant's reaction times during the first trial of Phases 1 and 4. SD indicates standard deviation.

P. No	Phase 1	Phase 4
05	5.47	7.55
08	10.65	16.06
09	10.89	43.55
10	5.66	9.02
13	3.47	5.33
14	9.34	7.64
16	2.53	7.45
17	35.22	116.97
18	6.14	14.70
19	13.50	22.75
Mean	10.29	25.10
SD	9.43	34.24

It can be seen from Table 5 above that nine participants (Participants 5, 8, 9, 10, 13, 16, 17, 18 and 19) produced larger RTs during the first probe of Phase 4 than was observed during the first probe of Phase 1. Participant 14 was the only participant to produce a larger RT during Phase 1 than Phase 4. Thus, first response RTs may indicate some behavioural disruption during the critical probe phase that is not

apparent across the entire block of Phase 4 probes. Reaction times may have reduced across probe trials due to increases in fluency over time. It emerged that RTs on first trials were indeed larger than mean RTs on the remaining trials.

A Wilcoxon Signed Ranks Test was conducted to examine whether or not the RT difference between the first trials of Phases 1 and 4 was statistically significant. This revealed that the difference was statistically significant ($z=1.992$, $p<.05$). This finding suggests that the effect of the conflicting contingency presented in Phase 4 was to reduce response fluency during that phase, compared to Phase 1.

The current data suggest that the conflicting contingency probes did produce somewhat delayed responding on early trials for most participants, as well as response pattern disruption for several participants (i.e., consistent and varied) and also across participants. It is important to understand that participants had passed an equivalence test immediately prior to exposure to Phase 4, so deterioration of derived relational responding and the transfer of functions is an unlikely explanation for the current effects. More specifically, it might be argued that for some participants the transfer of functions did not occur as predicted, and so consistent responding was unlikely. If this is the case, then variations in response patterns across participants were not caused by the conflicting contingencies. Ideally, an equivalence test would have been re-administered following the probe phase in order to determine the veracity of this criticism. This will be borne in mind for future studies. Nevertheless, these preliminary data do suggest the effects of conflicting contingencies and display some of the features which might be expected in an ecologically valid model of approach-avoidance conflict (i.e., response delays and variation).

2.2 Experiment 2: Approach-Approach Conflicts 2

Experiment 1 (Approach-Approach Conflicts 1) appeared to demonstrate relatively balanced competing stimulus control across participants during the probes for approach-approach conflicts. Specifically, six of the ten participants responded to the conflicting contingencies probes in a relationally consistent (i.e., predicted) pattern. Of those six participants, two varied their responses between the two predicted options while four participants responded in a predicted and stable pattern. The remaining four participants produced a response pattern that was relationally inconsistent (i.e., not predicted) with Phase 1 conditioning. Therefore, the conflicting contingencies created by the presentation of the 'A' stimuli appear to have produced a large amount of variance in responding both across and within participants. In effect, the experiment appears to have established both prediction and control over response variation.

When examined across all responses during Phase 4, RTs did not suggest any behavioural disruption or variation during Phase 4 compared to Phase 1. However, when only the first responses produced were considered, a very noticeable pattern of long RTs was observable compared to Phase 1 (indicating another form of response disruption). Moreover, this difference in RTs was statistically significant.

It is entirely possible, however, that response pattern variations and RT sizes may have been a function of the Phase 4 test format, as much as the conflicting contingencies themselves. That is, during Experiment 1, Phases, 1, 2 and 3, participants had no history of being presented with two stimuli, or a stimulus with multiple stimulus functions on any given trial. Then, during Phase 4, stimuli were presented that should control two responses. Given a history of producing only one response per trial, and given the fact that two responses were not permitted on any one

trial by the computer program, response variation may have occurred due to a lack of behavioural control over "correct" responding (i.e., two responses per trial) rather than conflicting contingencies, per se. Similarly, because producing one of the four trained responses during Phase 1 was the only way to terminate a trial in Phase 4, a participant who may have wished to abstain from responding could not do so. In effect, participants were constrained in their responding to the extent that a wider range of response variation, including non-responding and multiple responses were not observed.

Experiment 2 aimed to remedy these potential weaknesses of Experiment 1 by a) providing participants with a history of multiple responses on individual trials before Phase 4; b) allowing participants to make multiple responses during Phase 4; and c) providing participants with the option of not responding at all during conditioning and probe phases.

In particular, an additional phase was added to Phase 1 (i.e., Phase 1b). This phase established two box-click responses in the presence of two novel stimuli, neither of which participated in either of the equivalence classes established during Phases 2 and 3. This provided participants with a history of producing multiple responses on individual trials. Furthermore, an onscreen button containing the phrase "None of these are Correct" was presented simultaneously with the four coloured boxes onscreen during Phases 1, 1b and 4, thereby creating a history of familiarity with this button throughout the experiment.

2.2.1 Method

2.2.1.1 Participants

Fourteen unpaid volunteers were recruited from personal contacts. All participants were presented with the first operant conditioning phase and proceeded to a series of subsequent phases (see General Experimental Sequence below) on condition that their performances met predetermined criteria for each phase. Of the fourteen volunteers, ten (seven males and three females) met the pre-set criterion for each phase of the experiment and were presented with the final critical test phase. Only the data of the ten participants who completed the study are discussed here. Participants' ages ranged from 18 to 26 years, and the mean age was 21 years.

2.2.1.2 Ethical Considerations

The strict ethical considerations applied to Experiment 1 were also applied to Experiment 2 (see Appendix 1a).

2.2.1.3 Apparatus and Stimuli

All apparatus and stimuli were identical to those used in Experiment 1 with the following exceptions. Six stimuli in Arial font (size 48) were used as discriminative stimuli during Phase 1 conditioning. Eight nonsense syllables were utilized as sample and comparisons during the training and testing stages of the experiment (i.e., JOM, ROG, DAK, TAS, ROM, MAU, CUG and VEK). In the interest of clarity, these will be labelled using the alphanumerics; A1, B1, C1, A2, B2, C2, A3 and A4.

2.1.1.4 General experimental sequence

2.1.2.1 Phase la: Operant conditioning Part 1

Before beginning this phase the following instructions appeared on the screen:

In a moment some words and coloured boxes will appear on this screen. Your task is to look at the word at the top of the screen and choose one of the boxes at the bottom of the screen by "clicking on it" using the computer mouse and cursor. During this stage the computer will provide you with feedback on your performance. You should try to get as many correct answers as possible.

If you have any questions please ask them now.

When you are ready to begin please click Continue below.

Once the onscreen 'Continue' button was clicked the first trial of this phase was presented. A discriminative stimulus in black Arial font (size 48) was presented on its own in the top-middle of the screen for 1.5 seconds and then four coloured boxes (red, green, purple, yellow) appeared underneath (see Figure 4 below). A grey coloured box appeared in the bottom left of the screen with the caption "None of these are correct". Each box was 8cm in length and 5cm wide and the positions of the boxes were randomized across trials during training and testing. A smaller grey coloured button (with the caption 'Confirm') appeared in the bottom right of the screen. Clicking any of the four boxes had to be followed by clicking 'Confirm' to proceed with the experiment. A coloured box-click followed by a 'Confirm' box-click caused all the boxes and the nonsense syllable to disappear. If the correct box was clicked the word 'Correct' appeared immediately in green font (size 48) in the centre of the screen for 1.5 seconds. If the incorrect box was clicked the word 'Wrong' appeared immediately in red font (size 48) in the centre of the screen for 1.5 seconds. When the feedback disappeared, the computer screen remained blank for an inter-trial interval of 500ms, after which the next trial was presented.

This phase consisted of the same conditioning tasks used in Experiment 1 and are summarised as follows. In the presence of the B1 stimulus, clicking the red box was reinforced. Similarly, in the presence of the C1 stimulus, clicking the green box was reinforced. Furthermore, in the presence of the B2 stimulus, clicking the purple box was reinforced and in the presence of the C2 stimulus clicking the yellow box was reinforced. The criterion employed during this phase was identical to the criterion used during Phase 1 of Experiment 1.

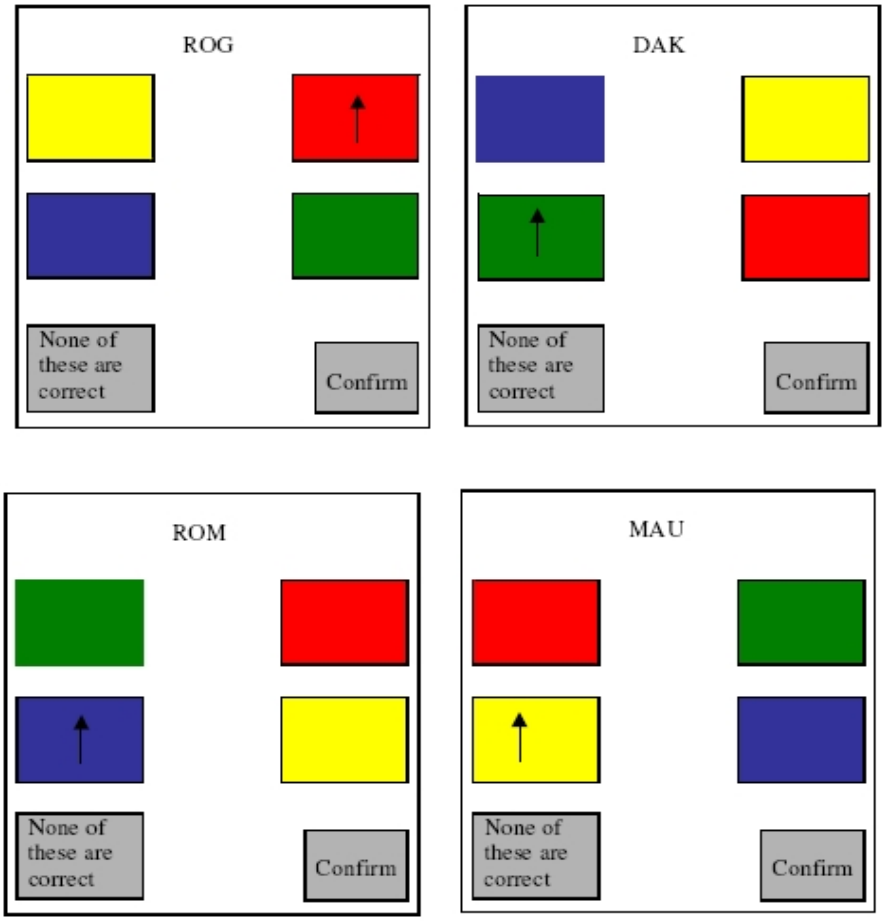


Figure 4. *The four tasks presented during Phase 1.* ROG= B1 Stimulus, DAK= C1 Stimulus, ROM= B2 Stimulus and MAU= C2 Stimulus. The ↑ symbol refers to the reinforced response for each trial.

Phase 1b: Operant Conditioning Part 2.

Before beginning this phase the following instructions appeared on the screen: In a moment some words and coloured boxes will appear on this screen. Your task is to look at the word at the top of the screen and choose between the

boxes at the bottom of the screen by "clicking" on them using the computer mouse and cursor. During this stage the computer will provide you with feedback on your performance. You should try to get as many correct answers as possible.

It is important to note that during this stage you need to "click" two boxes in order to score a correct answer.

If you have any questions please ask them now.

When you are ready to begin please click 'Continue' below.

Clicking the onscreen 'Continue' button below the instructions resulted in the presentation of the first trial of this phase. This stage was identical to Phase 1 except two different discriminative stimuli (A3 and A4) were presented separately on interspersed trials. Each required two separate boxes to be clicked in order to produce a correct response. More specifically, in the presence of the A3 stimulus clicking both the red and yellow coloured boxes on the screen was reinforced (Figure 5). Also, in the presence of the A4 stimulus, clicking the green and purple boxes was reinforced.

Although consistent responding was reinforced during Phase 1a: Operant Conditioning Part 1, during Phase 1b: Operant Conditioning Part 2, A3 and A4 stimuli were only trained to criterion but not tested during Phase 4 (see below). The A3 and A4 stimuli were trained with multiple responses to create a history of multiple responses for each stimulus. For instance, in the presence of A3 one or two responses could be produced instead of only one. This was not intended to be overtraining but testing was unnecessary as training was to criterion. Should these stimuli have been tested, this would have created additional confusion for the participant. It may well have resulted in participants expecting to feel required to respond twice during each stimulus presentation during probe phases which is not how responding occurs in the

real world. The number of trials and criterion were identical to those used in Phase 1a above.

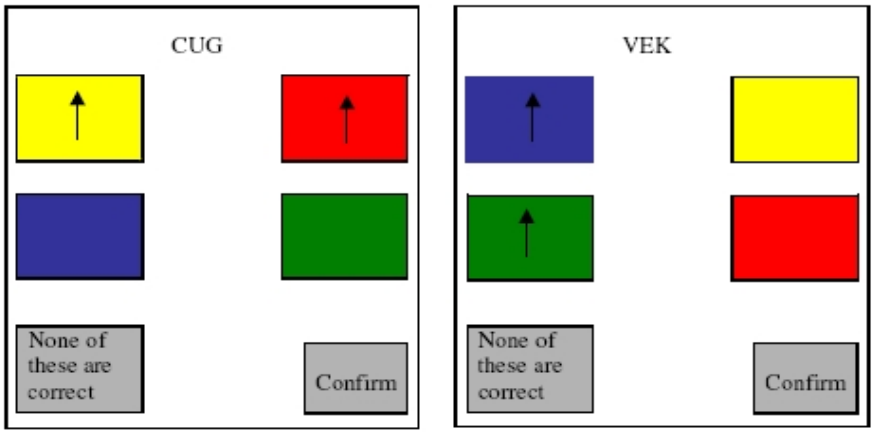


Figure 5. *The two tasks presented during Phase 1b.* CUG=A3 Stimulus and VEK= A4 Stimulus. The↑ symbol refers to the reinforced response for each trial.

2.2.2.3 Phase 1c: Operant conditioning Part 3 (Mixed)

Before beginning this phase the following instructions appeared on the screen:

In a moment some words and coloured boxes will appear on this screen. Your task is to look at the word at the top of the screen and choose between the boxes at the bottom of the screen using the computer mouse and cursor.

During this stage the computer will provide you with feedback on your performance. You should try to get as many correct answers as possible.

It is important to note that during this stage some tasks require a single click for a correct answer and others require two clicks.

If you have any questions please ask them now.

When you are ready to begin please click Continue below.

Clicking 'Continue' resulted in the presentation of the first trial of Phase 1c. This phase consisted of tasks from Phase 1a and Phase 1b and was divided into three parts. Tasks were presented in the following order: four trials from Phase 1a (Mixed Training Part One), four trials from Phase 1b (Mixed Training Part Two) and four

additional trials from Phase 1a (Mixed Training Part Three). Four correct responses in a block of four were required to pass Phase 1c Mixed Training Part 1. Three correct responses in a block of three were required to pass Phase 1c Mixed Training Part 2. Finally, four correct responses in a block of four were required to pass Phase 1c Mixed Training Part 3. Overall, a total correct response rate of 11/12 was required to pass Phase 1c Mixed Training. Each part of Phase 1c Mixed Training had a maximum of four exposures. Failure to reach the criteria for any part within four exposures resulted in the termination of participation in the experiment.

2.2.2.4 Phase 2: Equivalence training and Phase 3: Equivalence test

These phases, their respective instructions, tasks and criteria were identical to those used in Experiment 1 with the exception of the omission of Phase 2c (Mixed Training) due to experimenter error.

2.2.2.5 Phase 4: Conflicting contingencies test

> Before beginning this phase the following instructions appeared on the screen:
>
> In a moment some words and coloured boxes will appear on this screen. Your task is to look at the word at the top of the screen and choose between the boxes at the bottom of the screen using the computer mouse and cursor.
>
> During this stage the computer WILL NOT PROVIDE YOU WITH FEEDBACK on your performance. You should try to get as many correct answers as possible.
>
> It might help you to use what you learned in the previous phase to make correct choices in this phase. It is important that you continue to concentrate and try to get as many correct answers as possible.
>
> If you have any questions please ask them now.
>
> When you are ready to begin please click Continue.

The purpose of this phase was to record the responses made by participants in the presence of the 'A' stimuli. It was predicted that the 'A' stimuli should exhibit the response functions of all class members due to the training provided during previous phases. Given the class structures trained and tested during Phases 2 and 3, the A1 stimulus should produce both red and green box-clicks, due to its derived relation to both B1 and C1. In contrast, the A2 stimulus should produce both purple and yellow box-clicks, due to its derived relation to both B2 and C2. Participants were permitted to make either one or two responses only per trial. If a participant clicked more than two boxes, only the first two were accepted as their response but all box-clicks were recorded by the program.

Clicking 'Continue' resulted in the presentation of the first trial of this stage. This phase was identical to Phase 1a, 1b and 1c but no feedback was provided following responses. Furthermore, A1 and A2 stimuli were presented in place of 'B', 'C', A3 and A4 stimuli once each in a block of two, which was repeated ten times in quasi-random order (20 trials in total). At the end of this phase, the participant was presented with the following instructions:

This is the end of the experiment. Please contact the experimenter.

Thank you for your participation.

2.2.3 Results and Discussion

Of the fourteen volunteers who started the study, only ten (Participants 1, 4, 6, 7, 8, 9, 10, 11, 12 and 14) successfully completed Phases 1, 2, 3 and 4. Only the data of these ten participants are discussed here.

2.2.3.1 Phase la: Operant conditioning Part 1

Participant 1 produced 20/20 correct responses during their first exposure to this phase. Participant 7 produced 9/20 and 19/20 correct responses during their first and second exposure to this phase, respectively. Participant 4 produced 13/20 and 20/20 correct responses during their first and second presentations of this phase, respectively.

Participants 9, 10, 11, 12 and 14 required three presentations of Phase 1a. Participant 9 produced correct response rates of 5/20, 13/20 and 19/20 during their first, second and third exposures to this phase, respectively. Participant 10 produced a correct response rate of 20/20 during their third exposure to this phase. Correct response rates of 9/20 and 16/20 were produced during their first and second exposures, respectively. Participant 11 required three exposures to this phase producing correct response rates of 11/20, 18/20 and 19/20, respectively. Participant 12 produced a correct response rate 16/20 on their first exposure to this phase, 18/20 on the second exposure and 20/20 on the third. Participant 14 produced correct response rates of 13/20, 17/20 and 20/20 during their first exposures, respectively.

Participants 6 and 8 both required four exposures to this phase. Participant 6 produced a total correct response rate of 20/20 on their fourth exposure to Phase 1a. The previous three exposures produced correct response rates of 9/20, 5/20 and 17/20, respectively. Participant 8 produced correct response rates of 3/20, 11/20, 18/20 and 20/20, respectively.

2.2.3.2 Phase 1b: Operant conditioning Part 2

Participant 1 was the only participant to meet the pre-set criterion for this phase during their first exposure by producing a correct response rate of 19/20. Participants 6, 7, 9, 11, 12 and 14 required two exposures to this phase. Participant 6 produced 0/20 correct responses during their first exposure to this phase and 19/20 during their second exposure. Participant 7 produced 16/20 and 20/20 correct responses during their first and second exposures to this phase, respectively. Participant 9 produced correct response rates of 15/20 and 19/20, respectively. Participant 11 required two presentations of this phase and produced 17/20 and 20/20 correct responses, respectively. Participant 12 produced 5/20 and 20/20 correct responses, respectively. Participant 14 produced correct response rates of 13/20 and 20/20, respectively.

Participants 4, 8 and 10 required three exposures to this phase. Participant 4 produced correct response rates of 16/20, 18/20 and 20/20 during their first, second and third exposures to this phase, respectively. Participant 8 produced a correct response rate of 20/20 on their third exposure to Phase 1b. On their previous two attempts they produced correct response rates of 0/20 and 12/20, respectively. Participant 10 produced correct response rates of 12/20, 18/20 and 20/20, respectively.

2.2.2.3 Phase 1c: Operant conditioning Part 3 (Mixed)

Participants 6, 7 8, 9, 10, 12 and 14 produced total correct response rates of 12/12 during this phase. More specifically, they produced correct response rates of 4/4 during Part 1, 4/4 during Part 2 and 4/4 during Part 3 of Phase 1c Operant Conditioning Part 3 (Mixed). Participants 1 and 11 produced a correct response of

11/12 during this phase. Correct response rates of 4/4 during Part 1, 3/4 during Part 2 and 4/4 during Part 3 of this phase were produced.

2.2.3.4 Phase 2: Equivalence training and Phase 3: Equivalence test

Participants 1, 4 and 9 required only one exposure to Phases 2a, 2b and 3 to meet the pre-set criterion (see Table 6). Participants 12 and 14 required two exposures to Phase 2b (both producing correct response rates of 18/20 on their first exposures) and only one exposures to Phase 3 (both producing a correct response rate of 20/20). Participants 7 and 10 both required two exposures to Phases 2a and 3. Participant 11 required two exposures to Phases 2a and 2b but only one exposure for Phase 3. Participants 6 and 8 both produced correct response rates of 20/20 on their first exposures to Phases 2a and 2b but both required more than one exposure to Phase 3 to meet the criterion. Participant 6 produced correct response rates of 12/20, 18/20 and 20/20, respectively and Participant 8 produced correct response rates of 13/20 and 20/20, respectively.

Table 6: Each participant's correct response rates produced during Phases 2a, 2b and 3. Where extra lines appear for a given participant, these numbers refer to performances on additional exposures of the phase until criteria were met.

P. No.	Phase 2a	Phase 2b	Phase 3
1	20/20	19/20	20/20
4	20/20	20/20	20/20
6	20/20	20/20	12/20 18/20 20/20
7	18/20 19/20	20/20	18/20 20/20
8	20/20	20/20	13/20 20/20
9	19/20	20/20	20/20
10	18/20 20/20	20/20	17/20 19/20
11	18/20 20/20	18/20 19/20	20/20
12	19/20	18/20 20/20	20/20
14	20/20	18/20 20/20	20/20

2.2.3.5 Phase 4: Conflicting contingencies test

The patterns of responding identified in this experiment were identical to those analysed during Experiment 1: Relationally Consistent and Stable, Relationally Consistent and Varied, and Relationally Inconsistent. Analysis of response patterns revealed variability across participants (even though similarities in patterns existed) but not typically within participants (see Table 7). As in Experiment 1, similarities existed across participants but no two participants responded identically during Phase 4 of this experiment.

Due to the functions established during Phase 1 (B1 was discriminative for a red box-click and C1 for a green box-click) and the derived transfer of functions effect, participants were expected to click either the red or green box (or both) in the presence of A1 during Phase 4. Similarly, given the response functions established during Phase 1 (i.e., B2 was discriminative for a purple box-click and C2 for a yellow box-click), participants were expected to click either the purple or yellow boxes (or both) in the presence of A2.

Table 7: Each participant's responses produced during Phase 4. The column titles, *Red*, *Green*, *Purple and Yellow,* refer to the corresponding coloured box clicked by participants in the presence of the 'A' stimuli. The column titles *Red/Green and Purple/Yellow,* refer to the corresponding box clicks where participants clicked both boxes on a particular trial. *Mix* refers to responses which comprised more than one relationally inconsistent box click on a particular trial. In this column, *P* refers to purple, *Y* refers to yellow, *R* refers to red and *G* refers to green box clicks.

P. No.	A1 Probes							A2 Probes						
	Red	Green	Purple	Yellow	Red/ Green	Purple/ Yellow	Mix	Red	Green	Purple	Yellow	Red/ Green	Purple/ Yellow	Mix
1					10								10	
4	1				9								10	
6		1	1		8				1		2		7	
7	10							1			9			
8					7	1	2 P/ G						10	
9		6	1				3 P/G				4			5 Y/ R 1 G/P
10	2	8								1	9			
11		10							1		9			
12				10					10					
14					6	4						3	7	

Table 8: Each participant's response patterns produced during Phase 4. *Rel. Con. Stable* refers to a relationally consistent and stable response pattern. *Rel. Con. Varied* refers to a relationally consistent and varied response pattern. *Rel. Incon.* refers to a relationally inconsistent response pattern.

P.No.	Response Pattern		
	Rel. Con. Stable	Rel. Con. Varied	Rel. Incon.
1	*		
4		*	
6		*	
7	*		
8			*
9			*
10		*	
11	*		
12			*
14			*

Table 8 shows that Participants 1, 7 and 11 produced relationally consistent and stable response patterns. Participant 1 produced two colour box-click responses in the presence of both 'A' stimuli- red and green box-clicks in the presence of the A1 stimulus on ten trials and purple and yellow box-clicks in the presence of the A2 stimulus, also on ten trials.

Participants 7 and 11 both produced ten consistent and stable responses in the presence of the A1 stimulus and nine in the presence of the A2 stimulus (see Table 7).

They both produced one inconsistent response each in response to A2 stimuli. Participants 4, 6 and 10 demonstrated relationally consistent and varied response patterns. Participant 10 was the only participant to display relationally consistent and varied responding on all trials of this phase. This participant clicked the green box eight times and the red box twice in the presence of the A1 stimulus and clicked the yellow box nine times and purple box once in the presence of the A2 stimulus.

Participants 8, 9, 12 and 14 produced relationally inconsistent responding. Specifically, Participants 8 and 14 both produced relationally consistent responses on the majority of trials but did not meet the pre-set criterion for consistent responding. For example, Participant 8 responded consistently with Phase 1 training on 17/20 trials. Participant 14 responded consistently with the training phases on 13/20 trials of trials. Neither participant's response patterns reached the required 18/20 criterion and both were judged to be relationally inconsistent. Participant 9 produced ten responses that were relationally consistent but was deemed to have responded in a relationally inconsistent pattern because the pre-set criterion for consistent responding was not reached (see Tables 7 and 8). Participant 12 produced relationally inconsistent response rate of 20/20 during this phase by clicking the yellow box in the presence of the A1 stimulus on ten trials and clicking the green box in the presence of the A2 stimulus on the remaining ten trials.

One particularly interesting feature of the data presented in Tables 7 and 8 relates to how some participants responded across trials by clicking one box only per trial and others clicked two boxes per trial in response to the discriminative stimuli (i.e., variability in responding across participants but not within participants). For example, five participants (Participants 1, 7, 10, 11 and 12) clicked one coloured box only per trial across all trials and two (Participants 8 and 14) clicked two coloured

boxes per trial across all trials during Phase 4. The three remaining participants (Participants 4, 6 and 9) clicked one box only on some trials, but two boxes on others. In addition, no participants clicked the 'None of these are correct' box during Phase 4.

Further variability was evident between participants who responded with one box-click response per trial during Phase 4. For example, of the five participants that clicked one coloured box only per trial (i.e., Participants 1, 7, 10, 11 and 12), three (P1, P7 and P11) responded in a relationally consistent and stable pattern. One participant (P12) responded in a relationally inconsistent pattern. Participant 10 responded in a relationally consistent and varied pattern. In effect, the current response pattern data set is characterized by a very large amount of variability across participants.

Participants' RTs were also measured during Phases 1b and 4 (see Table 9) to allow for a comparison between RTs to directly established (i.e., 'B' and 'C' stimuli) and derived (i.e., 'A' stimuli) discriminative stimuli. RTs above 10 seconds were truncated to 10 seconds for the purposes of this analysis.

Table 9: Each participant's mean reaction times during Phase 1b and Phase4. SD indicates stand deviation.

P.No	Phase 1(b)	Phase 4
1	3.53	11.49
4	5.59	11.68
6	3.24	16.64
7	5.41	7.16
8	4.52	8.21
9	3.89	10.22
10	4.95	9.05
11	5.99	9.87
12	5.26	7.23
14	3.92	7.81
Mean	4.63	9.93
SD	0.95	2.86

Table 9 shows all ten participants produced a larger mean RT during Phase 4 than Phase 1 suggesting the presence of behavioural disruption during the conflicting contingency probes of Phase 4.

A Wilcoxon Signed Rank Test compared the mean RTs produced during Phases 1b and 4 and showed a statistically significant difference ($Z=-2.803$, $P<.01$). As in Experiment 1, it was considered that first trial RTs might serve as a more valid measure of behavioural disruption produced by contingency conflict. This was because increases in response fluency across multiple trials might obscure local disruption effects. In addition, it was considered that the presence of feedback during Phase 1b and its absence during Phase 4 may or may not account for the differences in RTs across these two phases. Thus, an analysis was conducted of first response RTs recorded during Phases 1b and 4 (see Table 10). Because participants could not be aware that feedback was not to be presented during test trials until the first response during testing had already been emitted, any RT effects observed during first trial RTs could not themselves be accounted for by the absence of feedback during Phase 4.

Table 10: Each participant's reaction times during the first trials during Phase 1b and Phase 4. SD indicates standard deviation.

P.No	Phase 1(b)	Phase 4
1	9.62	17.65
4	10.57	27.95
6	2.76	10.40
7	5.10	34.28
8	6.01	23.60
9	4.18	9.81
10	11.20	25.90
11	8.03	22.85
12	7.56	26.38
14	5.57	37.67
Mean	7.06	23.64
SD	2.81	9.09

Table 10 shows that all participants produced larger RTs during the first trials of Phase 4 than the first trials of Phase 1b. A Wilcoxon Signed Rank Test compared the RTs produced during the first trials of Phases 1b and 4 and found the differences in RTs to be statistically significant ($z=-2.521$, $p<.05$)

In conclusion, the current data demonstrate that the conflicting contingency test phase produced somewhat delayed responding on initial trials for all participants. In addition, response patterns within participants (i.e., consistent or varied and one or two box-clicks) and across participants varied considerably, as expected. These findings support those of Experiment 1 in suggesting that inter-participant response variability and delays in response time can be produced by conflicting approach-approach contingencies.

2.3 Experiment 3 (Approach-Approach Conflicts 3)

Experiments 1 and 2 would appear to have generated approach-approach conflicts may have demonstrated balanced competing stimulus control over responding during the probe phases, however it cannot be certain to what extent at this stage. In particular, of the ten participants in Experiment 2, three produced relationally consistent and stable response patterns and three also produced relationally consistent and varied response patterns. Four participants responded in a relationally inconsistent pattern. Interestingly, four participants clicked one coloured box only per trial across all trials and three clicked two coloured boxes per trial across all trials during Phase 4. The three remaining participants clicked both one box only per trial and two boxes per trial. In addition, no participants clicked the 'None of these are correct' box during Phase 4. Thus, while the response variability observed during Phase 4 of Experiment 2 was broader than that observed during Experiment 1, the same basic patterns of variation were replicated using the modified procedure. Moreover, analysis of RTs found that longer RTs were produced during the first trial of Phase 4 than during the first trial of Phase 1.

One important change that was made to capture a contingency conflict with good face validity relates to the stimulus presentation mode during Phase 4. Specifically, during Phase 4 of Experiments 1 and 2, only one stimulus was presented. That stimulus was expected, and indeed was shown, to simultaneously exhibit the distinct response functions of two class members. However, in presenting only one stimulus per trial during a probe phase, participants might have been more likely to produce one response only. This might have been the case despite the fact that a history of producing multiple responses was provided in Experiment 2 to preclude

precisely such an outcome. In effect, such a history might not have been sufficient to overcome the controlling functions of the task format (i.e., one stimulus presented per trial) in generating only one response per trial for most of the participants. Put simply, because the probe stimuli presented during Phase 4 had two response functions, and because participants had a history of producing only one response per trial across most trials of the experiment up to that point, it might have been the case that they responded to the task as a simple choice between functions, rather than a conflict, per se.

Thus, in order to create a more valid and salient contingency conflict, it was decided that a probe format in which two stimuli were presented would be preferable. Thus, a new design was employed in which only two response functions would be established for each of the two 'A' stimuli in two equivalence relations (i.e., A1-B1-C1 and A2-B2-C2). That way, the two 'C' stimuli could be presented simultaneously as a probe in order to examine the effects of a more clearly established contingency conflict.

The current procedure has the advantage that it also ensures that it allows us to more clearly demonstrate derived response conflicts in accordance with transitive relations. More specifically, it could be suggested that in Experiments 1 and 2 the functions established for the 'B' and 'C' stimuli transferred to the 'A' stimuli not through equivalence relations but via symmetrical relations. That is, the 'A' stimuli were directly trained with the 'B' and 'C' stimuli during conditional discrimination training. It may even be argued that the transfer of functions occurred as a result of some type of backward conditioning via associative learning processes (see Hall, 1996 for a review).

While the occurrence of such processes in no way diminishes the interesting nature of the response conflicts generated and observed during Experiments 1 and 2, it does limit generalization of these results to derived transitive (equivalence) relations. In order to address this issue a new paradigm was required in which conditioned and probe stimuli were related via transitive relations and separated by at least one node in an equivalence relation. For this additional purpose a linear, rather than a one-to-many training protocol was employed. This allowed the experimenter to establish competing functions in each of the two 'A' stimuli, and probe for response conflicts upon the simultaneous presentation of the two 'C' stimuli.

Phase 1b which was used to establish a history of multiple responses for individual stimuli, was omitted as it was no longer relevant to the current paradigm. However, both one and two box-click responses were permitted during Phase 4. Finally, in an attempt to address the relatively low participant yield observed during Experiment 2, Phase 2c (Mixed Training comprising each equivalence training task from 2a and 2b) was added to Experiment 3. This was also intended to counter any possible negative effects on yields of switching from a one-to-many to a linear training protocol (see Arntzen & Holth, 1997; 2000a; 2000b; Hove, 2003).

2.3.1 Method

2.3.1.1 Participants

Twenty unpaid volunteers were recruited from personal contacts. All participants were presented with Phase 1 (Operant Conditioning) and proceeded to a series of subsequent phases (i.e., Phase 2 Equivalence Training, Phase 3 Equivalence Testing and Phase 4 Conflicting contingencies test). The data discussed in this experiment consists of that from the 12 participants that completed all phases of the experiment including Phase 2c. Participants' ages ranged from 20 to 46, and the mean age was 28.

2.3.1.2 Ethical Considerations

Strict ethical guidelines identical to those adhered to during the previous two experiments were followed during this experiment (see Appendix 1a).

2.3.1.3 Apparatus and Stimuli

All apparatus and stimuli were identical to those used in Experiments 1 and 2 with the exception of the use of six nonsense syllables as sample and comparisons during the training and testing phases of the experiment (i.e. CUG, ROG, MEL, VEK, MAU and DAK). In the interest of clarity, these will be labelled using the alphanumerics; A1, B1, C1, A2, B2, and C2, respectively.

2.3.1.4 General experimental sequence

2.3.2.1 Phase l: Operant conditioning

Before beginning this phase the following instructions appeared on the screen:

In a moment some words and coloured boxes will appear on this screen. Your task is to look at the word at the top of the screen and choose one of the boxes at the bottom of the screen by "clicking on it" using the computer mouse and

cursor. During this stage the computer will provide you with feedback on your performance. You should try to get as many correct answers as possible.

If you have any questions please ask them now.

When you are ready to begin please click Continue below.

Clicking the 'Continue' button resulted in the presentation of the first trial of Phase 1. A discriminative stimulus in black Arial font (size 48) was presented on its own in the top-middle of the screen for 1.5 seconds and then four coloured boxes (red, green, purple, yellow) appeared. Each box was 8cm in length and 5cm wide and the positions of the boxes were randomized across trials during training and testing. There was also a 'Confirm' button in the bottom right corner of the screen, the participant needed to click this button after each response in order to register their response and proceed to the next trial. Clicking any of the four boxes followed by the 'Confirm' button caused all the boxes and the nonsense syllable to disappear. If the correct box was clicked the word "Correct" appeared immediately in green font (size 48) in the centre of the screen for 1.5 seconds. If an incorrect box was clicked the word "Wrong" appeared immediately in red font (size 48) in the centre of the screen for 1.5 seconds. When the feedback disappeared, the computer screen remained blank for an inter-trial interval of 500ms after which the next trial was presented

In the presence of the A1 stimulus, clicking the red box was reinforced and in the presence of the A2 stimulus, clicking the purple box was reinforced (Figure 6). This phase consisted of each task presented in a block of two that was repeated ten times (20 trials in total). If the participant produced a correct response rate less than 19/20 they were presented with instructions for this phase again. After clicking the 'Continue' button below the instructions on the screen they were re-exposed to this phase. If the participant's fourth exposure to this phase was unsuccessful, the

experiment ended. Nevertheless, if a total correct response rate of 19/20 or 20/20 was produced during one of the four exposures, the participant was presented with instructions for the next phase.

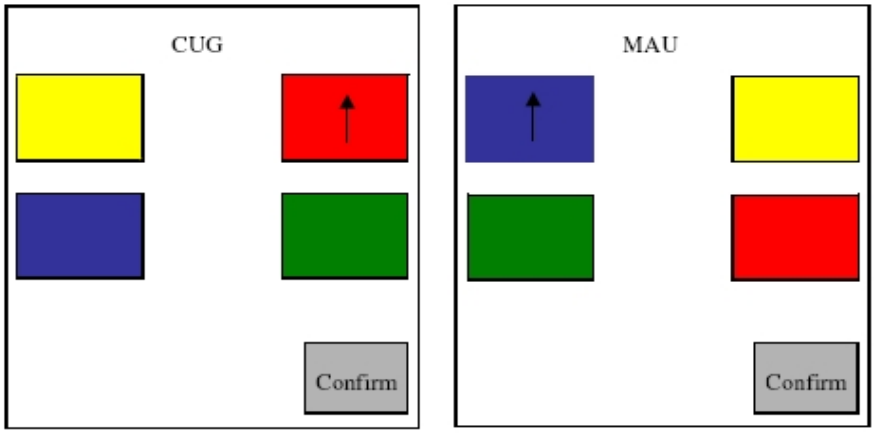


Figure 6. *The two tasks presented during Phase 1.* CUG=A1 Stimulus and MAU=A2 Stimulus. The ↑ symbol refers to the reinforced response for each trial.

2.3.2.2 Phase 2: Equivalence training

This phase was identical to Phase 2 in Experiments 1 and 2 with the following exceptions. Training was conducted in a blocked linear fashion (i.e., A-B-C). A-B Training (which will also be referred to as Phase 2a) consisted of two tasks: A1-B1 [B2] and A2-B2 [B1], where alphanumerics in square brackets indicate incorrect choices. These tasks were presented once each in a block of two in a quasi-random order, which was repeated 10 times (20 trials in total). When participants passed this A-B training they were then presented with B-C training (Phase 2b). The tasks B1-C1 [C2] and B2-C2 [C1] were presented in an identical fashion. Similarly, when participants passed B-C training they were presented with the Mixed Training phase (Phase 2c). During Phase 2c, which was a novel phase introduced for Experiment 3, trials consisted of the tasks A1-B1 [B2], A2-B2 [B2], B1-C1 [C2] and B2-C2 [C1]. Phase 2c consisted of the tasks presented during Phases 2a and 2b being presented in a quasi-random order for 30 trials with a maximum of four exposures. The criterion

for passing this phase was 29/30 correct responses. Successful completion of Phase 2c was followed by presentation of Phase 3 (Equivalence Test).

2.3.2.3 Phase 3: Equivalence test

This phase was identical to Phase 3 in Experiments 1 and 2 apart from the following exception. The equivalence test probed for the formation of the derived relations A1-C1, A2-C2, C1-A1 and C2-A2.

2.3.2.4 Phase 4: Conflicting contingencies test

This phase was identical to Phase 1 with the following exceptions. No feedback was provided following responses. In addition, both 'C' stimuli were presented (see Figure 7) onscreen at the same time without feedback in quasi-random order in a block of two, which was presented ten times (20 trials in total). The left and right position of the two 'C' stimuli onscreen was randomized across trials.

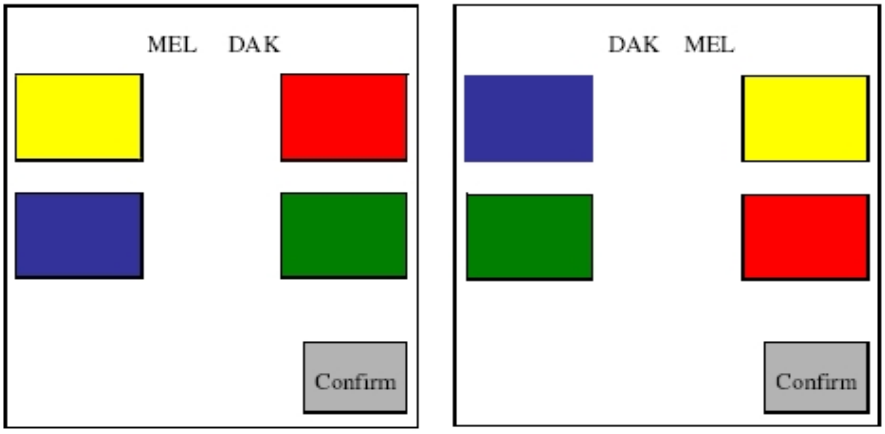


Figure 7. ***The two tasks presented during Phase 4.*** **MEL=C1 and DAK=C2.**

At the end of the test, participants were presented with the following instructions:

This is the end of the experiment. Please contact the experimenter.

Thank you for your participation.

2.3.3 Results and Discussion

Of the twenty volunteers, twelve (i.e., Participants 3, 5, 6, 7, 10, 11, 13, 15, 16, 17, 19 and 20) successfully completed Phases 1, 2, 3 and 4. Only the results of these twelve participants are discussed here.

