The Functional-Analytic Development of a Test for Behavioural History using the Concept of Derived Stimulus Relations

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Contents

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Abstract

Ten studies reported in this thesis outline the development of a behavioural test for assessing the role of verbal behaviour in identifying personal and social histories. The testing format was developed by employing the Stimulus Equivalence paradigm (Sidman, 1971) and extending upon the previous work of Watt, Keenan, Barnes and Cairns (1991). Chapter 1 presents a review of the behavioural literature concerned with stimulus equivalence and derived stimulus relations. Most importantly, a seminal study by Watt et al. (1991) is outlined. In that study, a simple stimulus equivalence paradigm was used to take advantage of the fact that people in Northern Ireland often respond to each other's names as indicative of religious background. Specifically, the researchers attempted to teach subjects the necessary baseline conditional discriminations to form two equivalence classes that were incongruent with the subject's social history. Watt et al. (1991) concluded subjects' personal and social histories interfere with their ability to derive specific equivalence relations in the laboratory. The relevance of this paradigm to all of the experimental work reported in this thesis is outlined.

Chapter 2 reports on two experiments (Experiments 1 & 2) that tested the applicability of the Watt et al. paradigm as a tool for assessing personal and social histories as discussed in Chapter 1. In Experiment 1, a novel Yes/No procedure was employed in a controlled experimental laboratory preparation to create and test for social histories. This novel YES/NO procedure required subjects to respond to two stimuli in the presence of the question "Do they go together" by clicking on either a Yes or No button on a computer screen. Experiment 2 involved an experiment that expanded upon this technique by applying this novel Yes/No adaptation of the Watt et al. paradigm in an

effort to assess the social categorisation of real-world terms by men and women from the general population. Both studies demonstrated the applicability of the adapted Watt et al. paradigm in assessing both laboratory-controlled and real-world social and personal histories. In Chapter 3, Experiment 3 explored the possibility of assessing differences in social history when using a novel instruction-based relational test. The test measure was capable of identifying subjects' laboratory created histories on the basis of response accuracy differentials across the test blocks in the absence of the equivalence training used in the Watt et al. Paradigm. That is, in place of equivalence training, subjects were presented with onscreen instructions informing them which stimuli to "put together" in the relevant phase of the test. Subjects were then presented with two test blocks, accompanied by different matching instructions. These blocks consisted of matching tasks involving the presentation of word pairs and in which responses to the Yes or No buttons were required. One set of rules was congruent with the subjects' personal/social history and the other set was incongruent with the subjects' personal/social history. This greatly modified Watt et al. procedure did not require equivalence training, but nevertheless successfully identified subjects' social and personal histories.

In Chapter 4, the relational test procedure (described in Chapter 3) was modified slightly and applied in a real-world setting to examine and identify the use of socially sensitive verbal relations within a series of different populations. This was explored across 2 experiments (Experiments 4 & 5). Experiment 4 demonstrated the utility of the current testing procedure in detecting cultural differences across populations with regard to the historical categorisation of socially sensitive stimuli relevant to the issue of homosexuality and homophobia. The test format was modified in that subjects no longer responded using the onscreen YES and NO keys, but by pressing either a Blue or Red button onscreen in place of YES and NO, respectively. In this experiment, homosexual males from the USA and Ireland completed the modified relational test procedure consisting of two test blocks. Each block consisted of identical matching tasks but was accompanied by a distinct set of instructions. One set of instructions was congruent with the subjects' history (i.e., gay goes with good) while the other was incongruent (i.e., gay goes with bad). The test was successful in identifying the cultural background of subjects taking the test.

A slight modification of the foregoing procedure in Experiment 5 gave rise to similar results with regard to female subjects' categorisation of terms relating to *children* and *sex*. That is, when the relational test procedure was presented as before, but with subjects responding using keys on the keyboard, female subjects' fluency in associating *child* and *sex* terms was lower than their fluency in relating *adult* and *sexual* terms. That is, when instructed matching was congruent with the female subjects' personal and social histories (i.e. child goes with nonsexual) response accuracies were greater than when matching instructions were incongruent (i.e. child goes with sexual).

In Chapter 5, the experimental focus moved towards the use of a single stimulus onscreen rather than stimulus pairs. This represented a radical departure from the procedure used in Chapters 2-4. Specifically, subjects were no longer required to explicitly match the stimuli onscreen in relation to each other. Instead, Experiment 6 sought to assess the rate of acquisition of common response functions to words considered compatible for a normal population compared to words considered incompatible for a normal population. The experiment identified gender differences in the rate of acquisition of common stimulus functions for members of distinct (e.g., child and sexual) and common (e.g., adult and sexual) verbal relations.

In Chapter 6, a laboratory analogue of the new single stimulus test procedure was developed. This was developed in tandem with a behavioural analysis of the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) due to the topographical similarity of both measures. Specifically, Chapter 6 examined the IAT test format in terms of behavioural processes whilst also providing a laboratory analysis of the current test procedure using arbitrary laboratory created stimuli across a series of experiments (Experiments 7, 8, 9 & 10). Chapter 6 showed that a laboratory history of respondent conditioning and derived relational responding is sufficient in generating an IAT effect. In addition, this effect is malleable depending on the type of stimulus equivalence testing employed (i.e., symmetry and transitivity combined, transitivity alone, or no test). Chapter 7 provides a summary of the entire research program presented in the thesis, and reviews the development of a functionally-understood model of the IAT. Some important empirical and conceptual issues that arise from the various findings are also outlined. Finally, the relationship of the current research to work outside the field of behaviour analysis is considered.

Chapter 1

An Introduction

Over the past 30 years, behaviour analysts have begun to make serious scientific headway in the conceptual and empirical analysis of human language and cognition and their roles in a whole host of complex human behaviours, including prejudice and discrimination (Hayes, Niccolls, Masuda, & Rye, 2002; Watt, Keenan, Barnes, & Cairns, 1991), depression (Hayes & Wilson, 1993), self-awareness (Dymond & Barnes, 1995), development of self concept (Barnes, Lawlor, Smeets, & Roche 1996), sexual arousal (Barnes & Roche, 1997; Roche & Barnes, 1997, 1998), attitude formation and change (Roche, Barnes, & Smeets, 1997), and group processes (Roche, Barnes-Holmes, Barnes-Holmes, Stewart, & O'Hora, 2002). The rapid acceleration of language and cognition research has been made possible by the identification of a phenomenon known as stimulus equivalence (Sidman, 1986) which has until relatively recently attracted sparse scientific attention within the behavioural sciences.

This thesis will deal, to a large extent, with the phenomenon of stimulus equivalence, or derived relational responding as it is known more generally. Derived relational responding is a phenomenon that until recently was difficult to conceive in behavioural terms. In fact, at times it was not even possible to entertain as an idea, namely as the philosophy to incorporate the data was unclear. Before outlining the phenomenon of stimulus equivalence itself a historical overview of the evolution of the analysis of complex human behaviour within behaviour analysis is necessary.

Skinner's "Verbal Behavior"

In 1957, Skinner wrote that verbal behaviour might be defined as any behaviour on the part of a speaker reinforced through the mediation of a listener who is trained by a verbal community so as to mediate such reinforcement. With the publication of *Verbal Behavior* in 1957, B. F. Skinner offered an all-inclusive behavioural account of language. His account was primarily theoretical and he suggested that he was merely presenting well-known facts in a structured manner. These facts comprised principles of operant and respondent conditioning, and Skinner relied almost exclusively on the "operant" in explaining the functions of verbal behaviour. Cooper, Heron, & Heward (2007) suggest that Skinner's *Verbal Behavior* is proving valuable, particularly when applied to language development. However, in their book *Relational Frame Theory. A post-Skinnerian Account of Language Cognition*, Hayes, Barnes-Holmes and Roche (2001) suggest that Skinner's definition of verbal behaviour is not as functional as it purports and additionally it is too broad for successful application. More specifically, Hayes et al. (2001) argued that it is a mistake to place the listener in a definition of verbal behaviour as Skinner does. That is, Skinner defines verbal behaviour as behaviour under the control of consequences mediated by other people. For instance, as verbal behaviour has to do with socially mediated consequences, giving a rat food after a lever press likely renders the lever press a "request", and thus a type of verbal behaviour. Given this, Hayes et al. (2001) ask how we can distinguish that behaviour of lever pressing from the rat using its vocal musculature to ask for food in functional terms. It would appear to be the same functional relationship between response and socially mediated consequence in both cases. It is doubtful that this is how Skinner intended his analysis to proceed

Skinner's account requires us to examine the behaviour and history of a speaker by examining that of the listener. However, if the behaviour of an individual is to be examined then surely, within the tradition of Skinner's own experimental analysis of behaviour, only the history of that individual is required to understand the behaviour. To introduce the history of an outside listener as a necessity to categorise the behaviour of a target individual is not functional.

Cooper, Heron, & Heward (2007) would disagree, however, suggesting that Skinner's *Verbal Behavior* is of benefit to applied behaviour analysis. These authors believe that viewing language as learned behaviour, involving a social interaction between speakers and listeners, changes how clinicians and researchers approach and ameliorate problems related to language. The late Ogden Lindsley's work using Precision Teaching is notable here. Lindsley (1990) spent the greater part of the *fifties* and *sixties* attempting to improve the education system using precision teaching with special needs children, and in particular with the use of The Standard Celeration chart. Furthermore, Cooper et al. (2007) suggest that Skinner's theory of language has been successfully applied to areas including child development (e.g. Bijou & Baer, 1965), memory (e.g. Palmer, 1991) and behavioural problems (e.g. McGill, 1999), to name but a few, with the most prolific and ongoing application being intervention programmes for children with autism.

It is not the task of the current thesis to disentangle the merits and limits of Skinner's account of verbal behaviour. Nevertheless, it is important that the foregoing differences in views be noted because the emergence of alternative views on human verbal behaviour accompanied the emergence of a new behavioural phenomenon known as Stimulus Equivalence. This new concept is a core concept underlying all of the research reported in the current thesis. The Stimulus Equivalence paradigm was first introduced by Murray Sidman (1971). This phenomenon relates to emergence of "derived" or untrained performances in human subjects and is of immediate relevance to the analysis of verbal behaviour. More recently, behaviour analysts have begun to focus intensely on this phenomenon in the study of complex language and cognition (Fields, Adams, Verhave, & Newman, 1990; Hayes, Barnes, & Roche, 2001; Sidman, 1986) and have begun to apply the concept of stimulus equivalence to a range of psychological phenomena not typically studied by behaviour analysts.

The phenomenon of stimulus equivalence (see below for a detailed account) has been used to explain a range of cognitive and language phenomena and has been used to build simple tests that allow behaviour analysts to; discriminate anxious from non-anxious patients (Leslie, Tierney, Robinson, Keenan, Watt, & Barnes, 1993), develop a diagnostic tool to identify children who have been sexually abused (McGlinchey, Keenan, & Dillenburger, 2000; see also Keenan, McGlinchey, Fairhurst, & Dillenberger, 2000) and to identify child sex offenders as a distinct social group within a larger population of non-sex offenders (see Roche, Ruiz, O' Riordan, & Hand, 2005). Other researchers have used the equivalence paradigm to assess subjects' attitudes towards themselves (Barnes, Lawlor, Smeets, & Roche, 1995; Merwin & Wilson, 2005), towards sexually explicit stimuli (Grey & Barnes, 1996) as well as attitudes of North-Americans towards Middle-Easterners (see Dixon, Dymond, Rehfeldt, Roche, & Zlomke, 2003). Before the relevance of stimulus equivalence to the current research can be fully appreciated, however, it is important to first outline the phenomenon in more detail.

Stimulus Equivalence and Derived Relations

The Sidman stimulus equivalence paradigm is used extensively in behavioural research with humans and also in animal cognition research. The phenomenon of stimulus equivalence can be described as follows; when a verbally-able human learns a series of related conditional discriminations, the stimuli involved in those discriminations often become related to each other in ways that were not explicitly trained. The arbitrary nature of stimuli used in equivalence suggest that it may provide a behavioural basis for everyday correspondences between words and things, between what we say and what we do, and between rules and contingences (Sidman, 1986).While arguments from Tonneau (2001) and Hayes et al. (2001) suggest that stimulus equivalence may now be “exhausted” the current author believes the importance (and potential) the phenomenon came to have after decades of work from Sidman is notable.

Murray Sidman began his research with an original aim of analysing the problems experienced by brain damaged patients. Such patients presented problems speaking, writing, and understanding spoken and written language and their behaviour was analysed using simple matching-to-sample, naming, and writing tests. In a classic experiment using match-to-sample procedures, Sidman (1971) established classes (or categories) of stimuli consisting of pictures, spoken words, and printed words. The subject entered the experiment with the ability to match pictures to spoken words but could not match the pictures to written words, or printed words to the spoken word. The subject had good auditory comprehension but poor reading skills. Using direct reinforcement, the subject was taught to match printed words to spoken words. Then, without any further training, the subject proved capable of matching printed words to pictures and pictures to words, an emergent relation. Together, the trained and untrained relations constituted a stimulus class. By establishing classes of stimuli created within the experimental environment, this method allowed the experimenter to systematically control the means by which stimulus relations were established.

Sidman found links between match-to-sample tasks and what is now known as "equivalence", saying; "Language symbols apparently come to be governed by the physical properties of the things they represent" (Sidman, 1986, p.13). Sidman then turned his attention to the nature of equivalence relations as he believed them to hold the key to explaining language and the central role language plays in everyday social interaction. Typically, to establish equivalence, a sample stimulus (e.g., an abstract shape) is presented in the centre of the screen, and two choice stimuli (referred to as comparisons) are presented at the bottom of the screen (e.g., nonsense syllables). The sample stimulus is often referred to as A1 and the comparison stimuli as B1 and B2, respectively. The subject's task is to choose between B1 and B2 conditional upon the sample stimulus. That is, when A1 is the sample the subject should choose B1, but given A2 as a sample they should choose the B2 comparison (this performance is known as a *conditional discrimination*). The computer presents feedback on performance after each trial. On two further tasks either B1 or B2 is presented as a sample, but two further stimuli, C1 and C2, are presented as comparisons. On these trials the subject must choose C1 when B1 is the sample, and choose C2 when B2 is the sample. When the foregoing tasks are presented repeatedly new relations typically emerge between the stimuli without further feedback to the subject. More specifically, subjects will spontaneously choose A1 given B1, B1 given C1, A2 given B2, and B2 given C2 (i.e., the taught relations are reversed and demonstrate *symmetry* between the stimuli). Furthermore, they will choose A1 given C1, C1 given A1, A2 given C2, and C2 given A2 (i.e., combine the taught relations, or demonstrate *transitivity* between the stimuli). When this occurs the stimuli are said to participate collectively in a stimulus equivalence relation.