2.3.3.1 Phase l: Operant conditioning

Participants 3, 7, 17 and 19 met the pre-set criterion during their first exposure to pass Phase 1 proceed with the experiment. Two exposures to Phase 1 were required by Participants 5, 10, 16 and 20 (who all produced total correct response rates of 18/20, 20/20, respectively), Participant 6 (who produced correct response rates of 17/20, 20/20, respectively), and Participants 13 and 19 (who produced correct response rates of 16/20, 20/20, respectively). Participant 11 required three exposures to Phase 1 and produced total correct response rates of 16/20, 15/20 and 20/20 during their first, second and third exposures, respectively.

Phase 2 and 3: Equivalence training and testing

Participants 3, 5, 6, 10, 11, 13, 16 and 17 all passed Phase 2a on their first exposure. Participant 7 required two exposures to Phase 2a (who produced 18/20 and 20/20 correct responses, respectively). Participant 20 required two exposures to Phase 2a (who produced 18/20 and 19/20 correct responses, respectively). Participant 19 also required two exposures to Phase 2a (who produced total correct response rates of 17/20 and 20/20, respectively). Participant 15 required three exposures to Phase 2a (who produced 17/20, 17/20 and 19/20 correct responses, respectively). All participants passed Phase 2b upon first exposure, except for Participant 10, who required two exposures (who produced correct response rates of 18/20 and 20/20, respectively).

Participants 3, 5, 7, 10, 13, 15, 19 and 20 all passed Phase 2c on their first exposure. Participant 17 required two exposures to this phase (who produced correct response rates of 11/20 and 20/20, respectively). Participant 6 required two exposures to Phase 2c (who produced correct response rates of 18/20 and 20/20, respectively). Participant 11 required three exposures to this phase (who produced 18/20, 18/20 and 20/20 correct responses, respectively). Participant 16 also required three exposures to this phase (who produced correct response rates of 15/20, 16/20 and 20/20, respectively).

During Phase 3, all participants produced correct response rates of 20/20 except for Participants 17 and 20 who both produced correct response rates of 19/20 on their first exposures.

Table 11: Each participant's correct response rate produced during Phases 2 and 3. Where extra lines appear for a given participant, these numbers refer to performances on additional exposures of the phase until criteria were met.

P. No.	Phase 2a	Phase 2b	Phase 2c	Phase 3
3	19/20	20/20	20/20	20/20
5	20/20	19/20	20/20	20/20
6	19/20	19/20	20/20	20/20
7	18/20 20/20	19/20	20/20	20/20
10	19/20	18/20 20/20	20/20	20/20
11	20/20	19/20	18/20 18/20 20/20	20/20
13	19/20	20/20	18/20 20/20	20/20
15	17/20 17/20 19/20	20/20	20/20	20/20
16	20/20	19/20	15/20 16/20 20/20	20/20
17	19/20	20/20	11/20 20/20	19/20 20/20
19	17/20 20/20	20/20	20/20	20/20
20	18/20 19/20	20/20	20/20	19/20 20/20

2.3.3.3 Phase 4: Conflicting contingencies test

Response patterns produced during Phase 4 were divided into four main categories: Consistent (1 response), consistent (2 responses), inconsistent (1 response) and inconsistent (2 responses). A consistent (1 response) responding pattern was defined as responding (with one coloured box-click per trial) consistently with the

first response produced for at least 18 of the 20 trials during this phase. Participants who produced this responding pattern almost exclusively clicked the same coloured box (red) on every trial in which C1/C2 were presented and the same coloured box (purple) on every trial in which C2/C1 were presented. The one exception to this pattern was the performance of P3 who consistently clicked the same coloured box (red) on every trial in which C1/C2 and C2/C1 were presented). All 12 participants responded to only the purple and red coloured boxes and did not respond to the green and yellow boxes. This relatively stable response pattern across participants suggests at least some degree of experimental control over response variability.

A consistent (2 responses) responding pattern was defined as producing two coloured box-click responses per trial which were consistent with the first responses for at least 18 of the 20 trials during this phase. Participants who responded in this pattern produced responses that were dependent on the compound structure of the stimuli. For example, if the C1 stimuli appeared to the left, and C2 on the right, participants who responded based on stimulus topography would likely respond to the stimulus on the left first and then the stimulus on the right afterwards. This might be expected given a history of reading from left to right for all participants literate in the English language. Those who produced two responses in a pattern labelled as consistent (2 responses), exclusively responded to the same two response keys (purple and red) on every trial.

An inconsistent (1 response) responding pattern was defined as responding with one box-click per trial and in a manner not consistent with the first response (i.e., less than 18 identical responses pout of 20). An inconsistent (2 responses) responding pattern was observed when the participant clicked two coloured boxes per trial and did not respond consistently with their first response produced for at least 18 of the 20 trials.

By definition, these response patterns were not under the control of the compound structure of the stimuli presented.

All participants responded in a consistent pattern in terms of the use of one or two box-clicks across trials. For example, if a participant made one response (as opposed to two) during the first trial, they continued to produce only 1 box-click for at least 18 of the 20 trials and vice versa.

Table 12: Each participant's responses produced during Phase 4. The C1/C2 and C2/C1 headings represent the order in which the 'C' stimuli were presented on screen during Phase 4. The column titles, *Red* and *Purple* refer to the corresponding coloured box clicked by participants in the presence of the C1/C2 and C2/C1 stimuli. The column titles *Red/Purple* and *Purple/Red* , refer to the corresponding box clicks where participants clicked both boxes on a particular trial.

P. No.	C1/C2 Probes				C2/C1 Probes			
	Red	Purple	Red/ Purple	Purple/ Red	Red	Purple	Red/ Purple	Purple/ Red
3	0	0	10	0	0	0	10	0
5	0	0	6	4	0	0	4	6
6	0	0	10	0	0	0	0	10
7	10	0	0	0	0	10	0	0
10	0	0	5	5	0	0	5	5
11	9	0	0	0	9	0	0	0
13	0	0	6	4	0	0	2	8
15	0	0	9	1	1	0	7	2
16	1	9	0	0	3	6	1	0
17	10	0	0	0	0	10	0	0
19	6	4	0	0	5	5	0	0
20	1	0	9	0	0	0	0	9

Table 13: Each participant's response pattern produced during Phase 4. Rel. Cons. 1 resp. **refers to a relationally consistent response pattern comprising one box-click only.** ***Rel. Cons. 2 resp.*** **refers to a relationally consistent response pattern comprising two box clicks.** ***Rel. Incon 1 resp.*** **refers to a relationally inconsistent response pattern comprising one box-click only.** ***Rel Incon. 2 resp.*** **refers to a relationally inconsistent response pattern comprising two box-clicks.**

P.No.	Response Pattern			
	Rel. Cons. 1 resp.	Rel. Cons. 2 resp.	Rel. Incon. 1 resp.	Rel. Incon. 2 resp.
3		*		
5				*
6		*		
7	*			
10				*
11	*			
13				*
15				*
16			*	
17	*			
19			*	
20		*		

Table 12 shows the number of times each response was produced by the twelve participants and Table 13 shows each participant's response pattern. Participants 3, 6, 7, 11, 17 and 20 responded consistently during Phase 4. Three participants clicked one coloured box in response to the 'C' stimuli (Participants 7, 11 and 11) and three clicked two boxes (Participants 7, 10 and 11). Six participants also responded inconsistently; two of these produced one box-click (Participants 16 and 19) and four

clicked two boxes (Participants 5, 10, 13 and 15). No participant clicked the green or yellow boxes.

It would appear that the competing contingencies present during Phase 4 resulted in little disruption to responding for the six participants who responded consistently, particularly those who responded with one box-click per trial. However, response variability was evident between and within the other 6 remaining participants who responded in the inconsistent pattern.

2.3.4 Response latencies

Participants' RTs were also measured during Phases 1 and 4 (see Table 14) to allow for a comparison between RTs to directly established (i.e., A1 and A2) and derived (i.e., both C1 and C2) discriminative stimuli. All participants produced larger RTs during Phase 4 than Phase 1 except for Participants 5, 10 and 13. RTs above 10 seconds were truncated to 10 seconds for statistical analysis.

Table 14: Each participant's mean reaction times during Phases 1 and 4. SD indicates standard deviation.

P. No.	Phase 1	Phase 4
3	2.63	5.00
5	5.63	2.66
6	3.26	6.28
7	2.91	6.04
10	2.69	4.15
11	4.41	12.17
13	7.42	6.79
15	3.32	9.62
16	4.07	5.11
17	2.57	3.94
19	5.10	26.38
20	3.19	3.97
Mean	3.90	7.70
SD	1.48	6.45

Table 14 shows that ten participants (Participants 3, 6, 7, 10, 11, 15, 16, 17, 19 and 20) produced larger mean RTs during Phase 4 than Phase 1. In addition, the mean RT for all participants was larger during Phase 4 (7.70) than during Phase 1 (3.90). A Wilcoxon Signed Rank test found that the difference between Phase 1 and Phase 4 mean RTs was statistically significant ($z=-2.432$, $p<.05$). This suggests behavioural disruption by the conflicting contingency probes. Even though overall mean RTs during phase 4 were higher than mean RTs recorded during Phase 1, RTs to first responses only across these phases were analysed to see if the effects were more marked (see Table 15).

Table 15: Each participant's reaction times to their first trials of Phases 1 and 4. SD indicates standard deviation.

P. No.	Phase 1	Phase 4
3	2.80	10.82
5	23.34	108.88
6	11.16	34.97
7	4.41	37.54
10	5.46	3.45
11	3.80	21.31
13	3.38	7.76
15	5.03	5.30
16	3.52	12.66
17	5.78	14.72
19	17.22	43.77
20	3.13	15.99
Mean	7.42	26.48
SD	6.53	29.11

It can be seen from Table 15 that eleven participants (Participants 3, 5, 6, 7, 11, 13, 15, 16, 17, 19 and 20) produced a larger RT during the first trial of Phase 4 than during the first trial of Phase 1. This effect appears to be even more marked than observed at the level of mean RTs across both phases.

A Wilcoxon Signed Rank test was conducted to investigate if there was any significant difference in the mean RTs produced between the first responses in Phase

1 and Phase 4 across participants. The main effect was found to be statistically significant ($z=-2.429$, $p<.05$).

In conclusion, it would appear that the juxtaposed contingencies present during Phase 4 interfered with participants' responding. Response variability in the presence of 'C' stimuli during Phase 4 and disruption to response latencies were observed between participants during the current experiment. Additional response variability was evident between participants in the number of responses they produced per trial (one box-click only or two box-clicks per trial). It would appear that the variability and response latencies were the result of the juxtaposed approach contingencies present during the conflicting contingencies test. More importantly, however, the probe phase of Experiment 3 was particularly successful in generating approach-approach conflict in terms of RT effects. Delays in responding were not only observed during the initial trials of Phases 1 and 4 but also in terms of mean RT differences between phases. At this point, it would seem that it was the presentation of stimulus compounds that produced more effective approach response function contingency conflicts rather than the formats employed during Experiments 1 and 2.

2.4 Discussion

Experiments 1, 2 and 3 each generated a separate response conflict involving competing approach contingencies through the derived transfer of functions effect. Response variability was demonstrated between participants across all three experiments. During Experiments 1 and 2 responses varied in terms of whether or not they were consistent with relations trained during equivalence training and testing and whether the response patterns produced were stable or varied across trials. Variability during Experiment 3 was observed in relation to consistency with previous responses (either consistent or inconsistent) and number of coloured boxes clicked during Phase 4 testing (either one or two clicks). Reaction time differences were also observed between training and testing phases, particularly between the first trials of each phase.

Despite response pattern variability across participants, within participant response consistency and an almost 100% response rate (i.e., few missed responses) were also observed throughout the three experiments. For example, during Experiment 1 six participants (Participants 5, 9, 10, 16, 17 and 18) produced a relationally consistent responding pattern. Four of these (Participants 5, 9, 17 and 18,) clicked the same button across trials even though they also could have clicked a second button that was also relationally consistent. It would appear that Participants 10 and 16 (Experiment 1) attempted to divide their responses across two relationally consistent buttons as a result of the balanced competing contingencies present during Phase 4. Similar consistent responding was also evident during Phase 4 of Experiments 2 and 3. Participants 1, 6, 7, 10, 11 and 14 (Experiment 2) produced relationally consistent responses across trials during the probe phase. Participants 3, 3, 6, 11, 17 and 20 (Experiment 3) produced responses consistently within

participants across trials during Phase 4. Interestingly, only one participant (Participant 7, Experiment 3) failed to produce a response during Phase 4.

One possible reason for the observed consistency during the probe phases could relate to the influence of the general demand characteristics of experiments such as the current one. Specifically, participants were required to be consistent in their responding to pass each phase of the experiment. To this extent variability may have functioned as a generalised discriminative stimulus for punishment (i.e., removal of reinforcement) as established by the selective reinforcement of consistent responding in previous phases. For example, prior to Phase 4 of all three experiments, relationally consistent responses were reinforced. Only one specific response topography was provided with reinforcement and consistency in responses produced across trials was reinforced by the cessation of training phases. Conversely, inconsistency was punished by the administration of repeated training phases. In addition, clicking the "None of these are Correct" button was not reinforced during training phases. It is not surprising, therefore, that participants did not repeatedly and reliably click this button during Phase 4 of Experiment 2, as they had no history of doing so during the previous three phases. In other words, the response consistency provided by the history of training may well have been too salient to have been undermined by the conflicting approach contingencies present during Phase 4. A potential solution to this problem caused by histories of consistent responding would involve exposure to training trials during which responding was not reinforced or punished. If this procedure was employed there is a possibility that such consistent behaviour would not be observed during probe phases. Paradoxically, of course, it could prove difficult to successfully establish equivalence relations in the absence of conditional feedback (see Harrison & Green, 1990).

The establishment of equivalence relations during Experiment 3 was less effective than during the previous two experiments. The reintroduction of Phase 2c (Mixed Training), comprising each task from Phases 2a and 2b, did not substantially improve the number of participants meeting the pre-set criterion for equivalence testing. Perhaps it was the change of procedure from one-to-many equivalence training (used during Experiments 1 and 2) to a linear protocol (during Experiment 3) that diminished the facilitating effect of Phase 2c. Research suggests that a one-to-many equivalence training protocol is more successful at establishing equivalence relations than a linear protocol (Arntzen & Holth, 1997; 2000a; 2000b). For example, Arntzen & Holth (1997) investigated the efficacy of one-to-many, many-to-one (also known as comparison-as-node) and linear equivalence training protocols. The authors found that one-to-many training was significantly more efficient than many-to-one. Furthermore, linear training was found to be the least effective of the three in terms of establishing equivalence relations. This may help explain the relatively low yield observed in Experiment 3, when compared with Experiments 1 and 2 (see also Hove, 2003).

In addition, the reader might have noticed that compound stimuli were presented in the same sequence on a number of trials during Phase 4 of Experiment 3. This was due to the very limited number of possible combinations of the stimuli presented during this phase (i.e., C1/C2 and C2/C1). This may have been a cause for concern should it have been determined that participants only produced responses in the order the stimuli appeared from left to right on screen during the presentation of the compound stimuli. For example, when presented with C1/C2, a participant may have initially only read the C1 component of the compound and then the C2 component afterwards and this may or may not have had an influence on how they

responded. To eliminate the possibility of reading behaviour such as this having control over responding, it could be suggested that stimuli be presented in a number of different ways such as one on top of the other, and so on. However, it is difficult to imagine what benefit if any such an exhaustive experimental analysis of every conceivable permutation would have at this juncture. Furthermore, during this particular experiment the order of the presentation of C1/C2 and C2/C1 stimuli was randomised across trials so such an issue would appear to be unlikely to have occurred. In order to reduce the likelihood of such a reading problem occurring in future experiments, the order of the presentation of the individual components of compound stimuli will continue to be randomised.

Equivalence training and testing may also have played a role in the observed within-participant response consistency during all three experiments. The repeated presentations of training tasks (through both one-to-many and linear protocols) served as a form of rehearsal of the stimulus relations before all critical probe phases. Such rehearsal might be considered a form of rumination which is believed to be a purposeful emotion regulatory process (Forsyth, Eifert & Barrios, 2007). In other words, the rehearsal of the relations across numerous trials and blocks may have led to covert forms of derived transfer of functions that may be difficult or even impossible to measure with the current methodologies. If this occurred, covert derived relational processes may have been at strength before the probe phase, and particular response options may have been covertly rehearsed even prior to the probe phase. While this interpretation is entirely speculative at this point, it may also explain the lack of erratic responding during test phases.

In contrast to the foregoing laboratory scenario, people with anxiety conditions are often placed in choice situations where the conflicting contingencies

present are very salient. Consider the case of a person with agoraphobia who greatly values their health but becomes ill and requires an immediate doctor's appointment. This person has little time to prepare a strategy to rehearse facing the busy street of the doctor's surgery before leaving the safety of their home. They must quickly make a decision that could possibly have unforeseen consequences for them. They could stay at home and develop a worse unknown illness or go to the doctor's surgery on the crowded street and deal with unknown environmental factors while possibly experiencing a panic attack. In addition, the functions of approach and avoidance in this case may be multiple. For example, going to the Doctor has the appetitive functions of possible escape from the symptoms of illness, self and socially delivered reinforcement for engaging socially with others, and possible direct reinforcement by natural contingencies for leaving the house (perhaps they will enjoy the views on the bus ride). The same response, however, may also have several aversive response functions (e.g., they may have a panic attack, they may humiliate themselves, the doctor may not be able to help, they may have an awkward social encounter on the bus, etc.).

Such a salient and threatening response conflict did not arise in the current experiments, however. That is, during each experiment participants were provided with a history of rehearsing the functions of the stimuli during conditioning phases and rehearsing the relations between stimuli during equivalence training and testing. Once the critical probe phase was presented participants were very familiar with the consequences and functions of each response. There were only two such functions and their conflict did not involve potentially unforeseen outcomes. In addition to the role of rehearsal of responses in the laboratory context, the consistent patterns of responding observed here may also have been affected by the strength of the stimuli

employed throughout the three experiments. As mentioned previously, it was not the aim of the experiments to create approach-avoidance conflicts and no responses were conditioned with aversive functions. As a result of this, participants did not experience the behavioural distress typically associated with approach-avoidance conflicts. It may be this very distress that mediates significant response disruption or even response omission.

In order to create an approach-avoidance conflict using the current experimental approach, new experimental designs are required. For example, using minor alterations to the design of Experiment 1, an onscreen button could be established as an aversive stimulus (e.g., mild electric shock) and the other established as an appetitive stimulus (e.g., financial reward). The reward and punishment would have to reach the precise point of equilibrium in order for participants to experience a conflict in which the probability of approach equalled the probability of avoidance. If only one response was to be permitted during such a probe phase, the behaviour resulting from these conflicting contingencies may then be even more disrupted than that observed here.

Using minor alterations to the design of Experiment 2 an approach-avoidance conflict could be generated as follows. Relationally consistent responses could be reinforced with an amount of money and relationally inconsistent responses could be punished by consequating them with mild electric shocks. Only one method of response (i.e., one box-click per trial or two box-clicks per trial) would be permitted. Such a preparation might generate response variability and response latencies similar to those produced during real-world approach-avoidance conflicts.

Finally, an approach–avoidance conflict could be generated by making the following alterations to the design of Experiment 3. During Phase 1 conditioning, the

A1 stimulus could be established as a discriminative stimulus for mild electric shock and the A2 Stimulus could be established as a discriminative stimulus for earning a small amount of money. Under these conditions, an approach-avoidance conflict would emerge during Phase 4.

Future research may also do well to employ a participant sample comprising clinically anxious clients. Anxious individuals are more likely to avoid anxiety-inducing situations (Davison, Neale & Kring, 2004) and it may be easier to generate powerful approach–avoidance effects with a population with a history of clinical anxiety. Alternatively, a sample of non-anxious participants exposed to inhalations of 20% CO2-enriched air, in the place of the electric shock suggested above may yield impressive levels of response disruption during probe phases (see Karekla, Forsyth, & Kelly, 2004; Spira, Zvolensky, Eifert & Feldner, 2004). It has been shown that such exposures to 20% CO2-enriched air have produced physiological sensations in typically healthy individuals similar to those experienced by people suffering panic attacks (Forsyth & Eifert, 1998). The use of such samples coupled with an anxiety questionnaire such as the State Trait Anxiety Inventory (STAI; Spielberger, Gorssuch, Lushene, Vagg, & Jacobs 1983) could provide valuable insight into the processes and experiences of the anxiety that occur during an approach-avoidance conflict. Interestingly, the use of a measure such as the STAI would allow researchers to identify high and low anxiety groups prior to participation. It may be of interest to administer the State portion of the questionnaire again during the experiment to investigate whether there was a change in anxiety levels during trials of probe phase such as Phase 4 of the current experiments immediately prior to or following a response. If a correlation was to be found between levels of State anxiety and

response latency then perhaps it could have real implications for our understanding of anxiety as a clinical condition.

It should be noted that in the previous experiments, there was no way to determine whether participants who responded inconsistently clicked the onscreen buttons because they believed they were relationally consistent or because they simply did not know how to respond. It could be suggested that the current experiments would benefit from distinguishing between participants who responded relationally (but inconsistently) from those whose responses were genuinely random or highly variable due to a lack of relational control.

One possible solution to this problem would be to present an onscreen measure to determine the participants' "feeling of knowing" the "correct" response. For instance, an onscreen 5-point Likert Scale presented immediately after participants responded could help gauge their level of confidence in their choice. Alternatively, a button with the caption "I don't know" could be used throughout the experiment. During probe phases its availability might increase response variability and across all phases it would ensure behavioural control by the button was established prior to critical probe phases.

The above suggestions could help future research in generating experiments of competing contingencies. It should be noted that the probe phase of Experiment 3 was particularly successful in generating approach-approach conflict in terms of RT effects. Reaction time delays were not only evident during the first trials of Phases 1 and 4 alone but also in terms of mean RT differences between phases also. It would appear that it was the stimulus compound paradigm more effectively juxtaposed the two approach response function contingencies rather than the formats of Experiments 1 and 2. As mentioned previously, perhaps the most important suggestion for future

research on conflicting contingencies at this point would be to incorporate a similar compound stimulus structure during critical probe phases.

It could be suggested that the RT effect observed above was the result of the expectation of feedback during Phase 4. More specifically, feedback was administered on each trial during Phases 1 and 2 but not during Phases 3 and 4. It may have been the case that the omission of feedback during the critical probe phase had destabilised response rates established in the presence of feedback across previous phases. While this is, of course possible, it would appear unlikely because some of the RT differences reported relate to the first trials of Phases 1 and 4 which were administered before feedback could be presented. In other words, participants had to have responded already before it would have been apparent that feedback was not going to be presented during that phase. It is important to add, however, that participants were explicitly informed that feedback would be shown onscreen during Phase 1 but not Phase 4. Thus, we cannot completely discount the suggestion that the removal of feedback may have caused a small degree of behavioural disruption during Phase 4. If this were the case however unlikely, it would be relatively straightforward to combat this expectation by simply not mentioning feedback in the instructions for either phase. It should be acknowledged, however, that the difference in RTs between Phases 1 and 4 reached statistical significance and it seems doubtful that feedback or the expectation of feedback could account for this difference. However, that is a complex empirical question that requires further investigation.

It could also be argued that the longer RTs produced during Phase 4 of Experiment 3 are related to the mode of response (i.e., one or two box-clicks per trial) produced. It is obvious that a response consisting of one box-click alone would take less time to produce than a response comprising two clicks. In fact, seven participants

(Participants 3, 5, 6, 10, 13, 15 and 20, Experiment 3) clicked two boxes in response to the C stimuli during Phase 4. Therefore, the difference in responses actually made, in addition to the effects of conflicting contingencies may be said to partly account for the observed effects. It is important to consider, however, that a close inspection of the raw data suggests otherwise. Indeed, participants who responded with one box-click per trial during Phase 4 of Experiment 3 produced higher mean RTs than those who responded by clicking two boxes per trial. Thus, while a two box-click response does require more time than a one box-click response, the overall effect of the conflicting contingencies on RTs appears to have diminished the relevance of this component of individual RTs. Of course, it is important to bear in mind that response latency as a measure of derived relational responding is open to interpretation (O'Hora, Roche, Barnes-Holmes and Smeets, 2002) and is still not a common measure in the experimental analysis of behaviour (see Bentall, Dickins & Fox, 1993).

The current experiments aimed to assist in developing a system to allow for the behaviour analytic investigation of laboratory generated approach-avoidance conflicts. Whilst adding further support to the growing derived transfer of functions literature in its own right, three separate approach-approach conflicts were generated in the laboratory. Experimental control over response variability across participants (but not within) was demonstrated through the well-balanced juxtaposition of two approach contingencies. It may be the case that the response variability within participants was not observed due to the reasons outlined above but this issue will be addressed empirically in the following chapters using novel methodologies.

CHAPTER THREE: EXPERIMENTS 4 AND 5

The previous chapter outlined and provided evidence of three procedures that established conflicts of competing contingencies in accordance with derived relational processes. The three experiments aimed to aid in the development of a procedure that can be used to generate approach-avoidance conflicts in the laboratory. However, response variability within participants was not typically observed. Furthermore, it cannot be generalised from a generic contingency conflict (such as those of Experiments 1, 2 and 3) if the same type of effects can be generated using approach-avoidance conflicts.

. Experiments 1, 2 and 3 each generated approach-approach conflicts through simple and conditional discriminations using derived stimulus relations. As mentioned previously, there is no prior research with humans that has sought to investigate the derived transfer of approach-avoidance conflicts. Of course, while these procedures may provide interesting paradigms within which to study approach-avoidance conflicts, this remains to be done. It should, in theory, be possible to use procedures similar to those used in Chapter 2 to generate an approach-avoidance conflict with humans by presenting them with stimuli with dual conflicting response functions that have been established via the derived transfer of functions. That is what will be attempted in the following two experiments in this chapter.

The lack of response variability within participants during the previous three experiments may have been related to the presentation of emotionally innocuous stimuli in the approach-approach conflicts presented. This may have resulted in an absence in the conflicts of any sort of salient competition with each other in terms of consequential functions. That is, the consequences of responding one way or another were merely completing the experiment or perhaps the social approval of the

experimenter. These may simply not be sufficient for a contingency conflict to generate the type of response omission or variability associated with acute fear or panic.

This chapter will examine the possibility that approach-avoidance conflicts may be modelled in the laboratory using images from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) as punishers and reinforcers. The use of emotionally appetitive and aversive stimuli should allow for a more clinically interesting demonstration of approach-avoidance conflict insofar as the emotional functions of the relevant stimuli will mimic closely those of real life stimuli for an acutely anxious client.

Experiments 4 and 5 involved establishing each of two distinct members of the same one-node four-member equivalence relation as a discriminative stimulus for approach and avoidance responses, respectively. Four-member classes were used in order to establish two opposing functions within the same class that were fully derived. During a test phase, participants were presented with equivalence class members that were of equal nodal distance from each of the discriminative stimuli. It was expected that response variation would be observed both within and across participants during the probe phases of both experiments.

3.1 Experiment 4: Approach-Avoidance Conflicts of Competing Functions From The Same Equivalence Class 1

3.1.1 Method

3.1.1.1 Participants

Ten unpaid volunteers were recruited from personal contacts. Participants' ages ranged from 20 to 29 years, and the mean age was 26 years. All participants were male. Of the 10 volunteers, 5 passed the equivalence training and testing (i.e., Participants 5, 7, 8, 9, and 10). Only the results of these 5 participants are discussed here.

3.1.1.2 Ethical Considerations

At least 24 hours before arriving at the laboratory, all participants signed a consent form which acknowledged the distasteful and sexual nature of some of the stimuli to be used during the experiment. Following identical ethical guidelines employed during previous experiments, participants were reminded that their participation was entirely confidential, that they were free withdraw at any point without any consequence and could remove their data following participation if requested (see Appendix 1b).

3.1.1.3 Apparatus and Stimuli

Before beginning the experiment, participants also responded to a series of printed five-point Likert scales to rate the pleasantness and unpleasantness of three sample aversive and three sample erotic images (printed 2" X 2") to be employed in the subsequent phases. Only a sample of the stimuli were rated in order to obtain estimates of stimulus potency for each participant, while simultaneously minimizing habituation to the larger stimulus sets. The ratings did not reveal any significant divergence from those expected given the standardized IAPS (Lang, Bradley, & Cuthbert, 2005). For valence

values see Appendix 4.These were employed as aversive and appetitive stimuli during respondent conditioning, avoidance function training, and approach function training. A total of 20 photographs, 10 aversive (e.g. bodily mutilations) and 10 appetitive (e.g. sexual situations) were selected. Stimuli were chosen to be either maximally aversive or erotic on the basis of their standardized IAPS valences and arousal ratings (see Appendix 3).

Two nonsense syllable stimuli (i.e., JOM and ZID) presented in Arial font were used as discriminative stimuli for the avoidance function and approach function training, respectively. Eight further nonsense syllables, also presented in Arial font, were utilized as sample and comparison stimuli during the training and testing stages of the experiment (i.e., CUG, JOM, PAF, MEL, VEP, ZID, LEB and KED). In the interest of clarity, these will be labelled using the alphanumerics A1, B1, C1, D1, A2, B2, C2 and D2, respectively (see Appendix 7).

3.1.1.4 General experimental sequence

3.1.2.1 Phase l: Respondent conditioning part 1

> Before beginning this phase the following instructions appeared on the screen: Thank you for agreeing to participate. This research involves examining human learning on a series of simple problem-solving tasks involving words and photographs. The first phase of the study will involve engaging in a learning task on this computer. This phase will also involve the presentation of images on the computer screen for three seconds each. Several of these images will involve bodily injury. The names and information provided by each participant in the study will be completely confidential. Please note you are free to withdraw from the study at any time without penalty. IT IS VERY

IMPORTANT YOU PAY ATTENTION TO THE SCREEN AT ALL TIMES.

When you are ready to start please click “Begin” below.

Once the “Begin” icon was clicked, the first trial of Phase 1 commenced. This stage of the experiment consisted of the presentation of B1 and B2 for 3 s each on separate trials. These were immediately followed by the presentation of aversive images (of mutilations) or appetitive images (of a sexual nature), respectively for 5s. In other words, during this phase, each presentation of the B1 stimulus was followed by an aversive stimulus and each presentation of the B2 stimulus was followed an appetitive stimulus. Thus, a trace conditioning procedure was employed during this phase. Both tasks were presented once each in a block of two trials, which was presented five times (i.e., 10 respondent conditioning trials). After each trial the screen went blank. Five seconds later, participants were asked to click the mouse on a button on the screen to continue with the experiment (i.e., an observation response). This was done by presenting the phrase "Please click Continue to proceed with the experiment" in the centre of the screen. The phrase remained on the screen until the participant clicked on the mouse button. This response lead to the inter-trial interval. To avoid temporal conditioning, the inter-trial interval was varied from 10 - 30 s randomly by the computer software.

The order of Pavlovian and operant conditioning was arbitrary during this experiment. Both forms of conditioning we were used create as strong a conflict as possible given the salience of the appetitive and aversive stimuli available during this experiment.

3.1.2.2 Phase 2: Approach and avoidance conditioning part 1

At the beginning of this stage, the following instructions were presented on the computer screen:

In a moment some items will appear on this screen. These will consist of nonsense syllables and pictures.

Now please look at the keyboard and make sure you can see the BLUE and YELLOW KEYS. Once you have read all the instructions and clicked on the Continue button below you should place your LEFT INDEX FINGER on the BLUE KEY and your RIGHT INDEX FINGER on the YELLOW KEY.

You may choose to AVOID certain images by PRESSING THE BLUE KEY on the keyboard before the picture is presented on the screen. You may choose to VIEW other images by PRESSING THE YELLOW KEY on the keyboard before the picture is presented.

In other words, if you don't like certain types of pictures and don't wish to view them press the BLUE KEY at the appropriate time. Similarly, if you like other types of pictures and wish to view them, then press the YELLOW KEY at the appropriate time. This will become clearer once you begin.

It is important that you view or avoid the following images based purely on your own personal preferences for particular types of pictures. Your choice to either view or avoid does not allow the researcher to make any judgment about your character or make any psychological assessments about you whatsoever. In addition, your data will be completely confidential.

Finally, please be aware that some of the following images may be upsetting to some people.

If you have any questions please ask the experimenter now.

Please click ‘Continue’ below to proceed with the experiment.

Clicking the mouse on the onscreen ‘Continue’ button in the centre-bottom of the screen below the instructions led to the presentation of the first trial. During all

trials, instructions appeared in blue and yellow font in the bottom left and bottom right corners of the screen respectively, reminding the participant how to respond appropriately. The instruction in blue font on the left of the screen read, "Press the BLUE key to avoid the image" and the other, presented in yellow font on the right side of the screen stated; "Press the YELLOW key to view the image". The blue and yellow keys were on the left and right of the computer keyboard (positioned on the A and L keys, respectively) and thus spatially corresponded to the blue and yellow instructions presented on-screen. When the participant made the appropriate avoidance response (i.e., pressed the blue key in the presence of the B1 Stimulus), the discriminative stimulus and instructions disappeared, the computer made a beep noise signalling the avoidance response had been registered and the screen remained blank for 5 s.

If a participant failed to make the appropriate avoidance response, both the discriminative stimulus and instructions remained onscreen for 3 s and were followed by an aversive image for 5 s in full-screen mode. If the participant made the appropriate approach response (i.e., pressing the yellow key in the presence of the B2 stimulus) to view an appetitive image, the discriminative stimulus and instructions disappeared, the computer made a different beep noise and an appetitive image was presented for 5 s in full-screen mode. If the participant failed to make an appropriate approach response, both the discriminative stimulus and instructions remained onscreen for 3 s and were followed by a blank screen for 5 s.

Participants were again required to make an observation response 5 s after each trial by clicking the mouse. This was done by presenting the phrase "Please click *Continue* to proceed with the experiment" in the centre of the screen. This sentence

remained on the screen until the participant clicked on the mouse button. This response was followed by the 10-30 s inter-trial interval.

In order to enhance the resistance to extinction of the avoidance and approach responses during Phases 5 and 8, in which no images were displayed (see below), an 80% CS-US contingency was employed during Phases 2 and 7 (see also Roche et al., 2000). That is, during these phases, on 20% of trials in which the appropriate approach response was produced, a sexual image was not presented. Similarly, on 20% of trials in which an appropriate avoidance response was not produced (i.e., the participant chose to view an aversive image), an image was nevertheless not presented. If a participant produced an approach response in the presence of the B1 stimulus on an omission trial, an aversive image was not presented. Trials without images were followed by the normal mouse-click observation response and intertrial intervals as described above. However, if the participant pressed the blue key during the 3 s B1 (S^{D+}) of an omission trial they still heard the same beep noise associated with B1. Similarly, if the participant pressed the yellow key during the 3 s B2 (S^{D-}) of an omission trial they heard the beep noise associated with B2. It is important to understand that the 80% contingency applied to the CS-US relation, and not to the response-consequence relation.

Phase 2 consisted of 20 avoidance and approach conditioning trials (e.g., blocks of four trials with two presentations of both B1 and B2 in a quasi-random order, with the block of four presented five times). If the participant failed to make 19 correct responses out of 20 they were re-exposed to the avoidance conditioning block again. This additional block was preceded by instructions as before. The participant was re-exposed to the conditioning block up to a maximum of three times. If the participant failed to make 19 correct responses out of 20 on a fourth exposure to the block of 20 trials, this signalled the end of their participation and the computer software instructed

them to report to the experimenter. Participant 4 was the only individual not to meet this criterion. If any participant responded correctly to 19 trials out of 20 during any exposure to this phase, they were presented with instructions for the next stage of the experiment .

3.1.2.3 Phase 3: Equivalence training

The instructions for this phase were presented on-screen as follows.

In a moment some words will appear on this screen. Your task is to look at the word at the top of the screen and choose one of the two words at the bottom of the screen by "clicking on it" using the computer mouse and cursor. During this stage the computer will provide you with feedback on your performance. You should try to get as many correct answers as possible. If you have any questions please ask them now. When you are ready to begin please click “Continue” below.

Participants acknowledged that they had read the instructions by clicking an onscreen button labelled “Begin” using the mouse button. When participants clicked the onscreen “Begin” button, the first equivalence training trial was presented. During this stage a sample appeared in the top-middle of the computer screen. After 1.5 s two comparison stimuli, one from each of the two equivalence relations, were shown, one in the bottom left, and one in the bottom right of the screen. All stimuli remained on the screen until the participant clicked on one of the comparisons. After clicking on one of the comparisons, the screen cleared and either "Correct" or "Wrong" appeared on the screen for 1.5 s. When the feedback disappeared, the computer screen remained blank for an inter-trial interval of 500 ms after which the next trial was presented. The left and right positions of both comparison stimuli was randomized across trials.

Two four-member equivalence relations were trained during this phase (see Figure 8) in a blocked one-to-many fashion to establish fully-derived opposing functions within classes. That is, A-B relations were trained to criterion before A-C relations, which were in turn trained before A-D relations. Specifically, in the presence of A1 selection of B1 was reinforced and selection of B2 was punished. Similarly, when A2 was presented, selection of B2 was reinforced and selection of B1 was punished. In the same way the A-C and A-D relations were trained. The trained relations were: A1-B1, A1-C1- A1-D1, A2-B2, A2-C2 and A2-D2.

A-B training (Phase 3a) consisted of two tasks: A1-B1 [B2] and A2-B2 [B1], where alphanumerics in square brackets indicate incorrect choices. These tasks were presented once each in a block of two in a quasi-random order, which was presented 10 times (20 trials). In effect, no one task could be presented more than two times in succession. If the participant failed to make 19 correct responses out of 20, they were re-exposed to the training block again, up to a maximum of three times. If the participant failed to make 19 correct responses out of 20 on a fourth exposure to the block of 20 trials, this signalled the end of their participation and the computer software instructed them to report to the experimenter. If the participant responded correctly to 19 trials out of 20, they proceeded to the next stage of the experiment.

When participants passed this A-B training they were then presented with A-C training (Phase 3b). The tasks A1-C1 [C2] and A2-C2 [C1] were presented in an identical fashion. Similarly, when participants passed A-C training they were moved on to A-D training (Phase 3c) that consisted of the tasks A1-D1 [D2] and A2-D2 [D1]. The same consistency criteria were also applied to Phases 3b and 3c. Participant 2 was the only participant not to meet the criterion for Phase 3c.

When participants had passed each of the three training blocks, a mixed training block (Phase 3d) was presented, comprising all six tasks presented five times each in a random order until the criterion of 29/30 correct responses on a single block of 30 trials was reached. If after four blocks a participant failed to make 29 correct responses in the block of 30, their participation was terminated. No participants failed this phase. When participants responded correctly 29 times in a block of 30, within the four-block limit they were then presented with instructions for Phase 4.

Figure 8: ***The two four-member equivalence classes and their associated functions established in Experiments 1 and 2.***

As with the order of Pavlovian and operant conditioning phases during this experiment, the order of the presentation of equivalence training and testing was also arbitrary. However, presenting equivalence training and testing at this point of the experiment had the added advantage of creating a temporal distance between the two different forms of conditioning tasks required to generate approach-avoidance conflicts during Phases 1 and 2 and 6 and 7, respectively.

3.1.2.4 Phase 4: Equivalence test

The instructions presented to participants at the outset of this phase were as follows:

> In a moment some words will appear on this screen. Your task is to look at the word at the top of the screen and choose one of the two words at the bottom of the screen by "clicking on it" using the computer mouse and cursor. During this stage the computer WILL NOT PROVIDE YOU WITH FEEDBACK on your performance. You should try to get as many correct answers as possible. It might help you to use what you learned in the previous phase to make correct choices in this phase. This phase has no particular time limit but will continue until you are making consistently correct choices. If you have any questions please ask them now. When you are ready to begin please click "Continue" below.

The stimulus equivalence test probed for the formation of the derived relations; B1-D1, B2-D2, D1-B1 and D2-B2. Each task was presented once in a block of four trials in a random order. The block was cycled five times. In effect, no one task was presented more than two times in succession. The blocks of 20 were presented until the participant responded correctly on 100% of the trials within a particular block (up to a maximum of four blocks).

All feedback was omitted during the equivalence testing tasks; responses were followed by the regular inter-trial interval only. Participants had to respond correctly to 20 trials out of 20 to successfully complete testing. If they failed to make 20 correct responses in a block of 20 the computer automatically re-administered the block. If they failed to respond correctly 20 times out of 20 trials within four consecutive testing blocks, their participation was terminated. Participants 1, 3, and 6 did not meet

this criterion. When participants made 20 correct responses in a block they were presented with the instructions for the next stage of the experiment.

3.1.2.5 Phase 5: Probes for responses to 'C' stimuli

The instructions for Phase 5 were as follows:

In a moment some more items will appear on this screen. PLEASE CONCENTRATE ON THE SCREEN AT ALL TIMES. IT IS IMPORTANT THAT YOU CONTINUE TO PAY ATTENTION. Now please look at the keyboard and make sure you can see the BLUE and YELLOW KEYS. Once you have read all the instructions and clicked the Continue button below you should place your LEFT INDEX FINGER on the BLUE KEY and your RIGHT INDEX FINGER on the YELLOW KEY. You may use these buttons as before if you wish. If you have any questions please ask the experimenter now. Please click "Continue" below to proceed with the experiment.