One important aspect of the derived relational responding repertoire is that when a response function is explicitly established for one of the stimuli participating in an equivalence relation, that function often spontaneously transfers to the remaining class members. Say an individual's heart rate increases upon hearing the word "snake". If we then tell this individual that in the Irish language the word for spider is "Nathair" (i.e., the two words are equivalent) we can expect that the individuals heart rate will also increase upon hearing the word "Nathair", even though it has never been associated directly with an actual snake. This is known as the derived *transfer-of-functions* effect and has exciting implications for a behaviour-analytic understanding of some of the most important properties of human language, in particular novelty and generativity (Dougher, Augustson, Markham, Greenway, & Wulfert, 1994; Roche & Barnes, 1997; Roche, Barnes-Holmes, Smeets, Barnes-Holmes, & McGeady, 2000; Smyth, Barnes-Holmes, & Forsyth, 2006).

One important issue needing consideration at this point is the relationship between derived relational responding and language processes. Many behaviour analysts believe that derived relations may help to explain human language (e.g. Horne & Lowe, 1996) or may provide an indication that language depends upon equivalence relations, (McIlvane, Serna, Dube, & Stromer, 2000; Sidman, 1994) but to many others they are synonymous (Relational Frame Theory; Barnes-Holmes, Barnes-Holmes, Smeets, Cullinan & Leader, 2004). The study of stimulus equivalence has been linked directly to the behaviour analysis of human language in a variety of contexts. For example, Barnes (1994) outlined five areas of research that provide evidence to support the view that stimulus equivalence and human language are closely interrelated. First, equivalence has not been demonstrated unambiguously by nonhumans or by humans who are not verbally-able (e.g., Barnes, McCullagh, & Keenan, 1990; Devany, Hayes, & Nelson, 1986; Dugdale & Lowe, 2000; Hayes, 1989). Second, learning to name stimuli may facilitate equivalence responding in young children (Eikeseth & Smith, 1992). Third, equivalence procedures can be used to treat language deficits in verbally-disabled individuals (e.g., Cowley, Green, & Braunling-McMorrow, 1992). Fourth, equivalence phenomena have been used to develop a behaviour-analytic interpretation of both symbolic meaning and the generative nature of grammar (e.g., Barnes & Hampson, 1993; Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000). Fifth, equivalence procedures have been used to examine highly verbal human behaviours such as social categorisation (Kohlenberg, Hayes, & Hayes, 1991; Roche & Barnes, 1996; Watt, Keenan, Barnes, & Cairns, 1991) and logical reasoning (Barnes & Hampson, 1993). Overall, therefore, the evidence for a close relationship between equivalence relations and human language is substantive at this stage.

Recently, an increasing number of behaviour analysts have been turning their attention to the analysis of verbal behaviour and derived stimulus relations in an effort to clarify language and cognitive processes. The analysis of derived stimulus relations has provided important opportunities for the prediction and control of many aspects of verbal behaviour (see Hayes, et al., 2001; Sidman, 1994). Most importantly, however, behaviour analysts have begun examining the relationship between language and important aspects of human functioning including; anxiety (e.g., Friman, Hayes, & Wilson, 1998), prejudice (Hayes, Niccolls, Masuda, & Rye, 2002; Watt, Keenan, Barnes, & Cairns, 1991), depression (e.g., Hayes & Wilson, 1994), self-awareness (Dymond & Barnes, 1995), the development of self concept

(Barnes, Lawlor, Smeets, & Roche 1996), sexual arousal (Barnes & Roche, 1997; Roche & Barnes, 1997, 1998), attitude formation and change (Roche, Barnes, & Smeets, 1997), and group processes (Roche, Barnes-Holmes, Barnes-Holmes, Stewart, & O'Hora, 2002). In truth, it is now accepted by several behaviour analysts that complex human behaviours cannot be analysed without considering the role of language processes, and more specifically, stimulus equivalence (see Hayes, et al., 2001; see also Leigland, 1999).

At this point, it is worth noting that without some overarching theoretical account equivalence remains merely the description of a behavioural outcome. Several researchers have provided an account for stimulus equivalence such as Relational Frame Theory (Hayes, Barnes-Holmes & Roche, 2001), Naming Theory (Horne & Lowe, 1996), Joint Control Theory (Lowenkron, 1996) and Sidman's own view that it is a *Basic Stimulus Function* like generalisation or reinforcement. Despite this, Stimulus Equivalence is still lacking a single encompassing theoretical account. Steele and Hayes (1991) suggested that attempts to account for most equivalence data are lacking in experimental evidence or more importantly cannot explain the derived relations themselves. Even the most prominent of the theories of derived relational responding (i.e., Relational Frame Theory; Hayes et al., 2001) has not been widely accepted by behaviour analysts as an adequate account (Burgios, 2003; Galizio, 2003, 2004; Malot, 2003; Marr, 2003; McIlvane, 2003; Osborne, 2003; Palmer, 2004; Salzinger, 2003; Spradlin, 2003; Tonneau, 2002).

While theoretical concerns remain regarding the most suitable account of the derived relational responding phenomena, these do not detract from the importance and utility of the phenomena itself, which has been studied extensively to date. Thus, the current thesis will not concern itself with these on-going theoretical debates but stay at the level of empirical methodology in an examination of the derived relational responding phenomenon itself and its utility in the development of tests of personal and social history. Indeed, this has been the strategy of most researchers working in the field. In the next section, I will consider the short evolution of this endeavour to apply the technology of stimulus equivalence to the analysis of social behaviour.

Applying Derived relations

The exciting possibility of applying relational tests based on the concept of stimulus equivalence stems from the crucial finding that subjects' personal and social histories interfere with their ability to derive specific equivalence relations in the laboratory. In a seminal study, Watt, Keenan, Barnes and Cairns (1991) used a simple stimulus equivalence paradigm to take advantage of the fact that people in Northern Ireland often respond to each other's names as indicative of religious background. Their study employed stimuli representative of Catholic and Protestant names and symbols and involved training subjects to relate them in a manner inconsistent with their social histories. Specifically, a three-phase experimental procedure was employed with the following experimental phases: (1) training with continuous reinforcement, (2) training with intermittent reinforcement and (3) testing.

Subjects were first exposed to a pre-training task comprising the presentation of either a nonsense syllable or a first and last name at the top of the screen (the "sample" stimulus). Three "comparison" stimuli were displayed separately below this. Subjects were instructed to select a comparison stimulus by pressing a corresponding key. Subjects were exposed to this single task for four trials to allow familiarisation with the matching-to-sample procedure. Stage 1 of the Watt et al. procedure comprised Equivalence Training with continuous reinforcement. In this stage, the trained relations (See Table 1 for actual training trials) were established using continuous reinforcement. Training comprised of one of three Catholic names being randomly chosen to serve as the sample stimulus. Beneath this, three nonsense syllables served as comparison stimuli and were arranged in a random order across the screen. Subjects were required to select the correct comparison in the presence of the sample stimulus. Essentially, this half of Stage 1 comprised A-B training.

Table 1: Shows Watt et al. Matching- to-Sample training tasks

Train Catholic names To nonsense syllables			Train nonsense syllables to Protestant symbols		
	BRENDAN DOHERTY			ZID	
ZID	YIM	VEK	LAMBEG DRUM	UNION JACK	ORANGE ORDER
	SEAMUS QUINN			YIM	
ZID	YIM	VEK	LAMBEG DRUM	UNION JACK	ORANGE ORDER
	PATRICK O' HAGAN			VEK	
ZID	YIM	VEK	LAMBEG DRUM	UNION JACK	ORANGE ORDER

When two successive cycles of this combination of sample and comparison stimuli were correctly completed, the second part of Stage 1 was presented. Here, the sample stimuli were selected from the list of nonsense syllables, and the comparison stimuli were selected from the list of Protestant symbols (i.e., B-C training). Similarly, two successive cycles of this new combination of sample and comparison stimuli had to be successfully completed before transition to the next part of the experiment. Feedback was provided on all trials during Stage 1.

For Stage 2 of the Watt et al. procedure, a training procedure with intermittent reinforcement was presented. At the onset of this stage subjects were told that corrective feedback would not be provided on all trials. In actuality, corrective feedback was only presented on 50% of responses. The stimulus combinations described in Stage 1 were all presented in random order during this condition. Each stimulus combination was presented twice and subjects were required to meet 100% criterion. If performance efficiency was 100% then the Stage 3 began immediately.

Stage 3 of the Watt et al. procedure involved Equivalence Testing. For this stage, no corrective feedback was provided. Ten presentations of each of the stimulus combinations from Stage 1 were randomly presented. Interspersed with these were ten presentations each of six other stimulus combinations. Each of the three Protestant symbols served as sample stimuli and two of the Catholic names served as comparison stimuli. An additional Protestant name was included as a comparison stimulus for each of these three combinations of sample and comparison stimuli. The purpose of the additional name was to determine the extent to which prior social learning could interfere with equivalence responding. This generalisation test (described below) was employed to allow for a preliminary exploration of the transfer of experimentally generated equivalence responding to other socially pertinent stimuli. Again, the Protestant symbols served as sample stimuli, but this time the same three new names served as comparison stimuli. Each of these names was either Catholic (Eamon McAleer), Protestant (Robert Scott), or neutral (IIya Galakov) within the Northern Irish context.

The results of the Watt et al. study showed that during equivalence testing, all of the English subjects correctly matched the Catholic names with the Protestant symbols, but 12 of the 19 Northern Irish subjects chose a novel Protestant name in the presence of the Protestant symbols, thereby failing to respond equivalently. These findings strongly suggested that the social contingencies operating in Northern Ireland interfered with the establishment of equivalence relations in the laboratory. More specifically, the equivalence test required Northern Irish subjects to juxtapose names and symbols in a manner that was counter-cultural for this group of subjects. Thus, it would appear that a derived relations paradigm can be used successfully to assess the social knowledge of subjects without alerting them to the nature of the task.

Likewise, in a study on gender identity Moxon, Keenan and Hine (1993) found that subjects had more difficulty forming equivalence classes when the classes included female names and stereotypic male occupations. That is, using a matching-to-sample procedure male and female subjects were trained to relate three occupations traditionally considered to be male to three nonsense syllables, and then to relate these nonsense syllables to three female names. Equivalence tests which included novel comparison stimuli were then performed. The novel stimuli employed in the testing phase were occupations traditionally considered to be female. The results indicate that equivalence responding was disrupted by the presence of the novel stimuli for members of both subject groups.

In a related study (Kohlberg, Hayes, & Hayes, 1991), six subjects acquired conditional equivalence classes controlled by 3 male and 3 female names as contextual stimuli. When equivalence relations were tested using novel names (3 male and 3 female), contextual control remained intact. Thus, generalized control of the composition of conditional equivalence classes by characteristically gender-identified names was shown. Analysis of this finding was tested in Experiment 2 with 6 subjects. Contextual equivalence classes were established using as contextual stimuli non-representational visual figures that were members of additional pre-trained 3-member equivalence classes. When other stimuli in the pre-trained equivalence classes were used as contextual stimuli, the conditional equivalence classes remained intact. Control Subjects showed that this effect depended on the equivalence relations established in pre-training. The results show that contextual control over equivalence classes can transfer through socially established equivalence classes.

Leslie, Tierney, Robinson, Keenan, Watt, and Barnes (1993) also employed the Watt et al. procedure in a study with clinical applications. They examined whether or not differences between clinically anxious and non-anxious subjects could be found using a stimulus equivalence training and testing task. Specifically, eight clinically anxious and eight non-anxious subjects were exposed to a stimulus equivalence training procedure. Each matching-to-sample training phase involved threatening situations nonsense syllables (B), and pleasant-state adjectives (C). All subjects met criteria for learning A-B relationships and B-C relationships in a matching-to-sample procedure, but in the critical test phase (where C sample elements are matched to A elements) the non-anxious group differed from the anxious group on two of the three C-A tests. That is, subjects in the anxious group found it difficult to match pleasant-state adjectives to threatening situations. In fact, six out of eight non-anxious subjects responded appropriately on all three C-A tests compared with only one out of eight anxious subjects. Essentially, the researchers employed the Watt et al. paradigm to show that the presence of clinical anxiety can significantly affect stimulus equivalence class formation.

In another study, Plaud (1995) explored the relation between aversive stimuli and the formation of equivalence relations. Specifically, female subjects were exposed to a stimulus equivalence training and testing procedure. The aversive stimuli employed were six snake-related words, and the innocuous stimuli were six flower-related words. The subjects' task was to form two 3-member equivalence classes from each set of six stimuli (i.e., two 3-member classes consisting entirely of snake-related words, and two 3-member classes consisting entirely of flower-related words). The results showed that more than half of the subjects required significantly more training and testing blocks to form equivalence classes in the snake-related condition than in the flower-related condition. Analysis of responses to a questionnaire on snakes indicated that the interference in forming equivalence classes with snake stimuli correlated with self-reported fear of snakes.

Another study employing the Watt et al. procedure within a clinical research context was conducted by Merwin and Wilson (2005). In their study, subjects completed two stimulus equivalence tasks using a matching-to-sample paradigm. One task involved direct reinforcement of conditional discriminations designed to produce derived relations between self-referring stimuli (e.g., me, myself, I) and positive evaluation words (e.g., whole, desirable, perfect). The other task was designed to produce derived relations between self-referring stimuli and negative evaluation words (e.g., unworthy, flawed, inadequate). Performance on each task was recorded via response latency and percent correct. Merwin and Wilson also administered explicit measures as a means of comparison. That is, prior to completion of the equivalence tasks, subjects completed 2 self-report measures. The first was the Outcome Questionnaire-45 (OQ-45; high or low distress) and the second was the Rosenberg Self- Esteem Scale (RSE; high or low self esteem). Subjects were divided into groups based on their explicit test score and significant differences in percent correct were found between both the OQ-45 groups and the RSE groups. That is, subjects who reported high distress and a negative sense of self made significantly more errors on the tests for equivalence for the task that required matching self-referential stimuli with positive evaluation words. The findings suggested that the use of stimuli that are deemed to be non-equivalent in the social-verbal community has a negative impact on the derivation of equivalence relations within which these stimuli are meant to participate experimentally.