The purpose of this phase was to test for derived transfer of functions from B1 and B2 to C1 and C2, respectively. This stage was similar to Phase 2 with the difference that C1 and C2 were presented in the place of B1 and B2 and no images were presented at any stage. Following all trials, regardless of the response made by participants, the screen remained blank, but the participants were still required to make an observation response 5 s after each trial. This response led to the regular inter-trial interval. Each task was presented twice in a block of four in a quasi-random order. The block was presented twice (i.e., eight trials in total).

3.1.2.6 Phase 6: Respondent conditioning part 2

This phase was identical to Phase 1 except that B1 and B2 were replaced by D2 and D1, respectively. It intended to establish aversive functions for D2 and appetitive functions for D1. This particular pattern of function training juxtaposed the eliciting

functions established in Phase 1, insofar as the equivalence relations would now contain members with both appetitive and aversive eliciting functions. Put simply, Phase 6 was intended to establish functional classes that were orthogonal to the equivalence relations. After 10 function training trials the instructions for Phase 7 were displayed.

3.1.2.7 Phase 7: Approach and avoidance conditioning part 2

This phase was identical to Phase 2, except that B1 was replaced by D2 and B2 was replaced by D1. It complemented Phase 6 in establishing discriminative response functions for the 'D' stimuli that would render the functional classes of appetitive stimuli (B2 and D1) and aversive stimuli (B1 and D2) orthogonal to the tested equivalence relations (i.e., in which B1 is equivalent to D1 and B2 is equivalent to D2). As with Phase 2, if a participant failed to make 19 correct responses out of 20 after four exposures to the block of 20 trials, their participation was to be terminated. All participants exposed to this phase met this criterion. When the participant responded correctly to 19 trials out of 20 they were presented with instructions for the next stage of the experiment.

3.1.2.8 Phase 8: 'C' and 'A' stimuli probes

This stage was a variation of Phase 5, with the addition of A1 and A2 stimuli and the removal of the response criterion. The C1 and C2 stimuli were presented in extinction to see if there had been a change in response functions following Phase 7. In other words, Phase 8 was conducted to investigate if responding patterns had changed following the presentation of Phase 6 (Respondent conditioning part 2) and Phase 7 (Approach and avoidance conditioning part 2) which introduced conflicting response functions into the existing equivalence classes. The 'A' stimuli were also presented to assess the possibility that nodal distance from the original 'B' (discriminative) stimuli might be a factor in determining the impact of Phase 7 on the

functions of equivalence class members. This phase consisted of a block of four tasks (i.e., one for each of the four 'A' and 'C' stimuli) presented in a quasi-random order, and cycled five times (i.e., 20 trials in total).

3.1.2.9 Extinction phase

For ethical reasons participants were exposed to a brief extinction procedure to extinguish all conditioned responses. Due to the considerable time demands of the current procedure, they were exposed to a minimal set of extinction trials. The instructions for this final phase of the experiment were as follows:

> The experiment is now over but in a moment you will see all the nonsense syllables again but no images. There is no need to avoid or approach but you will still need to click Continue to proceed. The computer will tell you when to contact the experimenter. Please click Continue to finish.

During extinction, all 8 stimuli were presented separately onscreen for 3 seconds each and were all followed by a blank screen during the 5 second period in which the picture might normally have been shown. In this phase blue and yellow key presses did not produce their associated beep noises and were not consequated in any way. The block of 8 tasks was presented twice (16 trials) with the usual observation response (see Phase 2) and a randomized inter-trial interval of 10-15 seconds. At the end of this phase, the following message appeared on the screen:

> Thank you for your participation. This is the end of the experiment. Please contact the experimenter to tell them that you are finished.

3.1.3 Results and Discussion

Of the 10 participants originally employed, five failed to pass one of the Phases 1- 7. This is not surprising given the complexity of the procedure and the fact that multiple criteria had to be met across a range of different phases in order for a participant to complete the experiment. Participant 4 failed Phase 2, Participant 2 failed Phase 3 and Participants 1, 3 and 6 failed Phase 4. Therefore, only the data of Participants 5, 7, 8, 9, and 10 are discussed here. All data for responses produced during Phases 2, 3, 4, and 7 are presented in Table 16. Data for Phases 5 and 8 can be seen in Table 17 and 18, respectively.

3.1.3.1 Phases 1 and 2: Avoidance Conditioning Phases

All participants were exposed to Phase 1 and were not required to respond during this phase aside from making an observational response following completion of each trial. Participants 5, 7, 8 and 10 passed phase 2 on their first exposure. Participant 9 achieved a score of 15/20 and 19/20 during their first and second exposures, respectively.

3.1.3.2 Phases 3 and 4: Equivalence Training and Testing

Table 16 shows Participant 5 produced a total correct response rate of 19/20 on their first exposure to Phase 3a (A-B Training) and Phase 3b (A-C Training). Two exposures to Phase 3c (A-D Training). This participant produced a correct response rate of 30/30 during Phase 3d (Mixed Training). No errors were made during the first presentation of Phase 4 (B-D Equivalence Test).

Participant 7 produced a total correct response rate of 19/20 during Phases 3a, 3b and 3c. 30/30 correct responses were produced during Phase 3d. Only one exposure to the equivalence test in Phase 4 was required.

Participant 8 produced a correct response rate of 20/20 on the first presentation of Phase 3a. Two exposures to Phase 3b were required following an initial score of 17/20. This participant scored 19/20 on their first exposure to Phase 3c. Two exposures to Phase 3d were required (28/30 and 30/30, respectively). A total correct response rate of 20/20 was obtained during the single presentation of Phase 4.

Participant 9 required only one exposure to Phases 3a, 3b, 3c, 3d and 4.

Participant 10 required two exposures to Phase 3a (18/20 and 20/20, respectively) and only one exposure to Phases 3b, 3c and 3d. Only one exposure to Phase 4 was required by this participant.

3.1.3.3 Phase 5: Probes for responses to 'C' stimuli

The pre-set criterion for passing this phase comprised producing three or more avoidance responses in the presence of the C1 stimulus and three or more approach responses in the presence of the C2 stimulus. More than one approach response in the presence of the C1 stimulus or one avoidance response in the presence of the C2 stimulus resulted in failure of this phase and termination of participation. By definition, all participants included in the analysis reached this criterion. Participants' performances can be seen in Table 17.

Participant 5 produced four avoidance responses given C1 and three approach responses given C2. He failed to respond to the presentation of C2 on the fourth trial, yet nevertheless met the pass criterion to proceed to the next phase.

Participant 7 produced three avoidance responses in the presence of C1 and produced an approach response to the C2 stimulus on all four trials it was presented on. He failed to respond to the first trial of the phase, which consisted of the presentation of a C1 stimulus.

Participant 8 produced an avoidance response on three trials given C1 and four approach responses given C2. Again, no response was made to the presentation of a C1 stimulus during the very first trial of this phase.

Participant 9 produced three avoidance responses given C1 and four approach responses given C2. The only error occurring during the first trial where the participant failed to respond to the C1 stimulus presented on-screen.

Participant 10 produced an avoidance response on four occasions given C1 and an approach response on four occasions given C2.

3.1.3.4 Phase 6: Respondent conditioning part 2 and Phase 7: Approach and avoidance conditioning part 2

These two phases were identical to Phases 1 and 2 with the difference that D2 and D1 replaced B1 and B2, respectively. Participants were not required to produce approach or avoidance responses during Phase 6. Participant 5, 7, 8 and 9 required only a single exposure to Phase 7. Participant 10 required two exposures to Phase 7 following an initial score of 18/20.

3.1.3.5 Phase 8: 'C' and 'A' stimuli probes

Phase 8 investigated whether patterns of responding changed following the presentation of Phases 6 and 7 conditioning. During this test phase participants generally responded consistently from the outset of the phase. For example, on the first trial of the phase, Participant 5 produced an avoidance response when presented with A1 (see Table 18). Thereafter, for the remainder of this phase this participant continued to produce avoidance responses to A1 and approach responses to A2. No participant completely failed to respond throughout this phase. Overall, two participants responded to the C stimuli consistent with Phases 1 and 2 conditioning (i.e., Participants 5 and 10) and two responded consistently with Phases 6 and 7

conditioning (i.e., Participants 7 and 9). Participant 8 showed no clear pattern associated exclusively with either Phases 1 and 2 or Phases 6 and 7. Rather, their responses appear to show control by both phases simultaneously (i.e., some within-participant variability).

Responses to A1 and A2 displayed a similar pattern. Participants 5 and 10 responded consistently with Phases 1 and 2 conditioning (i.e., avoided in response to C1 and approached in response to C2) but Participants 7, 8, and 9 responded consistently with Phases 6 and 7 conditioning (i.e., avoided in response to C2 and approached in response to C1).

Table 16: Each participant's correct response rate produced during Phases 2, 4 and 7 of Experiment 4. Where extra lines appear for a given participant these numbers refer to performances on additional exposures of the phase until criteria are met.

P. No.	Phase 2	Phase 3a	Phase 3b	Phase 3c	Phase 3d	Phase 4	Phase 7
5	20/20	19/20	19/20	18/20 20/20	30/30	20/20	19/20
7	20/20	19/20	19/20	19/20	30/30	20/20	19/20
8	20/20	20/20	17/20 20/20	19/20	28/30 30/30	20/20	19/20
9	15/20 19/20	20/20	20/20	20/20	30/30	20/20	19/20
10	20/20	18/20 20/20	20/20	20/20	30/30	20/20	18/20 20/20

Table 17: Each participant's responses produced during Phase 5 of Experiment 4. The number of approach and avoidance responses to C stimuli during Phase 5 are shown.

	Phase 5			
P. No.	**Avoid C1**	**Approach C1**	**Avoid C2**	**Approach C2**
5	4	0	0	3
7	3	0	0	4
8	3	0	0	4
9	3	0	0	4
10	4	0	0	4

Table 18: Each participant's responses produced during Phase 8 of Experiment 4. The number of response to C and A stimuli during Phase 8 are shown.

Phase 8								
P. No.	**Avoid C1**	**Approach C1**	**Avoid C2**	**Approach C2**	**Avoid A1**	**Approach A1**	**Avoid A2**	**Approach A2**
5	5	0	0	5	5	0	0	5
7	0	5	5	0	0	5	5	0
8	1	4	2	3	0	5	5	0
9	0	4	5	0	0	5	5	0
10	3	1	0	5	5	0	0	5

Despite a lack of variance in response patterns within participants, the response patterns observable at the group level would appear to be under clear stimulus control by the conflicting contingencies. That is, well-distributed patterns of responding *across* participants is precisely what we would predict when approach and

avoidance contingencies are in conflict. At this point in the research, a number of procedural issues came to the experimenters' attention. Firstly, feedback regarding the appropriateness of particular responses may have been inadvertently delivered during Phase 8. Specifically, during training and testing phases an expected response in the presence of a discriminative stimulus led to the immediate removal of that stimulus from the computer screen. During Phase 8, probe stimuli were removed from the screen irrespective of the response (i.e., because no particular response was either correct or incorrect). Nevertheless, the removal of stimuli immediately following responses may have functioned as a type of feedback for "correct" responding. This may explain why responses were typically consistent across probe trials rather than varied.

It was reasoned that if extended response latencies were observed during critical probe trials compared to probes for derived transfer of functions (Phase 5), this might lend crucial support to the idea that a response conflict could be generated using the current procedures even when within-participant variability was not observed.

Also, it might be interesting to examine the effects of the competing approach and avoidance contingencies on the stimulus functions of the equivalence class members across the different phases of the experiment and across repeated testing phases. The following experiment will address these issues.

3.2 Experiment 5: Approach-Avoidance Conflicts of Competing Functions From The Same Equivalence Class 2

Experiment 4 (Approach-Avoidance Conflicts of Competing Functions From The Same Equivalence Class 1) demonstrated balanced competing derived stimulus control *across* participants for both the C1 and C2 stimuli. A similar, yet not identical, pattern was also observed for responses to the 'A' stimuli. Despite the generation of competing approach and avoidance contingencies, however, responding appears to have been controlled clearly and solely by one and only one stimulus function of the 'A' and 'C' stimuli from the first trial of Phase 8 for four of the five participants. This may be viewed as compromising the claim that an approach-avoidance conflict was experienced by any individual participant. Experiment 5 was designed to address this potential criticism.

As discussed, there were several issues that required addressing in order to fully establish that an approach-avoidance conflict had been modelled during Experiment 4. Moreover, these methodological improvements might lead to the generation of greater levels of response variability within participants. Firstly, to address the issue of potential inadvertent feedback during training and testing phases, Experiment 2 involved the presentation of stimuli onscreen for 3 s regardless of responses emitted during its presentation. Programmed consequences, however, were not altered.

In an effort to more sensitively measure the disruptive effect of conflicting approach and avoidance contingencies on response patterns, a response time measure was also employed during Experiment 5.

Two extra test phases were also added to Phase 8 in Experiment 5. Specifically, Phase 8b was designed to assess derived responses to the 'C' stimuli following the approach-avoidance probes presented in Phase 8 (now referred to as Phase 8a). Phase 8b

also involved further probes for responses to the 'A' stimuli, followed by B stimulus probes. Phase 8b allowed the experimenters to examine more fully any changing effects of the competing approach and avoidance contingencies on the stimulus functions of the equivalence relation members across time and across repeated testing phases. A novel Phase 9 involved re-exposure to stimulus equivalence testing in an attempt to ascertain whether the probes for competing stimulus control had affected the organization of equivalence relations. Any such reorganization could help to explain the emergence of particular sources of stimulus control during critical probes.

3.2.1 Method

3.2.1.1 Participants

Eight male participants, aged 20 to 24 years old (M= 22), were recruited through personal contacts. Of the 8 participants, 5 (Participants 11, 12, 13, 17, and 18) passed the equivalence training and testing and showed a derived transfer of avoidance as defined by a pre-set criterion. Participants 14 and 16 failed Phase 2 and Participant 15 failed Phase 3c. Only the results of the 5 individuals who passed all phases are discussed here.

3.2.1.2 Ethical Considerations

The ethical considerations were identical to those outlined during Experiment 4.

3.2.1.3 Apparatus and Stimuli

All apparatus and stimuli were identical to those used in Experiment 4.

3.2.1.4 General experimental sequence

The consent procedure was identical to that employed in Experiment 4. Participants again rated the pleasantness and unpleasantness of a sample of aversive and erotic images. The ratings did not reveal any significant divergence from those expected given the standardized IAPS valence values (see Appendix 4). All features of the experimental setting were identical to those for Experiment 1. Participants were exposed to nine phases (see Appendix 7).

Phases 1-8a were identical to and corresponded with Phases 1-8 of Experiment 1 apart from the following differences. Firstly, during probe phases stimuli were present onscreen for 3 s irrespective of any responses emitted. No consequence followed a response produced before the end of the 3 s stimulus presentation until the 3 s had elapsed.

Secondly, the number of probes for responses to the ‘A’ and ‘C’ stimuli during Phase 8a was reduced from 10 to 8.

3.2.2.1 Phase 8b

This phase consisted of probes for responses to ‘C’, ‘A’ and ‘B’ stimuli and allowed for a re-examination of any changes in responding to C stimuli that may or may not have occurred following Phase 8a. Each stimulus was presented 4 times (24 trials) in a quasi-random order. In addition, it allowed for a more detailed study of any alteration in the effects of the competing approach and avoidance contingencies on the stimulus functions of the equivalence class members across time and across repeated exposure to the testing phase.

3.2.2.2 Phase 9

This phase comprised a re-exposure to the equivalence test in an effort to determine whether the probes for competing stimulus control had any effect on equivalence class membership. This phase was identical to Phase 4.

3.2.3 Results and Discussion

Of the 8 participants originally recruited, 3 participants failed to pass one of the phases prior to Phase 8a. Specifically, Participants 14 and 16 failed Phase 2 and Participant 15 failed Phase 3c. Therefore, only the data of Participants 11, 12, 13, 17, and 18 are discussed here. All data for Phases 2, 3, 4, 7, and 9 are presented in Table 19. All data for responses produced during Phases 5, 8a, and 8b are presented in Tables 20, 21 and 22, respectively.

3.2.3.1 Phases 1 and 2: Avoidance Conditioning Phases

All participants were exposed to Phase 1 and were not required to formally respond during this phase but were instructed to make an observational response following completion of each trial.

Participants 11 and 17 required only one exposure to Phase 2. Two exposures to Phase 2 were required by Participant 13 (17/20 and 20/20, respectively). Participant 18 required three exposures to Phase 2 (producing 17/20, 18/20 and 20/20 correct responses, respectively). Finally, Participant 12 required four exposures to this phase (the total correct responses produced were 17/20, 18/20, 17/20 and 19/20, respectively).

3.2.3.2 Phases 3 and 4: Equivalence Training and Testing

Tables 19 shows Participants 11, 12,13 and 18 met the pre-set criterion to pass Phase 3a (A-B Training) during their first exposure to the phase. Participants 17 required two exposures of this phase. Participants 12 and 18 required a single exposure to Phase 3b (A-C Training) and Participants 11, 12 and 17 met the criterion following their second exposure. Participants 11, 12, 13 and 17 passed Phase 3c (A-D Training) on their first exposure and Participant 18 required two exposures to this phase. Participants 11, 12 and 13 required one exposure to pass Phase 3d, Participant

17 required two exposures and Participant 18 required three. All participants, passed Phase 4 (Equivalence Test) during their first exposure to the phase.

3.2.3.3 Phase 5: Probes for responses to 'C' stimuli

As expected, all participants showed a pattern of avoiding C1 and approaching C2, although there were a small number of failures to respond recorded.

3.2.3.4 Phase 8a: 'C' and 'A' stimuli probes

Participants again responded consistently with their initial responses during this phase (see Table 4). No participant completely failed to respond throughout the phase, although there were several missed responses to the C stimuli. Three participants responded to the C stimuli consistent with Phase 1 and 2 contingencies. Two participants responded in accordance with Phase 6 and 7 contingencies. Response patterns to the 'A' stimuli were similar and in line with responses to the 'C' stimuli for each participant, although no missed responses were observed for 'A' stimuli.

3.2.3.5 Phase 8b: 'C', 'A' and 'B' stimulus probes.

Three of the four participants exposed to this phase responded to the 'C' and 'A' stimuli according to the same patterns observed during Phase 8a (see Table 21). However, P13 displayed an altered performance during this phase (control shifted from Phase 6 and 7 contingencies to Phase 1 and 2 contingencies). In effect, the administration of Phase 8b allowed for the observation of a degree of within-participant response variability across test blocks. Three of the four participants responded correctly to the 'B' (conditioned) stimuli during this phase. However, P17 responded incorrectly to these stimuli by approaching B1 and avoiding B2, in line with their response pattern to the 'C' and 'A' stimuli. In effect, the original conditioned functions of B1 and B2 appear to have been over-ridden by the functions of D1 and D2 established in Phases 6 and 7 for this one participant.

Table 19: Each participant's correct response rate produced during Phases 2, 3, 4, 7 and 9 of Experiment 5. Where extra lines appear for a given participant these numbers refer to performances on additional exposures of the phase until criteria are met. The horizontal dash symbol (-) indicates that the participant was not presented with that particular phase.

P. No.	Phase 2	Phase 3a	Phase 3b	Phase 3c	Phase 3d	Phase 4	Phase 7	Phase 9
11	19/20	20/20	16/20 20/20	20/20	30/30	20/20	20/20	-
12	17/20 18/20 17/20 19/20	19/20	18/20 20/20	20/20	30/30	20/20	19/20	0/20
13	17/20 20/20	19/20	20/20	20/20	30/30	20/20	15/20 19/20	20/20
17	19/20	17/20 20/20	17/20 20/20	19/20	25/30 29/30	20/20	20/20	20/20
18	17/20 18/20 20/20	19/20	14/20 19/20	18/20 19/20	22/30 28/30 30/30	20/20	18/20 20/20	19/20

3.2.3.6 Phase 9: Re-exposure to the Equivalence Test

Due to experimenter error, Participant 11 was not exposed to this phase. Participant 12 failed the equivalence test during this phase (0/20), indicating that the emergent equivalence relations observed in Phase 3 had been completely reversed as a result of the juxtaposed functional classes established across Phases 1, 2, 6, and 7. However, Participants 13, 17, and 18 passed the equivalence test on the first and only exposure.

Table 20: Each participant's responses produced during Phase 5 of Experiment 5. The number of approach and avoidance responses to 'C' stimuli during Phase 5 are shown.

	Phase 5			
P. No.	Avoid C1	Approach C1	Avoid C2	Approach C2
11	4	0	0	4
12	3	0	0	4
13	3	0	0	4
17	3	0	0	3
18	4	0	0	3

Table 21: Each participant's responses produced during Phase 8a of Experiment 5. The number of approach and avoidance responses to 'C' and 'A' stimuli during Phase 8a are shown.

	Phase 8a							
P. No.	Avoid C1	Approach C1	Avoid C2	Approach C2	Avoid A1	Approach A1	Avoid A2	Approach A2
11	4	0	0	4	4	0	0	4
12	4	0	0	3	4	0	0	4
13	0	4	4	0	0	4	4	0
17	0	3	4	0	0	4	3	1
18	4	0	0	4	3	1	0	4

Table 22: Each participant's responses produced during Phase 8b of Experiment 2. The number of approach and avoidance responses to 'C', 'A' and 'B' stimuli are shown. The horizontal dash symbol (-) indicates that the participant was not presented with that particular phase. Ap and Av indicate approach and avoidance responses, respectively.

	Phase 8b											
P. No.	Av C1	Ap C1	Av C2	Ap C2	Av A1	Ap A1	Av A2	Ap A2	Av B1	Ap B1	Av B2	Ap B2
11	-	-	-	-	-	-	-	-	-	-	-	-
12	4	0	0	4	4	0	0	4	4	0	0	3
13	4	0	0	3	4	0	0	4	3	0	0	4
17	1	3	4	0	0	4	4	0	0	4	4	0
18	2	2	0	4	3	1	0	4	4	0	0	4

3.2.4 Response Latencies

Tables 23 and 24 show the mean response times for each participant and for each probe delivered during Phases 5, 8a, and 8b, as well as the group mean response times for each probe trial. The table shows that three of the five participants (P12, P17, P18) took longer to respond to C1 during Phase 8a compared to Phase 5. Furthermore, three of the five participants (P11, P13, P18) took longer to respond to C2 during Phase 8a compared to Phase 5. The combined mean response time to both 'C' stimuli was higher in Phase 8a than in Phase 5, in line with experimental hypotheses. Response latencies to A1 and A2 during Phase 8a also tended to be consistently high compared to those observed for the C stimuli in Phase 5. Overall, the combined group mean response latencies to all probes in Phase 8a were longer than the combined group mean response latency of all probes in Phase 5, indicative of a contingency conflict. Interestingly, these effects appear to be even more apparent in the second block of probing during Phase 8b. Indeed, all of the participants exposed to Phase 8b produced a longer mean response time to *both* the C1 and C2 stimuli than

to the mean group response time to both of these stimuli during Phase 5. Moreover, the group mean response time to both of the 'C' stimuli rose from Phase 8a to 8b. The mean group response time to A1 also rose while that recorded for A2 dropped slightly.

Table 23: Each participant's Reaction Times (RTs) in milliseconds (ms) produced during Phases 5 and 8a of Experiment 5. SD indicates standard deviation.

	Phase 5		Phase 8a			
P. No.	**C1**	**C2**	**C1**	**C2**	**A1**	**A2**
11	1380	1137	1367	1344	1067	1633
12	1984	2078	2523	1566	1540	1496
13	1792	0824	1484	1641	1156	1691
17	1766	1848	1859	1816	1777	1633
18	1000	0824	1090	1258	1727	1980
Mean	1583	1342	1665	1525	1453	1687
SD	393.40	586.60	553.62	201.93	325.89	179.01
Phase mean	1463		1582			

Table 24: Each participant's Reaction Times (RTs) in milliseconds (ms) produced during Phase 8b of Experiment 5. SD indicates standard deviation.

	Phase 8b					
P. No.	**C1**	**C2**	**A1**	**A2**	**B1**	**B2**
11	-	-	-	-	-	-
12	2367	1941	1667	1680	1563	1601
13	1979	2180	1724	1475	1859	1590
17	1984	1750	1700	1563	1609	1509
18	1656	1828	1891	1906	1750	1703
Mean	1997	1925	1740	1655	1700	1622
SD	290.79	187.36	99.77	185.97	104.21	69.55
Phase mean	1773					

As expected, the response times recorded for the original conditioned 'B' stimuli were shortest of all. In fact, these response times may be taken as an alternative baseline for conditioned avoidance against which to assess the response times to C stimuli during critical probe phases. In this case, we again see that the critical probes for approach-avoidance produced response latencies whose extended length over conditioned responses is predicted given the conflicting contingencies presented during Phases 8a and 8b.

In conclusion, Experiments 4 and 5 seem to have generated a derived transfer of both avoidance and approach functions in accordance with four member equivalence classes and approach-avoidance conflicts through the derived transfer of functions effect. Response variability across but not within participants was observed.

Whilst an absence of responding was not observed response latency differences were produced during the approach-avoidance conflicts of Experiment 5.

3.3 Discussion

The current experiments appear to have demonstrated a derived transfer of both avoidance and approach functions in accordance with four member (one-node) equivalence relations although the evidence is somewhat limited at this point. However, these data thereby extend the findings of Augustson and Dougher (1997), Dymond et al. (2007, 2008), Dougher et al. (1994) and Roche et al. (2008). More importantly, the current experiments are the first to generate an approach-avoidance conflict with human participants by virtue of the derived transfer of functions effect.

Variability in responses to the C1 and C2 stimuli was observed across, but typically not within participants, in both Experiments 4 and 5. The current distribution of approach and avoidance responses during probe phases is as expected when well-balanced approach and avoidance contingencies are juxtaposed (i.e., equal probability of either response class emerging for each stimulus). In other words, the current experiments demonstrate derived relational stimulus control over variability in response patterns *across* participants.

Only one individual (Participant 8, Experiment 4) failed to produce a consistent pattern of responding to the C stimuli during a critical probe phase. One further participant (P13) showed a change in response patterns to the C stimuli across the two probe phases (8a and 8b) in Experiment 5. It might be surprising that more participants did not produce varied responses to stimuli within probe blocks or completely fail to respond. Indeed, the relatively clear, consistent (but varying) responses observed across participants in the current experiments contrasts with the effects observed using functionally analogous preparations with animals. The research literature suggests that animals show response rate decreases when presented with

competing approach and avoidance contingencies involving food and electric shock, respectively. For instance, in one study, Miller (1948) trained rats to run an alley in order to gain access to food in a box. The rats were then shocked while eating the food. On subsequent trials, the rats typically ran the alley to a specific point, before halting just short of it. According to Miller, the approach and avoidance contingencies were equal at this point in time and space. Miller found that this point of equilibrium could be altered by varying the intensity of food deprivation or shock.

While complete failures to respond were not observed using the current procedures, hesitation in responding during conflict probes was observed in Experiment 5 using the response time measures. The response latency data gathered for Experiment 5 support the suggestion that an approach-avoidance conflict was generated in the current study. While the effect of conflicting contingencies on response latency is not apparent for all participants in Phase 8a, it does emerge clearly at the group level. This is a first indicator of experimental control over the approach-avoidance phenomenon. In addition, these effects become even clearer for both individuals and at the group level during Phase 8b.

It is important to point out that the elongated response times observed during probes in Experiment 5 are especially noteworthy when it is considered that under normal circumstances we would expect to see the reverse due to practice effects as participants move from Phase 5 to Phase 8a and on to Phase 8b. Previous evidence provided by O'Hora, Roche, Barnes-Holmes & Smeets (2002) and Roche, Linehan, Ward, Dymond & Rehfeldt (2004) show that in such test phases response times drop rapidly across trials and asymptote rapidly towards a value of a few hundred milliseconds. Such a performance was certainly not observed in the current study. Indeed, given the rises in response times observed across Phases 8a and 8b, there is no

evidence at all for expected practice effects and, indeed, there is an opposite trend suggestive of a response conflict.

In an attempt to generate even clearer response conflicts with human participants, researchers would do well to consider the strength of the unconditioned stimuli employed. For instance, the images employed in the current experiments as aversive and appetitive UCSs and consequential stimuli may have been simply too weak to generate an approach-avoidance conflict that is characterized by the absence of responses and/or erratic responding across probe trials. The use of more salient visual or other consequential stimuli, such as mild electric shock, might allow researchers to generate more impressive analogues of approach-avoidance conflicts in the laboratory.

While it may be suggested that a manipulation check could have been added to these experiments, due to the procedures providing participants with the option to not avoid and complete the block of trials, this shows that all those who met the criteria by definition had shown an aversion to the aversive images and had shown that the sexual images were appetitive to them. In addition, samples of the images had been shown in advance and were rated by each participant prior to commencing the procedure. Nevertheless, it would be prudent to ensure the salience of stimuli by using more through pre-rating of stimuli, perhaps participant selection using personality or trait measures such as the STAI.

Another possible suggestion for future research may be to ensure the functional equivalence of the appetitive and aversive stimuli before the commencement of conditioning phases. Indeed, in the current research subjective ratings for these stimuli were recorded at the outset of each experiment for this very purpose (see Appendices 2 and 4). These did not reveal obvious differences in ratings

of the stimuli that might explain control by approach or avoidance contingencies during critical probe phases. That is, all participants rated the aversive stimuli as less pleasant than the erotic stimuli and so approach responses to C1 during Phases 8 and 8a, for example, cannot be explained by positive subjective rating of the aversive stimuli (see Appendices 2 and 4) because these were never observed. Moreover, it is important to understand that participants generally produced equal amounts of approach and avoidance responses during probe phases, but these responses were distributed differently among the stimuli. That is, some avoided C1 and approached C2, while others did the reverse. No participant avoided *both* 'C' stimuli or approached *both* 'C' stimuli during any phase. Thus, varied but always conditional control over responding was observed for almost all participants during probes phases, suggesting separate control by distinct approach and avoidance stimulus functions.

The current findings may have some relevance to the literature on nodal distance in derived relational responding. Specifically, it would appear that there were more differentiated patterns of responding to the 'A' stimuli relative to 'C' stimuli during probe phases in both experiments. The tendency for responses to the 'C' stimuli to be more varied than those to 'A' stimuli may have resulted from differences in the relational complexity involved in these two trial types. More specifically, responding to the 'C' stimulus involved derived transitive relations (between C and D and C and B), whereas responding to 'A' stimuli required responding only to a symmetrical relation (i.e., between B and A). Similarly, in Experiment 5, response times to the 'A' stimuli were generally shorter than those observed for the 'C' stimuli (although probes using the 'C' stimuli also measured a response conflict). As we would expect, response times to the conditioned 'B' stimuli

during Phase 8b were generally shorter than those observed for the symmetrically related 'A' stimuli and the transitively related 'C' stimuli. This observation is fully in line with previous research which shows that responding at the level of transitive relations is a more complex task that responding at the level of symmetrical relations, and is associated with longer response latencies (e.g., O'Hora et al., 2002; Reilly, Whelan, & Barnes-Holmes, 2005).

At this point, we should address what might be learned from the current findings about the relationship between functional and stimulus equivalence. Consideration of this issue may also provide some insights into performances during probe phases. Specifically, the current experimental preparations bear some functional similarity to preparations used to examine the effect of established functional classes on the emergence or reorganization of stimulus equivalence classes, and vice versa (e.g., Roche, Barnes & Smeets, 1997; Tyndall, Roche, & James, 2004, Wirth & Chase, 2002). Such studies have generally found that incongruous relations between functional and stimulus equivalence classes lead to the delayed emergence or disruption of one or the other. Thus, we might expect the competing functional classes established in the current experiments to lead to either equivalence class disruption, or a failure for those functional relations (i.e., B1-D2 and B2-D1) to emerge in the first instance. More specifically, when D1 acquired its appetitive functions in Phases 6 and 7, it may have caused the reversal of the previously derived aversive C1 functions and conditioned B1 functions, due to the pre-existence of a derived B1-C1-D1 equivalence relation. Similarly, when D2 acquired its aversive functions in Phases 6 and 7, it may have led to the reversal of the previously derived appetitive C2 functions and the conditioned B2 functions. If this were to occur, we would expect to observe only one derived function for the C1 and C2 stimuli (i.e., no

approach-avoidance competition) during critical probe phases. Given that the functions of D1 and D2 in Phases 6 and 7 were appetitive and aversive, respectively, we might expect to see approach responses to C1 and avoidance responses to C2 for some participants during the conflict probe trials. Indeed, there is research evidence for this precise outcome. Specifically, Wirth and Chase (2002) found that the reversal of selected baseline simple discriminations used to disrupt two functional equivalence classes resulted in the complete reversal of response functions across both classes. They argued that this is to be expected because once functional equivalence among stimuli is established, any change in responding applied to one stimulus of a set must, by definition, be applied similarly to the other stimuli in the class.

Of course, a pattern of responding consistent with the foregoing account (i.e., approach C1 and avoid C2) was not observed for all participants in the current study. Moreover, only one participant of ten (P17) showed a reversal of the conditioned B1 and B2 functions. Thus, an account in terms of disrupted stimulus functions by incongruous stimulus equivalence relations is, if tenable, at least insufficient to account for all of the current data. The performance of P13 should also be taken into account in any serious consideration of the foregoing explanation. This participant demonstrated control by Phase 6 and 7 contingencies during Phase 8a (i.e., approached C1 and avoided C2), but *did not* show reversal of the conditioned B stimulus functions in Phase 8b. Moreover, the source of control over responses to 'C' and 'A' stimuli shifted from Phase 8a to 8b, in the absence of any further intervention.

What the current data show in summary, therefore, is possible evidence of disruption by stimulus equivalence relations of conditioned stimulus functions for one Participant (P17) and possible disruption of stimulus equivalence classes by incongruous functional relations for another Participant (P12). Clearly this issue is a

complex one and the possibility of changes in stimulus functions and class structure across phases cannot be dismissed. However, from the varying cases described above, it would appear that an account of the current data in terms of class disruption will have to modify the explanatory process to take account of each individual participant performance. This is clearly less parsimonious than an account in terms of competing contingencies as offered here.

Finally, the conflict experienced by participants in the current research was likely different to that experienced by anxious clients in the world outside the laboratory. More specifically, anxious clients may sometimes find themselves in stimulating contexts in which a failure to respond appropriately and rapidly produces an enormously punishing consequence (e.g., a panic attack may be caused by failing to correctly discriminate whether a stranger as threatening or benign). In such a context, physiological signs of distress and disruption to normal response rates would likely be observed. In contrast, the consequences of "incorrect" responses during the current probe phases were relatively minor. Future studies should focus attention on generating more robust approach and avoidance response by using more salient stimuli such as mild electric shock (aversive) and monetary incentives (appetitive). Motivational variables might also be manipulated through the use of establishing operations relevant to the stimuli employed. For example, a food deprived individual may be more likely to experience an anxiety provoking approach-avoidance response involving the loss or gain of food, than a fully sated individual. Such potential improvements notwithstanding, the current research extends the available literature on derived fear and avoidance by showing that, in principle, both approach and avoidance functions can be derived simultaneously by human participants. Such

conflicts result in delayed responding and response pattern variability across participants which may serve as a model for many forms of human anxiety.

CHAPTER FOUR: EXPERIMENTS 6 and 7

The previous chapter outlined two experiments which extend the available literature on derived fear and avoidance by showing that both approach and avoidance functions can be derived simultaneously by human participants and that response conflicts can be created leading to large response variability. Response variability was observed across, but not within participants, during Experiments 4 and 5. Reaction times produced during Experiment 5 also suggested that participants experienced approach-avoidance conflicts during the critical probe phase.

It could be argued that the previous two experiments used only a competing contingency approach and did not examine fully an approach-avoidance conflict. Even when approach and avoidance contingencies were put in conflict, only one response (i.e., approach or avoid) could be made on any trial during test phases. Thus, from the participants' position the probe phases may have functioned as tests for "correct" responding. Specifically, the contingencies presented during probe phases required participants to choose which of two possible responses were likely to be correct in a context in which only one response was permitted.

In such a case as above, large variation would be expected even if the particular response functions under analysis were not those of approach and avoidance. Indeed, this is exactly the same pattern observed in Experiments 1, 2 and 3, where no avoidance functions were established at all. At this point, the model of approach-avoidance was advanced theoretically from a mere contingency conflict model in which ambiguity over dominant contingencies is introduced. Rather, what was required was a model in which two competing contingencies were *simultaneously and unambiguously* introduced. Therefore, a participant could be certain during probe trials that *both* of two possible responses were required and correct. Put simply,

participants would be required to make a choice, not based on the validity of that choice or a discrimination of prevailing contingencies, but on the basis of the relative competing strengths of well-balanced reinforcing and punishing consequences (i.e., images of bodily mutilation or erotic scenarios during the previous two experiments).

Furthermore, the use of more salient stimuli was introduced to enhance the strength of the conflicts experienced during the critical probe phase. Specifically, mild electric shocks and small amounts of money were introduced as punishers and reinforcers, respectively.

During Experiment 6, a monetary value that was equivalent in strength to the reinforcing value of avoiding a mild shock was established. Two four-member equivalence classes were trained and tested. Each class contained a member that was established as a discriminative stimulus for approach and avoidance, respectively. During the probe phase, participants were simultaneously presented with stimuli that elicited approach and avoidance functions, respectively. Response patterns, response latencies and self-report anxiety ratings were recorded.

4.1 Experiment 6: Approach-Avoidance Conflicts Using Competing Contingencies From Separate Equivalence Classes 1

4.1.1 Method

4.1.1.1 Participants

Twelve volunteers were recruited from personal contacts. All participants were first presented with Phase 1 (Consequence Establishment) and proceeded to a series of subsequent phases (see General Experimental Sequence below) on condition that their performances met predetermined criteria for each phase. Of the twelve participants, five (four males and one female) met the pre-set criteria for each phase of the experiment and were presented with the final critical test phase. Only the data for the five participants who completed the study are discussed here. The five participants' ages ranged from 22 to 25 years, and the mean age was 23.5 years.

4.1.1.2 Ethical Considerations

Ethical clearance by the NUIM Ethics Committee was granted for the establishment of approach-avoidance conflicts using mild electric shocks and small amounts of money. As with Experiments 4 and 5, participants were given 24 hours to consider their participation after provisionally agreeing to take part. Each participant signed a consent form prior to commencing the experiment (see Appendix 1c). Any presentations of the electro-tactile stimulus would not exceed the agreed level as established during Phase 1 of the Experiment (see below) and participants were made aware of this. In addition to the ethical issues mentioned previously during other experiments, the form also reminded participants that the experiment involved the use of mild electric shocks and that shocks could be avoided or approached. It was also stated that small amounts of money could be either earned or rejected. As with all

experiments, participants were presented with an extinction phase at the end of the procedure, were fully debriefed afterwards and thanked for their participation.

4.1.1.3 Apparatus and Stimuli

All apparatus and stimuli were identical to those used in previous experiments with the following exceptions. The eight nonsense syllables used during Experiments 4 and 5 were utilized as sample and comparisons during the training and testing stages of the experiment (i.e., CUG, JOM, PAF, MEL, VEP, ZID, LEB and KED). In the interest of clarity, these will be labelled using the alphanumerics; A1, B1, C1, D1, A2, B2, C2 and D2. A Lafayette Isolated Square Wave Stimulator (Model 82415IS) was used to administer mild electric shocks at a constant voltage. Shocks to be administered had a duration of 300 ms and with a maximum voltage output of 100 Volts. Two disposable solid gel Ag/AgCl sensor electrodes used were used to transfer the shock from the stimulator to the participant. Each was 15mm in diameter and 40 mm apart on the participant's nondominant inner arm. A five-point Likert Scale was presented during certain phases of the experiment on the computer screen.

4.1.1.4 General experimental sequence

4.1.2.1 Phase l: Establishing shock level

The level of shock to be administered was set by each participant before beginning the procedure. This involved administering a single mild electric shock to the participant at the lowest level the Lafayette Isolated Square Wave Stimulator would administer and gradually increasing the strength of the shock, one shock at a time, until the participant indicated to the experimenter that they had reached the maximum level of shock they were willing to receive. Participants were informed that any shocks administered during the experiment would not exceed this agreed level.

Instructions were presented on the computer screen at the start of each remaining phase.

4.1.2.2 Phase 2: Establishing reinforcer value

Before beginning this phase the following instructions appeared on the screen:

Thank you for agreeing to participate. This research involves examining human learning on a series of simple problem-solving tasks. IT IS VERY IMPORTANT YOU PAY ATTENTION TO THE SCREEN AT ALL TIMES. When you are ready to start please click 'Begin' below.

When the participant clicked the onscreen 'Begin' button the next set of instructions appeared:

In a moment some items will appear on this screen. These will consist of amounts of money and coloured boxes.

You may choose to AVOID the brief electric shocks and money by CLICKING THE RED BOX on the screen before the shock is administered.

You may choose to receive the mild shock and the amount of money displayed by CLICKING THE GREEN BOX on the screen before you expect to receive either the money or brief shock.

In other words, if you do not want to receive a shock or the amount of money displayed at all, click on the RED BOX. Similarly, if you are willing to receive a shock and money, then click the GREEN BOX at the appropriate time. This will become clearer once you begin.