Transfer of Functions

One important process in deriving relations that has been identified and now requires more discussion is the above mentioned transfer of functions. Transfer of functions accounts for, and allows for the understanding of many social issues including racism (Dixon, Dymond, Rehfeldt, Roche, & Zlomke, 2003) and sexual fetishes (Barnes & Roche, 1997), amongst others. For instance, Dixon, Dymond, Rehfeldt, Roche, & Zlomke's (2003) applied the stimulus equivalence paradigm to the understanding of the September 11th terrorist attacks in the USA. They suggested that the terrorist attacks themselves be referred to as "A", the feeling of the rage and hate from the American male be referred to as "B", and the images of the terrorists as "C". On hearing of the terrorist attack (A) our white American male instantly experiences feelings of rage (B). The media claim that Terrorists are responsible for these horrifying acts, and depicts pictures of these Terrorists on the television (C). The images of the terrorists themselves may now come to elicit feelings of hate or rage through a transfer of function across the stimuli in the newly created relation. As noted in the section on stimulus equivalence, given A related to B, and A related to C, B will become related to

C. Thus, when our white American male sees pictures of the suspected terrorists in the media he may become rather emotional and possess feelings of hate. Furthermore, as the most salient features of the unknown terrorists are their race, religion, and country of origin these feelings of hate and rage towards the terrorists begin to transfer to other persons sharing the same skin colour, religion, and country of origin because of a formal similarity between them and the terrorists. That is, innocent Muslims of a Middle Eastern descent are now added to the A-B-C relation as a fourth stimulus “D”. The Middle Eastern man at the corner store “looks just like” the terrorists on television to our American male. The group of Muslims in town who go to church and pray every day “have the same faith” as those terrorists on TV to our American male. The neighbour down the block is “from the same country” as the terrorists. He may now be considered suspicious to our American male. The formal properties of the B stimuli and the D stimuli are approximately the same through transfer of stimulus functions. Moreover, the feelings of hate and rage held by our American white male were initially occasioned only by the terrorist attacks now have transferred beyond the terrorists themselves. They have transferred to innocent Middle Eastern persons. A racist has evolved from a once neutral young man.

Grey and Barnes (1996) employed a rationale similar to that outlined by Dixon et al. (2003) to propose a behavioural model of attitudes. Specifically, they suggested that a negative attitude towards normal heterosexual interactions can be seen as responding in accordance with an equivalence relation between normal opposite-sex adults and descriptive terms such as 'disgusting'. In their empirical study, Grey and Barnes provided subjects with the necessary conditional discrimination training to form the following derived equivalence relations; A1-B1-C1, A2-B2-C2, and A3-B3-C3, using nonsense syllables as stimuli. One member from each of two of these relations (i.e., A1 and A2) was then used to clearly label one of two VHS videocassettes. The cassettes contained films of either a sexual/romantic or religious theme. Subjects viewed the films and were subsequently required to categorize four further novel cassettes as “good” or “bad”. Subjects were given no information about these novel cassettes and were not allowed to watch their contents, but each was labelled with one of the nonsense syllables; B1, C1, B2 or C2. Subjects categorised the novel cassettes according to the derived equivalence classes, even though they could not have known what the video cassettes contained. More specifically, subjects classified the B1 and C1 cassettes in the same way as the A1 cassette, and the B2 and C2 cassette in the same way as the A2 cassette. In effect, the study demonstrated the transformation of an attitudinal or evaluative response from A1 to other stimuli only indirectly related to it.

In another related study, Barnes and Roche (1997) attempted to generate a derived laboratory induced fetish to extend the work of Rachman (1966). These researchers trained seven subjects on a series of conditional discrimination tasks (i.e., see A1 pick B1, see B1 pick C1, see A2 pick B2, see B2 pick C2, see A3 pick B3, see B3 pick C3, where all stimuli were nonsense syllables). Training on these tasks led to the emergence of the following linear equivalence relations during testing; A1-B1-C1, A2-B2-C2, and A3-B3-C3. Sexual and nonsexual functions were then established for the C1 and C3 stimuli where presentations of the C1 and C3 stimuli on a monitor were followed contingently and contiguously with presentations of sexual and nonsexual film clips, respectively. The acquisition of sexual arousal functions by the C1 stimulus was monitored physiologically. Following conditioning, subjects showed differential arousal responses to the stimuli (i.e., C1 produced significantly greater arousal than C3, because C1 predicted the presentation of a sexual film clip and C3 did not). More importantly, these respondently conditioned sexual arousal functions spontaneously transformed the functions of the A1 and A3 stimuli, in the absence of any further respondent conditioning or reinforcement. Specifically, five of seven subjects showing significantly greater arousal to C1 over C3 also showed a significant arousal response differential to A1 over A3. This effect can only be explained in terms of the derived relations between the C and A stimuli, as neither stimulus had any direct association with the sexual film clips (i.e., A1 is equivalent to C1 which predicts a sexual film clip). Again, the study demonstrated the transfer of an attitudinal or evaluative response from C1 to other stimuli only indirectly related to it, that is a derived transfer of sexual stimulus functions.

In a theoretical paper from the same authors (Barnes & Roche, 1997) it was suggested that such a transfer of functions may account for behaviours in the real world, particularly those of a sexual nature (see also Roche & Barnes, 1998). This application suggests that relational responding may be used to identify sexually deviant individuals from the normal population on the basis of different verbal histories. Indeed, this procedure may lend itself to application for any population with a unique verbal culture. As such, relational responding is abstracted to the extent that it can be arbitrarily applied to any stimulus events.

One published study has already employed a stimulus equivalence paradigm to develop a diagnostic tool to identify children who have been sexually abused (McGlinchey, Keenan, & Dillenburger, 2000). In that study, McGlinchey, Keenan and Dillenburger (2000) examined the extent to which normal equivalence responding can be disrupted by socially loaded stimuli. A group of children first participated in a standard equivalence training and testing procedure, using nonsense syllables and a range of pictures. The trained relations were as follows; A1 - a picture of goggles, B1

- a triangle; C1 - picture of a girl, arrow pointing to leg; A2 - picture of a hat, B2 - a triangle; C2 - picture of a girl, arrow pointing to neck; X1 - picture of braces; and X2 - picture of shirt. Subjects were then tested for derived relations among the stimuli (e.g., B1 goes with B2 in a derived equivalence relation because both are related to a triangle). Each child subsequently took part in a dressing-up role play in which the photographed hat, goggles, braces and shirt were employed. In order to socially load the clothing items and related stimuli, some of the clothes were purposely placed on inappropriate body parts. This was intended to indirectly recombine the relations between the stimuli in the naturalistic manner in which a child might acquire confusing or inappropriate information during an abusive episode. Each child was then re-exposed to the equivalence test. It was expected that equivalence responding (e.g., matching B1 to B2) would be disrupted following the role play. While results were not easy to interpret, McGlinchey et al., (2000) found support for the use of a derived relations-based screening procedure in their data. In effect, the final equivalence test revealed patterns of responding that were sensitive to the inappropriate information that the children had knowingly or unknowingly acquired during the dress-up role play.

A Test without a Process?

The foregoing literature review showed that behaviour analysis has arrived at a type of equivalence-based attitude or discourse measure that can illuminate personal histories, ways of speaking and categorising events and objects in the world. However, two important points for concern must first be raised. Firstly, all of the derived relations studies mentioned above have assumed that the interference observed in forming equivalence relations is caused by social history, as originally suggested by Watt et al. (1991). However, no study to date has examined this idea in a laboratory controlled analogue study. Such assumptions are being replicated in the literature in the absence of empirical evidence required to fully understand the Watt et al. procedure. For instance, Leslie et al. suggested that their results “provide further support for the view put forward by Watt et al. (1991) that previously established behavioural relations can interfere with the emergence of equivalence classes in verbally competent human subjects” (p. 159). Given the foregoing, one of the aims of the current thesis will be to provide evidence that this interference effect *is* in fact caused by an extended history of incongruous stimulus relations. Furthermore, the current research aims to develop this paradigm into a better understood and more easily administered test format for the same general purpose.

The second point for concern refers to the concept of an attitude which is problematic within Behaviour Analysis. While some researchers have attempted to broach the topic in stimulus equivalence research (Grey & Barnes, 1996, Roche, Barnes, & Smeets, 1997) a complete account and functional definition is still outstanding. Of course, this in itself should not be seen as a problem as it does not behove behaviour analysis to account for all or any terms borrowed from the vernacular. Nevertheless, the types of behaviours referred to as constituting attitudes in the general psychology literature have become of interest to behaviour analysts. It might serve the reader well, therefore, to briefly consider the behaviour analyst’s stance on attitudes and social behaviour more generally before we proceed with the empirical investigations to follow.

Behaviour Analysis and Social Behaviour

Lloyd (1980) was of the belief that social psychology and behavioural psychology were not as far removed from each other as followers from either group would like to believe. That is, he believed that many phenomena of social psychology could be reworded in behavioural terms as verbal behaviour is mediated by people and is an inherently social process. That is, social control should be apparent between what we say and what we do and in the formation and reporting of attitudes. In addition, he noted the large role that verbal behaviour plays in human behaviour. This is, all behaviour is either verbal (reinforced by the community) or nonverbal but verbally governed nonetheless (Guerin, 1992). This poses a problem in social psychology, however, as verbal behaviour and nonverbal behaviour do not always match. This is where Lloyd believed an opening lay for behaviour analysis to expand the field and reach a larger audience while helping to advance our knowledge of behaviour. Lloyd summed his argument with the idea that social psychologists have been dealing with phenomena that are often difficult to measure using direct observations, most notably attitudes. The onus therefore lies with Behaviour Analysts to augment the work of Social Psychologists using a behavioural approach.

To facilitate a behavioural approach to social phenomena Lloyd exploited the knowledge that, for social psychologists, verbal and social behaviour are not always compatible. Specifically, what an individual says and what an individual actually does are often incongruent and when analysed do not correlate. As social psychology relies on the idea of a high correlation between attitude and behaviour but only measures the attitude through verbal report (i.e., explicit measures), such high correlations are seldom evident. This poses what it referred to as the *attitude-behaviour congruence problem*.

A practical, prominent example of the problem between attitude-behaviour congruence was presented by LaPierre (1934). LaPierre travelled across the United States of America with a Chinese couple and recorded 250 motels and restaurants that provided them with food and board. On returning from his trip, LaPierre issued a response questionnaire to all the establishments they visited. Of the 128 replies he received from proprietors 90% reported they would not serve a Chinese couple. LaPierre's findings, among others (Kutner, Wilkins, & Yarrow, 1952), suggest that attitudes, taken as a whole, will be unrelated to overt behaviours.

Lloyd suggests that consistency between attitudes and behaviour is contingent upon the verbal community in which the behaviour or attitude is expressed. That is, feedback on either verbal or nonverbal behaviour can alter the future occurrence of these behaviours. He calls upon a wealth of research from the *Do Say* and *Say Do* literature to reinforce the argument that feedback may alter behaviour. These studies explore the correspondence between doing and saying or more specifically, attitudes and behaviour. That is, *Do Say* studies observe a particular behaviour and later require the subject to self report whether they emitted that behaviour or not. Once a baseline is established, subjects are reinforced if they report emitting the behaviour and this may result in an increase in the frequency of reporting the behaviour (Risley & Hart, 1968). These studies involve changing attitudes in order to change behaviour.

In contrast, the *Say Do* studies explore the relationship between a subject saying (attitude) they will emit a particular behaviour and actually emitting it (behaviour). *Say Do* (Bickman, 1972; Risley & Hart, 1968) studies are designed to observe different response classes emitted by subjects on a continuing basis and employ positive feedback post-behaviour if that behaviour is congruent with the attitude expressed at the outset. That is, the reward or reinforcement applies to the *doing* of the behaviour and not merely the *saying*. Lloyd believes the *Say Do* literature will allow us to gain some insight into social behaviour as we can directly measure the behavioural outcome in relation to the original verbal behaviour (attitude) proposed by the subject. Take for example, one study on energy consumption. Lloyd reports on a study by Seligman and Darley (1977) which aimed at changing behaviour, not attitudes, of householders and their energy consumption. The researchers recorded the actual energy consumption over a 24 hour period and reported back to the householder on their immediate past consumption. Doing so changed the householder's behaviour in relation to energy consumption over the next 24 hour period.

While some of the challenges facing those attempting to change behaviour using attitudes have been outlined one important question still remains; what are attitudes? Attitudes help guide our judgement and behaviour particularly in the social world. Attitudes provide summary assessments that assist in decisions about how to interact with the world. However, we must concede that there is considerable debate over what the term attitude actually refers to. There are both structural and functional approaches to the definition of an attitude. From a structural perspective an individual's beliefs and values lead to the formulation of an attitude which is a positive or negative evaluation about something or someone. This attitude then gives rise to an intention to behave in a particular manner which results in the behaviour itself. In contrast, the functional approach assumes that attitudes aid a person to mediate between the inner demands of the self and the outside world by serving four functions; the adaptive function, the knowledge function, the self- expressive function and the ego-defensive function (Katz, 1960).

Clearly, the relationship between attitudes and behaviour is conceived as a complex one. For instance, in contrast to the common-sense view that attitudes are always predictive of behaviour, behaviours predict attitudes as much as attitudes predict behaviour and behaviour is not always related to attitudes (Augoustinos, Walker & Donaghue, 2006). This complex relationship between attitudes and behaviour is illustrated clearly in Azjen and Fishbein's (1977) Theory of reasoned action in which they argue that it is not attitudes that predict behaviour directly but behavioural intentions. Behavioural intentions are a function of attitudes to the behaviour and subjective norms which refer to what the individual thinks their significant others believe they should do. As a result of the difficulties in defining attitudes and the complex relationship between attitudes and behaviour, measuring attitudes is clearly a complicated undertaking. The foregoing overarching conceptual issues served to guide the research reported in this thesis. However, it may be helpful at this stage to provide a summary of attitudes from a behavioural perspective. Specifically, a behaviour analyst may define an attitude as an occurrence of verbal behaviour that is under social control. The stability of an attitude is a function of the contingencies controlling the emission of that verbal statement. This conception of an attitude is more socially focused than definitions of an attitude in traditional social psychology literature (Guerin, 1994). However, this definition is not informed by the recent developments in verbal behaviour and derived relational responding. A definition that embraces these recent developments defines an attitude as a network of derived and explicitly reinforced stimulus relations according to which the functions of events are transformed (e.g., Grey and Barnes, 1996). This definition allows us to conceive of an attitude as a verbal event which emerges from our interactions with others and with our environment. However, it also respects the fact that response functions may also be derived and extended in accordance with verbal relations to emerge for stimuli in often unpredictable ways.