If you have any questions please ask the experimenter now.

Please click Continue below to proceed with the experiment.

Clicking the 'Continue' button resulted in the presentation of the first trial of this phase. An amount of money between 5 cents and 50 cents (Euro) in black Arial font

(size 48) was presented on its own in the top-middle of the screen for 1.5 seconds and then two coloured boxes (red and green) appeared underneath (see Figure 9). The red box was positioned in the lower left corner of the screen and contained the caption "Click this box to avoid the shock and money." The green box was positioned in the lower right corner of the screen and contained the caption "Click this box to receive money and the shock." Each box was 8cm in length and 5cm wide.

Clicking either box resulted in the disappearance of both boxes and the amount of money. A five-point Likert Scale then immediately appeared onscreen with the following instructions:

> Please rate how anxious you felt as you made your choice during the previous trial.

Participants then rated their anxiety on the scale. An anxiety rating of 1 on the scale corresponded to "Not at all" anxious, whilst an anxiety rating of 5 corresponded to "Very much so" (see Figure 9, top and bottom centre panels). After rating their anxiety and clicking the "Submit and Continue" button below the scale on the screen, participants were immediately presented with feedback on their response (see Figure 9, top and bottom right panels).

Clicking the red box resulted in a feedback message with the caption "You clicked the red box and refused the shock and amount of money onscreen." Similarly, clicking the green box resulted in a feedback message with the caption "You clicked the green box and just received a shock and will receive the amount of money on offer at the end of the experiment." (see Figure 9, top and bottom right panels, respectively) The feedback remained onscreen for 3 seconds and was followed by the inter-trial interval. Inter-trial intervals were between 5-15 seconds in a quasi-random order to avoid temporal conditioning.

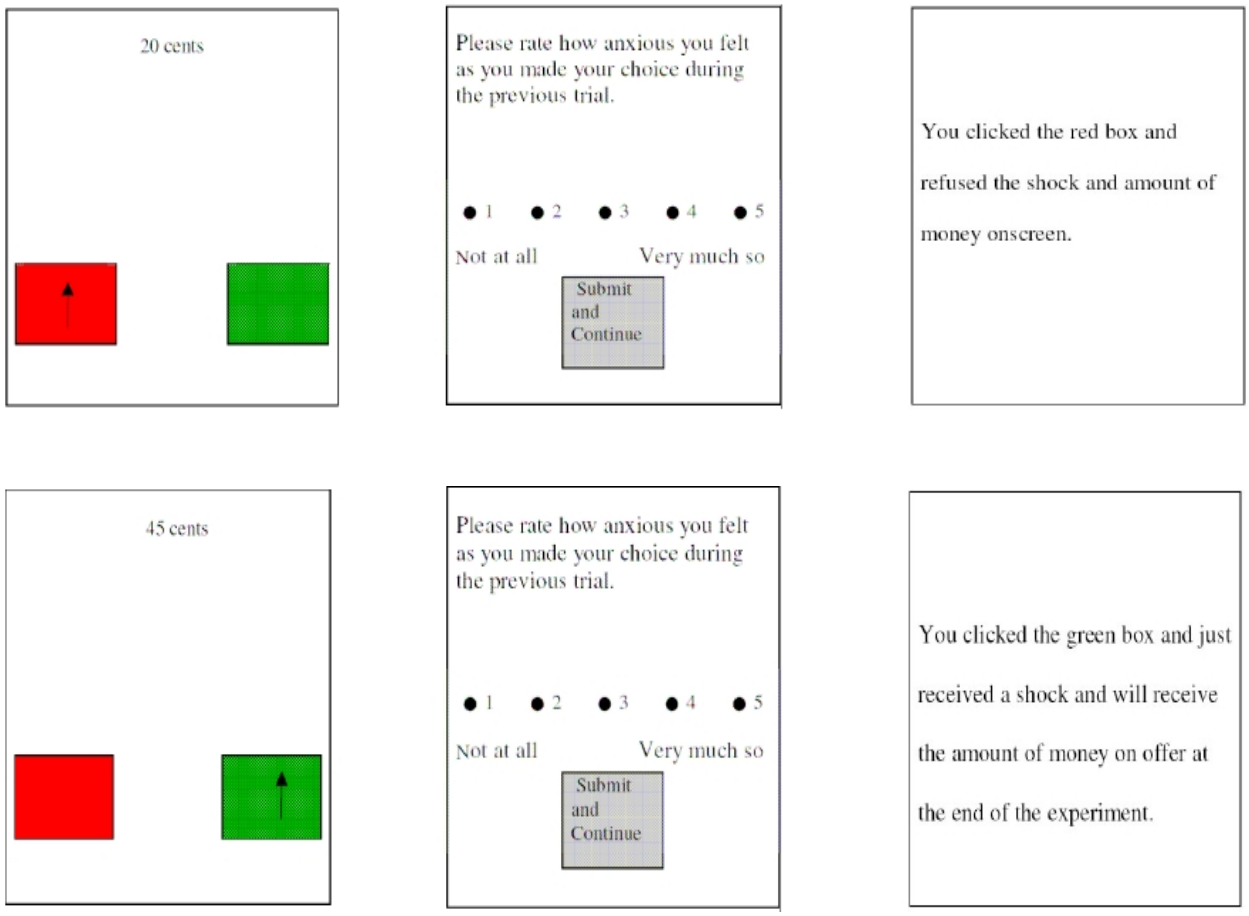


Figure 9 ***Examples of tasks presented, Likert Scales and related feedback during Phase 1.*** **The ↑ symbol indicates a mouse-click on an onscreen coloured box.**

This phase consisted of ten trials. Amounts of money between 5 and 50 cents (in multiples of 5 cents) were presented in a quasi-random order. In order to meet the pre-set criterion, participants were required to produce at least one approach response and at least one avoidance response during this phase. This was necessary in order to

ensure that the lowest and highest amounts of money offered were insufficient and more than sufficient, respectively, to create an approach response. In other words, this ensured that the range of monetary consequences offered was sufficient to produce an approach-avoidance conflict during later stages of the experiment (see below). If a participant did not meet this criterion, their participation was terminated. However, if a participant produced at least one avoidance and one approach response they were informed of the amount of money that would be on offer per trial for the remainder of the experiment after the final trial had been presented. This amount of money was calculated by dividing the sum of the lowest amount of money approached and the highest amount avoided by 2 (i.e., the mean). The participant was then presented with instructions for the next phase on the computer screen.

4.1.2.3 Phase 3: Approach and avoidance conditioning

Before beginning this phase the following instructions appeared on the screen:

In a moment some items will appear on this screen. These will consist of nonsense words, amounts of money and coloured boxes.

You may choose to AVOID the brief electric shocks or the amount of money on offer by CLICKING THE BLUE BOX on the screen before the shock is administered. You may choose to receive the mild shock or the amount of money offered by CLICKING THE YELLOW BOX on the screen before you expect to receive either the money or brief shock.

In other words, if you do not want to receive a shock or the amount of money displayed at all, click on the BLUE BOX. Similarly, if you are willing to receive a shock or the money on offer, then click the YELLOW BOX at the appropriate time. This will become clearer once you begin.

If you have any questions please ask the experimenter now.

Please click Continue below to proceed with the experiment.

Clicking the 'Continue' button resulted in the presentation of the first trial of Phase 3. A nonsense syllable in black coloured Arial font (size 48) was presented on its own in the top centre of the screen for 1.5 seconds. Following this, two uncaptioned boxes (blue and yellow) appeared underneath. The blue box was positioned in the lower left corner of the screen and the yellow box was positioned in the lower right corner of the screen. Clicking either box resulted in the disappearance of all stimuli from the screen and the immediate presentation of a five-point Likert Scale with instructions identical to those presented during Phase 2. After rating their anxiety and clicking 'Submit and Continue', participants were presented with a feedback message for 3 seconds.

In the presence of the B1 stimulus clicking the blue box was reinforced by the cancellation of a mild electric shock. If a participant clicked the yellow box in the presence of the B1 stimulus they received a mild electric shock. Clicking the yellow box in the presence of the B2 stimulus was reinforced by the awarding of the set amount of money established during Phase 1. This amount was to be totalled and given to the participant at the end of the experiment. Participants were informed this by the experimenter before beginning this phase. In the presence of the B2 stimulus, clicking the blue box resulted in the participant not receiving the amount of money on offer during that particular trial.

This phase consisted of 10 trials with both tasks presented in a block of two repeated five times. Shocks were administered on 75% of the trials they were on offer in order to enhance resistance to extinction. The first ten trials were presented without a pre-set criterion (i.e., an acquisition phase). Participants were then presented with

this phase a second time (i.e., a test phase). A criterion of 9/10 correct responses was required to proceed with the next phase of the experiment. If a participant produced a correct response rate of either 7/10 or 8/10 during the second exposure to this phase they were presented with this phase a final third time. A criterion of 9/10 correct responses was again applied during the third presentation, where required. If a participant produced a correct response rate of 6/10 or less on the second block, or 8/10 or less on the third block, their participation was terminated. Following successful completion of this phase participants were immediately presented with the first trial of the next phase without a break for instructions.

4.1.2.4 Phase 4: Probes for non-derived approach-avoidance conflicts

This phase was identical to Phase 3 apart from the following exceptions. Both B1 and B2 stimuli were presented simultaneously in a compound form. The order of presentation of stimuli was randomized across trials (i.e., B1/B2 and B2/B1). No pre-set criterion applied to this probe phase. After 10 trials participants were presented with instructions for the next phase. The purpose of this phase was to assess whether non-derived approach-avoidance conflicts could be generated. Rates of approach and avoidance, as well as measures of anxiety and reactions times during this phase could serve as a baseline against which to compare subsequent probes for derived approach-avoidance conflicts (i.e., Phase 8).

4.1.2.5 Phase 5: Equivalence training

Phase 5, its respective instructions and criteria were identical to those used in Experiments 4 and 5 (see Appendix 7 also for all target relations).

4.1.2.6 Phase 6: Equivalence test

The relations tested during Phase 6 were B-D, D-B, B-C, C-B, C-D and D-C relations. Each task was presented once in a block of six which was repeated five times (30 trials).

4.1.2.7 Phase 7: Probes for responses to 'C' stimuli

Before beginning this phase the following instructions appeared on the screen:

In a moment some more items will appear on this screen.

PLEASE CONCENTRATE ON THE SCREEN AT ALL TIMES. IT IS IMPORTANT THAT YOU CONTINUE TO PAY ATTENTION.

Please note that amounts of money will no longer be displayed onscreen BUT YOU WILL STILL BE EARNING IT AND THE TOTAL WILL BE CALCULATED AT THE END OF THE PHASE.

Also, shocks may not be delivered on a trial by trial basis BUT WILL BE TOTALLED AND DELIVERED INDIVIDUALLY WITH THE MONEY AT THE END OF THE EXPERIMENT.

You may use the onscreen buttons as before if you wish. During this phase the computer will not provide you with feedback.

If you have any questions please ask the experimenter now.

Please click Continue below to proceed with the experiment.

Clicking the 'Continue' button lead to the presentation of the first trial of this phase. The purpose of this phase was to test for the derived transfer of functions from B1 and B2 stimuli to C1 and C2 stimuli, respectively. This phase was identical to Phase 3 apart from the following exceptions. C1 and C2 stimuli replaced B1 and B2 stimuli, respectively. No feedback was presented during this phase. Also, no consequences (i.e., shock or money) were presented during this phase. Participants were informed that shocks and money would be totalled and presented at the end of the experiment.

In order to proceed with the experiment, participants were required to avoid the C1 stimulus on at least four trials and not approach it more than once and to approach the C2 stimulus at least four times and not avoid it more than once. If a participant did not meet this pre-set criterion their participation was terminated. If a participant met this criterion they were immediately presented with the first trial of the next phase without a break for instructions.

4.1.2.8 Phase 8: Probes for responses to C1/C2, C2/C1 and C1/D1 and C2/D2 stimuli

This phase was chronologically a continuation of Phase 7 above as it was presented without a break between both phases. The purpose of this phase was to measure participants' responses to four compound stimuli. Specifically, responses and reaction times produced in the presence of compound stimuli with both aversive and appetitive functions combined (i.e., C1/C2 and C2/C1) were measured. In addition, responses and reaction times produced in the presence of compound stimuli with either aversive or appetitive functions only (i.e., C1/D1 and C2/D2) were also measured. C1/C2, C2/C1, C1/D1 and C2/D2 compound stimuli were presented once each in a block of four repeated five times (20 trials) in a quasi-random order. In effect, the same task was never presented twice in succession during this phase. At the end of this phase participants were immediately presented with the first trial of the next phase without a break for instructions.

4.1.2.9 Phase 9: Re-exposure to the equivalence test

This phase was identical to Phase 6 except it was only presented once regardless of participants' correct response rate. The purpose of this phase was to examine the effect (if any) of conflict probe trials on the previously established

stimulus equivalence relations. After completing this phase participants were presented with instructions for the extinction phase.

4.1.2.10 Extinction phase

For ethical reasons participants were exposed to a brief extinction procedure to extinguish all conditioned responses. Due to the considerable time demands mentioned during Experiments 4 and 5, participants were exposed to a minimal set of extinction trials. The instructions for this final phase of the experiment were as follows:

> The experiment is now over but in a moment you will see all the nonsense syllables again but no images. There is no need to avoid or approach but you will still need to click Continue to proceed. The computer will tell you when to contact the experimenter. Please click Continue to finish.

Clicking the 'Continue' button resulted in the presentation of the first trial of this phase. This phase was identical to Phase 8 apart from the following exceptions. All 8 stimuli and four compound stimuli were presented separately onscreen. During extinction, blue and yellow box clicks were not consequated in any way other than the trial ending. The block of 8 tasks was presented twice and the block of four was presented four times (32 trials) and a quasi-randomized inter-trial interval of 5-15 seconds. At the end of this phase, the following message appeared on the screen: Thank you for your participation. This is the end of the experiment. Please contact the experimenter to tell them that you are finished.

4.1.3 Results and Discussion

Of the 12 participants originally sampled, seven failed to meet the pre-set criterion of Phases 1-8. Specifically, Participants 1 and 3 failed Phase 2, Participant 8 failed Phase 3, Participant 11 failed phase 5, Participant 7 failed Phase 6 and Participants 4 and 5 failed Phase 7. Therefore, only the data of Participants 2, 6, 9, 10 and 12 are discussed here. All of the data reported here consist of totals of numbers of responses produced during training/testing, reaction times in milliseconds and self-report anxiety ratings.

4.1.3.1 Phase 2: Establishing reinforce value

All participants were presented with Phase 2 following the establishment of their agreed level of mild electric shock (Phase 1: Establishing Shock Level). Participants 1 and 3 did not each produce at least one avoidance and at least one approach response during this phase and their participation was terminated. Each remaining participant met this pre-set criterion. The set amounts for monetary consequences established for Participants 2, 6, 9. 10 and 12 were 35 cents, 15 cents, 25 cents, 15 cents and 25 cents, respectively.

4.1.3.2 Phase 3: Approach and avoidance conditioning

Participants were presented with this phase once in the absence of its pre-set criterion. Each participant produced a correct response rate of 10/10 during their first exposure with the criterion (see Table 26).

4.1.3.3 Phase 4: Probes for non-derived approach-avoidance conflicts

Participant 2 approached the B1/B2 Stimulus once and the B2/B1 Stimulus twice and avoided all other presentations of the B1/B2 and B2/B1 stimuli during the remainder of the phase. Participants 6, 9 and 10 produced approach responses on

every trial during this phase. Participant 12 produced approach responses on 8 trials (consisting of four B1/B2 presentations and four B2/B1 presentations) and avoided the B1/B2 stimulus on one trial and avoided the B2/B1 stimulus on one trial (see Table 25).

Table 25: Each participant's responses produced during Phases 4. The number of approach and avoidance responses to B1/B2 and B2/B1 stimuli during Phase 4 are shown.

	Phase 4			
P. No.	**Avoid B1/B2**	**Approach B1/B2**	**Avoid B2/B1**	**Approach B2/B1**
2	4	1	3	2
6	0	5	0	5
9	0	5	0	5
10	0	5	0	5
12	1	4	1	4

4.1.3.4 Phase 5: Equivalence Training

Table 1 shows each participant's correct response rate produced during Phases 5 and 6. Participant 12 was the only participant who required two presentations of Phase 5a. The remaining four participants met the pre-set criterion for Phase 5a. Participants 2, 6 and 9 each produced an initial correct response rate of 18/20 and then 20/20 during their first two exposures to Phase 5b. Participants 10 and 12 met the pre-set criterion for this phase during their first presentation. Participants 2, 6, 9 and 10 required only one exposure to Phase 5c but Participant 12 required two presentations. Each participant met the pre-set criterion for Phase 3d within their first presentation of the phase.

4.1.3.5 Phase 6: Equivalence Test

Each participant met the set criterion for Phase 6 within their first exposures (see Table 26).

Table 26: Each participant's correct response rate produced during Phases 3, 5a, 5b, 5c, 5d, 6 and 9during Experiment 6. Where extra lines appear for a given participant these numbers refer to performances on additional exposures of the phase until criteria are met.

P. No.	Phase 3	Phase 5a	Phase 5b	Phase 5c	Phase 5d	Phase 6	Phase 9
2	10/10	19/20	18/20 20/20	20/20	29/30	30/30	30/30
6	10/10	19/20	18/20 20/20	19/20	30/30	30/30	29/30
9	10/10	19/20	18/20 20/20	20/20	30/30	30/30	30/30
10	10/10	20/20	20/20	19/20	30/30	30/30	30/30
12	10/10	18/20 20/20	19/20	18/20 19/20	29/30	30/30	30/30

4.1.3.6 Phase 7: Probes for responses to 'C' stimuli.

Participants reliably produced avoidance responses in the presence of the C1 stimulus and approach responses in the presence of the C2 stimulus. Participant 2, 6, 9, 10 and 12 avoided the C1 stimulus 5 times and approached the C2 stimulus 5 times during this phase (see Table 27).

Table 27: Each participant's responses produced during Phase 7 Experiment 6. The number of approach and avoidance responses to 'C' stimuli during Phase 7 are shown.

	Phase 7			
P. No.	**Avoid C1**	**Approach C1**	**Avoid C2**	**Approach C2**
2	5	0	0	5
6	4	1	0	5
9	5	0	0	5
10	5	0	0	5
12	5	0	0	5

4.1.3.7 Phase 8: Probes for responses to C1/C2, C2/C1, C1/D1 and C2/D2 stimuli

Four out of five participants produced approach responses in the presence of C1/C2 and C2/C1 stimuli (see Table 28). As expected, participants tended to avoid C1/D1 stimuli and approach C2/D2 stimuli. Specifically, Participant 2 avoided all presentations of C1/C2, C2/C1 and C1/D1 compound stimuli and approached C2D2 stimuli. Participant 6, 9, 10 and 12 produced approach response patterns in the presence of C1/C2, C2/C1 and C2/D2 stimuli. These participants produced avoidance responses in the presence of all C1/D1 stimuli. However, some minimal dispersal was observed across the conflict probes. For example, both P6 and P12 produced one avoidance response in the presence of the C1/C2 stimulus but produced approach responses during the remaining 4 presentations of the same stimulus. Indeed, slight variation in responding to probes within and across participants was observed.

Table 28: Each participant's responses produced during Phase 8 of Experiment 6. The number of approach and avoidance responses to C1/C2, C2/C1, C1/D1 and C2/D2 stimuli during Phase 8 of Experiment 6 are shown.

	Phase 8							
P. No.	Avoid C1/C2	Approach C1/C2	Avoid C2/C1	Approach C2/C1	Avoid C1/D1	Approach C1/D1	Avoid C2/D2	Approach C2/D2
2	5	0	5	0	5	0	0	5
6	1	4	0	5	5	0	0	5
9	0	5	0	5	5	0	0	5
10	0	5	0	5	5	0	0	5
12	1	4	0	5	5	0	0	5

4.1.3.8 Phase 9: Re-exposure to the Equivalence Test

Each produced a correct response rate of 30/30 with the exception of Participant 6 who produced a correct response rate of 29/30 (see Table 26).

4.1.4 Response latencies

Table 29 shows the mean response times for each participant, each stimulus during Phases 3 and 4 and Table 30 shows the mean response times for each participant to each stimulus during Phases 7 and 8. During Phase 8 four participants (Participants 2, 6, 9 and 10) produced longer mean RTs during conflict trials than non-conflict trials. In addition, the mean RT for all conflict trials was larger than the mean RT produced during the non-conflict trials combined.

Analysis of the RTs produced during the first presentations of each stimulus revealed that the first conflict trials presented produced larger RTs on average than the first non-conflict trials presented, for all participants (see Table 32). Reaction Times produced during first conflict trials were larger than RTs produced during the first presentations of C1/D1 and C2/D2 for four individual participants (Participants 2, 6, 9 and 10). Reaction Times produced during the first presentation of C1/D1 were larger than RTs produced during the first presentation of C2/D2 for three out of five participants (Participants 2, 9 and 10).

Table 29: Each participant's mean Reaction Times (RTs) in milliseconds (ms) produced during Phases 3 and 4. SD indicates standard deviation.

P. No	Phase 3		Phase 4
	B1	B2	B1/B2 and B2/B1
2	2820	2841	2677
6	2736	2491	2752
9	2602	2789	2519
10	2194	2617	2679
12	2305	2467	3505
Mean	2531	2641	2826
SD	271.68	169.75	388.72
Phase Mean	2586		2826

Table 30: Each participant's mean Reaction Times (RTs) in milliseconds (ms) produced during Phases 7 and 8. SD indicates standard deviation.

P. No	Phase 7		Phase 8			
	C1	C2	C1D1	C2D2	Conflict Probes	Non-conflict Probes
2	2694	2288	4118	2456	13407	3287
6	3491	4244	2238	2003	2954	2120
9	4862	3150	3144	2571	3521	2858
10	2881	2503	3169	2363	4320	2766
12	6909	4150	3197	2681	2755	2939
Mean	4167	3267	3173	2414	5391	2794
SD	1752.3	906.39	664.96	232.04	4044.45	380.32
Phase Mean	3717		4093			

Table 31: Each participant's Reaction Times (RTs) in milliseconds (ms) produced during the first trials of Phases 3 and 4. SD indicates standard deviation.

P. No	Phase 3		Phase 4
	B1	B2	B1/B2 and B2/B1
2	2469	2281	3828
6	4156	5171	6640
9	8000	9828	6391
10	3266	2218	4000
12	2609	4265	6313
Mean	4100	4753	5434
SD	2279.91	3110.69	1394.50
Phase mean	4227		5434

Table 32: Each participant's Reaction Times (RTs) in milliseconds (ms) produced during the first trials of Phases 7 and 8. SD indicates standard deviation.

P. No	Phase 7		Phase 8			
	C1	C2	C1/D1	C2/D2	Conflict Probes	Non-conflict Probes
2	3844	1921	12203	1938	114171	7073
6	4531	5891	2000	2172	5812	2086
9	9703	3625	4688	3813	8438	4250
10	4594	2578	5250	2359	8766	3805
12	7641	5094	3016	3234	3188	3125
Mean	6062	3822	5431	2703	28075	4068
SD	2508.41	1489.89	4001.52	790.50	48181.88	1867.48
Phase mean	4942		12070			

4.1.5 Self-report anxiety ratings

Self-report anxiety ratings showed that higher anxiety was produced during conflict trials than non-conflict trials of Phase 8 for all participants (see Table 34). When anxiety ratings during the first trials were analysed a higher rating was produced during conflict than non-conflict trials of Phase 8 by 4/5 participants (see Table 36). The mean self-report anxiety ratings and ratings produced during first trials of Phase 3 and 4 are shown in Tables 33 and 35, respectively. Three participants rated their anxiety higher during the derived conflict trials of Phase 8 than during the non-derived conflict trials of Phase 4. During first trials only, three rated their anxiety the

same during Phases 4 and 8, one rated anxiety higher during Phase 4 and one rated anxiety higher during Phase 8.

Table 33: Each participant's mean self-report anxiety rating on the 5-point Likert Scales presented during Phases 3 and 4. A rating of "1" corresponds to a reported feeling of "not anxious at all" whilst a rating of "5" corresponds to a reported feeling of "very anxious". SD indicates standard deviation.

P. No	Phase 3		Phase 4
	B1	B2	B1/B2 and B2/B1
2	2.3	3.3	3.1
6	2.8	2.2	1.4
9	1.4	1.4	2.1
10	1.1	1.2	2.6
12	3.4	2.2	3.4
Mean	2.2	2.1	2.5
SD	0.96	0.83	0.80
Phase mean	2.15		2.5

Table 34: Each participant's mean self-report anxiety rating on the 5-point Likert Scales presented during Phases 7 and 8. A rating of "1" corresponds to a reported feeling of "not anxious at all" whilst a rating of "5" corresponds to a reported feeling of "very anxious". SD indicates standard deviation.

P. No	Phase 7		Phase 8			
	C1	C2	C1D1	C2D2	Conflict Probes	Non-conflict Probes
2	2.2	2.2	1.0	1.0	1.7	1.0
6	2.2	1.4	1.0	1.6	2.3	1.3
9	1.0	1.0	1.0	1.0	1.2	1.0
10	1.0	1.0	1.0	1.0	2.8	1.0
12	4.0	3.2	2.8	2.2	3.7	2.5
Mean	2.1	1.8	1.4	1.4	2.3	1.4
SD	1.23	0.94	0.80	0.54	0.97	0.65
Phase mean	2.0		1.6			

Table 35: Each participant's self-report anxiety rating on the 5-point Likert Scales presented during the first trials of Phases 3 and 4. A rating of "1" corresponds to a reported feeling of "not anxious at all" whilst a rating of "5" corresponds to a reported feeling of "very anxious". SD indicates standard deviation.

P. No	Phase 3		Phase 4
	B1	B2	B1/B2 and B2/B1
2	3	3	5
6	3	2	3
9	3	3	3
10	2	2	2
12	4	4	5
Mean	3.0	2.8	3.6
SD	0.70	0.84	1.34
Phase mean	2.9		3.6

Table 36: Each participant's self-report anxiety rating on the 5-point Likert Scales presented during the first trials of Phases 3 and 4. SD indicates standard deviation

P. No	Phase 7		Phase 8			
	C1	C2	C1D1	C2D2	Conflict Probes	Non-conflict Probes
2	3	4	1	1	3	1
6	3	2	1	3	3	3
9	1	1	1	1	3	1
10	1	1	1	1	3	1
12	4	3	4	3	5	4
Mean	2.4	2.2	1.6	1.8	3.4	2.0
SD	1.34	1.30	1.20	1.10	0.89	1.41
Phase mean	2.3		2.2			

In summary, participants showed a slight degree of variability in response to conflict probes. However, 4 of the 5 participants produced a predominantly approach response pattern during both Phase 4 non-derived conflict probes and Phase 8 derived conflicts. This may be due to the sample size used but also may be the result of another process yet to be identified. Analysis of mean RT data revealed that 4 out 5 participants produced larger RTs during Phase 8 derived conflict probes than Phase 4 non-derived probes. In addition the Phase 8 mean conflict RT was larger than the Phase 4 mean conflict RT. Four out of 5 participants took longer to respond during conflict trials than non-conflict trials during Phase 8. Perhaps more interesting was the finding that all five participants produced longer RTs during their first exposure to a Phase 8 derived conflict trial than during their first exposure to a Phase 8 derived non-

conflict trial. Three out of five participants also produced a larger RT during a Phase 8 derived conflict trial than a Phase 4 non-derived conflict trial. Higher self-report anxiety ratings during Phase 8 conflict trials than Phase 8 non-conflict trials for all participants and for 4/5 participants, when first trials of Phase 8 only were analysed. Three out of five participants produced higher mean self-reported anxiety rates during Phase 8 than Phase 4. During first trials only, one participant produced a higher self-reported anxiety rating during Phase 8; one participant produced a higher rating during Phase 4 and the remaining participants produced an equal rating during both phases. The mean anxiety rating produced during first trials during Phase 4 was slightly higher than Phase 8. Four out of five participants passed the re-exposure to the equivalence test and thus equivalence class disruption cannot be used to explain any response patterns observed. Despite a small level of variability in response patterns within participants, a greater level of such within-participant response variability was expected. Once again, the current procedures did not produce an exaggerated response variability effect, while clearly demonstrating response delays and heightened anxiety associated with derived approach-avoidance conflict probes. The reason why this conflict is not as clear in response patterns as it is with other measures is not yet clear.

4.2 Experiment 7: Approach-Avoidance Conflicts Using Competing Contingencies From Separate Equivalence Classes 2

During Experiment 6, 4/5 participants produced approach responses when presented with C1/C2 and C2/C1 conflict probes during Phase 5b. As expected participants tended to avoid C1/D1 stimuli and approach C2/D2 stimuli. Analysis of mean RT data revealed that 4/5 participants took longer to respond during conflict trials than non-conflict trials during this phase. Perhaps more interesting was the finding that all five participants produced longer RTs during their first exposure to a conflict trial than during their first exposure to a non-conflict trial. Self-report anxiety ratings showed a trend in which higher ratings were produced during conflict trials than non-conflict trials for all participants. When anxiety ratings during the first trials were analysed a higher rating was produced during conflict than non-conflict trials by 4 of the 5 participants. These findings suggested again that approach-avoidance conflicts can be measured in the laboratory. However, a strong tendency was observed for participants to approach during conflict trials. This may be due to the small sample size but it may also be due to processes not yet identified.

A series of minor procedural issues were identified that may help to account for the outcome of Experiment 6. It became apparent that perhaps the entire experimental sequence was too long. Fatigue resulting from the experimental demands placed on participants may help to explain the imbalanced response patterns observed for most participants during the critical approach-avoidance probes. Phase 4 (Probes for non-derived approach-avoidance conflicts) was removed to reduce the attention and learning demand placed on the participant. Phase 7 (which tested for derived transfer of functions) was presented after Phase 8 (Probes for responses to C1/C2, C2/C1, C1/D1 and C2/D2 stimuli) to allow for the demonstration of the

derived transfer of functions before the presentation of a specific test for this effect. Should the derived transfer of functions test be presented before the critical probe phase it may have facilitated responses during probes with the result that were not truly novel and derived but a repetition of the well-practiced derived transfer of responses observed during a previous phase.

In addition, instructions may have been functioning to reduce the salience of consequences by rendering them temporally remote. More specifically, in the case of the present experiment, consequences were temporally distant as participants were informed by prior instruction that any money or mild electric shocks to be awarded would be totalled and administered at the end of the experiment. The interim period between responding to tasks and the expected presentation of consequences may have had an effect on participants' responding. The instructions during the previous experiment were serving to delay consequences and therefore reduced the influence of the consequences of conflict trials. Therefore instructions before the critical probe phase did not inform participants that shocks would be totalled and delivered at the end of the experiment. This change was made so that responses, particularly during the initial trials, were produced without any explicit instruction that aversive consequences would be delayed.

One final amendment was made to address the possibility that they valences of consequences were altering across the duration of the experiment from Phase 1 to Phase 8 due to habituation or fatigue. If this were to occur it may be difficult to establish a perfect approach-avoidance conflict towards the end of the experimental sequences. Thus, participants were re-exposed to Phase 2 before the presentation of the extinction phase to see if values established during Phase 1-8 had changed or not during the experiment.

4.2.1 Method

4.2.1.1 Participants

Nine male and two female participants, aged 20 to 25 years old (M= 22), were recruited through personal contacts. Of the eleven participants, 4 (Participants 4, 5, 7 and 11) passed the equivalence training and testing and showed a derived transfer of avoidance as defined by a pre-set criterion. Only the results of the four individuals (three male and one female) who passed all phases are discussed here.

4.1.1.2 Ethical Considerations

Ethical considerations for this experiment were the same as those in Experiment 6 (see Appendix 1c).

4.2.1.3 Apparatus and Stimuli

All apparatus and stimuli were identical to those used in Experiment 7.

4.2.1.4 General experimental sequence

The consent procedure was identical to that employed in previous experiments. Phases 1-8 were identical to and corresponded with Phases 1-8 of Experiment 6 with the following differences (see Appendix 7). Firstly, Phase 4 (Probes for non-derived approach-avoidance conflicts) was omitted. Second, Phase 7 (Probes for C1 and C2 stimuli which tested for derived transfer of functions) was presented after the critical probes of Phase 8 (Probes for responses to C1/C2, C2/C1, C1/D1 and C2/D2 stimuli) to allow for the demonstration of the derived transfer of functions before the presentation of a specific test probing for the derived transfer of

functions effect, thereby making it more likely that any derived conflicts observed were genuinely novel demonstrations of this phenomenon in conflict.

Thirdly, instructions before the critical probe phase did not inform participants that shocks would be totalled and delivered at the end of the experiment. As mentioned previously, this was done to investigate responses made, particularly during the earlier trials, without any expectations arising as a result of the wording of the instructions presented during Experiment 6. Finally, participants were re-exposed to Phase 2 (Establishing reinforcer value*)* before the presentation of the extinction phase to determine if values of consequential stimuli (i.e., shock and money) established during Phase 2 had changed during the course of the experiment.

4.2.2 Results and Discussion

Of the 11 participants originally employed, 7 participants failed to pass one of the phases prior to Phase 8. Specifically, Participants 2 and 10 failed Phase 2, Participant 3 failed Phase 5d, Participants 1 and 6 failed Phase 6 and Participants 8 and 9 failed Phase 8.

4.2.2.1 Phase 2: Establishing reinforcer value

All participants were presented with Phase 2 following the establishment of their agreed level of mild electric shock (Phase 1: Establishing Shock Level). Participants 2 and 10 did not each produce at least one avoidance and at least one approach response during this phase and their participation was terminated. Each remaining participant met this pre-set criterion. The reinforcer values established for Participants 4, 5, 7 and 11 were 30 cents, 30 cents, 25 cents and 15 cents respectively.

4.2.2.2 Phase 3: Approach and Avoidance Conditioning

Participants were presented with this phase once in the absence of its pre-set criterion. Participants 4 and 11 produced a correct response rate of 9/10 during their second exposure (see Table 37). Participants 5 and 7 produced correct response rates of 10/10 on their second exposure. No participant required a third exposure.

4.2.2.3 Phase 4: Equivalence Training

Participants 4 and 5 both produced correct response rates of 19/20 during their first exposure to Phase 4a (see Table 37). Participants 7 and 11 both produced correct response rates of 18/20 and 20/20 on their first and second exposures to Phase 4a, respectively. Participants 4 and 11 both produced a correct response rate of 19/20 during their first exposure to Phase 4b. Participants 5 and 7 both required two exposures of Phase 4b to proceed with the experiment. Participant 4 was the only

participant to meet the pre-set criterion of Phase 4c within their first exposure. Participants 5 and 11 required two exposures and Participant 7 required three exposures to Phase 4c. Participant 4 also required only one exposure to Phase 4d to meet the pre-set criterion. Participant 5 required two exposures to Phase 3d and Participants 7 and 11 both required three exposures to meet the pre-set criterion of this phase.

4.2.2.4 Phase 5: Equivalence Test

Participant 4 passed Phase 4 during their first exposures to the phase. Participants 5, 7 and 11 each required two exposures to meet the pre-set criterion of Phase 5 (see Table 37).

4.2.2.5 Phase 6: Probes for responses to C1/C2, C2/C1, C1/D1 and C2/D2 stimuli

Three out of four participants produced approach responses in the presence of C1/C1 and C2/C1 stimuli (see Table 38). As observed during Experiment 6, participants tended to avoid C1/D1 stimuli and approach C2/D2 stimuli. Specifically, Participants 4, 7 and 11 produced approach response patterns in the presence of C1/C2, C2/C1 and C2/D2 stimuli. These participants produced avoidance response patterns in the presence of C1/D1 stimuli. Participant 5 produced avoidance response patterns in the presence of C1/C2, C2/C1 and C1/D1 stimuli and an approach response pattern in the presence of C2/D2 stimuli. Participants only showed a very slight degree of variability in response to conflict probes. For example, P4 produced 2 avoidance responses in the presence of the C1/C2 stimulus and 3 approach responses to the same stimulus.

Table 37: Each participant's correct response rate produced during Phases 3, 4a, 4b, 4c, 4d, 5 and 8 during Experiment 7. Where extra lines appear for a given participant these numbers refer to performances on additional exposures of the phase until criteria were met.

P. No.	Phase 3	Phase 4a	Phase 4b	Phase 4c	Phase 4d	Phase 5	Phase 8
4	9/10	19/20	19/20	20/20	30/30	30/30	30/30
5	10/10	19/20	15/20 20/20	16/20 19/20	27/30 30/30	25/30 30/30	29/30
7	10/10	18/20 20/20	13/20 20/20	14/20 17/20 20/20	28/30 28/30 29/30	29/30 30/30	30/30
11	9/10	18/20 20/20	19/20	17/20 20/20	21/30 22/30 29/30	26/30 30/30	30/30

Table 38: Each participant's responses produced during Phases 6. The number of approach and avoidance responses to C1/C2, C2/C1, C1/D1 and C2/D2 stimuli during Phase 6

	Phase 6							
P. No.	**Avoid C1/C2**	**Approach C1/C2**	**Avoid C2/C1**	**Approach C2/C1**	**Avoid C1/D1**	**Approach C1/D1**	**Avoid C2/D2**	**Approach C2/D2**
4	2	3	0	5	5	0	0	5
5	5	0	5	0	5	0	0	5
7	0	5	0	5	4	1	0	5
11	0	5	0	5	5	0	0	5

4.2.2.6 Phase 7: Probes for responses to 'C' stimuli

Participants produced avoidance responses in the presence of the C1 stimulus and approach responses in the presence of the C2 stimulus. All four participants avoided the C1 stimulus 5 times and approached the C2 stimulus 5 times during this phase (see Table 39).

Table 39: Each participant's responses produced during Phase 7. The number of approach and avoidance responses to C1 and C2 stimuli during Phase 7 of Experiment 7 are shown.

	Phase 7			
P. No.	**Avoid C1**	**Approach C1**	**Avoid C2**	**Approach C2**
4	5	0	0	5
5	5	0	0	5
7	5	0	0	5
11	5	0	0	5

4.2.2.7 Phase 8: Re-exposure to the Equivalence Test

Each produced a correct response rate of 30/30, with the exception of Participant 5 who produced a correct response rate of 29/30 (see Table 37).

4.2.2.8 Phase 9: Re-exposure to Establishing Reinforcer Value

The reinforcer value established during Phase 7 remained the same for Participant 4 (30 cents). However, a new and lower reinforcer value was established for Participant 5 (25 cents, compared to 30 cents initially established). A new and lower reinforcer value was also established for Participant 11 (10 cents compared to 15 cents initially established). Interestingly, a reinforcer value could not be set for Participant 7 because they avoided all amounts of money and shocks on each trial. Thus, it can be concluded that the reinforcer value equivalent to the mild shock had changed for this participant during the curse of the experiment.

4.2.3 Response Latencies

Tables 40 and 41 show the mean response times for each participant, each stimulus and phase during Phases 3, 6 and 7. During Phase 6, three participants (Participants 4, 7 and 11) produced larger mean RTs during conflict trials than non-conflict trials. Each participant's reaction time produced during the first trials of Phase 3 are shown in Table 42. Analysis of the RTs produced during the first presentations of each stimulus (see Table 43) revealed that the first conflict trials produced larger RTs than the first non-conflict trials for two participants (Participants 4 and 7) during Phase 6. The mean RT for first presentations of C2/D2 was the largest mean produced during Phase 6. In conclusion, the general trends of RT data are in the direction of conflict trials producing larger RTs than non-conflict trials.

Table 40: Each participant's mean Reaction Times (RTs) in milliseconds (ms) produced during Phase 3. SD indicates standard deviation.

P. No	Phase 3	
	B1	B2
4	2436	2347
5	1831	1947
7	2281	2153
11	2506	2719
Mean	2264	2292
SD	303.27	328.48
Phase Mean	2278	

Table 41: Each participant's mean Reaction Times (RTs) in milliseconds (ms) produced during Phases 6 and 7. SD indicates standard deviation.

P. No	Phase 6				Phase 7	
	C1D1	C2D2	Conflict Probes	Non-conflict Probes	C1	C2
4	1847	2505	2900	2176	3771	1888
5	1850	2547	1873	2198	2306	2134
7	3278	2243	4448	2760	2513	2400
11	2581	2621	2920	2601	1975	2975
Mean	2389	2479	2834	2434	2641	2349
SD	685.92	164.48	1061.17	292.36	785.08	466.62
Phase Mean	2534				2495	

Table 42: Each participant's Reaction Times (RTs) in milliseconds (ms) produced during the first trials of Phases 3. SD indicates standard deviation.

P. No	Phase 3	
	B1	B2
4	2000	2562
5	1830	1828
7	3203	1953
11	2281	4344
Mean	2329	2672
SD	611.94	1160.02
Phase Mean	2500	

Table 43: Each participant's Reaction Times (RTs) in milliseconds (ms) produced during the first trials of Phases 6 and 7 of Experiment 7.

P. No	Phase 6				Phase 7	
	C1D1	C2D2	Conflict Probes	Non-conflict Probes	C1	C2
4	1984	1875	3546	1930	11109	1938
5	1906	5453	2093	3677	2781	3234
7	4562	2562	5093	3562	2171	2141
11	3734	4250	2828	3992	2063	2250
Mean	3047	3535	3390	3290	4531	2391
SD	1316.44	1621.96	1280.96	800.96	3807.64	576.84
Phase Mean	3324				3461	

4.2.4 Self-report anxiety ratings

Table 44 shows the mean anxiety ratings produced during Phase 3. Analysis of self-report anxiety ratings showed that three out of four participants (Participants 5, 7 and 11) rated their anxiety as higher during non-conflict trials than conflict trials during Phase 6 (see Table 45). Three participants (Participants 4, 5 and 7) rated their anxiety higher during C1/D1 presentations than C2/D2 presentations. The mean C1/D1 rating was higher than C2/D2 conflict and non-conflict means for Phase 6. However, when anxiety ratings during the first trials were analysed, a higher rating was produced during conflict than non-conflict trials by Participants 4 and 5 (see Table 47). Participant 7 produced the same ratings in the presence of each compound stimulus during their first presentations of Phase 6. Participant 11 rated their anxiety higher during C1/D1, C2/D2 and combined non-conflict trials than conflict trials.

Table 44: Each participant's mean self-report anxiety rating on the 5-point Likert Scales presented during Phase 3 of Experiment 7. A rating of "1" corresponds to a reported feeling of "not anxious at all" whilst a rating of "5" corresponds to a reported feeling of "very anxious". SD indicates standard deviation.

P. No	Phase 3	
	B1	B2
4	3.4	4.6
5	1.6	1.8
7	2.8	4.4
11	3.8	3.8
Mean	2.9	3.7
SD	0.96	1.28
Phase Mean	3.3	

Table 45: Each participant's mean self-report anxiety rating on the 5-point Likert Scales presented during Phases 6 and 7 of Experiment 7. A rating of "1" corresponds to a reported feeling of "not anxious at all" whilst a rating of "5" corresponds to a reported feeling of "very anxious". SD indicates standard deviation.

P. No	Phase 6				Phase 7	
	C1D1	C2D2	Conflict Probes	Non-conflict Probes	C1	C2
4	1.8	1.0	2.2	1.0	3.4	1.4
5	1.8	1.0	1.6	1.8	1.0	1.0
7	5.0	4.4	3.4	4.7	5.0	3.4
11	2.2	3.2	2.6	2.7	3.0	2.4
Mean	2.7	2.4	2.5	2.6	3.1	2.1
SD	1.54	1.69	0.75	1.59	1.65	1.08
Phase Mean	2.55				2.6	

Table 46: Each participant's self-report anxiety rating on the 5-point Likert Scales presented during the first trials of Phase 3 of Experiment 7. A rating of "1" corresponds to a reported feeling of "not anxious at all" whilst a rating of "5" corresponds to a reported feeling of "very anxious". SD indicates standard deviation.

P. No	Phase 3	
	B1	B2
4	1	5
5	3	5
7	3	3
11	5	5
Mean	3.0	4.5
SD	1.63	1.00
Phase Mean	3.8	

Table 47: Each participant's self-report anxiety rating on the 5-point Likert Scales presented during the first trials of Phases 6 and 7 of Experiment 7. A rating of "1" corresponds to a reported feeling of "not anxious at all" whilst a rating of "5" corresponds to a reported feeling of "very anxious". SD indicates standard deviation.

P. No	Phase 6				Phase 7	
	C1D1	C2D2	Conflict Probes	Non-conflict Probes	C1	C2
4	1	4	4	1	5	1
5	2	2	3	2	1	1
7	5	5	5	5	5	5
11	4	4	3	4	4	3
Mean	3.0	3.8	3.8	3.0	3.8	2.5
SD	1.83	1.26	0.96	1.83	1.89	1.91
Phase Mean	3.4				3.2	

In summary, participants only showed a very slight degree of variability in response to conflict probes. However, 3 of the 4 participants produced a predominantly approach response pattern during both Phase 2b and 5b. During Phase 5a, three participants produced longer mean RTs during conflict trials than non-conflict trials. The first conflict trials presented produced larger RTs than the first non-conflict trials for two out of four participants. Three out of four participants produced higher mean anxiety ratings during non-conflict trials than conflict trials. Two out of four participants rated their anxiety as higher during the first conflict trial than non-conflict trial whilst one rated both the same and the remaining participant rated non-conflict trials higher.

The same general effects observed previously have been observed again during Experiment 7, with the unexpected outcome of anxiety ratings now appearing to be unrelated to experimental manipulations. This may be due to the fact that with a low number of participants the type of variations observed in Experiment 6 became more problematic in obscuring trends that may only have only been visible at the large group level. On the other hand, it must be conceded that the anxiety levels may have been relatively reliable and therefore indicate the absence of any particular psychologically related anxiety during the probe phase. It must be remembered, however, that while self-reported anxiety may not indicate any particular conscious anxiety caused by the conflicts, RTs suggest that the conflict trials did impinge negatively on task fluency.

In other words, anxiety levels may be so low as to render the self-reported measure relatively meaningless. In addition, it should be remembered that the demonstrated changes in the reinforcer values for three of the four participants across

the experimental sequence strongly suggested that these values were transient and sensitive to environmental conditions. This provides an important insight into why more “unstable” response patterns were not observed during the present and previous experiments.

4.3 Discussion

The experiments reported in this chapter appear to have established approach-avoidance conflicts through derived stimulus relations with more salient stimuli than previously used. Across two experiments, nine participants were provided with the opportunity to approach or avoid varying amounts of money and mild electric shocks, both simultaneously and in isolation. Response patterns, reaction times and self-reported rates of anxiety were measured as indicators of possible behavioural disruption. Response variability across participants, reaction time delays during conflict trials and (to a lesser degree higher) self-reported anxiety ratings were observed during conflict trials than non-conflict trials were observed.

Although response variability was evident across participants, response consistency was typical within participants. Specifically, during Experiments 6 and 7, 4 of 5 and 3 of 4 participants, respectively, produced approach response patterns across trials during conflict trials during the probe phases. This suggests that the reinforcing value of avoiding a shock was not as high as the reinforcer value established for the participants during Phase 1. As for previous experiments, one possible reason for the absence of response variation (particularly across trials) during critical probe phases of Experiments 6 and 7 is the history of training during previous phases. More specifically, during previous phases of this experiment and previous experiments, consistent responding was reinforced. For example, during equivalence training, if a participant did not produce the required amount of consistently correct responses, they were re-exposed to that phase a further three times. If they failed to meet the criterion within four exposures their participation was terminated. Inconsistent responding was both directly (the word “Wrong” appearing onscreen)

and indirectly (re-exposure to phases when criteria were not met) punished. It is not surprising, therefore, that responses produced across probe phases tended to be consistent with responses made at the beginning of the phase.

In order for an approach-avoidance conflict outside of the laboratory to result in significant behavioural instability or in the absence of responding altogether, the consequences of approach and avoidance responses would have to be perfectly equal. Perhaps it is unusual for such a situation to occur in the real world, much less to be modelled in a laboratory. Interestingly, however, any verbally able human should be able to experience such perfect approach-avoidance conflicts as a result of verbal contingencies. That is, either hypothetical scenarios can be presented verbally to an individual or the individual can construct the scenario for themselves. As an example, an agoraphobic client may be told, or may state themselves that if they stay indoors they will die, and if they leave the house they will die. Both responses to the client's dilemma are equally drastic and equally aversive. Similarly, each response is equally appetitive (i.e., avoiding death). In this instance it might be expected to see considerable distress despite the fact that the consequences are entirely verbally constructed (i.e., the client will not die in either case).

Instead of seeking response variability within participants and examining reaction times across trials, a definition describing a typical anxious client is probably very broad and would likely include repertoires of more avoidance than approach and vice versa. For example, consider the case of two clients with Generalised Anxiety Disorder. One of the clients works in a job that involves confronting social situations and often thinks about staying at home to avoid any unpleasantness that those situations elicit. The other usually stays at home to avoid such situations but often thinks about going to work for their own gratification. In both cases, responses are

consistent across each occasion an approach-avoidance conflict arises but are different across individuals. Thus, in the real world, response variability or the complete absence of responding may rarely occur, even when actual well-balanced contingency conflicts arise. This may indeed be the case and the matter of behavioural consistency and stability in responding will be further discussed in the General Discussion.

Perhaps it is the case that response variability across trials or an absence in responding is not the most important measure of anxiety in approach-avoidance conflicts. The role of reaction time differences may play a more vital role than it seems. In simple terms, the reaction time measures the length of time the participant experienced the approach-avoidance conflict before it is terminated by a response (i.e., the dilemma is resolved). In addition, as mentioned above, the fact that the same response occurs on a number of occasions that a particular stimulus is presented does not mean that a conflict was not experienced prior to making that response.

Analysis of mean RT data revealed that 4 of the 5 participants during Experiment 6 and 3 of the 4 participants during Experiment 7 took longer to respond during conflict trials than non-conflict trials during this phase. Perhaps more interesting was the finding that during Experiment 6 all five participants produced longer RTs during their first exposure to a conflict trial than during their first exposure to a non-conflict trial. During Experiment 7, two participants produced larger RTs during the first conflict trials than the first non-conflict trials. Examination of Tables 3 and 4 and, to a lesser degree, of Tables 9 and 10 shows a noticeable difference between the reaction times produced during the first presentations of each stimulus and phase and the mean for each stimulus and phase.

At this point it is difficult to know to what extent the compound stimuli presented during Phase 5b during Experiment 6 and Phase 5a during Experiment 7

function as discriminative stimuli for approach and avoidance. This is particularly difficult to ascertain during the latter trials of the phases. For instance, during early trials of the probe phases of both experiments, the contingencies were clearly juxtaposed. However, once the juxtaposed stimuli have controlled responding several times, there is likely to be a change in the form of stimulus control exerted. For example, the CI/C2 compound stimulus, is likely to function as a single stimulus eliciting a single response as the phase progresses. This is also likely to be true for the deriving of the functions of the C1 and C2 stimuli on their own during the test for the derived transfer of function phases. Once responding is under the control of the C1 and C2 stimuli it is likely the participant no longer explicitly derives the relations during each trial in which the 'C' stimuli are presented. During trials later on in the critical probe phase, compound stimuli no longer function as discriminative stimuli for incompatible responses whose functions have been derived. Should this be the case, a rapid decrease in response times appears likely even though the trials presented involve contingency conflicts.

During probe and training phases, a 5-point Likert-Scale was presented for participants to rate their anxiety across trials. It may be the case that the timing of the administration of the mild electric shocks punished responding on the onscreen Likert-Scales and as a result interfered with response patterns produced. More specifically, the point could be made that participants were being punished for responding to the scale and not for approaching the shock. However, it is important to note that participants tended to avoid shocks across both experiments, so there was a relatively small number of trials on which participants received the electro-tactile stimulus following their response to the scale. Furthermore, due to the nature of both experiments, shocks were only on offer for approximately 50% of trials (i.e., where an

aversive stimulus was presented. In addition, due to omission trials, on only 75% of those 50% of trials were shocks to be actually administered. This may be too lean a schedule to establish a robust punishment function for the scale. While there were problems associated with delivering the self-report scales during trials, it was crucial to get participants' self-reported anxiety ratings in vivo. If this was not done, the scale would simply become a post-hoc survey. The current design remains true to analysing moment-to-moment behaviour and it seems very likely that these ratings would be different if the scale was to be administered at the end of the experiment.

Following completion of Experiment 7, it came to the experimenter's attention that the absence of an observation response during the critical probe phases of Experiments 6 and 7 might have been problematic. That is, it could be suggested that participants only acknowledged the first structure in the compound stimulus and responded accordingly, particularly during non-conflict trials. However, it must be pointed out that during experiments participants tended to produce approach responses in the presence of both C1/C2 stimuli and C2/C1 stimuli. Furthermore, Phase 4 of Experiment 6 provided participants with a history of receiving both consequences on offer and feedback on their responses.

Should the current data be interpreted in terms of conditioned inhibition, the following would need to be considered. Conditioned inhibition has been defined as the learned ability of a stimulus to control the likelihood of a response instead of excitation (Rescorla, 1969). During instances of conditioned inhibition each stimulus has a clear function, except in the presence of each other. While this concept only applies to classical conditioning, and this is an operant conditioning paradigm, some respondent conditioning effects may have influenced the stimulus properties on conflict trials. The availability of the consequence to each stimulus is removed or

reduced through the presence of the other stimulus during instances of conditioned inhibition. From this perspective, in the case of the current data, when C1/C2 and C2/C1 compound stimuli were presented, C2 may have signalled the availability of a small amount of money except when C1 was present, in which case the availability of a mild electric shock was also signalled. It may have occurred that the availability of this different outcome could have reduced the salience of C2, or in other terms inhibited its stimulus function, such that responding rates were inhibited. Some or all of the response time delays observed in the conflict trials might be attributable to such a process.

Nonetheless, it needs to be remembered that the process of conditioned inhibition is respondent, and such an account leaves no room for conflicts in the reinforcing effects but reduces all effects due to the respondent process. Indeed, it has been long understood that choices also occur in operant paradigms (Baum, 1979; Davison & McCarthy, 1988; de Villiers, 1977; Herrnstein, 1961; Mazur, 1991; McDowell, 2005; Pierce & Epling, 1983; Williams, 1988). For example, according to the matching law (Herrnstein, 1961), a person will divide their time and effort between two or more behavioural options that are concurrently available in proportion to the level of reinforcement that is contingent on each. The matching law originated following an experiment where Herrnstein presented pigeons with two buttons that led to the varying availability of food in a Skinner box. The pigeons tended to produce a response pattern of pecking the button that resulted in greater availability of food than the other button at a similar rate to the rate of reward available. During the current experiment, it may be the case that some participants produced response rates similar to the levels of reinforcement available, also. For example, it may have been reinforcing for some participants to respond consistently across trials because the

consequences of the conflicts may have been similar in terms of reinforcement to the time and effort required for responding. It may also be that participants deemed the time and effort involved in producing a consistent pattern of responding to be similar to the level of reinforcement of producing response consistency itself. This is not unreasonable as producing consistent verbal behaviour has been shown to be reinforcing for verbal activity itself (Roche, Barnes-Holmes, Barnes-Holmes, Stewart and O'Hora, 2002). Further consideration will be given to the response patterns produced and the observation of within-participant response consistency in the General Discussion chapter.

In terms of the current operant study, it is likely that the consequences of the appetitive and aversive stimuli presented to generate conflicts through derived relations require more than a respondent conditioning account alone even if respondent process may have been involved to some degree. In other words, to conclude, the consequences of the stimuli presented themselves can come into conflict or be responded to differentially due to operant processes and not just due to respondent processes operating at the level of the conditioned stimuli.

A second and, perhaps, more noteworthy point relates to the lack of variability in structure of C1/D1 and C2/D2 stimuli in the current experiments and how this may or may not have accounted for some of the stability observed. More specifically, during probe phases there were a limited number of trial types (3) and only a single punisher and single reinforcer available. When using such a restricted range of stimuli and well-established reinforcing consequences, behavioural stability across probe phases seems somewhat likely even when contingencies are in conflict with each other. Reversing the order of the presentation of C1/D1 stimuli to D1/C1 stimuli and similarly C2/D2 to D2/C2 and presenting all four compound structures during future

studies may eliminate this potential criticism as the order of compound stimuli were not counterbalanced up to this point.

Similarities obviously exist between Phases 2 (Establishing reinforcer value) and 3 (Approach and avoidance conditioning) of both Experiment 7 and 8 where the reinforcer value was established and approach and avoidance responses were conditioned, particular to responses to the type of tasks presented. In terms of Multiple Exemplar Training, establishing the reinforcer value could be seen as also establishing response patterns to conflicts. At this point, it is difficult to say if that was the case. Nonetheless, this phase of the experiment was required and efforts were made to distinguish it from subsequent phases. More importantly, the main point of the two phases is that in order to proceed with approach/avoidance conditioning, a reinforcer value had to be established beforehand. This goes some way to show the difficulties of conducting this type of research as every manipulation can easily result in interference with functions or stimuli already in use or that were used in a similar role in a previous version of an experimental preparation.

During Experiment 7, the reinforcer value established at the beginning of the experiment changed for three out of four participants at some point during the procedure. As noted previously, this difference in value could lead to difficulties in establishing approach-avoidance conflicts where both contingencies were required to be as equal as possible toward the end of the experiment. One solution to this issue is to no longer depend upon one fixed unchanging value established by Phase 2 It may be more beneficial to probe for conflicts using a wide variety of monetary values during the probe phase to see if any can be used to create significant response disruption.

For example, conflict probes could be presented where the money on offer varies on a trial-by-trial basis. Participants may or may not respond to each amount of money on offer differently. Response variability across trials may become more likely even if the availability of the reinforcer is signalled. In theory, each trial presented during the probe phase would then consist of a genuinely novel task. As stimulus conditions for each trial would be far more variable than they have been on previous experiments this may undermine any rule following. At the same time, however, this technique may allow for the examination of stable responding across similar trial types responded to in a far more naturalistic manner.

In addition, future studies may benefit from tailoring consequential functions for individual participants to establish a more precise point of the approach-avoidance equilibrium. One way of achieving this may be to record approach and avoidance rates during a free operant phase in which access to appetitive and aversive stimuli is possible on separate trials. Alternatively, psychophysiological measures, such as electrodermal activity, might be employed to assess pre-experimental stimulus potency. The use of such an assessment would initially reveal whether pre-experimental differences in the functions of the aversive and appetitive images were predictive of responding during the critical probe phase. Furthermore, it would also allow for the observation of any physiological arousal produced by the approach-avoidance conflict trials and allow for the comparison of anxiety levels during conflict and non-conflict trials. Experiment 8 will address these issues by introducing psychophysiological recording to assess not just valence of consequences but also any anxiety that may arise. In addition, the use of such measures would eliminate the concerns raised above about the administration of self-report anxiety Likert Scales

interfering with responses produced during trials. In effect, it may offer a more reliable and perhaps valid alternative.

CHAPTER FIVE: EXPERIMENT 8 (APPROACH-APPROACH CONFLICTS AND ELECTRODERMAL ACTIVITY)

The experiments outlined in Chapter 4 (Experiments 6 and 7) appear to have made a reasonable attempt to generate approach-avoidance conflicts using mild electric shocks and small amounts of money as aversive and appetitive stimuli, respectively. Response variability across participants, response consistency within participants and delayed responding during the conflict trials of the probe phase were observed. However, self-reported anxiety ratings did not reveal that subjective anxiety was increased during the conflict trials, relative to the non-conflict trials.

Although the main effects mentioned above were observed in Experiments 6 and 7 and other previous experiments, self-reported anxiety ratings appeared to be unrelated to experimental manipulations. It would be reasonable to conclude, on the basis of the subjective anxiety reports, that anxiety was not produced by the conflict trials. However, such a conclusion does not tally with the consistent finding that RTs were increased during conflict trials and that response patterns are fairly reliably altered It is more likely, therefore, that the levels of anxiety produced by the conflicting contingencies present during conflict trials were simply too slight for reliable measurement.

One possible explanation for the anxiety ratings produced during Experiments 6 and 7 relates to the mode of administration of the subjective anxiety scale (i.e., its onscreen presentation during trials). Specifically, it may be that the presentation of the subjective rating scale on-screen during trials interfered with subjective ratings by altering the salience of the approach-avoidance contingencies. For instance, during an avoidance trial (non-conflict) a participant was expected to produce an overt avoidance response. This should then have been followed by the appropriate

consequence (i.e., aversive or appetitive). However, avoidance responses were in fact first consequated on several trials by the presentation of the subjective rating scale. This procedure had two possibly disrupting effects. Firstly, the presentation of the scale may have reduced the salience of the response-consequence contingency, or at least the overt discrimination of this contingency, due to the intermediate requirement to respond verbally to the subjective rating scale. Secondly, this procedure may have led to the inadvertent punishment of rating scale responses, insofar as responses to the scales were sometimes followed closely and contingently by mild electric shock. If these two effects were to occur, we should expect to see less reliable subjective ratings of anxiety. A similar form of disruption might also occur during non-conflict approach trials. To avoid this possible confound, electrodermal activity (EDA) was measured in the place of subjective ratings during Experiment 8.

Electrodermal activity recording techniques involve measuring the changes in electrical signals sent to eccrine sweat glands by the autonomic nervous system (ANS). Eccrine sweat glands are located all over the body and their primary function is thermoregulation. However, these glands are also responsive to significant emotional stimuli and are present in large quantities on the hand and fingers (see Edelberg, 1972). Changes in skin resistance (SR) and conductance (SC) have been linked to arousal of the autonomic nervous system (ANS) and EDA has been found to be a useful measure of arousal in a wide range of psychological research, examining basic processes such as emotion, arousal and attention (Dawson, Schell & Filion, 2000), to derived relational responding (i.e., Roche & Barnes, 1995a, b; 1997) and applied psychopathological studies (i.e., Fung, Raine, Loeber, Lynam, Steinhauer, Venables, & Stouthamer-Loeber, 2005; Schlenker, Cohen, Hubmann, Mohr, Wahlheim, Watzl, & Werther, 1995; Turpin & Clements, 1993).

Of particular interest to the present study is the role of electrodermal activity in fear conditioning. For example, Experiment 1 of the study by Dougher et al. (1994) and Experiment 2 of the study by Rodriguez et al. (2009) discussed previously which both demonstrated differences in skin conductivity, evidence of classical conditioning and a derived transfer of respondent eliciting functions in the majority of participants of both experiments. Indeed, electrodermal activity has proven to be a suitable metric of fear or anxiety in studies of the kind outlined in this thesis up to this point. One additional advantage of electrodermal responses as metrics of fear and anxiety, is that they are easily discriminable and quantifiable immediately following stimulus presentations. EDA also allows for a convenient measure of autonomic activity when procedures involve multiple presentations of discrete stimuli (see Dawson et al., 2000).

In Experiment 8, skin resistance was measured during conditioning and probe phases. This eliminated the presentation of an onscreen scale during trials and reduced the likelihood of any interference by such a measure. In effect, the use of EDA measurement may prove to be relatively unintrusive and may provide more reliable measures of anxiety.

As well as eliminating the mid-trial anxiety scales, another way of enhancing the salience of the approach-avoidance conflicts presented is to enhance the conditioning of the discriminative stimuli. Previous experiments employed the use of omission trials to increase resistance to extinction during critical probe phases, in which no consequences to responding are delivered. However, this may have had the simultaneous effect of making the reinforcement contingency more sparse, requiring more training trials to produce a given level of response (e.g., avoidance) fluency. As an alternative means of enhancing resistance to extinction during probe phases,

Experiment 8 included the use of precise instructions presented prior to the probe phase, which informed participants that the mild electric shocks and amounts of money presented would not be presented trial-by-trial but would be totalled and presented after the experiment had finished. As a result, during probe trials, participants were aware that stimuli were being presented in extinction but were also aware that real consequences would be delivered at a slightly postponed time point. In effect, they could not know from trial to trial if consequences were being registered for later delivery.

To further enhance the salience of the response conflict, a time limit for responding was also introduced. During previous experiments, participants had not been placed under any considerable time pressure and as a result, the consequences of failing to respond appropriately were not maximally aversive. While it is not possible to increase the level of mild electric shocks for ethical reasons, it is possible to increase the pressure to respond. This was done by employing a strict response window that varied randomly in length. The response window was intended only to create a sense of urgency in responding and the variance in the length of the response window across trials would simultaneously prevent any temporal conditioning. This temporal contingency should better analogue real-life decision making processes for anxious clients and may enhance the anxiety experienced by participants during the conflict probes.

Another important development in the current experiment relates to exploring the boundary conditions of the contingency conflict effect. More specifically, Experiments 6 and 7 presented discriminative stimuli in pairs, each of which was balanced against the other in terms of reinforcing and punishing value. However, it is not known whether or not control can be exerted over responding (i.e., predicted

approach or avoidance) using unbalanced stimulus pairs. For instance, if the monetary value of an appetitive stimulus could be reduced during a probe trial, it might be more likely to observe avoidance rather than approach (i.e., the aversive stimulus would be of greater value). At the very least, such a procedure would confirm that response patterns, while random across participants during probe trials, are nevertheless still under experimental control. For this reason, Phase 2 of Experiment 8 consisted of simultaneously presenting discriminative stimuli for avoidance along with signalled amounts of money equal to, above or below (5c-10c) the amount established during Phase 1 as equal in reinforcing value to the electric shock. These signalled amounts of money were also presented onscreen in the presence of conflict and non-conflict stimuli during Phase 5. This procedure also had the added benefit of rendering each trial a novel task which required a unique decision to be made based on the amount of money on offer and the presence or absence of shock on that trial. This should help to reduce any behavioural momentum built up through long chains of identical responses (i.e., insensitivity to the conflict itself).

It is important to point out here that in this experiment, a final effort was being made to demonstrate a stronger and clearer approach-avoidance conflict than has been observed to this point. While the number of simultaneous modifications to the procedure above suggests that a systematic analysis of the effects of the various modifications is not possible, this was not the purpose of Experiment 8. It was strongly suspected at this point that approach-avoidance conflicts of any considerable clarity would not be easily observable in the laboratory without the salience of the aversive stimuli changing to a point that at least approached the lower salience values of aversive stimuli that produce avoidance in anxious clients in the real world. This is simply not possible given the various ethical guidelines of professional societies for

psychologists around the world. Therefore, the following experiment was approached as a final attempt to produce absolutely unambiguous approach-avoidance conflicts across all and any measures using stimuli of low emotional valence. Any failure to do so would confirm that such responses are not easily observable in the laboratory, and perhaps that they are not as common or as easily produced in daily life as suggested in the literature.

5.1 Experiment 8: Approach-Avoidance Conflicts and Electrodermal Activity

5.1.1 Method

5.1.1.1 Participants

Nine volunteers were recruited from personal contacts. All participants were first presented with Phases 1 (Establishing Shock Level)) and 2 (Establishing Reinforcer Value) and proceeded to a series of subsequent phases (see General Experimental Sequence below) on condition that their performances met predetermined criteria for each phase. Of the nine participants, four (all male) met the pre-set criteria for each phase of the experiment and were presented with the final critical test phase. Only the data for the four participants who completed the study will be discussed. The four participants' ages ranged from 24 to 30 years, and the mean age was 26.75 years.

5.1.1.2 Ethical Considerations

The procedure was conducted in accordance with the ethical considerations previously outlined during Experiment 6 and 7. As with all experiments, participants were informed they could withdraw at any time and all data would be treated confidentially.

5.1.1.3 Apparatus and Stimuli

All apparatus and stimuli were identical to those used in previous experiments apart from the following exceptions. Skin resistance responses were measured with a Dell Optiplex GX110 desktop computer running Biobench software (Layfayette instruments) with a Biobench (Version 1.0) physiological data acquisition card. The computer was interfaced with a 16-channel Lafayette Instruments *Datalab 2000* polygraph. A Lafayette Instruments biopotential amplifier (Model 70702), which was

connected to the 16-channel Lafayette Instruments *Datalab 2000* polygraph, supplied a 10 micro-ampere constant current through two electrodes 5cm^2 electrodes.

Due to the constant current system of the apparatus used, skin resistance rather than skin conductance responses were measured during Experiment 8 (skin resistance is simply the reciprocal of conductance). Furthermore, as noted by Roche & Barnes (1997), phasic (stimulus specific) SRRs have been shown to correlate particularly highly with more permanent (tonic) changes in skin resistance (Lykken & Venables, 1971) and therefore, the measurement of tonic changes in skin resistance levels seemed to be unnecessary in the context of the present experiment.

Time-locked stimulus markers were transmitted from the Visual Basic experiment program on the stimulus presentation computer, to a digital event marker port on the polygraph via the PC's printer port output. Skin resistance was recorded via two 5cm^2 silver-silver chloride (AgAgCl) electrodes attached to the distal phalanges of the index and middle fingers of the non-dominant hand of each participant (Dawson, et al. 2000).

5.1.1.4 Response Quantification

According to Ohm's law, skin resistance (R) is equal to the voltage (V) applied between two electrodes placed on the skin surface divided by the current (I) that is passed through the skin ($R=V/I$). When the current is held constant then it is possible to measure the voltage between the electrodes, which will fluctuate directly with skin resistance. The relevant literature suggests that phasic electrodermal responses typically start within 3 s and peak within 5 s of the presentation of a stimulus. According to Dawson et al. (2000, p. 207), any electrodermal activity observed within this window following stimulus onset "is considered to be elicited by that stimulus." The present experiment employed the level of skin resistance at the point of stimulus presentation as the baseline against which to calculate response changes in a positive

direction only (i.e., response amplitudes). In other words, each SRR was measured in terms of a floating baseline that was identified individually for each conditioning and probe trial at the point of stimulus presentation in place or response onset.

A SRR was defined as the maximum absolute decrease in ohmic skin resistance, relative to the skin resistance level taken at the time of stimulus onset (see Roche & Barnes, 1997, Appendix A, Point 3), recorded within 3 s of stimulus onset. Skin resistance increases (indicating relaxation) were not quantified but were read as having a value of zero. Although the inclusion of zero values in statistical analyses may result in confounded response frequency with response amplitude (Prokasy & Kumpher, 1973), the omission of zero values in studies of psychophysiology frequently leaves researchers with little or no data to analyse (Dawson et al., 2000) Thus, zero values were included in all SRR calculations in the present experiment.

The current study employed the distal phalanges electrode configuration as it is less prone to participant movement artefacts, consequently yielding more reliable EDA measures than other electrode configurations (Dawson et al., 2000).

5.1.1.5 General experimental sequence

Ethical clearance for the general procedure employed in the present study was granted by the NUIM Ethics Committee. The same briefing and consent procedure as Experiments 6 and 7 was used during the present experiment (see Appendix 1d)).

Before the procedure began, the electrodes were connected to the distal phalanges of the index and middle fingers of participants' non-dominant hand, using Velcro® straps. The electrodes remained attached for the duration of the experiment. At this point, the experimenter verified whether the electrodes had been attached properly and whether the software was prepared for recording. A level of mild electric shock was then set using the procedure outlined in Experiment 6 in accordance with

NUIM Ethics Committee's approval to use this procedure. The experimenter then left the room. Skin resistance responses were recorded during Phases 3 and 6 only.

The procedure was identical to Experiment 7 apart from the following exceptions (see Appendix 7). Firstly, the 5-point self-report Likert Scale was not administered at any stage during the experiment. In its place, skin resistance was measured to compare levels of electrodermal activity during conditioning trials of Phase 3 and conflict and non-conflict trials of Phase 6. Participants were asked to remain as still as possible once the experiment began.

Secondly, during Phases 3 and 6, an amount of money equal to, above or below (5c-10c) the reinforcer value established during Phase 2 was presented onscreen during each trial. Specifically, during Phase 3 conditioning, the reinforcer value established during Phase 2 was presented in the presence of B1 and B2 stimuli on four separate trials and amounts of money 5 and 10 cents above and below this amount were also presented once each in the presence of B1 and B2 stimuli on separate trials (16 trials in total). Instructions delivered to participants explained that the amount of money displayed onscreen in text form would indicate the amount of money on offer for that particular trial. Amounts of money were presented in black Arial font (size 48) directly below the nonsense syllables (also in black Arial font of size 48) in the top-middle of the screen during Phases 3 and 6.

During Phase 6 probes, the stimuli presented were C1/C2, C2/C1, C1/D1, D1/C1, C2/D2 and D2/C2. In the presence of C1/C2 and C2/C2 stimuli, the reinforcer value was presented onscreen on four separate trials for each compound stimulus. Amounts of money 5 cents and 10 cents above and below the reinforcer value established during Phase 1 were presented on three separate trials for each conflict compound stimulus. In the presence of C1/D1, D1/C1, C2/D2 and D2/C2 non-conflict compound stimuli, the monetary value established during Phase 1 was presented four

times per stimulus. Amounts of money 5 and 10 cents above and below this amount were presented once each per stimulus (64 trials in total). Due to the large number of trials during Phase 6, the non-conflict probes of this phase were used in place of and as an alternative test for the derived transfer of functions (i.e., Phase 7 from Experiment 7 was not required). A correct response rate of 15/16 was required during Phase 3 to proceed with the experiment.

Thirdly, omission trials to enhance resistance to extinction were not employed during the current experiment. This alteration was expected to enhance conditioning effects and therefore the salience of the approach-avoidance conflicts during the probe phase. The problem of resistance to extinction was addressed by instructions presented prior to the critical probe phase. These instructions informed the participant that any mild electric shocks and money to be received would be totalled and administered at the end of the experiment (see Appendix 5).

Finally, during Phases 2, 3 and 6, it was necessary for participants to respond within 3-7 seconds of stimulus presentation. If a participant failed to respond during the relevant response window on that trial (which varied randomly), the appropriate consequence was presented with an onscreen feedback message for 3 seconds in black Arial font (size 48). For example, during Phase 2, if a participant failed to respond in the allocated time the following onscreen message was displayed; "You failed to respond in the time allowed and just received a mild electric shock. You will not receive (amount of money on offer) cents." During Phase 3, if a participant did not respond in the allocated time in the presence of the B1 stimulus the following onscreen message was displayed; "You failed to respond in the time allowed and just received a mild electric shock." If a participant did not respond in the allocated time in the presence of the B2 stimulus they were presented with the following onscreen

message; “You failed to respond in time and will not receive (the amount of money onscreen) cents.” No feedback or consequences were presented during Phase 6.

On each trial the discriminative stimulus was present onscreen for at least 3 seconds during which skin resistance responses were recorded. The response window was randomised across trials (3, 4, 5, 6 or 7 s) to help prevent rapid temporal conditioning and to create a realistic sense of unspecified urgency as might be experienced in a real-world panic situation.

5.1.2 Results and Discussion

Of the 9 participants that originally began the experiment, five failed to meet the pre-set criteria of Phases 2-6. Specifically, Participant 3 failed to meet the criteria for Phase 2, Participant 6 failed to meet criteria for Phase 5 and Participants 2, 7 and 8 failed to meet the criteria for Phase 6. Therefore, only the data of Participants 1, 4, 5 and 9 are discussed here. All of the data reported here consist of total numbers of responses produced during training/testing, reaction times in milliseconds and skin resistance responses.

5.1.2.1 Phase 2: Establishing Reinforcer Value

All participants were presented with Phase 2 following the establishment of their agreed level of mild electric shock (Phase 1: Establishing Shock Level). Participant 3 did not produce at least one avoidance response and at least one approach response during this phase and their participation was terminated. Each remaining participant met this pre-set criterion. The reinforcer values established for Participants 1, 4, 5 and 9 as equivalent in reinforcing value to the electric shock were 30 cents, 15 cents, 35 cents and 35 cents, respectively.

5.1.2.2 Phase 3: Approach and Avoidance Conditioning

Participants were presented with this phase once in the absence of its pre-set criterion. In other words, participants’ correct response rates produced during the first

presentation of this phase did not have an effect on the number of repeated exposures to the phase. Each participant produced a correct response rate of 15/16 during their second exposure to this phase (see Table 47). No participant required a third exposure.

5.1.2.3 Phase 4: Equivalence Training and Phase 5: Equivalence Test

Participants 1, 5 and 9 required only one exposure to Phase 4a (A-B Training). Participant 4 required two exposures to Phase 4a and produced rates of 17/20 and 20/20, respectively. Each participant met the pre-set criterion of Phase 4b (A-C Training) within one exposure. Participants 1, 4 and 5 produced correct response rates of 19/20 and Participant 9 produced a rate of 20/20 on their first exposure to Phase 4b. Participants 1 and 5 produced correct response rates of 20/20 on their first exposures to Phase 4c (A-D Training). Participant 9 produced a rate of 19/20 on their first exposure to Phase 4c. Participant 4 produced correct response rates of 18/20 and 20/20 on their first and second exposures to Phase 4c, respectively. Participants 4, 5 and 9 each produced a correct response rate of 29/30 on their first exposure to Phase 4d (Mixed Training). Participant 1 produced correct response rates of 28/30 and 30/30 on their first and second exposures to Phase 4d, respectively. Participants 1, 4 and 5 produced correct response rates of 30/30 on their first exposures to Phase 5 (Equivalence Test). Participant 9 produced correct response rates of 29/30 and 30/30 during their first and second exposures to Phase 5, respectively (see Table 48).

Table 48: Each participant's correct response rate during Phases 3, 4a, 4b, 4c, 4d, 5 and 7 during Experiment 8. Where extra lines appear for a given participant these numbers refer to performances on additional exposures of the phase until criteria are met.

P. No.	Phase 3	Phase 4a	Phase 4b	Phase 4c	Phase 4d	Phase 5	Phase 7
1	15/16	20/20	19/20	20/20	28/30 29/30	30/30	30/30
4	15/16	17/20 20/20	19/20	18/20 20/20	30/30	30/30	30/30
5	15/16	19/20	19/20	20/20	30/30	30/30	30/30
9	15/16	19/20	20/20	19/20	30/30	29/30 30/30	29/30

5.1.2.4 Phase 6: Derived approach-avoidance probes

Tables 49, 50, 51, 52, 53 and 54 show responses produced during Phase 6 in the presence of amounts of money equal to the reinforcer value established in Phase 2, as well as amounts 5 cents and 10 cents above and below the reinforcer values established during Phase 2, respectively. Participants 1, 4 and 5 produced approach response patterns in the presence of C1/C2 and C2/C1 conflict stimuli during Phase 6 even when the amount of money on offer was below the reinforcer value established during Phase 2. Participant 9 produced approach responses during conflict trials when the reinforcer value or amounts greater than this were on offer (see Tables 49 and 51). All participants showed evidence of the derived transfer of function effect by

producing avoidance response patterns in the presence of C1/D1and D1/C1 stimuli and approach response patterns in the presence of C2/D2 and D2/C2 stimuli.

Table 49: Number of responses to C1/C2 and C2/C1 compound stimuli during Phase 6. All responses were produced in the presence of the monetary value established during Phase 2. Ap and Av indicate approach and avoidance responses, respectively. An asterisk (*) indicates a failure to produce at least one response in the presence of a particular stimulus.

	Phase 6			
P. No.	Av C1/C2	Ap C1/C2	Av C2/C1	Ap C2/C1
1	0	4	2	2
4	1	3	0	4
5	0	3*	0	4
9	0	4	0	4

Table 50: Number of responses to C1/D1, D1/C1, C2/D2 and D2/C2 compound stimuli during Phase 6. All responses were produced in the presence of the monetary value established during Phase 2. Ap and Av indicate approach and avoidance responses, respectively. An asterisk (*) indicates a failure to produce at least one response in the presence of a particular stimulus.

	Phase 6							
P. No.	Av C1/D1	Ap C1/D1	Av D1/C1	Ap D1/C1	Av C2/D2	Ap C2/D2	Av D2/C2	Ap D2/C2
1	4	0	4	0	0	4	0	4
4	3	1	4	0	0	4	0	4
5	4	0	3	1	0	3*	0	4
9	4	0	4	0	0	4	0	4

Table 51: Number of responses to C1/C2 and C2/C1 compound stimuli during Phase 6. All responses were produced in the presence of amounts of money *above* the monetary value established during Phase 2. Ap and Av indicate approach and avoidance responses, respectively. An asterisk (*) indicates a failure to produce at least one response in the presence of a particular stimulus.

	Phase 6			
P. No.	Av C1/C2	Ap C1/C2	Av C2/C1	Ap C2/C1
1	0	6	0	6
4	0	6	0	6
5	1	3*	0	6
9	0	6	0	6

Table 52: Number of responses to C1/D1, D1/C1, C2/D2 and D2/C2 compound stimuli during Phase 6. All responses were produced in the presence of amounts of money *above* the monetary value established during Phase 2. Ap and Av indicate approach and avoidance responses, respectively. An asterisk (*) indicates a failure to produce at least one response in the presence of a particular stimulus.

	Phase 6							
P. No.	Av C1/D1	Ap C1/D1	Av D1/C1	Ap D1/C1	Av C2/D2	Ap C2/D2	Av D2/C2	Ap D2/C2
1	2	0	1	1	1	1	0	2
4	2	0	2	0	0	2	0	2
5	2	0	1*	0	0	1*	0	1*
9	2	0	2	0	0	2	0	2

Table 53: Number of responses to C1/C2 and C2/C1 compound stimuli during Phase 6. All responses were produced in the presence of amounts *below* the monetary value established during Phase 2. Ap and Av indicate approach and avoidance responses, respectively. An asterisk (*) indicates a failure to produce at least one response in the presence of a particular stimulus.

	Phase 6			
P. No.	Av C1/C2	Ap C1/C2	Av C2/C1	Ap C2/C1
1	0	6	1	5
4	0	6	1	5
5	1	5	0	6
9	6	0	6	0

Table 54: Number of responses to C1/D1, D1/C1, C2/D2 and D2/C2 compound stimuli during Phase 6. All responses were produced in the presence of amounts of money *below* the monetary value established during Phase 2. Ap and Av indicate approach and avoidance responses, respectively. An asterisk (*) indicates a failure to produce at least one response in the presence of a particular stimulus.

	Phase 6							
P. No.	Av C1/D1	Ap C1/D1	Av D1/C1	Ap D1/C1	Av C2/D2	Ap C2/D2	Av D2/C2	Ap D2/C2
1	1*	0	1	1	0	2	0	2
4	2	0	1	1	0	2	0	2
5	0	2	2	0	0	2	0	2
9	2	0	2	0	0	1*	0	2

5.1.2.5 Phase 7: Re-exposure to Equivalence Test

Participant 1, 4 and 5 produced a correct response rate of 30/30 on their re-exposure to the equivalence test during Phase 7. Participant 9 produced a correct response rate of 29/30 during this phase (see Table 47).