If an attitude can be conceived in terms of verbal behaviour then the Watt et al. paradigm has presented the potential for the development of a test for social history (i.e., the probability of a response given a particular history) and a past history of private and public verbal behaviour. This is timely in light of the recent explosion of interest in implicit tests for attitudes. Such tests include the Implicit Association Test (Greenwald, McGhee, & Schwarz, 1998), the Extrinsic Affective Simon Task (EAST; DeHouwer, 2003) and The Go/No Go Task (GNAT; Nosek & Banaji, 2001), to name but a few. These tests have been largely developed within a cognitive or a social-cognitive framework and analysing them directly in behavioural terms is beyond the scope of the current thesis. Instead, I will focus on exploring the potentials of the Watt et al. procedure to create a functionally understood and easily administered test of an individual's social history that will constitute a genuine application of the stimulus equivalence phenomenon to assessing behaviour in a wide variety of basic and applied settings. To achieve this goal, ten experiments were conducted and these will be reported in the following chapters. These experiments will systematically and methodologically create a pathway from the known paradigm of stimulus equivalence to a functionally understood and tested account of behavioural testing.

The first empirical chapter of the current thesis, Chapter 2, aims to provide a process-based account for the Watt et al. approach to testing for social histories and attitudes. This investigation will be conducted across two experiments. The first experiment (Experiment 1) employs arbitrary stimulus sets to create a history of stimulus associations in the laboratory. Subjects are exposed to equivalence training and a modified equivalence testing procedure to probe for emergent stimulus relations. The alternative Yes/No testing procedure is employed as a variant on the Watt et al. Match-To-Sample procedure in an attempt to streamline and hasten the testing phase. This experiment aims to test the idea that the Watt et al. technique relies upon the juxtaposition of previously trained stimulus relations with trained stimulus equivalence relations. Experiment 2 examines the utility of the Yes/No testing procedure in assessing differences in the social categorisation of *child* and *sexual* terms by men and women from the general population. More specifically, this experiment examines the ability of a population of adult males and females to derive the equivalence relations *child-sexual* and *adult-playground* using a standard MTS equivalence training procedure and the alternative testing phase employed in Experiment 1. Experiment 2 was designed to examine whether or not the process-level analysis of a stimulus-equivalence based test for social history developed in Experiment 1 was applicable in a real-world testing context. The procedures applied in Experiments 1 and 2 do not provide a practical and easily administered measure for use on large populations. The problem of the cumbersome and time-consuming training procedure is not overcome by the YES/NO test format. In fact, here as in most studies on stimulus equivalence, the training phase requires between 10 and 30 minutes to complete. Thus, while both Experiments 1 and 2 prove successful in demonstrating that differences in a personal history of stimulus association are sufficient for the generation of a "Watt et al. effect", what is required at this point is a solution to the laborious training procedure.

In Experiment 3 (Chapter 3), an equivalence test procedure using an arbitrary stimulus set is employed. This experiment uses instructional control in place of equivalence training with the aim of creating a more efficient procedure to identify social and personal history in a laboratory controlled experiment. The experiment creates a novel stimulus association history similar to that employed in Experiment 1, before testing for the stimulus relations using the novel Yes/No testing procedure employed in Experiments 1 and 2. Experiment 3 also employs a modified test measure that goes beyond simply identifying whether or not predicted equivalence relations emerge from the traditional Matching-to-Sample training procedure. More specifically, the test measures response accuracy differentials in forming instructed stimulus matches across two test blocks. This test format has the additional advantage that it requires only minutes to administer to each research subject. An obvious shortcoming with Experiment 3, however, is the fact that real world stimuli are not employed during the laboratory based investigation. A logical next step, therefore, is to assess the utility of the now rapid test procedure in a real-world setting by employing it to examine socially sensitive stimulus relations

In Chapter 4, an even more streamlined testing procedure is developed. In the first experiment (Experiment 4), a similar test method to that employed in Chapter 3 is applied to assess a social history of categorising homosexual and heterosexual stimuli in homosexual males from Ireland and the USA. Specifically, the test compares responses to word-pairs under different rule conditions (i.e. congruent and incongruent with the subject's personal history). The test format also includes some important topographical modifications of previous tests. That is, in place of the *Yes/No* words presented on screen during the Yes/No testing, subjects are required to press coloured keys on a keyboard. This format should be less demanding of subjects than a traditional Matching-to-Sample or Yes/No test format. While this test method proves effective in assessing social and personal history in a relatively unobtrusive and time efficient manner, there were high error rates observed for many subjects in both groups. In effect, the test format would appear to have been more, rather than less demanding than previous test formats. Therefore, Experiment 5 of Chapter 4 involved a further simplification of the test format in which subjects respond using a keyboard press rather than using the cursor and mouse to choose a stimulus on-screen. Experiment 5 applies this evolving test measure to a group of female subjects. The test assesses differences in the social categorisation of *child* and *sexual* terms by women with words relating to the concepts of *adults, children, sexual* and *nonsexual* as stimuli. Again, the test format proves successful in identifying differences in the categorisation of the various stimuli, but high error rates still remain during all test blocks. This issue is addressed by embarking on a highly novel approach to testing that does not rely explicitly on stimulus matching.

Chapter 5 develops an entirely novel approach to behavioural testing. That is, while the new procedure developed and examined aims to assess the same types of stimulus relations of interest in previous chapters, a highly novel test format is employed to do so. This novel approach directly examines the rate of acquisition of common stimulus functions by members of distinct verbal relations. Specifically, during reach test trial subjects respond only to a single stimulus onscreen (rather than a pair of stimuli) by pressing one of two keys on the computer keyboard. In effect, one of two stimulus functions is established for each of four stimulus types (e.g., *child* terms, *adult* terms, *sexual* terms, *nonsexual* terms). The test format was devised hypothetico-deductively on the basis of research literature which suggests that we should expect to see slower acquisition of common stimulus functions for members of distinct verbal relations (i.e., class competition) compared to common verbal relations (i.e., no class competition). In effect, a test for stimulus function acquisition by multiple stimuli should allow the experimenter to determine the pre-experimental association strength of the relevant stimulus classes (i.e., put simply, whether or not the stimuli "go together" for a given subject). Experiment 6 assesses any differences across gender in the categorisation of individual sexual and child-related stimuli using this new test method. However, one criticism of Experiment 6 is that it should have been developed in laboratory analogues, as in previous experiments, before being employed in a more applied study. This issue is addressed in Chapter 6.