5.1.2.6 Phase 8: Re-establishing reinforcer value

During this phase, a new and lower reinforcer value was established for Participant 1 (25 cents compared to 30 cents initially established), Participant 5 (20 cents compared to 35 cents initially established) and Participant 9 (25 cents compared to 35 cents initially established) during Phase 8. Interestingly, a reinforcer value could not be established for Participant 4 because they approached all amounts of money and mild electric shocks on each trial during Phase 8. Therefore, it can be concluded that the reinforcer value equivalent to the mild shock had changed for these participants during the course of the experiment.

5.1.3 Response latencies

Tables 55, 56, 57, 58, 59 and 60 show the mean RT produced during Phases 3 and 6 in the presence of the reinforcer value established during Phase 2 and in the presence of amounts of money 5 and 10 cents above and below this amount, respectively. Tables 61 and 62 shows the RT produced by each participant during the first conflict and non-conflict trial during Phases 3 and 6 irrespective of the monetary value presented, respectively. During Phase 6, three participants (Participants 1, 4 and 9) produced larger mean RTs during conflict trials than during non-conflict trials in the presence of the reinforcer value established during Phase 2 (see Table 56) Two participants (Participants 4 and 5) also produced larger mean RTs during conflict trials than non-conflict trials in the presence of amounts of money above the

established reinforcer value during the probe phase (see Table 58). Three participants (Participants 1, 4 and 5) produced larger mean RTs during conflict trials than non-conflict trials in the presence of amounts of money below the established reinforcer value (see Table 60). Total mean RTs produced during conflict trials were larger than mean RTs produced during the non-conflict trials combined in the presence of the established reinforcer value and in the presence of amounts above and below this value (see Tables 56. 58 and 60).

Three participants (Participants 4, 5 and 9) produced a larger RT during the first presentation of a conflict trial than the first presentation of a non-conflict trial during Phase 6 (see Table 62). Participant 5 failed to produce a response in the time permitted during the first presentations of C1/C2, D1/C1 and C2/D2 stimuli. Finally, the mean RT of the first presentations of conflict trials was larger than the mean RT of the first presentation of non-conflict trials.

Table 55: Each participant's mean Reaction Times (RTs) in milliseconds (ms) produced during Phase 3. Responses were produced in the presence of the amount of money established during Phase 2. SD indicates standard deviation.

P. No	Phase 3	
	B1	B2
1	4148	4328
4	3516	3734
5	4016	4164
9	3860	4593
Mean	3885	4205
SD	272.71	360.18
Phase Mean	4045	

Table 56: Each participant's mean Reaction Times (RTs) in milliseconds (ms) produced during Phase 6. Responses were produced in the presence of the amount of money established during Phase 2. SD indicates standard deviation.

P. No	Phase 6							
	C1/C2	C2/C1	C1/D1	D1/C1	C2/D2	D2/C2	Conflict probes	Non-conflict probes
1	3836	4406	4184	3594	3574	3746	3950	3786
4	4516	4406	3481	4039	4273	4359	4479	4025
5	3558	3343	4160	3349	3375	3323	3450	3552
9	4913	4594	4477	4289	3770	4103	4771	4156
Mean	4206	4200	3873	3818	3748	3883	4203	3831
SD	619.88	569.77	421.72	424.59	385.36	449.94	584.03	266.85
Phase Mean	3955							

Table 57: Each participant's mean Reaction Times (RTs) in milliseconds (ms) produced during Phases 3. Responses were produced in the presence of amounts of money *above* the value established during Phase 2. SD indicates standard deviation.

P. No	Phase 3	
	B1	B2
1	3627	3852
4	4797	4320
5	3494	3367
9	4562	4593
Mean	4120	4033
SD	655.39	539.22
Phase Mean	4077	

Table 58: Each participant's mean Reaction Times (RTs) in milliseconds (ms) produced during Phases 6. Responses were produced in the presence of amounts of money *above* the value established during Phase 2. SD indicates standard deviation.

P. No	Phase 6							
	C1/C2	C2/C1	C1/D1	D1/C1	C2/D2	D2/C2	Conflict probes	Non-conflict probes
1	3760	3800	3406	4090	4074	4000	3780	3893
4	4473	4673	4477	5313	3403	3480	4573	4168
5	3398	3516	3477	3390	3367	3297	3457	3383
9	3964	3719	3391	4254	3632	4865	3841	4035
Mean	3899	3927	3688	4262	3619	3912	3913	3870
SD	448.71	511.48	527.50	794.70	325.25	702.56	471.31	343.37
Phase Mean	3808							

Table 59: Each participant's mean Reaction Times (RTs) in milliseconds (ms) produced during Phases 3. Responses were produced in the presence of amounts of money *below* the value established during Phase 2. SD indicates standard deviation.

P. No	Phase 3	
	B1	B2
1	4240	3878
4	5781	3686
5	4255	3414
9	5242	3688
Mean	4880	3667
SD	762.25	190.90
Phase Mean	4274	

Table 60: Each participant's mean Reaction Times (RTs) in milliseconds (ms) produced during Phase 6. Responses were produced in the presence of amounts of money *below* the value established during Phase 2. SD indicates standard deviation. SD indicates standard deviation.

P. No	Phase 6							
	C1/C2	C2/C1	C1/D1	D1/C1	C2/D2	D2/C2	Conflict probes	Non-conflict probes
1	3986	3951	3401	3670	3969	3367	3969	3727
4	4445	4914	4492	5086	4305	4656	4680	4635
5	3398	3516	3466	3391	3367	3301	3457	3381
9	3855	3664	3693	3492	4586	3938	3760	3927
Mean	3921	4001	3763	3910	4057	3816	3967	3918
SD	430.77	6.28.35	501.86	792.60	524.46	629.10	520.03	528.84
Phase Mean	3911							

Table 61: Each participant's Reaction Times (RTs) in milliseconds (ms) produced during the first presentation of each stimulus during Phase 3. An asterisk (*) indicates a failure to produce a response in the presence of a particular stimulus. SD indicates standard deviation.

P. No	Phase 3	
	B1	B2
1	4781	4391
4	6601	4672
5	*	3438
9	6594	5484
Mean	5992	4496
SD	1408.76	844.09
Phase Mean	5244	

Table 62: Each participant's Reaction Times (RTs) in milliseconds (ms) produced during the first presentation of each stimulus during Phase 6. An asterisk (*) indicates a failure to produce a response in the presence of a particular stimulus. SD indicates standard deviation

P. No	Phase 6							
	C1/C2	C2/C1	C1/D1	D1/C1	C2/D2	D2/C2	Conflict probes	Non-conflict probes
1	3578	3922	5422	3484	3938	4093	3922	5422
4	4031	4859	3969	3375	3281	3297	4859	3969
5	*	6469	3812	*	*	5391	6469	4602
9	6671	5484	5640	5688	*	5484	6671	5640
Mean	4760	5184	4710	4182	3610	4566	5480	4908
SD	1670.40	1070.75	953.47	1305.08	328.5	1057.89	1317.77	769.28
Phase Mean	4675							

5.1.4 Skin resistance

All data were recorded in kohms and transformed for purposes of data analysis and graphical representation to the function log (SRR+1; Venables & Christie, 1980). This standardization of SRR data reduces the skewness and kurtosis that is often observed across several SRRs and allows for the inclusion of zero values as the log of zero is not defined.

Due to the noisiness of electrodermal measures (Dawson et al., 2000; Roche & Barnes, 1995a; 1995b), the most suitable method to analyse data of the nature of the present experiment is group means (Roche, Barnes-Holmes, Smeets, Barnes-Holmes & McGready, 2000). Tables 63, 64, 65, 66, 67 and 68 show the mean Skin Resistance Response (SRR) produced during Phases 3 and 6 in the presence of the reinforcer value established during Phase 2 and in the presence of amounts of money 5 and 10 cents above and below this amount, respectively. Tables 69 and 70 show the SRR

produced by each participant during the first conflict and non-conflict trials in Phases 3 and 6 irrespective of the monetary value presented. Figure 10 and Appendix 6 each show each participants SRR produced during each trial during Phase 6.

During Phase 6, one participant (P5) produced larger mean SRRs during conflict trials than non-conflict trials in the presence of a monetary amount equal to the set reinforcer value (see Table 64). Contrary to expectation, two participants (Participants 1 and 4) also produced larger mean SRRs during conflict trials than non-conflict trials in the presence of amounts of money above the established reinforcer value during the probe phase (see Table 66). As expected, no participant produced a larger mean SRR during conflict trials than non-conflict trials in the presence of amounts of money *below* the established reinforcer value during Phase 6 (see Table 68).

While the foregoing appears to conform roughly to experimental hypotheses, group effects observed when all participants' data were combined show a paradoxical reduction in the clarity of this effect. Group level mean SRRs produced during conflict trials were actually lower than mean SRRs produced during the non-conflict trials in the presence of the established reinforcer value and amounts above and below this value (see Tables 64, 66 and 68). Table 70 shows that one participant (Participant 5) produced larger mean SRRs during the combined first presentations of non-conflict than conflict trials. However, contrary to hypotheses, at the group level, the mean SRR for non-conflict trials during first trials was larger than SRRs produced during first conflict trials.

Table 63: Each participant's mean Skin Resistance Response (SRR) in kilohms and transformed to the function log (SRR+1) during Phase 3. Responses were produced in the presence of the amount of money established during Phase 2. . SD indicates standard deviation

P. No	Phase 3	
	B1	B2
1	1.041	1.176
4	1.255	1.380
5	1.041	1.301
9	1.279	1.398
Mean	1.144	1.314
SD	0.130	0.101
Phase Mean	1.229	

Table 64: Each participant's mean Skin Resistance Response (SRR) in kilohms and transformed to the function log (SRR+1) during Phase 6. Responses were produced in the presence of the amount of money established during Phase 2.SD indicates standard deviation.

P. No	Phase 6							
	C1/C2	C2/C1	C1/D1	D1/C1	C2/D2	D2/C2	Conflict probes	Non-conflict probes
1	1.041	0.569	0.897	0.822	0.659	0.997	0.805	0.844
4	1.147	0.702	1.147	1.088	0.794	0.878	0.925	0.977
5	1.128	0.609	0.997	0.628	0.866	0.839	0.869	0.833
9	0.552	1.014	0.819	0.839	1.052	1.169	0.783	0.967
Mean	0.967	0.724	0.965	0.844	0.843	0.971	0.846	0.905
SD	0.280	0.201	0.141	0.188	0.163	0.148	0.064	0.077
Phase Mean	0.886							

Table 65: Each participant's mean Skin Resistance Response (SRR) in kilohms and transformed to the function log (SRR+1) during Phase 3. Responses were produced in the presence of amounts of money *above* the value established during Phase 2. SD indicates standard deviation.

P. No	Phase 3	
	B1	B2
1	1.041	0.903
4	1.204	1.176
5	0.954	1.255
9	1.041	1.07
Mean	1.060	1.101
SD	0.104	0.152
Phase Mean	1.081	

Table 66: Each participant's mean Skin Resistance Response (SRR) in kilohms and transformed to the function log (SRR+1) during Phase 6. Responses were produced in the presence of amounts of money *above* the value established during Phase 2. SD indicates standard deviation

P. No	Phase 6							
	C1/C2	C2/C1	C1/D1	D1/C1	C2/D2	D2/C2	Conflict probes	Non-conflict probes
1	1.069	0.757	0.628	0.716	1.138	1.079	0.913	0.890
4	0.888	0.678	0.866	0.423	1.278	0.477	0.783	0.761
5	0.840	0.787	0.954	1.065	0.588	0.977	0.814	0.896
9	0.946	0.598	0.929	1.128	1.304	0.716	0.772	1.019
Mean	0.936	0.705	0.844	0.833	1.077	0.812	0.821	0.892
SD	0.098	0.084	0.149	0.327	0.334	0.270	0.064	0.105
Phase Mean	0.868							

Table 67: Each participant's mean Skin Resistance Response (SRR) in kilohms and transformed to the function log (SRR+1) during Phase 3. Responses were produced in the presence of amounts of money *below* the value established during Phase 2. SD indicates standard deviation.

P. No	Phase 3	
	B1	B2
1	1.114	1.176
4	1.146	1.380
5	1.322	1.146
9	1.255	1.322
Mean	1.209	1.256
SD	0.096	0.112
Phase Mean	1.233	

Table 68: Each participant's mean Skin Resistance Response (SRR) in kilohms and transformed to the function log (SRR+1) during Phase 6. Responses were produced in the presence of amounts of money *below* the value established during Phase 2. SD indicates standard deviation.

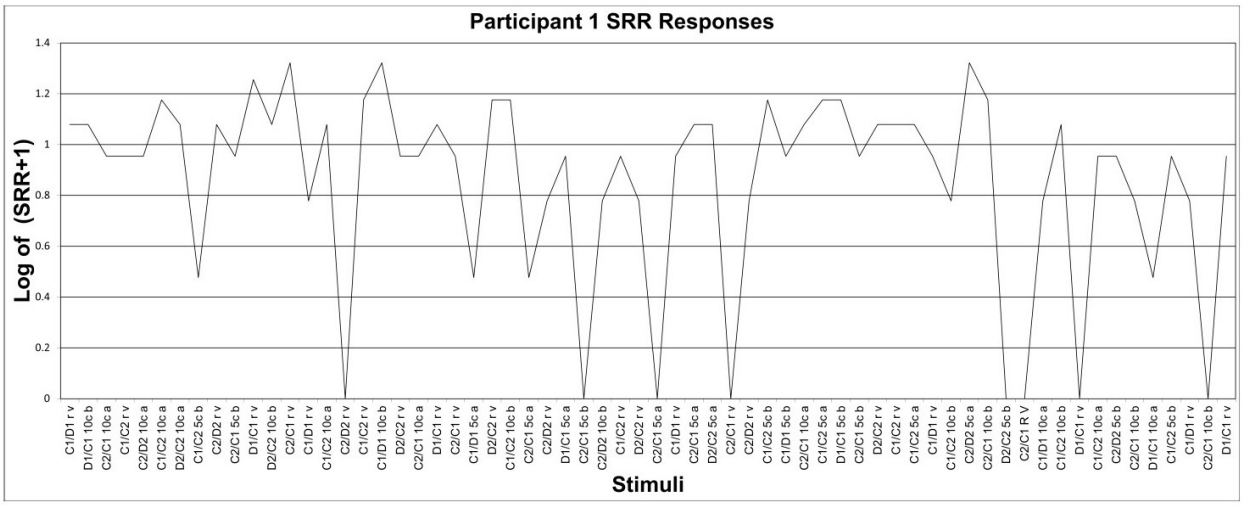
P. No	Phase 6							
	C1/C2	C2/C1	C1/D1	D1/C1	C2/D2	D2/C2	Conflict probes	Non-conflict probes
1	0.940	0.644	1.138	1.128	0.866	0.540	0.792	0.918
4	0.969	0.972	1.004	1.065	1.017	1.182	0.971	1.067
5	0.898	1.040	1.377	1.289	1.017	1.128	0.969	1.202
9	0.914	0.596	0.628	0.690	1.304	0.866	0.755	0.872
Mean	0.930	0.813	1.037	1.043	1.051	0.929	0.872	1.015
SD	0.031	0.225	0.313	0.254	0.183	0.294	0.114	0.150
Phase Mean	0.967							

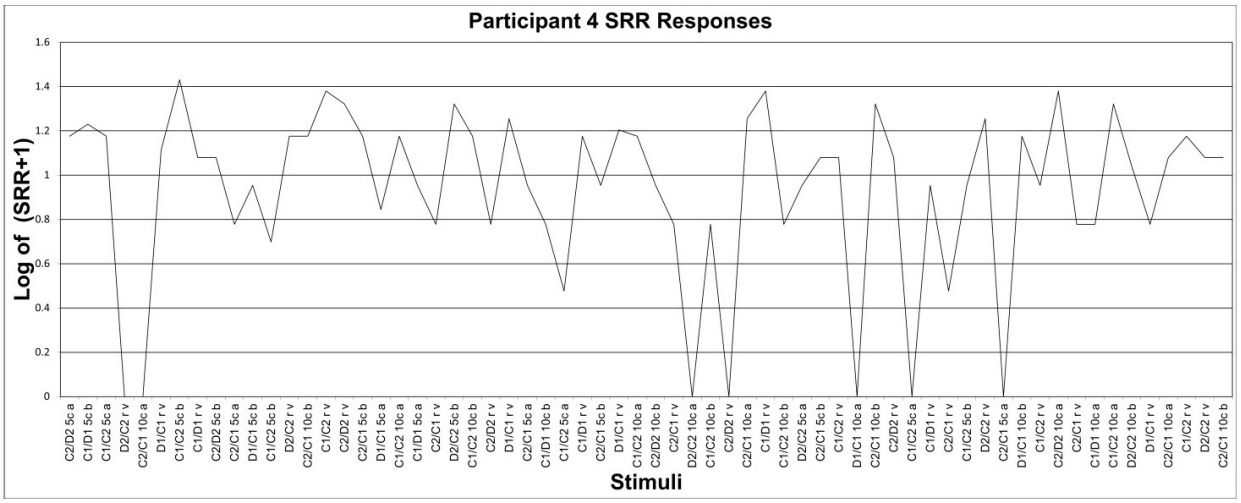
Table 69: Each participant's mean Skin Resistance Response (SRR) in kilohms and transformed to the function log (SRR+1) produced during the first presentation of each stimulus during Phase 3. Responses were produced in the presence of amounts of money *below* the value established during Phase 2. SD indicates standard deviation

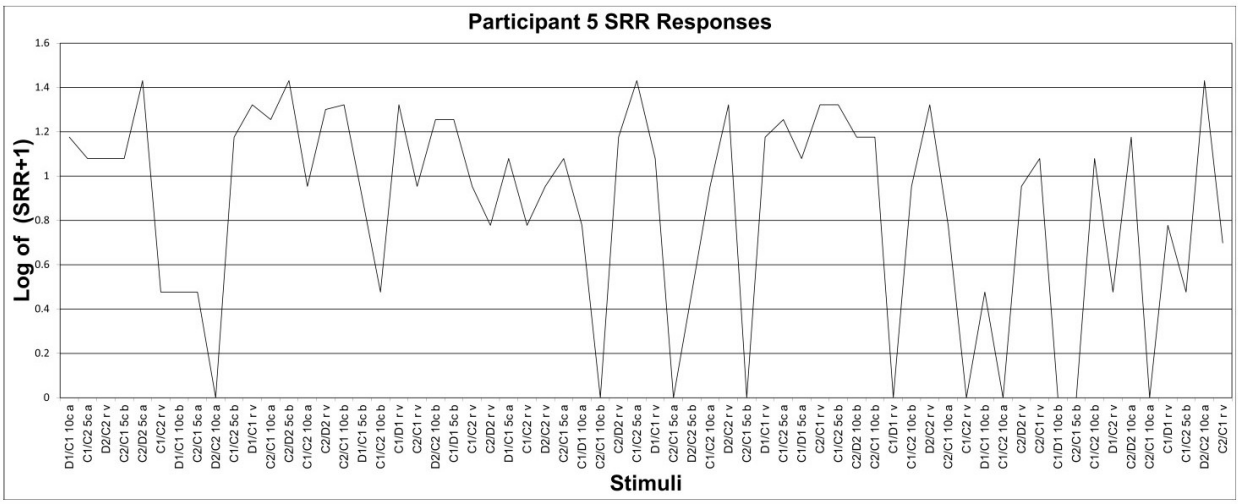
P. No	Phase 3	
	B1	B2
1	1.079	1.431
4	1.204	1.176
5	1.255	1.176
9	1.623	0.477
Mean	1.290	1.065
SD	0.233	0.410
Phase Mean	1.178	

Table 70: Each participant's mean Skin Resistance Response (SRR) in kilohms and transformed to the function log (SRR+1) produced during the first presentation of each stimulus during Phase 6. Responses were produced in the presence of amounts of money *below* the value established during Phase 2. SD indicates standard deviation.

P. No	Phase 6							
	C1/C2	C2/C1	C1/D1	D1/C1	C2/D2	D2/C2	Conflict probes	Non-conflict probes
1	0.954	0.954	1.079	1.079	0.954	1.079	0.954	1.048
4	1.176	0.000	1.230	1.114	1.176	0.000	1.088	1.130
5	1.079	1.079	1.322	1.176	1.431	1.079	1.079	1.252
9	1.176	1.079	1.079	1.079	1.176	1.079	1.128	1.103
Mean	1.096	1.028	1.178	1.112	1.184	1.059	1.062	1.133
SD	0.105	0.522	0.119	0.045	0.194	0.539	0.075	0.086
Phase Mean	1.110							


Participant 1 SRR Responses
Log of (SRR+1)
Stimuli


Participant 4 SRR Responses
Log of (SRR+1)
Stimuli


Participant 5 SRR Responses
Log of (SRR+1)
Stimuli

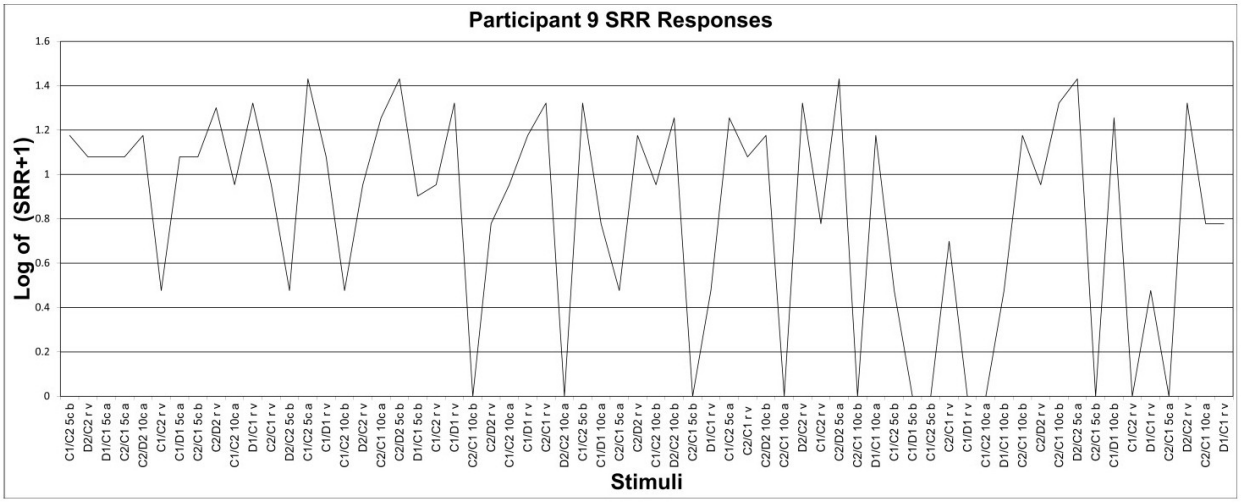


Figure 10: Each participant's Skin Resistance Response (SRR) produced during Phase 6 of Experiment 8. SRRs were recorded in kilohms and transformed to the function log (SRR+1). A "c" following a number refers to the amount of cents (Euro) that were on offer during a particular trial that were that number either above ("a") or below ("b") the reinforcer value (rv)established during Phase 2 of Experiment 8.

5.1.5 Discussion

The current experiment would appear to have generated some degree of approach-avoidance conflict through derived stimulus relations using mild electro-tactile stimuli and small amounts of money as consequential stimuli. Four participants were provided with the opportunity to approach or avoid varying amounts of money and mild electric shocks, both concurrently and in isolation. Response patterns, reaction times and skin resistance responses were recorded to identify any possible behavioural disruption. Response variability across participants, and reaction time delays during conflict trials were once again observed as in previous experiments. Furthermore, the current experiment replicated the now familiar effect in which response variability is observed across participants, while within-participant variability is not. This latter effect is particularly surprising when it is considered that responding to tasks in this experiment involved *varying* sizes of monetary reinforcers on a trial-by-trial basis. Thus, we would at least expect to see variance in responding in tandem with changes in the relative values of the aversive and appetitive consequential stimuli. It would appear, on contrast, that response stability is not easily disrupted, even with changes in the values of reinforcers.

Larger mean RTs were observed during conflict trials than non-conflict trials in the presence of amounts of money above, below and at the reinforcer value at the group level were the result of the compound structure of the stimuli presented during the probe phase. It could be argued that this delay in responding was due to the fact that compound stimuli more are complex stimuli than a single nonsense syllable and would require a greater length of time for participants to respond to. This argument would appear to be flawed when it is considered that during previous experiments participants also produced larger mean RTs in the presence of compound conflict

trials than compound non-conflict trials. Specifically, 4/5 participants during Experiment 6 and 3/4 participants during Experiment 7 showed evidence of response delay during conflict trials specifically and not during non-conflict trials, where both trial types comprised of compound stimuli. In other words, the evidence from earlier experiments suggests that the presence of a compound stimulus is not a sufficient condition for the elongation of RTs.

The format of the probe phase itself (and particularly the large number of trials presented) may have played a role in the consistent responding across trial types. More specifically, in the case of the present experiment, consequences were temporally distant as participants were informed by prior instruction that any money or mild electric shocks to be delivered would be totalled and administered at the end of the experiment. The interim period between responding to tasks and the expected presentation of consequences may have had an effect on participants' responding.

It may have been the case that the re-introduction of delayed consequences during the critical probe phase in order to improve the procedure had unfortunate consequences in terms of interfering with the value of the reinforcer values initially established in the experiment. Indeed, changes in the reinforcing value of avoiding a mild electric shock across stages of the experiment were observed from Phase 2 to Phase 8. This shift in reinforcer value observed in Phase 8 was larger than previously observed in Experiment 7. That is, a lower reinforcing value for the electric shock was recorded for (P1, P5 and P9) at the end of the experiment (and such a change was not possible to record for the final participant, P4, because they approached on every trial regardless of the monetary value of the reinforcer).

In terms of response patterns produced during the critical probe phase, Participants 1, 4 and 5 produced approach response patterns in the presence of C1/C2 and C2/C1 derived conflict stimuli on trials during which the amount of money on

offer was below the reinforcer value. In other words, the temporal remoteness of the shock consequence may have led to interference with its (negative) reinforcing value, to a greater extent than such temporal remoteness altered the reinforcing value of the money. The demonstrated changes in the reinforcer value established during Phases 2 and 8 for three of the four participants strongly suggest that these values are transient (e.g., habituation, satiation) and may be sensitive to environmental conditions. This may provide an important insight into why more "unstable" response patterns were not observed in this and previous experiments. This concept and its implications for the study of approach-avoidance conflicts will be addressed further in Chapter 6.

Interestingly, the structure of the linear equivalence relations established here may have led to differences in the reinforcing values of the 'C' and 'D' stimuli. More specifically, patterns of responding to stimulus functions in an equivalence relation have been shown to be related to nodal distance. For instance, in one experiment, Fields & Watanabe-Rose (2008) established two 4-node 6-member classes with nodal structures of A→B→C→D→E→F, by training AB, BC, CD, DE, and EF. Then, specific responses were established for the 'C' and 'D' stimuli in both classes. The responses trained for 'C' stimuli transferred to 'B' and 'A' stimuli, while the responses trained for 'D' transferred to 'E' and 'F' stimuli. As a result, each 4-node 6-member equivalence class was divided into two 3-member functional classes: A→B→C and D→E→F. The class membership was predicted by the nodal structure of the initial equivalence relation. A relations test showed that the original 4-node 6-member class was still intact at the end of the experiment.

The authors explained the coexistence of the original relation and the two new relations as a result of the stimuli in the class acquiring two sets of relational properties. Specifically, if the relational test format allows for only one response option per class, responding on those trials will be in accordance with class

membership and will not show the influence of nodal distance. Should the format of the test trial allow for more than a single response option per class, responding on those trials will be controlled by the nodal structure of the class. They concluded that the relational properties of stimuli in an equivalence relation are determined by the discriminative function of the format of a test trial. In the case of the present experiment, only one response option was available to participants during equivalence tests. Thus, participants may have responded to 'B' stimuli differently than they did to 'C' and 'D' stimuli during the probe phase. (The reader is reminded, however, that 'B' stimuli were not presented during the current probe Phase). However, analysis of skin resistance responses to the stimuli that were presented during Phase 6 did not reveal any clear pattern to support this idea.

Researchers have also found that anxiety levels and electrodermal activity do not always co-vary reliably and several failures to record anxiety using skin conductance have been noted (see Naveteur, Buisine & Gruzelier, 2005). Indeed, electrodermal activity has never been a clear interpretable measure of any single psychological process since it was first developed as a measure (see Landis, 1930). Thus, the failure to observe differences in the electrodermal responses of participants across the probe trial types may also be partially due to the intrinsic noisiness of the skin conductance measure itself (see also Roche & Barnes, 1997), compounded of course by the low salience of the relevant stimuli. Naveteur et al. (2005) also note that lower than expected levels of electrodermal activity may be related to coping behaviours of participants, which may themselves involve voluntary relaxation. Given these considerations, researchers may do well to measure anxiety concurrently with the procedures employed here, using more sensitive physiological measures, such as EEG and *f*MRI.

It is important to understand, given the foregoing discussion, that employing additional participants and expanding the range of values of the monetary reinforcers, would likely not eliminate the changes that occurred during this experiment. Aside from the conceptual issues that would raise, it is also not feasible to repeatedly administer the probe phase to participants in the hope of observing statistically inferred stability through the averaging out of variance. This would certainly destroy the salience of the stimuli due to habituation. An important conclusion at this point of the research is that proceeding further with the current experimental preparation now appears to presuppose that a static set point of aversive-appetitive value trade-off actually exists for each participant and that it can be used to generate approach-avoidance conflicts. In fact, such values are variable, even from trial to trial, and the potency of the stimuli employed within the ethical constraints of research, appear to be incapable of generating considerable physiologically observable anxiety with the current procedure. An even more important conclusion, is that stability now appears to be a marked property of human behaviour in these contexts. Across this and previous experiments, approach and avoidance response patterns persisted within participants, in spite of changing reinforcer values, and regardless of the relative randomness of choices in the first instance (i.e., assuming reinforcer values are equal). Thus, it would appear that there is considerable momentum characterising human responses on sequential trials of the type employed here. This issue will be addressed in the general discussion chapter.

CHAPTER SIX: GENERAL DISCUSSION

The primary aim of this thesis was to investigate the conditions under which approach-avoidance conflicts could be generated in human participants in the laboratory through derived stimulus relations. This phenomenon is interesting because the approach-avoidance conflict can be used as a metaphor for many forms of psychological suffering and it has a particular relevance to the forms of suffering of interest to the modern behavioural therapy, Acceptance and Commitment Therapy. In particular, from the ACT perspecitve, avoidance behaviour becomes problematic when it puts the individual in contact with aversive events (other than the event avoided) and removes access to reinforcing events (that coexist with the avoided event).

Across the preceeding chapters, eight computer-based experiments were outlined, each of which provided participants with opportunities to respond to tasks involving conflicting contingencies. In Experiments 1-5, participants were exposed to contingencies in which appetitive, aversive, and a combination of both appetitive and aversive stimuli were presented, conditional upon particular approach and avoidance responses. In Experiments 6-8, a task context in which personally-tailored and near-balanced reinforcing and punishing values for the consequence of responding was established. This concluding chapter will discuss the conceptual and empirical implications of these findings will be considered.

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A conclusion reached at this juncture of the research programme was that attempting to pursue an exact point of aversive-appetitive values that exists and that can be used to establish approach-avoidance conflicts in the laboratory may be naive. As demonstrated, such values are changeable and appear to vary across trials. In addition, the potency of the stimuli which it is possible to employ is restricted within the ethical guidelines governing this research and it may not be possible to generate considerable physiologically observable

anxiety with the present procedures. More importantly, the observed response stability and reaction time delays appear to be a highly reliable feature of human behaviour in the presence of derived approach-avoidance conflicts and it is important to accept this as a conclusion of the research, in itself, rather than as a failure to in confirmation of initial hypotheses.

6.1. General Issues

A number of general conceptual issues arose during the research and others arise now in a reflection of the research findings. These issues are addressed individually.

6.1.1 The Matter of Within Participant Response Consistency

Throughout the experiments conducted during the present research programme, participants rarely deviated in their responding patterns from their initial approach or avoidance response produced. Early animal research on approach-avoidance conflicts previously discussed (e.g., Lewin 1935; Miller 1959), indicated that laboratory rats may be expected to abstain altogether from responding, or produce erratic responding, when presented with the opportunity to receive food and a mild electric shock simultaneously. In the current research, however, no participant reliably and repeatedly failed to produce responses when presented with derived approach-avoidance conflict tasks.

If participants had displayed a complete failure to respond, this may have constituted an example of relationally derived learned helplessness. Learned helplessness is an apathetic condition in an animal or human being, caused by exposure to insoluble problems or inescapable physical or emotional stress. It would appear to be learned from direct contingencies. Early experiments of this phenomenon (e.g., Overmeier & Seligman, 1967) involved strapping experimental dogs into harnesses to prevent them escaping, and then presenting them with inescapable shocks. Later, the dogs were placed in a situation in which they had to respond to a warning signal by jumping over a low barrier in order to avoid additional shocks. Most became apathetic and lethargic and failed to learn this simple

avoidance response. On the other hand, a control group of dogs that had no exposure to shocks learned the avoidance response quickly and relatively easily.

The above example provides a useful conceptual paradigm for understanding many human experiences that appear parallel to the approach-avoidance conflict discussed thus far. For example, if a person who suffers from anxiety is presented with an enjoyable activity that they find appetitive, such as socialising, they may experience a panic attack on one occasion. Despite the punishing consequenes, the appetitive functions of socialising may still control such behaviour in the future. Indeed, on future occasion, the experience may not be punishing at all. Nevertheless, the weight of punishment to reinforcment may in some cases be so well balanced that it may require many socialising experiences before the overall effect of a slightly greater punishing value of panic over the reinforceing value of socialising begins to control behaviour and lead to avoidance. In other words, what started as an apparent approach-avoidance conflict has resolved itself through the ongoing effect of punishment that has led to a cessation of socialising and the loss of reinforcers in the person's life. This, in effect, is what is meant by learned helplessness at a process level.

However, the difference that exists between humans and non-humans may not be explained exclusively using direct contingencies, although this is not specific to cases of learned helplessness only. Self-discriminations can be reactive for verbally able humans (Dymond & Barnes, 1995, 1996) but this is unlikely to be the case with non-humans (Friman, et al, 1998). This is because, as mentioned previously, it is still uncertain whether or not non-humans can reliably demonstrate derived stimulus relations. Whether non-humans can or cannot present evidence of the derived transformation of functions and other related effects is not of direct relevance to the current research programme. It is relevant is to note the difference in self-discrimination that exists between humans and non-humans as this should

be acknowledged when analysing responses produced during approach-avoidance conflicts and other situations.

Friman et al (1998) outline an example of a hungry laboratory rat that can acquire food instantly but will also simultaneously receive a mild electric shock and a separate instance where a short delay must pass in order for the rat to receive food but in the absence of any shock. It is likely that if the levels are correctly set, the rat will impulsively take the food immediately and receive the shock. If a using a preparation similar to Lattal (1975), the rat could be trained to press a lever if had received an electric shock and to press a different lever if it had not. This would, in effect, be a method for the rat to report to the experimenter whether or not it had received the shock (self-discrimination). The authors argue that the self-discrimination of the rat is not likely to have an influence on future similar responses (i.e., it is not likely to be bidirectionally related to the event it is reporting of). In this instance the event-report relation does not also involve a report-event relation. Other than the existence of this bidirectionality, it is not known if there is any pathway for the report to influence future events similar to those initially reported of. In addition, no known pathway in the experimental preparation as outlined exists to allow for the reporting of the shock itself to become unpleasant. As the report would not be bidirectionally related to the event of the shock, the report and the shock would not share the same functions. In functional terms, the report produced is related to food and not to the shock. Reports of punishing events are not known to be aversive for organisms that do not show instances of derived relational responding. Responses of verbally-able humans in similar situations would be expected to be different to rats when what is known about the role of verbal behaviour in human suffering is considered.

Unlike the rat, the shock and report would be expected to share a bidirectional relationship and functions for humans. At least some of the effects of the shock could be

expected to be present when the event of the shock is reported by the verbally-able human. Furthermore, the human's report of the behaviour previous to the shock would also be expected to influence the likelihood of being shocked in the future as a result of the bidirectionality of verbal (i.e., derived) reports. In this case the relationship is event-report and report-event. In this way, a verbally-able human's self-discrimination will affect his or her behaviour in similar situations in the future. This would not appear to be the case with rats or other non-humans. The behaviour of the rat in the above example can be understood in terms of direct contingencies but the indirect responding of the human through derived relations cannot and a verbal explanation for the behavioural effects is recommended by the authors (Friman et al, 1998). Whilst, they may indeed experience physiological fear when presented with an aversive stimulus, nonhumans appear to be unlikely to experience the transformation of that fear across stimulus classes, for example. Given what is now known from the stimulus equivalence and derived transformation of functions literature, approach and avoidance responses would appear to likely to function differently for verbally-able humans and non-humans at this juncture.

To understand learned helplessness at a process level in more practical terms, consider the current example of the phobic client. Every time they attempt to socialise, their social encounter is punished through social or non social (panic) consequences. As a result, the effect of punishment generalises to all responses towards socialising until perhaps even the appetitive functions have been extinguished. However, what of the case in which the aversive functions of approach to appetitive stimuli (socialising) are not directly established as consequences but have been merely derived by virtue of participation of an otherwise innocuous stimulus in a relational network? Consider, for instance, a person who suffers from anxiety being asked if they would like to go to a Mongolian barbecue for the first time. The individual has no direct experience of aversive or appetitive consequences for this behaviour.

Nevertheless, the person may produce a derived relational response of avoidance due to the participation of the prompt for social interaction in derived relations with other such prompts that have led to aversive consequences. Alternatively, they may make an approach response by agreeing to attend the Mongolian barbecue. Finally, they may not respond at all and may appear in conflict due to the competing contingencies supporting both avoidance and approach in equal measure. In this latter case, the person may stall and not know what to do. They may appear flustered, confused and anxious at having to make a choice.

Of course, it is not yet known how typical a learned helplessness form of response would be observed in a randomly selected group of participants. For instance, some may show long reaction times but respond relatively consistently across approach-avoidance tasks. Others may show no responding at all. Still, others may show inconsistent responding but with no notable response time delays. In other words, it is unclear what types of personal historical variables might participate in an over-arching manner on current responding (e.g., histories of emotioanal avoidance).

No participant in this research tended to produce a clear changeable responding pattern during any experiment. Some suggestions for this lack of variability and attempts to tackle it were offered during previous chapters but the cause of the response consistency observed may indeed be more grounded in the basic principles of derived relational responding itself, rather than the format of a particular phase of any experiment outlined here. Indeed, during his early research on stimulus equivalence, Sidman (1994) noted that incorrect test performances often turned positive in the absence of any observable change in contingencies. While addressing this, Sidman (1994) acknowledged that every stimulus is a member of a number of classes, and not just the class generated by the experiment. For example, although a sample stimulus A1 may be a member of an equivalence relation with a comparison stimulus B1, from the perspective of the participant A1, may also participate in

another class with A2, based on physical similarities (e.g., both A1 and A2 may contain similar shaped edges). Therefore, given the B1 stimulus as a sample in test for symmetrical relations, with A1 and A2 stimuli as comparisons, participants may respond by choosing A1 based on existing experimental contingencies, or A2 based on pre-experimental contingencies. Effectively, responding to the A2 stimulus would be considered "incorrect" based on the aim of the experiment itself, but "correct" from the participant's point of view.

Due to the presentation of equivalence tests (and in the case of the present thesis also the critical probe phases of each experiment) in extinction, participants are given no indication if their responses are correct or incorrect. Although a response to a specific comparison, given a specific sample, may be correct from the point of view of the participant, it may not be possible to make the same response on future trials with the same comparison stimulus. More precisely, because incorrect comparisons are typically presented in a random order and position across trials, participants will be unable to respond in a consistent pattern based on pre-experimental contingencies, until a sufficiently large number of trials have been presented. It is only in cases where a sufficient number of trials have been administered that a consistent basis of responding becomes apparent and controls responses. As more and more of these trials are presented, the inconsistent modes of responding are removed from the behavioural repertoire of the participant and the relation that is possible to respond to on every trial eventually provides the opportunity for consistent responding across future trials (see Harrison & Green, 1990, for empirical evidence of this effect).

This position has been expanded upon by Relational Frame Theory (RFT; Hayes, 1991; Hayes, Barnes-Holmes & Roche, 2001) which suggests that, given an extended history of language interactions in the social community, a number of contexts would likely support ongoing derived relational responding without direct reinforcement. In simple terms, according to RFT, producing verbal consistency will function as a relatively powerful

reinforcer for relational activity itself and as a result will become a vital aspect of the verbal behaviour of most people (Roche et al, 2002). Furthermore, from the time they learn to control their social environments through speaking, children are taught to be consistent in what they say and do. Inconsistency in the behaviour of adults is often severely punished (see Guerin, 1994, pp. 159). Roche, et al (2002) made the point that it should not, therefore, be a surprise should the situation arise where verbal consistency and behaviour consistency more generally, become conditioned reinforcers for verbal behaviour itself. In this light, the behavioural consistency widely observed in this research is not surprising.

In addition, when presented with a history of derived relation responding, a verbally-able human may respond to consistencies across behaviour or verbal episodes that are topographically different. For example, a speaker may interpret two separate statements made in two different languages as sharing the same meaning. Also, they may respond to the verbal coherence that is contained in analogues (e.g., "hand is to glove as foot is to shoe") and metaphors (e.g., "cats are dictators") in a way that would not appear possible for nonverbal organisms (see Stewart, Barnes-Holmes, Roche & Smeets, 2001). Therefore, RFT would suggest that once a wide-ranging network of relational frames is established and history of reinforcement is provided for coherent relational networks (i.e., not contradicting oneself), coherence will function as a continuously available reinforcer for derived relational responding. In other words, language will become a self-sustaining process because relational networks are conditioned reinforcers for future relational activity.

Thus, in the case of the present thesis, high levels of response consistency within participants across experiments should not be interpreted as indicative of inadequate procedures for generating derived approach-avoidance conflicts. On the contrary, response variability across participants was both predicted and observed. Given the format of each experiment and the pre-experimental verbal histories of participants within which verbal

consistency is reinforced, such consistent responding appears most likely in the context of the critical probe phases of the each experiment. At this juncture, it is not known whether or not response inconsistency within participants would occur in any circumstance where derived approach-avoidance conflicts are presented to verbally-able participants, nor if such responding is indeed a good indicator of the experience of such conflicts.

In summary, response stability may be typical for verbal organisms due to the possibly conditioned reinforcing functions of behavioural consistency. Indeed, that very consistency was established and reinforced during relational training phases in each of these experiments in this research and yet the experimenter still expected to observe variable behaviour during critical probe phases. Thus, while variability may have become less likely as a result of the types of methodological issues discussed earlier (e.g., shifting reinforcer values), it may not be easily achievable for verbal organisms for whom discriminated stability in one's own behaviour is itself a conditioned reinforcer. Therefore, it may well be that approach-avoidance conflicts can easily generate near random response patterns when considered across participants, and response delays within participants, but not response variability within participants. In effect, this outcome may not be so much a failure of the current procedures, as a genuine discovery of the current research. The phenomenon was observed sufficiently often here, using different samples of participants across a sufficiently large variety of procedures (both approach-approach and approach-avoidance), that a conclusion that stability is a defining feature of human response patterns is not unreasonable.

6.1.2 Reaction Time Differences

Differences in response latencies between conflict and non-conflict trials were observed in several experiments of the current thesis. In addition, the reaction times produced in the presence of the first conflict trial of a critical probe phase were typically shown to be larger than those for the first non-conflict trial- generally regardless of the order in which

these trials appeared. Specifically, larger reaction times were produced during conflict trials than non-conflict trials during Experiments 5, 6, 7, and 8. Reaction time effects were observed during first conflict trial presentations during Experiments 1, 2, 3, 6, 7, and 8. Such prevalence of the effect appears to suggest, at the very least, that the derived approach-avoidance conflicts did disrupt the responding of participants to some extent.

Admittedly, behavioural measures do not usually put emphasis on reaction times due to the wide range of interpretations associated with this measure. However, their use has been encouraged in certain cases and also shown to further the understanding of derived relational responding (see Dymond and Rehfeldt, 2001). For example, Bentall et al., (1993) reported that participants produced responses more quickly on trials for directly trained relations than on trials for derived relations. In a separate study, Spencer and Chase (1996) found that response speed (as opposed to response latency) was related to nodal distance and differed significantly across symmetry and transitivity probes, but not across probes for transitivity and combined symmetry and transitivity. Spencer and Chase (1996) proceeded to make the case that response latency is a more sensitive measure of derived relational responding than response accuracy because differences in response latency across trial types can remain when response accuracy has stabilised. Furthermore, Steele and Hayes (1991) reported that participants responded more quickly to derived Same relations than Opposite relations. These authors suggested that this finding indicated the different levels of complexity of Same and Opposite relations (i.e., two Same relations combine to form a further Same relation, whereas two Opposite relations combine to form a relation of different form). In addition, reaction times at the level of mutual entailment for Same, Opposite, More than and Less than decreased across trials within a test block, and across an additional stimulus set (O'Hora et al., 2002). On a novel stimulus set, participants derived relations more quickly than they did during the initial testing block, suggesting a generalisation of derived relational responding. It

is important to note at this point that response latency revealed learning and generalisation patterns that were not easily ascertainable using accuracy alone.

Interestingly, in the current experiments, the reaction time effects produced during conflict trials compared to non-conflict trials suggest a degree of response disruption across experiments precisely because response times should decrease rather than increase across trials and across phases, (e.g., O'Hora et al, 2002). As mentioned briefly during Chapter 3, delays in responding were repeatedly observed across participants during the presentation of conflict trials throughout experiments. These larger reaction times were produced during critical probe phases of experiments that were presented toward the latter stages of experiments where more rapid responding would appear to be more likely. Although we should be cautious in appealing to these response delays as proof of a contingency conflict, when these delays are considered in conjunction with the other findings reported in the experiments reported here, the idea that response conflicts were successfully generated is made stronger.

6.1.3 The Relevance of Psychophysiological Measures

During Experiment 8, only one participant produced larger mean SRRs during conflict trials than non-conflict trials in the presence of a monetary amount equal to the established reinforcer value. Unexpectedly, two participants also produced larger mean SRRs during conflict trials than non-conflict trials in the presence of amounts of money above the established reinforcer value during the probe phase. As anticipated, no participant produced a larger mean SRR during conflict trials than non-conflict trials in the presence of amounts of money *below* the established reinforcer value during Phase 5. It would appear that the approach-avoidance phenomenon did not create sufficiently acute anxiety for it to be measurable using SRRs. This may cast doubt on the conflict phenomenon reported here but

the other data presented point more firmly toward the idea that response conflicts were observed across several experiments.

Due to the relatively low number of participants in each experiment, it would not have been meaningful to investigate correlations and predictive relationships between self-report anxiety ratings, SRRs and avoidance responses. It should be noted, however, that the self-report anxiety ratings indicated that participants did in fact experience a degree of anxiety during conflict probes. During Experiment 6, for example, mean self-report anxiety ratings showed that higher anxiety was produced during conflict trials than non-conflict trials for all participants, and anxiety ratings produced during the first conflict trials were higher than those produced during the first non-conflict trials for 4 of the 5 participants. Four of the five of these participants also produced approach response patterns during the same phase. During Experiment 7, self-report anxiety ratings did not tend to show the same effect as Experiment 6, but of the two participants who produced higher mean self-report anxiety ratings, both (P4 and P5) tended to produce avoidance response patterns. Also, when anxiety ratings during the first trials were analysed, a higher rating was produced during conflict than non-conflict trials by two out of four participants.

Whilst it would have been possible to gather further data, it became apparent that the trends in SRR data were not weak due to a low number of participants and that additional participants would not have clarified these trends to any noteworthy degree. Instead it was concluded that the salience of the approach-avoidance conflicts was likely to be insufficient to establish measurable effects in the laboratory using procedures of this kind. That is, within ethical boundaries it is simply not possible to create the types of distressing response conflicts that would be measurable on a polygraph, or more importantly, that would be sufficiently differentiated from a non-anxious response to be statistically verifiable. This matter, it would appear, is worthy of investigation in a further doctoral research programme, in its own right.

The issue of the salience of stimuli was raised previously during Chapter 3, where it was suggested that replacing the use of IAPS images as unconditioned stimuli to establish approach-avoidance conflicts with mild electric shocks might have enhanced the salience of the experience of the conflicts. The IAPS images may have been too weak to establish clear approach-avoidance conflict related response disruption or, indeed, anxiety measurable on a polygraph. It now appears to be the case that the levels of mild electric shock permitted within relevant ethical guidelines cannot produce a strong autonomic reaction even if the procedures employed had produced predictable derived avoidance behaviour, conflict trial responses (i.e., even when this included perfectly distributed response patterns) and reaction times consistent with hypotheses.

6.1.4 Functional Equivalence, Stimulus Equivalence and their Disruption

The present findings contribute to the current literature on nodal distance between stimuli in an equivalence class and the structure of the class itself (as discussed during the previous chapter). Specifically, a phenomenon reported in a study by Fields & Watanabe-Rose (2008) has relevance to the findings of the present thesis. That study established two 4-node 6-member classes with nodal structures of A→B→C→D→E→F by training AB, BC, CD, DE, and EF. Different responses were trained to the C and D stimuli in each class. The responses trained to C transferred to B and A, while the responses trained to D transferred to E and F. In effect, each 4-node 6-member equivalence class was divided into two 3-member functional classes: A→B→C and D→E→F. The class membership was predicted by the nodal structure of the initial equivalence relation and the original classes were still intact at the end of the experiment. According to the authors, the coexistence of the original relation and the two new relations was the result of the stimuli in the class acquiring two sets of relational properties. Precisely, if the relational test format allows for only one response option per class, responses produced on those trials will be in accordance with class

membership and will not display the control by nodal distance. In the case of Experiment 8 (Chapter 5) participants may have responded to 'B' stimuli (should they have been presented) differently than they did to 'C' and 'D' stimuli during Phase 5 (although SRR analysis did not support this). However, it must be noted that the Fields & Wantanabe-Rose (2008) findings do not apply directly in the current case as a one-to-many rather than a linear stimulus equivalence training protocol was employed. Nevertheless, it is at least conceivable that the stimulus classes employed here did divide into two contextually controlled classes, both of which contained the A stimuli, although such a suggestion is highly speculative, and indeed unlikely.

A similar issue relates to the degree of how closely connected the stimuli are within an equivalence class in the transfer of function process. Indeed, the procedures employed during the present thesis were likely to be in some way destructive to established equivalence relations. That is, the functions established were likely to centre to some extent around the central node. This is to be expected as it has been repeatedly found that nodal distance between stimuli is inversely related to the probability of the transfer of response functions, within five member equivalence classes are trained with a linear protocol (e.g., A-B-C-D-E-F). For instance, Fields, Adams & Verhave (1993) trained participants in the conditional discriminations AB, BC, CD, and DE, which led to the formation of two five-member equivalence classes. The researchers then established A1 and A2 as discriminative stimuli for two simple responses. These response functions were less reliably produced by the D and E stimuli compared to the B and C stimuli. In effect, Fields et al. (1993) had demonstrated that the mathematical equivalence relation as conceived by Sidman (1971; 1994) appears more coherent than its functional counterpart (i.e., functional equivalence). In addition, when the research considered earlier in this chapter is borne in mind, we can also state that even mathematical equivalence does not consist of equally related stimuli, insofar as reaction times

are related to nodal distance and the nature of the relation being derived between two stimuli (see also Bortoloti & de Rose, 2009; Fields, Landon-Jimenez, Buffington, & Adams, 1995; Fields & Watanabe-Rose, 2008). In some experiments reported here (Experiments 5, 6, 7, and 8), tests for equivalence were administered at the end of the procedure to test for equivalence class disruption and this was found generally not to have occurred. Nevertheless, it is an interesting conceptual point that the current procedure was possibly intrinsically destructive to the equivalence relations themselves, and this may have interfered to some extent with the transfer of functions observed. This possibility will be considered below, but first it is necessary to consider the functional-mathematical equivalence relationship in more detail.

A number of well cited studies have demonstrated the effects of reversing baseline conditional discriminations on stimulus equivalence class stability (e.g., Saunders, Saunders, Kirby, & Spradlin, 1988; Spradlin, Saunders, & Saunders, 1992). Studies of this nature often report that symmetrical, but not transitive relations are sensitive to reversal of one baseline conditional discrimination during re-training for stimulus equivalence (e.g., Pilgrim, Chambers, & Galizio, 1995; Pilgrim & Galizio, 1990, 1995). This has caused some researchers to question whether or not stimulus equivalence should be viewed as an integrated behavioural unit (e.g., Pilgrim & Galizio, 1996). Difficulties in settling the varying opinions have arisen from differences in training and testing protocols employed across studies (see Garotti, De Souza, De Rose, Molina, & Gil, 2000). Nevertheless, the general observation that equivalence classes can be reorganized with varying success by reversing baseline conditional discriminations has led researchers to question the conditions under which stimulus equivalence relations are altered following baseline discrimination reversals or exposure to competing reinforcement contingencies generally (e.g., Garotti & De Rose, 2007; Garotti et al., 2000; Wirth & Chase, 2002). In this vein, several researchers have looked to the effect of establishing competing stimulus functions for common equivalence

class members as a means to effectively control the disruption or reorganization of established stimulus equivalence relations.

In one study, Roche, Barnes & Smeets (1997) established compatible and competing sexual and innocuous eliciting functions within and across stimulus equivalence classes, respectively. The study reported that equivalence class structure was relatively unaffected by the establishment of functional classes (i.e., sexual and innocuous) that competed with the trained and tested equivalence classes. Interestingly, these researchers also found that when the functional classes were established first, they were not readily reorganized by stimulus equivalence training designed to force participants to discriminate between stimuli with common elicitation functions. In another study, Carr & Blackman (2001, Experiment 1) established competing sources of discriminative control within and between two three-member equivalence classes. However, in additional experiments names were also provided for the arbitrary stimuli (Experiment 2) and participants were required to use those names during conditional discrimination training (Experiment 3). It was reported that in all three experiments, equivalence classes were disrupted for some, but not all, participants. More interestingly, in Experiments 2 and 3 frequent noncorrespondence between listener or speaker patterns and the structure of derived equivalence relations was observed. In effect, the researchers reported a noncorrespondence between functional and equivalence classes. This outcome may not be surprising, given that stimulus equivalence and functional equivalence involve fundamentally different training processes (i.e., simple discrimination as opposed to conditional discrimination).

In another study, Tyndall et al., (2004) established two sets of stimuli; six S+ stimuli (i.e., produce a simple operant response to the stimulus) and six S- stimuli (i.e., respond away). The stimuli and simple operant responses were emotionally innocuous in all cases. It was found that participants required more testing blocks to form two three-member stimulus

equivalence classes from among the six S+ stimuli than the six S- stimuli. This finding suggested that stimuli with shared functions (i.e., functional classes) are more difficult to organise into incongruous stimulus equivalence classes than stimuli with less salient or weak shared functions. The findings were used to suggest that functional classes can indeed interfere with the acquisition of equivalence relations, where those relations contain members with different operant response functions (see also Tyndall, Roche & James, 2009).

In the case of the experiments outlined in Chapter 3 (Experiments 4 and 5), the participation of the D and B stimuli in a common equivalence class may have been sufficient for an incongruous function established for one member of each class to interfere with other class member response functions. Obviously, this account is highly interpretive at this juncture, but further investigation of the processes involved may yield important information not known at the time of writing. For instance, Experiments 4 and 5 may have benefitted from a functional class test following Phase 7 to establish whether or not the competing B-D classes were intact before exposure to the critical probe phase. Notwithstanding the foregoing, it still appears likely that an approach-avoidance conflict was generated in the current research because at least some participants during Experiments 4 and 5 produced avoidance responses when presented with C1 stimuli, and approach responses when presented with C2 stimuli. Nonetheless, it may help to explain the variance in the performances across participants and the absence of a larger number of non-responses (i.e., evidence of a very pronounced approach-avoidance conflict).

6.1.5 Verbal Behaviour and The Expectancy Model Of Conditioning

Another noteworthy issue that arose during the present research relates to the relationship between the processes of derived relational responding and the expectancy model of conditioning proposed by Lovibond (2006). Prior to the critical probe phases of the experiments outlined in the present thesis, participants were never exposed to tasks consisting

of derived competing contingencies. Lovibond's (2006) expectancy account would explain responding to conflict stimuli as the result of the propositional knowledge of participants based on their experimental history. Specifically, this account suggests that participants' awareness of the CS-US contingencies resulting from initial conditioning phases, accounts for the responding patterns produced. Lovibond (2006) stated that "an important task for future clinical research is to determine the optimal combination of language and experience for various anxiety disorders" (pp129-130). Whilst the expectancy-based account of conditioning has received recent support (Declercq & De Houwer, 2008, 2009a, 2009b, 2011; Lovibond, et al 2009; Lovibond et al,2008; Ly & Roelofs, 2009), a number of issues arise in terms of explaining findings such as those of the present thesis. Several of these issues were recently raised by Dymond, Schlund, Roche, Whelan, Richards & Davis (2011). The Dymond et al. (2011) study established two separate three-member equivalence classes (AV1-AV2-AV3 and N1-N2-N3) and an avoidance response was trained for a member of one class (AV2) and a non-avoidance response was trained for a member of the other class (N2). Inferred avoidance and non-avoidance behaviour and ratings of how likely the presentation of an aversive stimulus was to be were measured in the presence of each other stimulus. A significantly higher percentage of avoidance to both the learned and inferred avoidance cues and less avoidance to both the learned and inferred non-avoidance cues was observed. Ratings produced in the absence of avoidance behaviour were found to be high during both training and testing to avoidance cues and low to non-avoidance cues and were typically lower in the presence of avoidance behaviour. A number of issues arose which could aid in the expansion of the Lovibond (2006) expectancy account but, crucially, they also have relevance to the current thesis.

Firstly, avoidance behaviour was consistently observed in the presence of AV3, even though avoidance was never directly learned in its presence. In addition, US ratings showed

modulation by the presence or absence of the avoidance response during presentations of the AV3 stimulus. In order for Lovibond's (2006) account to explain this, and also the patterns of responding observed in the present thesis, it is necessary to accept that the indirect avoidance and non-avoidance test phase established a context similar to the learning phase which produced expectancies concerning the predicted omission of the US in the presence of avoidance behaviour and the non-omission of the US in the absence of the avoidance response to AV3. Dymond et al (2011) argued that in order to explain their findings a revised model of the expectancy account would need to accurately determine the features of the testing context that result in indirect avoidance and ratings of aversive consequences.

A second issue of concern here relates to efforts to build associative models of indirect pathways to the emergence of avoidance (Declercq & De Houwer, 2009b; Lovibond et al., 2009; see also, Dunsmoor, Mitroff & LaBar, 2009; Dunsmoor, White & LaBar, 2011). The study by Dymond et al. (2011) produced indirect avoidance in the presence of the AV3 stimulus that had not been directly paired with the avoidance cue AV2. The delayed matching to sample training protocol used ensured that during testing, the offset of the sample stimulus (AV2) was immediately followed by the onset of the comparison stimuli (AV3 and N3). The procedure employed in the study by Dymond et al. (2011) ensured that the sample and predicted comparison(s) were never presented simultaneously onscreen; it appears most unlikely that avoidance behaviour emerged through sensory pre-conditioning, second-order conditioning or stimulus compounding processes (Hall, 1996; Rehfeldt & Hayes, 1998; Smeets & Barnes-Holmes, 2003). While the findings of Dymond et al. (2011) along with those of the current thesis, may be understood in accordance with the expectancy model, the explanation of the emergence of avoidance purely in terms of associative learning processes is not parsimonious and requires a deliberation of the role of verbal relational processes in the acquisition of indirect avoidance (Dougher, Augustson, Markham, Greenway, & Wulfert,

1994; Dougher, Hamilton, Fink, & Harrington, 2007; Dymond & Roche, 2009; Hayes & Hayes, 1992; Smyth, Barnes-Holmes, & Forsyth, 2006).

Finally, Dymond et al. (2011) make the point that although Lovibond's (2006) expectancy model may have heuristic value, it should be kept in mind that the causal relationship between expectancy and avoidance requires further clarification. More precisely, while expectancy may mediate avoidance responses in their study, the authors assert that it is equally likely that the equivalence relations established by the procedure functioned as the causal mechanism for both the participants' expectancies and avoidance responses. It is also the finding of the present thesis that derived relational processes and the derived transfer of functions effect, in particular, functioned as the causal mechanism for participants responding throughout each experiment. According to Dymond et al. (2011), expectancy can be understood in terms of the contingencies produced by the experiment itself. This view has fewer assumptions (i.e., is more parsimonious) than a purely expectancy-based account and is a commonly held functional view amongst researchers in the field of derived relational responding. (e.g., Hayes, Barnes-Holmes, & Roche, 2001; Hayes & Hayes, 1992; Sidman, 1994; Smyth, Barnes-Holmes, & Barnes-Holmes, 2008; see also, De Houwer, 2011; Hughes, Barnes-Holmes, & De Houwer, in press, for related arguments). Dymond et al. (2011) suggest that an expectancy may be interpreted as comprising a discriminated stimulus relation and as a result is the *outcome* of a relational learning process, rather than the immediate *cause* of relational learning effects, such as indirect avoidance (Dymond & Roche, 2009; Dymond et al., 2007, 2008; Friman et al., 1998; Roche et al., 2008). More generally, Dymond et al. (2011) argue that relational learning functions as a "third variable" that can aid in the explanation of the emergence of expectancy and avoidance responses. From this perspective, expectancy and avoidance represent cases of relational responding. A functional, behaviour-analytic approach of this nature can be distinguished from the cognitive/mechanistic view

that places emphasis on inferences and expectancies as mediational constructs (De Houwer, 2011; Dymond & Roche, 2009; Friman et al., 1998; Hayes & Brownstein, 1986).

6.1.6 Opportunities for Future Research

During Experiment 8, the values of money on offer were varied on a trial-by-trial basis and as a result so too were the relative reinforcing values of the appetitive and aversive stimuli of the approach-avoidance conflicts presented. An alternative process to altering the reinforcing and punishing values of the approach-avoidance conflicts would be to explore methods for varying the temporal relations between responses and consequences. This may also address the problem of how to get consequences weighed exactly equal in value. While it is technically difficult to do this with precision in the first instance, the current studies show that even once this is achieved within acceptable limits of error, reinforcing values drift over time (more than likely due to different rates of habituation for the different stimuli, and perhaps other processes). Time, on the other hand, would appear to be open to experimental manipulation more easily. Changing the temporal location of consequences relative to each other may allow for greater control over the experience of the conflicts.

This suggested approach opens up the need to incorporate the concept of relational frames, which are a more complex form of derived relational responding than discussed up to this point. While a discussion of Relational Frame Theory (Hayes, Barnes-Holmes, & Roche, 2001) and its associated procedures is unnecessary here, a general outline of the broad experimental procedure is possible. Specifically, stimuli could still participate as here in stimulus equivalence classes. However, contextual cues could also be established that specify the temporal functions of consequential stimuli. For instance, three cues for 10 s, 20 s and 30 s could be established. During a pre-training phase, participants could be trained to respond in the presence of these cues, and consequences could be delivered at one of the three temporal intervals (10 s, 20 s or 30s), corresponding with the cue present during the relevant trial. In

this way, the temporal features of the consequence delivery would come to control responding. During a probe phase for derived approach-avoidance conflicts, one of these contextual stimuli could be presented alongside each of the two derived approach and avoidance stimuli. Each would then have different temporal functions, such that the salience of each stimulus would be different and easily manipulable. It may even be possible using this relational frame approach to create supernormal threat stimuli that are never in fact presented (for ethical reasons).

This could be achieved by employing relational frames of comparison as in the Dougher, Hamilton, Fink & Harrington (2007) study. Those authors employed a matching-to-sample protocol to establish arbitrary relational functions for three abstract visual stimuli. Participants were trained to select the smallest, middle and largest members in the presence of samples A, B and C over a series of comparison trials. In the first of three experiments, the B stimulus (choose middle) was then trained to produce a steady rate of keyboard pressing, before the A (choose smallest) and the C (choose largest) stimuli were presented. Participants produced slower presses to A stimuli and faster to C stimuli than to B stimuli. The B stimulus was then paired with a mild electric shock in a respondent conditioning procedure which used skin conductance change as the dependent variable. It was found that 6 of the 8 participants produced smaller skin conductance changes to A stimuli and larger skin conductance changes to C stimuli than to B stimuli. When presented with A and C, 6 of 8 experimental participants showed smaller skin conductance changes to A and larger skin conductance changes to C than to B. During Experiment 2 of the study, the A stimulus was used as a sample to establish an arbitrary size ranking among four coloured circle comparisons of the same size. One of the middle circles was then used to establish a steady rate of key pressing before the presentation of the other circles. It was found that 5 of the 6 participants responded more slowly to the “smaller” circle and faster to the “larger” circle

than they did to the "middle" circle. During the third experiment, A, B and C stimuli were presented on a series of test trials during which participants were required to choose the comparison that was less than, greater than or equal to the sample. Novel stimuli were included on random trials. It was found that the relational training procedures produced derived relations among the stimuli presented in training and that these allowed for accurate inferences of relative size ranking among the novel stimuli that were presented.

One of the most important contributions of the Dougher et al., (2007) study is that it may be possible to generate higher levels of anxiety using relational frames than were achieved during the present thesis using stimulus equivalence. In the current experiments, the potency of the derived aversive stimuli was limited by the potency of the mild electric shocks, which across several experiments did not seem to be sufficiently aversive to create marked anxiety. However, they did allow for the creation of some response disruption.

Future research on approach-avoidance conflicts may also benefit from the inclusion of a greater number of response options during critical probe phases. Providing participants with too many response options (or choice overload; Iyengar & Lepper, 2000; Scheibehenne, Greifeneder, & Todd, 2010) has been shown to result in adverse experiences, including a depletion in cognitive resources and feelings of regret following the task. For instance, recently, Reed, DiGennaro Reed, Chok & Brozyna (2011) examined whether choice overload would emerge when human services workers confronted hypothetical scenarios involving choices of treatment strategies. On different trials, the participants indicated preference for single-option, limited-options, and extensive-options scenarios, wherein the number of extensive-options alternatives geometrically increased across successive trials. In general, preference for extensive-options scenarios decreased with the number of options that they incorporated. The inclusion of additional response options would readily lend themselves to procedures similar to those outlined in the present thesis without any additional ethical

considerations. In addition, the response disruption and any potential experimentally induced anxiety could be increased in such situations.

It may be that in order to generate derived approach-avoidance conflicts, that stimuli may have to be particularly aversive, or perhaps that a participant has a particular personal history, akin to learned helplessness, for large effects on behaviour to result in response variability within participants or a delay in responding. Future research could easily examine this issue by generating learned helplessness effects in the laboratory (using unsolvable problem solving tasks, etc.) and measure the effects on extended histories of this kind on response patterns during approach-avoidance conflicts.

As noted by Dymond & Roche (2009), in order to further develop a behavioural model of anxiety, translational research is required in which "findings from the laboratory are replicated with and extended to clinical populations and problems" (Lerman, 2003, p.415). Extensions of studies similar to those of the present thesis, examining avoidance behaviour of clients with anxiety disorders and with subclinical participants categorised as high or low in anxiety using validated psychometric tests, would appear to be worthwhile. Dymond and Roche (2009) have emphasised the importance of projects of this nature, particularly in light of the swift emergence of a number of new treatment techniques within modern behaviour therapy that are focused on derived relational responding (e.g., Forsyth & Eifert, 2008; Hayes et al, 1999).

Perhaps the most important contribution of the current research has been the articulation of the myriad of procedural artefacts that need to be taken into account when studying accurately controlled dual contingencies simultaneously. The fact that derived relational research has even come to analyse behavioural effects of this level of subtlety is remarkable given the conservative nature of the behavioural approach and the technically precise nature of its procedures. It is hoped that these procedures and research suggestions

will open the door for a more progressive analysis of approach-avoidance conflicts and the psychological conditions they characterise, both inside and outside the clinical setting.

6.1.7 Clinical Implications

It is noteworthy that participants in the current research did not produce response variability within participants or completely abstain from responding when presented with approach-avoidance conflicts. This in itself is a novel and unexpected finding. However, as mentioned during the previous chapter, this behaviour may in fact be expected, given the current experimental procedures. For example, each of the previous experiments found that response stability within participants occurs repeatedly in the presence of competing contingencies. Once a participant made an initial response during a critical probe phase, they tended to respond in this way each time the same trial was presented. Participants did not repeatedly and reliably abstain from responding in the presence of conflict trials. It may indeed be the case that producing consistent response patterns during the previous experiments was in itself reinforcing. It may also be the case that verbally-able humans are simply not as "dysfunctional" when presented with approach-avoidance conflicts, at least in a laboratory setting. It may be the case that only participants with a clinical history of anxiety would show complete response cessation using these laboratory procedures. response cessation. The lack of response variability within participants and the absence of complete response cessation across repeated approach-avoidance conflicts is an important finding, therefore, because it represents the beginning of the mapping out of the boundary conditions for approach-avoidance based response disruption, first in normal, and ultimately in clinical populations.

According to Acceptance and Commitment Therapy (ACT; Hayes, Strosahl & Wilson, 1999), forms of emotional regulation such as experiential avoidance; (a) are learned and can be learned independently of fear conditioning experiences (e.g., as a generalized

operant), (b) can make aversive emotions more severe and increase the possibility of re-occurrence and; (c) can obstruct meaningful life activities (Forsyth et al., 2007). In other words, clients wish to engage in many activities as part of a life of good quality, and engaging in avoidance behaviour tends to militate against this end because avoidance can lead to the removal of reinforcers. For this reason, experiential avoidance is one of the most important targets of the treatments in ACT (Eifert, Forsyth, Arch, Espejo, Keller, & Langer, 2009). An experiential acceptance posture involves the full experiencing of private events, and doing so without defence. In other words, it involves directly contacting stimulus functions of events in the absence of attempting to reduce or otherwise manipulate those functions, without acting on the basis of their derived verbal functions (Hayes, 1994, p. 30). Unlike experiential avoidance, acceptance encompasses an openness to both aversive *and* appetitive experiences (see Hayes, Villatte, Levin & Hildebrandt, 2011, for a review).

Importantly, ACT incorporates a commitment to forego attempting to make changes in cases where it has a negative effect on the functioning of the client and only increases distress (Marx & Sloan, 2004). In attempting to decide upon which ends are worth pursuing through therapy, ACT attempts to identify clients' values, which are defined as "chosen qualities of purposive action that can never be obtained as an object but can be instantiated moment by moment" (Hayes, Luoma, Bond, Masuda, Lillis, 2006, p.9). By clarifying the values of the client, the potency of different response consequences can be slightly altered. For example, if a client can come into psychological contact with the loss it is causing them to avoid going to work, the avoidance of work can become even more costly (i.e., punishing) and attending work can become more rewarding (i.e., negatively reinforcing). In this way, values can shift the balance between approach and avoidance contingencies, while leaving both approach and avoidance repertoires perfectly in tact.

In ACT, clients are often asked to consider how their previous efforts to control unpleasant experiences may have interfered with what they value. When an anxious client is engaging in costly avoidance behaviour, or inactivity, committed action is incorporated to assist in linking the present situation to the client's values. The ACT position, is that much avoidance behaviour is verbally regulated (i.e., derived). Thus, verbally regulated avoidance contingencies that are leading to approach-avoidance conflicts in the natural environment must be weakened. As this verbal regulation is targeted in therapy, through such strategies as cognitive defusion (see Hayes et al., 1999) an accepting posture arises. From this accepting stance, clients can see their anxious feelings as just that, and can learn to respond in ways that are not always congruent with the private feelings they are experiencing, but are more congruent with immediate environmental demands and personal values (see Forsyth et al. 2007). In effect, by reducing the control of verbal contingencies, approach contingencies may begin to dominate over avoidance contingencies. As they do, more direct consequences for behaviour are contacted, and normal behavioural regulation by increasingly nonverbal contingencies can become more pervasive in the life of the client. Therapists would do well to focus on shifting the balance between approach and avoidance contingencies, rather than trying to eliminate avoidance contingencies alone (see Eifert & Forsyth, 2005).

6.1.8 Conclusion

The development of a procedure to establish derived approach-avoidance conflicts outlined in the present thesis provides a contribution to the experimental analysis of behaviour in an attempt to answer the call to develop a comprehensive behaviour analytic account of human anxiety (Dymond & Roche, 2009). The current research represents a contribution to the existing literature on derived relational responding and, in particular, the derived transfer of functions effect, in addition to the understanding of derived avoidance responding. This is the first research of its kind to produce approach-avoidance conflicts in

the laboratory using derived stimulus relations, or even with human participants. It is hoped that the findings presented here assist in the effort to develop a more comprehensive behaviour-analytic understanding of avoidance behaviour and anxiety that can speak to other branches of psychology (i.e., the role of verbal behaviour in the expectancy model of conditioning). To the extent that these modest advances will allow behaviour analysts to provide more appealing and compelling accounts of anxiety to clinicians and other psychologists outside the behavioural field, and to pursue these questions better equipped with the wealth of procedural information provided here, the current research endeavour was worthwhile.

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List of Appendices **Page**

Appendix 1a

Informed Consent Forms-Experiments 1, 2 and 3

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

This research is being conducted by Steven Gannon, a postgraduate student at the Department of Psychology, National University of Ireland, Maynooth. The method proposed for this research project has been approved in principle by the Departmental Ethics Committee, which means that the Committee does not have concerns about the procedure itself as detailed by the student. It is, however, the above- named student's responsibility to adhere to ethical guidelines in their dealing with participants and the collection and handling of data. If I have any concerns about participation I understand that I may refuse to participate or withdraw at any stage.

I have been informed as to the general nature of the study and agree to voluntarily participate.

There are no known expected discomforts or risks associated with participation.

All data from the study will be treated confidentially. The data from all participants will be compiled, analysed, and submitted in a report to the Psychology Department. No participant's data will be identified by name at any stage of the data analysis or in the final report.

At the conclusion of my participation, any questions or concerns I have will be fully addressed.

I may withdraw from this study at any time, and may withdraw my data at the conclusion of my participation if I still have concerns.

Signed:

_____Participant

_____Researcher

_____Date

Appendix 1b

Participant Briefing/Screening and Informed Consent Form-

Experiments 4 and 5

The study which I am conducting involves examining human learning on a series of simple problem-solving tasks involving words and photographs.

As part of the problem-solving procedure you will also be exposed to a series of photographs some of which you may find very distressing. These will include images of people with severe bodily injuries. In the first phase of the study these will be presented on a questionnaire and you will be asked to rate how you feel about each of 6 pictures, three of which will involve images of bodily injury.

The next phase of the study will involve engaging in a learning task on a computer. This phase will also involve the presentations of images on the computer screen for three seconds each. Several of these images will also involve bodily injury.

The names and information provided by each participant in the study will be completely confidential.

Of course, even if you turn up to participate in the study you are free to terminate your procedure in the study at any time.

Please feel free to ask any questions now and then read and sign the attached consent form in order to confirm that you are willing to help with this research.

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

This research is being conducted by Steven Gannon, a postgraduate student at the Department of Psychology, National University of Ireland Maynooth. It is the responsibility of Mr. Gannon to adhere to ethical guidelines in their dealings with participants and the collection and handling of data. If I have any concerns about participation I understand that I may refuse to participate or withdraw at any stage.

I have been informed as to the general nature of the study. I understand that as a requirement of participating in the study I will be exposed to images which some people may find distressing.

All data from the study will be treated confidentially. The data will be compiled, analysed and submitted in a report to the Psychology Department, NUI, Maynooth. My data will not be identified by name at any stage of the data analysis or in the final report.

At the conclusion of my participation, any questions or concerns I have will be fully addressed.

I may withdraw from this study at any time, and may withdraw my data at the conclusion of my participation if I still have concerns.

Signed:

_____Participant

_____ Researcher

_____ Date

Appendix 1c

Participant Briefing/Screening and Informed Consent Form-

Experiments 6 and 7

The study which I am conducting involves examining human learning on a series of simple problem-solving tasks involving words, the possibility of earning money and mild electric shocks.

As part of the problem-solving procedure you will also be exposed to a series of tasks which involve the presentation and matching of words on a computer.

The next phase of the study will involve engaging in another learning task. This phase also entails presentations of words but in addition, will include the possibility of earning money and the use of mild electric shocks. The shocks will not exceed a level set by you, the participant. These are of no greater strength than static shocks experienced in every day life such as a shock off a car door on a hot day. No tissue damage or severe psychological trauma will occur as a result of the shock. You can choose to avoid all shocks during the experiment if you want to. Throughout the experiment, you will be presented on an onscreen questionnaire and will be asked to rate how you felt during the previous trial.

If you have any health problems that may make exposure to mild shocks hazardous such as a heart condition, a history of chronic pain or epilepsy please inform the experimenter now as you may not be able to participate.

The names and information provided by each participant in the study will be completely confidential.

Of course, even if you turn up to participate in the study you are free to terminate your procedure in the study at any time.

Please feel free to ask any questions now and then read and sign the attached consent form in order to confirm that you are willing to help with this research.

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

This research is being conducted by Steven Gannon, a postgraduate student at the Department of Psychology, National University of Ireland Maynooth. It is the responsibility of Mr. Gannon to adhere to ethical guidelines in their dealings with participants and the collection and handling of data. If I have any concerns about participation I understand that I may refuse to participate or withdraw at any stage.

I have been informed as to the general nature of the study. I understand that as a requirement of participating in the study I will be exposed to a situation where I can receive or alternatively, avoid a mild electric shock.

All data from the study will be treated confidentially. The data will be compiled, analysed and submitted in a report to the Psychology Department, NUI, Maynooth. My data will not be identified by name at any stage of the data analysis or in the final report.

At the conclusion of my participation, any questions or concerns I have will be fully addressed.

I may withdraw from this study at any time, and may withdraw my data at the conclusion of my participation if I still have concerns.

Signed:

_____Participant

_____ Researcher

_____ Date

Appendix 1d

Participant Briefing/Screening and Informed Consent Form-

Experiment 8

The study which I am conducting involves examining human learning on a series of simple problem-solving tasks involving words, the possibility of earning money, mild electric shocks and a measure of skin conductance by a polygraph.

As part of the problem-solving procedure you will also be exposed to a series of tasks which involve the presentation and matching of words on a computer.

The next phase of the study will involve engaging in another learning task. This phase also entails presentations of words but in addition, will include the possibility of earning money and the use of mild electric shocks. The shocks will not exceed a level set by you, the participant. These are of no greater strength than static shocks experienced in every day life such as a shock off a car door on a hot day. No tissue damage or severe psychological trauma will occur as a result of the shock. You can choose to avoid all shocks during the experiment if you want to. Throughout the experiment, you will be presented on an onscreen questionnaire and will be asked to rate how you felt during the previous trial.

If you have any health problems that may make exposure to mild shocks hazardous such as a heart condition, a history of chronic pain or epilepsy please inform the experimenter now as you may not be able to participate.

The polygraph equipment is used to measure any rise or fall in the resistance of the skin to the passage of a weak electric current. There are no known side-effects or discomforts related to this procedure.

The names and information provided by each participant in the study will be completely confidential.

Of course, even if you turn up to participate in the study you are free to terminate your procedure in the study at any time.

Please feel free to ask any questions now and then read and sign the attached consent form in order to confirm that you are willing to help with this research.

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

This research is being conducted by Steven Gannon, a postgraduate student at the Department of Psychology, National University of Ireland Maynooth. It is the responsibility of Mr. Gannon to adhere to ethical guidelines in their dealings with participants and the collection and handling of data. If I have any concerns about participation I understand that I may refuse to participate or withdraw at any stage.

I have been informed as to the general nature of the study. I understand that as a requirement of participating in the study I will be exposed to a situation where I can receive or alternatively, avoid a mild electric shock.

All data from the study will be treated confidentially. The data will be compiled, analysed and submitted in a report to the Psychology Department, NUI, Maynooth. My data will not be identified by name at any stage of the data analysis or in the final report.

At the conclusion of my participation, any questions or concerns I have will be fully addressed.

I may withdraw from this study at any time, and may withdraw my data at the conclusion of my participation if I still have concerns.

Signed:

_____Participant

_____ Researcher

_____ Date

Appendix 2

Participant Screening Form for Experiments 4 and 5

1)

How unpleasant do you find the above picture?

Very Unpleasant Very Pleasant

1 2 3 4 5

2)

How unpleasant do you find the above picture?

Very Unpleasant Very Pleasant
1 2 3 4 5

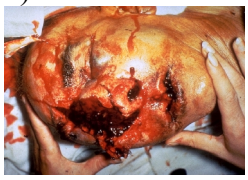
3)

How unpleasant do you find the above picture?

Very Unpleasant Very Pleasant

1 2 3 4 5

4)



How unpleasant do you find the above picture?

Very Unpleasant Very Pleasant

1 2 3 4 5

5)

How unpleasant do you find the above picture?

Very Unpleasant Very Pleasant

1 2 3 4 5

6)

How unpleasant do you find the above picture?

Very Unpleasant Very Pleasant

1 2 3 4 5

Thank you very much for your co-operation

Appendix 3

The mean and standard deviation valence and arousal ratings for the IAPS (Lang, Bradley, & Cuthbert, 2005) stimuli employed in the study. IAPS ratings are scored on a 9-point scale. A rating of 9, for example, represents a high rating of that particular dimension (i.e., high pleasure or high arousal) and a rating of 1 represents a low rating on that particular dimension (i.e., low pleasure or low arousal).

	Valence		Arousal	
Aversive Stimuli	Mean	Standard deviation	Mean	Standard deviation
IAPS picture # 3010 Mutilation	1.71	1.19	7.16	2.24
IAPS picture # 3030 Mutilation	1.91	1.56	6.76	2.10
IAPS picture # 3053 Burn Victim	1.31	0.97	6.91	2.57
IAPS picture # 3060 Mutilation	1.79	1.56	7.12	2.09
IAPS picture # 3068 Mutilation	1.80	1.56	6.77	2.62
IAPS picture # 3069 Mutilation	1.70	1.41	7.03	2.41
IAPS picture # 3130 Mutilation	1.58	1.24	6.97	2.07
IAPS picture # 3250 OpenChest	3.78	1.72	6.29	1.63
IAPS picture # 3063 Mutilation	1.49	0.96	6.35	2.60
IAPS picture # 3000 Mutilation	1.59	1.35	7.34	2.27
IAPS picture # 3062 Mutilation	1.87	1.31	5.78	2.57
IAPS picture # 3080 Mutilation	1.48	0.95	7.22	1.97
Appetitive Stimuli				
IAPS picture # 4800 EroticCouple	6.44	2.22	7.07	1.78
IAPS picture # 4810 EroticCouple	6.56	2.09	6.66	2.14
IAPS picture # 4689 EroticCouple	6.90	1.55	6.21	1.74

IAPS picture #4683 EroticCouple	6.17	2.07	6.62	1.79
IAPS picture # 4681 EroticCouple	6.69	1.82	6.68	1.70
IAPS picture # 4687 EroticCouple	6.87	1.51	6.51	2.10
IAPS picture # 4677 EroticCouple	6.58	1.65	6.19	2.08
IAPS picture # 4651 EroticCouple	6.32	2.18	6.34	2.05
IAPS picture #4652 EroticCouple	6.79	2.02	6.62	2.04
IAPS picture # 4656 EroticCouple	6.73	1.94	6.41	2.19
IAPS picture # 4658 EroticCouple	6.62	1.89	6.47	2.14
IAPS picture# 4659 EroticCouple	6.87	1.99	6.93	2.07

Appendix 4

Participants ratings of images on a 5-point Likert Scale presented before beginning Experiment 4. *Aver.* refers to aversive images and *Appet.* refers to appetitive images.

P. No.	IAPS picture # 3010	IAPS picture # 3060	IAPS picture # 3069	IAPS picture # 4800	IAPS picture # 4689	IAPS picture # 4687	Aver. Mean	Appet. Mean
5	1	1	1	4	4	5	3	13
7	1	1	1	4	4	4	3	12
8	1	1	1	4	4	4	3	12
9	2	2	1	5	4	4	5	13
10	2	2	2	5	5	5	6	15

Appendix 4

Participants ratings of images on a 5-point Likert Scale presented before beginning Experiment 5. *Aver.* refers to aversive images and *Appet.* refers to appetitive images.

P. No.	IAPS picture # 3010	IAPS picture # 3060	IAPS picture # 3069	IAPS picture # 4800	IAPS picture # 4689	IAPS picture # 4687	Aver. Mean	Appet. Mean
11	1	1	1	4	4	4	3	12
12	1	1	1	3	3	3	3	9
13	3	3	2	5	4	4	8	13
17	2	1	2	4	3	3	5	10
18	1	2	1	4	4	4	4	12

Appendix 5

Instructions presented before Phase 6 of Experiment 8

In a moment some more items will appear on this screen.

PLEASE CONCENTRATE ON THE SCREEN AT ALL TIMES. IT IS IMPORTANT THAT YOU CONTINUE TO PAY ATTENTION.

Please note that shocks and money may or may not be delivered during this phase. If shocks and money are to be delivered you will not receive them immediately. Instead any shocks or money to be delivered will be recorded by the computer and will be delivered together at the end of the experiment.

You may use the onscreen buttons as before if and when you feel it is appropriate.

During this phase the computer will not provide you with any feedback. At the end of the experiment you will receive feedback on your performance during this phase.

If you have any questions please ask the experimenter now.

Please click ‘Continue’ below to proceed with the experiment.

Appendix 6: Each participant's Skin Resistance Responses (SRR) produced during Phase 6 of Experiment 8. SRRs were recorded in kilohms and transformed to the function log (SRR+1). A "c" following a number refers to the amount of cents (Euro) that were on offer during a particular trial that were that number either above ("a") or below ("b") the reinforcer value (rv) established during Phase 2 of Experiment 8.

Participant 1: SRRs produced during Phase 6 of Experiment 8

Stimulus	**C1/D1 r v**	**D1/C1 10c b**	**C2/C1 10c a**	**C1/C2 r v**	**C2/D2 10c a**
SRR	1.07918	1.07918	0.95424	0.95424	0.95424

Stimulus	**C1/C2 10c a**	**D2/C2 10c a**	**C1/C2 5c b**	**C2/D2 r v**	**C2/C1 5c b**
SRR	1.17609	1.07918	0.47712	1.07918	0.95424

Stimulus	**D1/C1 r v**	**D2/C2 10c b**	**C2/C1 r v**	**C1/D1 r v**	**C1/C2 10c a**
SRR	1.25527	1.07918	1.32222	0.77815	1.07918

Stimulus	**C2/D2 r v**	**C1/C2 r v**	**C1/D1 10c b**	**D2/C2 r v**	**C2/C1 10c a**
SRR	0.00	1.17609	1.32222	0.95424	0.95424

Stimulus	**D1/C1 r v**	**C2/C1 r v**	**C1/D1 5c a**	**D2/C2 r v**	**C1/C2 10c b**
SRR	1.07918	0.95424	0.47712	1.17609	1.17609

Stimulus	**C2/C1 5c a**	**C2/D2 r v**	**D1/C1 5c a**	**C2/C1 5c b**	**C2/D2 10c b**
SRR	0.47712	0.77815	0.95424	0.00	0.77815

Stimulus	**C1/C2 r v**	**D2/C2 r v**	**C2/C1 5c a**	**C1/D1 r v**	**C2/C1 5c a**
SRR	0.95424	0.77815	0.00	0.95424	1.07918

Stimulus	**D2/C2 5c a**	**C2/C1 r v**	**C2/D2 r v**	**C1/C2 5c b**	**C1/D1 5c b**
SRR	1.07918	0.00	0.77815	1.17609	0.95424

Stimulus	C2/C1 10c a	C1/C2 5c a	D1/C1 5c b	C2/C1 5c b	D2/C2 r v
SRR	1.07918	1.17609	1.17609	0.95424	1.07918

Stimulus	C1/C2 r v	C1/C2 5c a	C1/D1 r v	C1/C2 10c b	C2/D2 5c a
SRR	1.07918	1.07918	0.95424	0.77815	1.32222

Stimulus	C2/C1 10c b	D2/C2 5c b	C2/C1 r v	C1/D1 10c a	C1/C2 10c b
SRR	1.17609	0.00	0.00	0.77815	1.07918

Stimulus	D1/C1 r v	C1/C2 10c a	C2/D2 5c b	C2/C1 10c b	D1/C1 10c a
SRR	0.00	0.95424	0.95424	0.77815	0.47712

Stimulus	C1/C2 5c b	C1/D1 r v	C2/C1 10c b	D1/C1 r v
SRR	0.95424	0.77815	0.00	0.95424

Participant 4: SRRs produced during Phase 6 of Experiment 8

Stimulus	**C2/D2 5c a**	**C1/D1 5c b**	**C1/C2 5c a**	**D2/C2 r v**	**C2/C1 10c a**
SRR	1.17609	1.23045	1.17609	0.00	0.00

Stimulus	**D1/C1 r v**	**C1/C2 5c b**	**C1/D1 r v**	**C2/D2 5c b**	**C2/C1 5c a**
SRR	1.11394	1.43136	1.07918	1.07918	0.77815

Stimulus	**D1/C1 5c b**	**C1/C2 5c b**	**D2/C2 r v**	**C2/C1 10c b**	**C1/C2 r v**
SRR	0.95424	0.69897	1.17609	1.17609	1.38021

Stimulus	**C2/D2 r v**	**C2/C1 5c b**	**D1/C1 5c a**	**C1/C2 10c a**	**C1/D1 5c a**
SRR	1.32222	1.17609	0.8451	1.17609	0.95424

Stimulus	**C2/C1 r v**	**D2/C2 5c b**	**C1/C2 10c b**	**C2/D2 r v**	**D1/C1 r v**
SRR	0.77815	1.32222	1.17609	0.77815	1.25527

Stimulus	**C2/C1 5c a**	**C1/D1 10c b**	**C1/C2 5c a**	**C1/D1 r v**	**C2/C1 5c b**
SRR	0.95424	0.77815	0.47712	1.17609	0.95424

Stimulus	**D1/C1 r v**	**C1/C2 10c a**	**C2/D2 10c b**	**C2/C1 r v**	**D2/C2 10c a**
SRR	1.20412	1.17609	0.95424	0.77815	0.00

Stimulus	**C1/C2 10c b**	**C2/D2 r v**	**C2/C1 10c a**	**C1/D1 r v**	**C1/C2 10c b**
SRR	0.77815	0.00	1.25527	1.38021	0.77815

Stimulus	**D2/C2 5c a**	**C2/C1 5c b**	**C1/C2 r v**	**D1/C1 10c a**	**C2/C1 10c b**
SRR	0.95424	1.07918	1.07918	0.00	1.32222

Stimulus	**C2/D2 r v**	**C1/C2 5c a**	**C1/D1 r v**	**C2/C1 r v**	**C1/C2 5c b**
SRR	1.07918	0.00	0.95424	0.47712	0.95424

Stimulus	D2/C2 r v	C2/C1 5c a	D1/C1 10c b	C1/C2 r v	C2/D2 10c a
SRR	1.25527	0.00	1.17609	0.95424	1.38021

Stimulus	C2/C1 r v	C1/D1 10c a	C1/C2 10c a	D2/C2 10c b	D1/C1 r v
SRR	0.77815	0.77815	1.32222	1.04139	0.77815

Stimulus	C2/C1 10c a	C1/C2 r v	D2/C2 r v	C2/C1 10c b
SRR	1.07918	1.17609	1.07918	1.07918

Participant 5: SRRs produced during Phase 6 of Experiment 8

Stimulus	**D1/C1 10c a**	**C1/C2 5c a**	**D2/C2 r v**	**C2/C1 5c b**	**C2/D2 5c a**
SRR	1.17609	1.07918	1.07918	1.07918	1.43136

Stimulus	**C1/C2 r v**	**D1/C1 10c b**	**C2/C1 5c a**	**D2/C2 10c a**	**C1/C2 5c b**
SRR	0.47712	0.47712	0.47712	0.00	1.17609

Stimulus	**D1/C1 r v**	**C2/C1 10c a**	**C2/D2 5c b**	**C1/C2 10c a**	**C2/D2 r v**
SRR	1.32222	1.25527	1.43136	0.95424	1.30103

Stimulus	**C2/C1 10c b**	**D1/C1 5c b**	**C1/C2 10c b**	**C1/D1 r v**	**C2/C1 r v**
SRR	1.32222	0.90309	0.47712	1.32222	0.95424

Stimulus	**D2/C2 10c b**	**C1/D1 5c b**	**C1/C2 r v**	**C2/D2 r v**	**D1/C1 5c a**
SRR	1.25527	1.25527	0.95424	0.77815	1.07918

Stimulus	**C1/C2 r v**	**D2/C2 r v**	**C2/C1 5c a**	**C1/D1 10c a**	**C2/C1 10c b**
SRR	0.77815	0.95424	1.07918	0.77815	0.00

Stimulus	**C2/D2 r v**	**C1/C2 5c a**	**D1/C1 r v**	**C2/C1 5c a**	**D2/C2 5c b**
SRR	1.17609	1.43136	1.07918	0.00	0.47712

Stimulus	C1/C2 10c a	D2/C2 r v	C2/C1 5c b	D1/C1 r v	C1/C2 5c a
SRR	0.95424	1.32222	0.00	1.17609	1.25527

Stimulus	C1/D1 5c a	C2/C1 r v	C1/C2 5c b	C2/D2 10c b	C2/C1 10c b
SRR	1.07918	1.32222	1.32222	1.17609	1.17609

Stimulus	C1/D1 r v	C1/C2 10c b	D2/C2 r v	C2/C1 10c a	C1/C2 r v
SRR	0.00	0.95424	1.32222	0.77815	0.00

Stimulus	D1/C1 10c b	C1/C2 10c a	C2/D2 r v	C2/C1 r v	C1/D1 10c b
SRR	0.47712	0.00	0.95424	1.07918	0.00

Stimulus	C2/C1 5c b	C1/C2 10c b	D1/C2 r v	C2/D2 10c a	C2/C1 10c a
SRR	0.00	1.07918	0.47712	1.17609	0.00

Stimulus	C1/D1 r v	C1/C2 5c b	D2/C2 10c a	C2/C1 r v
SRR	0.77815	0.47712	1.43136	0.69897

Participant 9: SRRs produced during Phase 6 of Experiment 8

Stimulus	C1/C2 5c b	D2/C2 r v	D1/C1 5c a	C2/C1 5c a	C2/D2 10c a
SRR	1.17609	1.07918	1.07918	1.07918	1.17609

Stimulus	C1/C2 r v	C1/D1 5c a	C2/C1 5c b	C2/D2 r v	C1/C2 10c a
SRR	0.47712	1.07918	1.07918	1.30103	0.95424

Stimulus	D1/C1 r v	C2/C1 r v	D2/C2 5c b	C1/C2 5c a	C1/D1 r v
SRR	1.32222	0.95424	0.47712	1.43136	1.07918

Stimulus	C1/C2 10c b	D2/C2 r v	C2/C1 10c a	C2/D2 5c b	D1/C1 5c b
SRR	0.47712	0.95424	1.25527	1.43136	0.90309

Stimulus	C1/C2 r v	C1/D1 r v	C2/C1 10c b	C2/D2 r v	C1/C2 10c a
SRR	0.95424	1.32222	0.00	0.77815	0.95424

Stimulus	C1/D1 r v	C2/C1 r v	D2/C2 10c a	C1/C2 5c b	C1/D1 10c a
SRR	1.17609	1.32222	0.00	1.32222	0.77815

Stimulus	C2/C1 5c a	C2/D2 r v	C1/C2 10c b	D2/C2 10c b	C2/C1 5c b
SRR	0.47712	1.17609	0.95424	1.25527	0.00

Stimulus	D1/C1 r v	C1/C2 5c a	C2/C1 r v	C2/D2 10c b	C2/C1 10c a
SRR	0.47712	1.25527	1.07918	1.17609	0.00

Stimulus	D2/C2 r v	C1/C2 r v	C2/D2 5c a	C2/C1 10c b	D1/C1 10c a
SRR	1.32222	0.77815	1.43136	0.00	1.17609

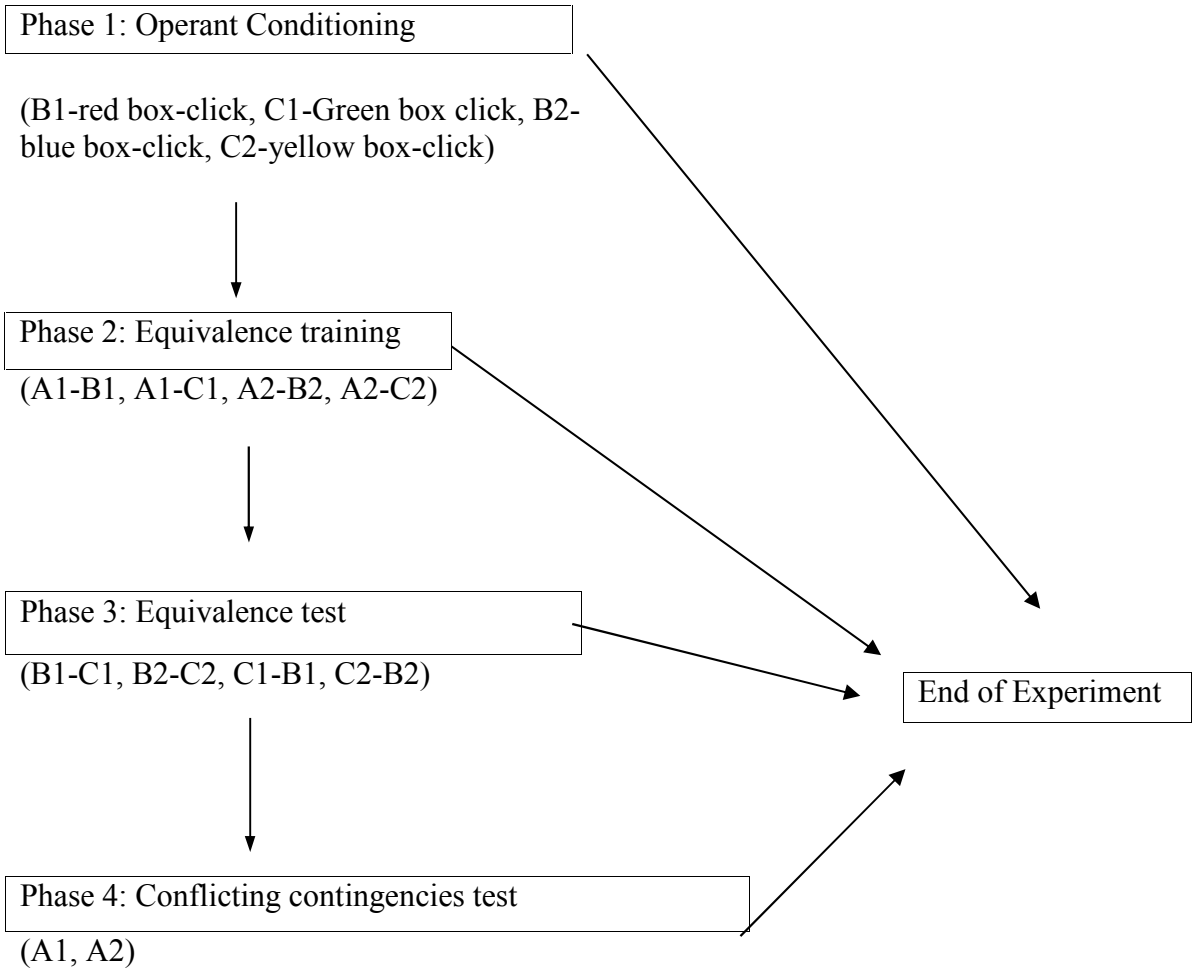
Stimulus	C1/C2 5c b	C1/D1 5c b	C1/C2 5c b	C2/C1 r v	C1/D1 rv
SRR	0.47712	0.00	0.00	0.69897	0.00

Stimulus	C1/C2 10c a	D1/C1 10c b	C2/C1 10c b	C2/D2 r v	C2/C1 10c b
SRR	0.00	0.47712	1.17609	0.95424	1.32222

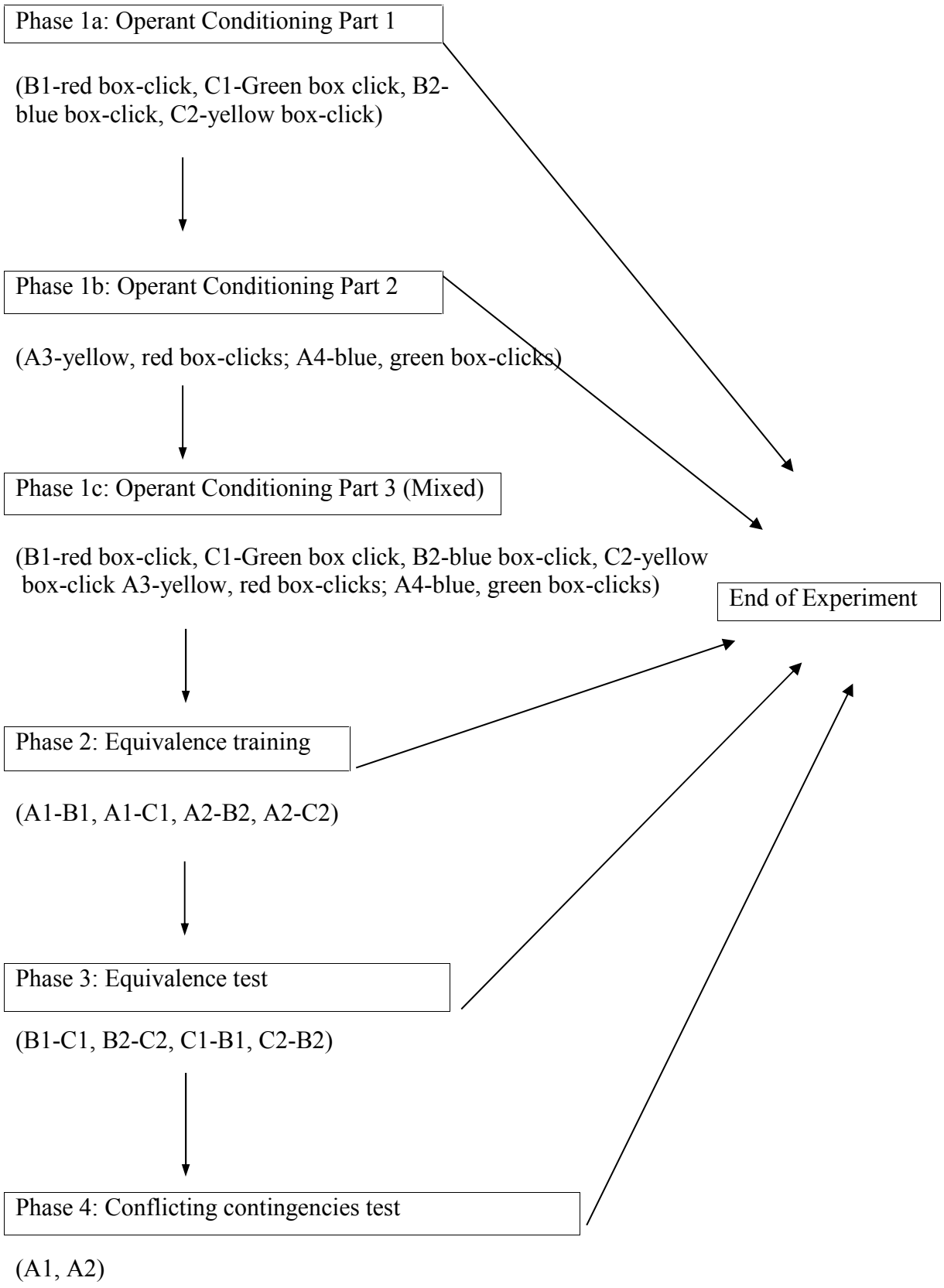
Stimulus	D2/C2 5c a	C2/C1 5c b	C1/D1 10c b	C1/C2 r v	D1/C1 r v
SRR	1.43136	0.00	1.25527	0.00	0.47712

Stimulus	C2/C1 5c a	D2/C2 r v	C2/C1 10c a	D1/C1 r v
SRR	0.00	1.32222	0.77815	0.77815

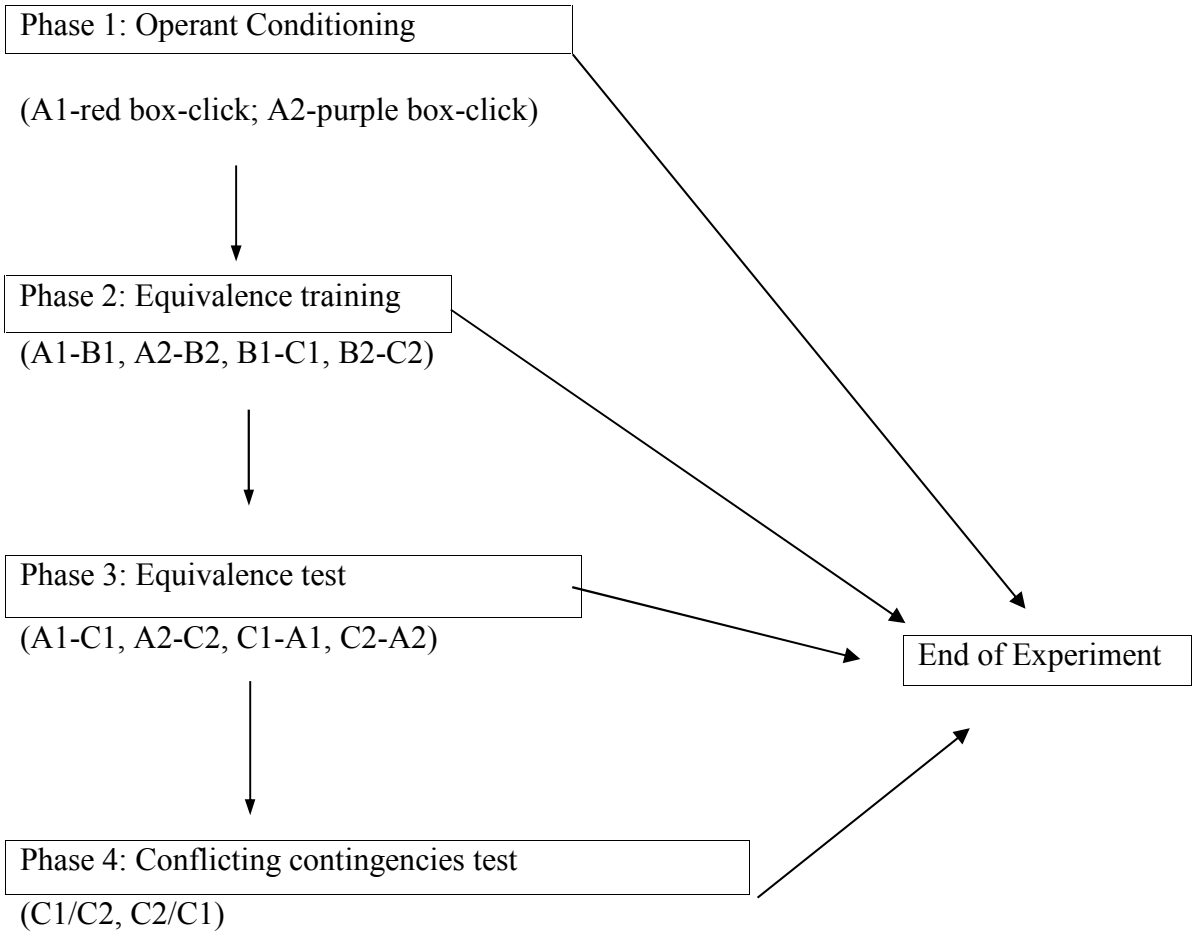
Appendix 7: The procedural sequence and target relations for Experiment 1



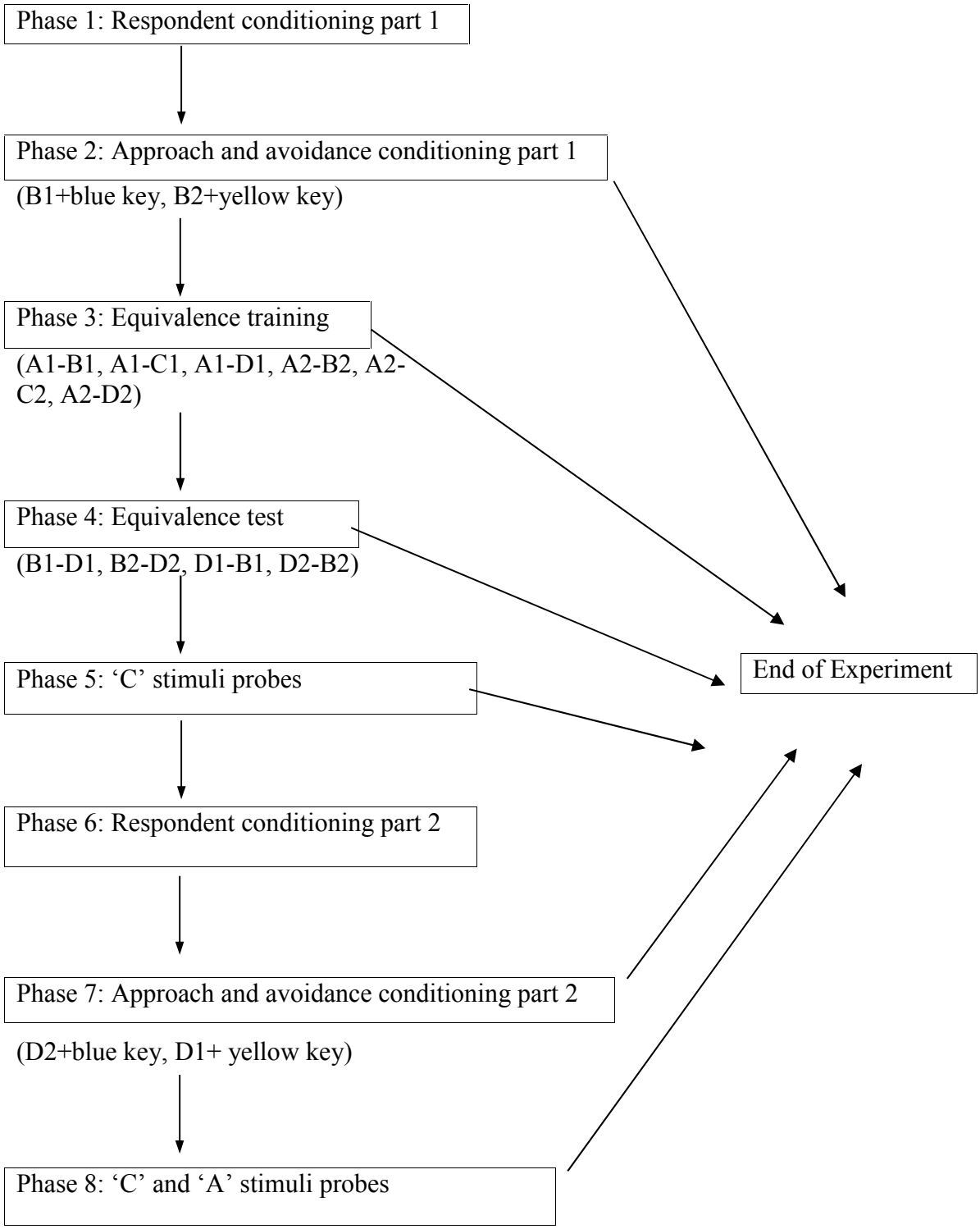
The procedural sequence and target relations for Experiment 2



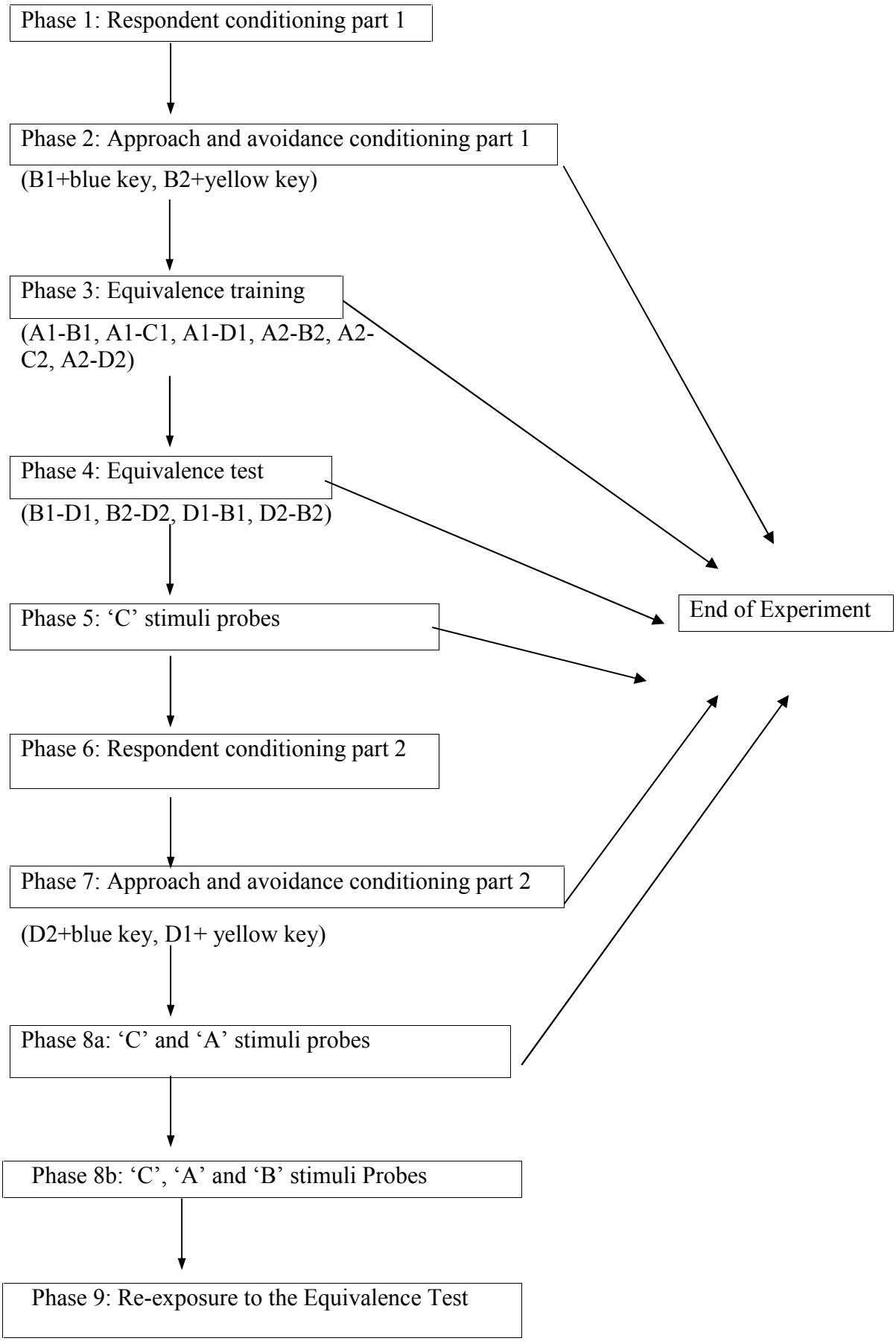
The procedural sequence and target relations for Experiment 2



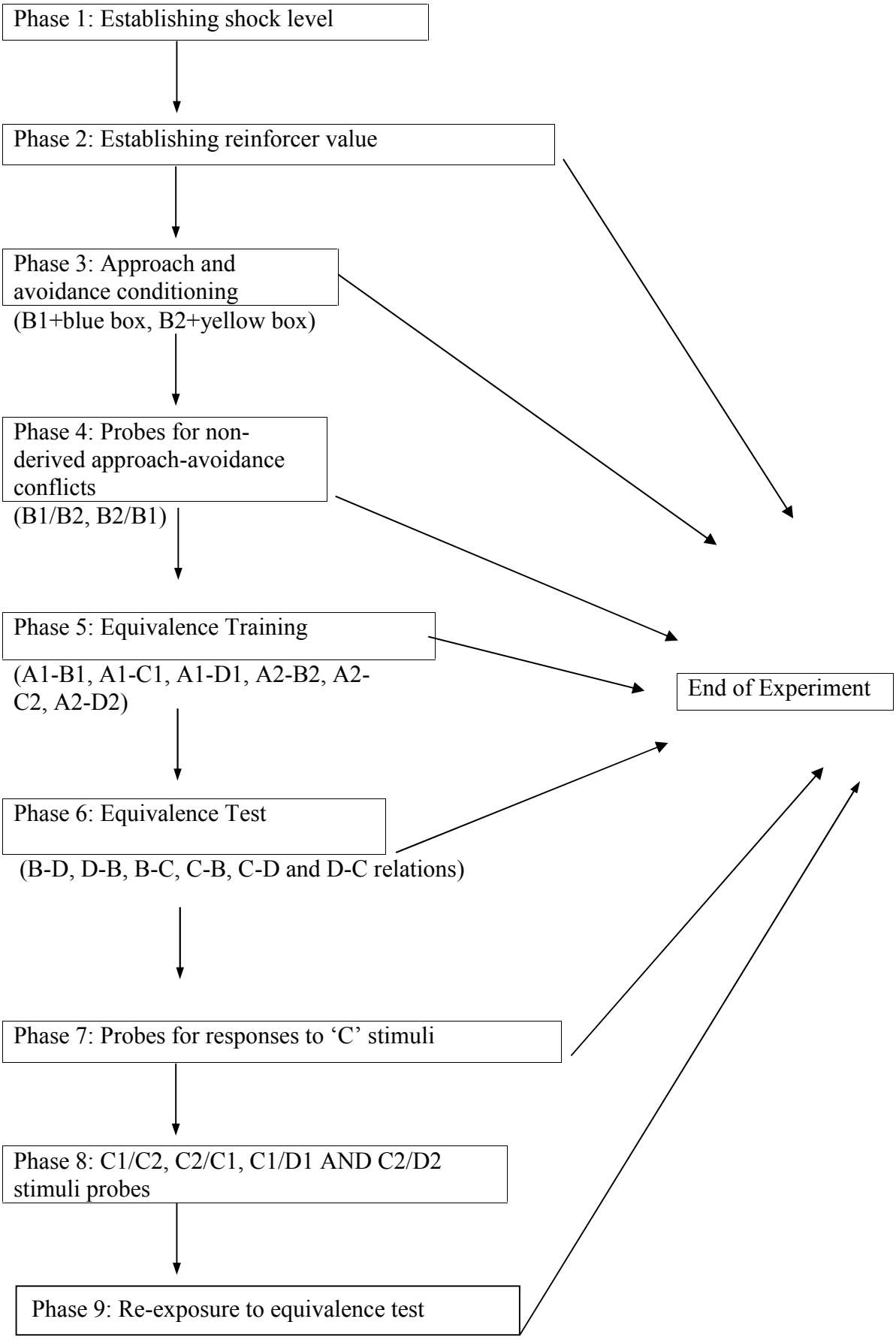
The procedural sequence and target relations for Experiment 4



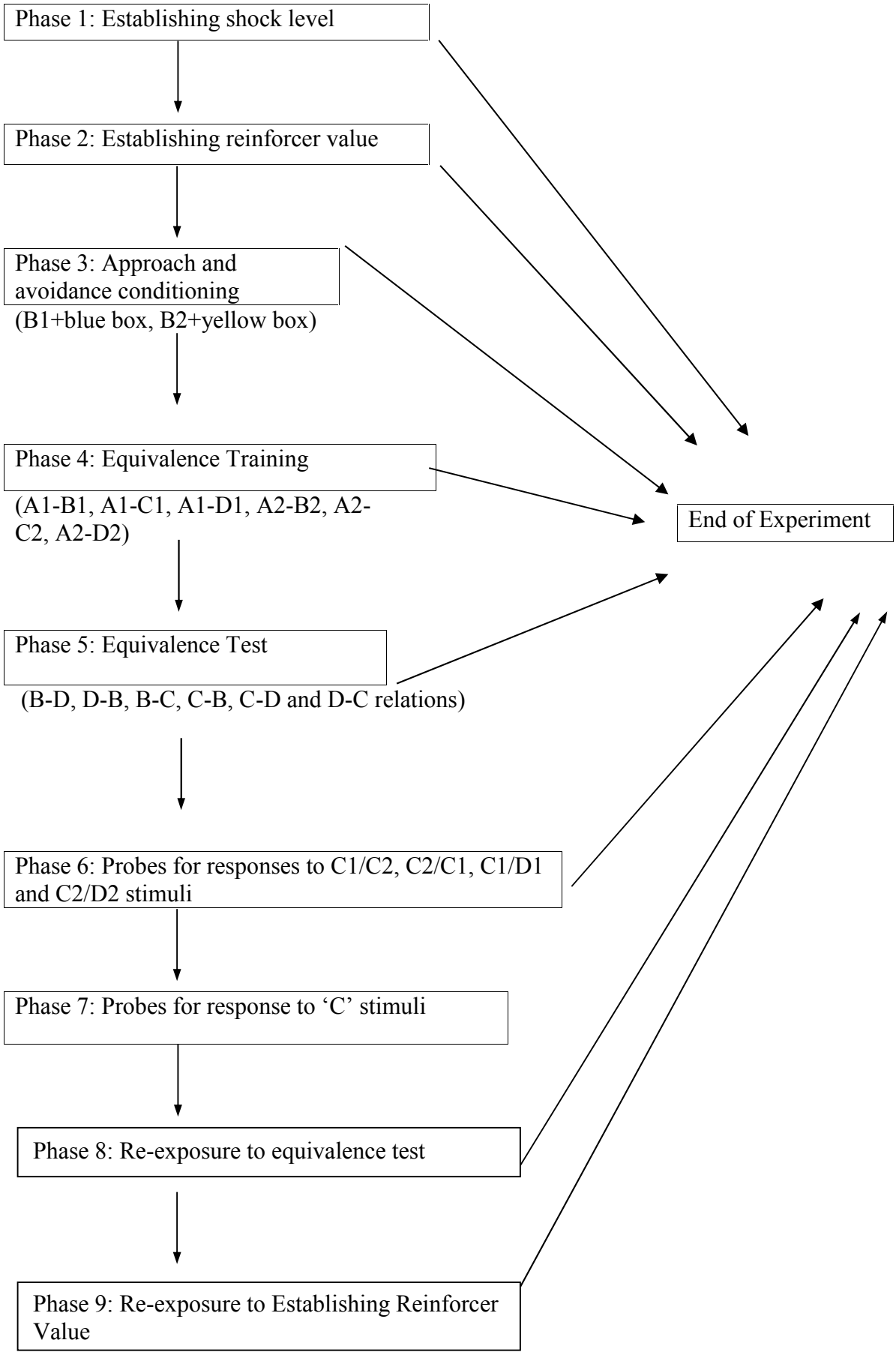
The procedural sequence and target relations for Experiment 5



The procedural sequence and target relations for Experiment 6



The procedural sequence and target relations for Experiment 7



The procedural sequence and target relations for Experiment 8