The last empirical chapter of the current thesis, Chapter 6, employs a series of experiments to provide a laboratory analogue of the new stimulus function acquisition test procedure using arbitrary laboratory created stimuli. That is, four experiments sequentially explore the reliability of the new test procedure in an effort to provide a functional account of this new method of behavioural testing. The first of the four experiments (Experiment 7) creates a laboratory based history of stimulus associations, followed by a relational history involving the formation of verbal relations. Experiment 7 aims to see if an effect similar to the popular Implicit Association Test effect can be obtained using this laboratory created history and test procedure. Experiment 8 assesses whether or not a novel laboratory history can be employed as an intervention to alter an Implicit Association Test effect. This matter is important because it moves the focus of research from theoretical speculation about what precisely the current behavioural test (and the IAT) measures to the matter of obtaining prediction and influence over the test outcome. Experiments 9 and 10 alter the intervention to further assess the malleability of the current test effects and those of the Implicit Association Test, to which it bears a procedural similarity. Finally, Chapter 7 reviews the main findings of the thesis. This chapter focuses on the contribution to the research literature made by the current experimental findings and test developments. The most significant contribution of this research is its success in providing insight into the underlying behavioural processes of the Watt et al. (1991) procedure and the Implicit Association Test (Greenwald et al., 1998). In addition, Chapter 7 considers the relevance of this behavioural account to the behavioural literature and the field of implicit testing more generally.

Chapter 2

A process-level analysis and application of a stimulus equivalence-based test for verbal history

Psychology has witnessed a recent explosion in the use of implicit measures of behaviour and attitudes. The use of these measures is commonly reported within the fields of social (Greenwald & Farnham, 2000), clinical (Mihailides, Devilly, & Ward, 2004) and health psychology (Jajodia & Earleywine, 2003). Such measures, while promising in their ability to identify group differences, are being employed in increasingly wider settings in the absence of a thorough-going functional analysis. A functional analysis allows for a clear demonstration of the variables controlling any given behavioural event under a variety of conditions. In behavioural terms, such a demonstration constitutes scientific understanding, insofar as once a behaviour has been both predicted and controlled it can be said to be understood (see Sidman, 1960; see also Hayes & Brownstein, 1986). In general terms, a functional analysis starts by observing a behaviour of interest with a high degree of precision in the observation or recording measurements used. It then involves gaining control over all of the possible antecedents and consequences to that behaviour in a systematic attempt to identify the sources of control over the behaviour of interest. This analysis usually proceeds with individual subjects using a single subject research design paradigm. The emphasis on single subjects increases the likelihood that functional relations between antecedent or consequences and behaviour will be illuminated through the idiosyncratic variations in behavioural relations observed across research participants. Put simply, attention to detail with individual subjects enhances the opportunity to observe causal relationships on a response by response basis (see Cooper, Heron & Heward, 2007). Such an approach to behavioural research, while common-place for behaviour analysts, may prove useful to the cognitive and social-cognitive researchers currently developing and employing the most commonly used implicit tests of behaviour and attitudes.

In the absence of a thorough functional analysis, a behavioural measure or test cannot be understood, and therefore it cannot, in any meaningful sense, be evaluated. As an example, the constantly evolving Implicit Association Test (IAT; Greenwald, McGhee & Schwarz, 1998) has been used in hundreds of studies, almost all of which have simply employed it to assess "attitudes" or "biases" in the absence of a process-based analysis of precisely what is being measured. Examinations of what precisely the test measures take the form of hypothesis tests that are difficult to assess in an unambiguous way due to their theoretical and hypothetico-deductive nature. Furthermore, these studies rely on group effects examined statistically (Greenwald & Farnham, 2000; Lane, Mitchell, & Banaji, 2005; Olsson, Ebert, Banaji, & Phelps, 2006). In effect, the matter of understanding the IAT has become a theoretical matter, sometimes addressed empirically in hypothetico-deductive studies, rather than an empirical matter to be addressed using an inductive approach wherein full control and prediction over the behavioural phenomenon of interest is achieved.

Only a relatively small number of IAT studies have concerned themselves with identifying the controlling conditions over the IAT tests performances and none have attempted to bring it under control through experimental manipulations. This later strategy is crucial to the behaviour-analytic approach and will be employed in the forthcoming research, beginning with the experiments reported in the current chapter. That is, from a behavioural point of view, it is crucial that behaviour be clearly under the control of experimental contingencies, rather than extra-experimental or pre-experimental contingencies assumed to operate in the world outside the laboratory (e.g., a social history). Indeed, in the absence of the demonstrated ability to control behaviour (i.e., demonstrate the effect of the controlling conditions), behaviour analysis can scarcely be differentiated from cognitive psychology, for which prediction of behaviour alone is often sufficient (see Hayes & Brownstein, 1986).

It is surely not surprising that, from a behaviour analytic perspective, a functional-analytic approach should be adopted in the analysis and development of implicit tests. Surprisingly, however, prominent social cognitive theorists have commented on the need for a process-based experimental analysis of popular implicit tests (e.g., DeHouwer, 2006). Indeed, some have even embarked on functional analyses of context effects on test performances (Karpsinki & Hilton, 2001; Steffens & Plewe, 2001; Wittenbrink, Judd, & Park, 2001). However, following an extensive review of the literature Fiedler, Messner and Bluemke (2006) reported the distinct absence of a testable model underlying the most popular implicit measure; the IAT. The current research was intended to fill this knowledge gap by adopting a thorough functional-analytic approach in the attempt to analyse and develop an equivalence-based implicit test for behavioural history.

As outlined in previous chapters, the possibility of developing behavioural implicit tests using the concept of derived relations was first presented by Watt, Keenan, Barnes and Cairns (1991). Watt et al. (1991) used a simple stimulus equivalence paradigm to take advantage of the fact that people in Northern Ireland often respond to each other’s names as indicative of religious background. Their study employed stimuli representative of Catholic and Protestant names and symbols and involved training subjects to relate them in a manner inconsistent with their social histories. During equivalence testing, all of the English subjects correctly matched the

Catholic names with the Protestant symbols, but 12 of the 19 Northern Irish subjects chose a novel Protestant name in the presence of the Protestant symbols, thereby failing to respond equivalently. These findings strongly suggest that the social contingencies operating in Northern Ireland interfered with the establishment of equivalence relations in the laboratory. More specifically, the equivalence test required Northern Irish subjects to juxtapose names and symbols in a manner that was counter-cultural for this group of subjects. Thus, it would appear that a derived relations paradigm can be used successfully to assess the social knowledge of subjects without alerting them to the nature of the task.

This stimulus equivalence-based approach to implicit testing has also been employed as a discriminatory tool in a series of studies on clinical populations (Leslie, Tierney, Robinson, Keenan, Watt, & Barnes, 1993; McGlinchey, Keenan, & Dillenburger, 2000; see also Keenan, McGlinchey, Fairhurst, & Dillenberger, 2000). Attitudes towards self and attitudes towards race and gender have also been examined using this equivalence paradigm (Barnes, Lawlor, Smeets, & Roche, 1995; Dixon, Dymond, Rehfeldt, Roche, & Zlomke, 2003; Grey & Barnes, 1996; Merwin & Wilson, 2005). The stimulus equivalence-based approach to implicit testing does not afford the ease-of-use and subtlety of the cognitive-based implicit measures. Nevertheless, it lays the foundation for the development of implicit behavioural tests based on sound functional-analytic research. Specifically, it suggests a starting point for a test that can be administered to asses the social histories of subjects without raising the problems of social desirability typically associated with explicit measures (Keillor, Owens, & Pettijohn, 2001). To this extent the Watt et al. paradigm could be seen as a rudimentary behavioural implicit test.

One of the main advantages of the other implicit measures is that they can be administered in a very brief time frame. In comparison, the stimulus equivalence based procedure requires anything from 20 minutes to an hour to administer. Clearly, this is not practical in terms of its utility as a test that can be used to assess the behavioural history or implicit behaviour's of a large number of subjects in any practical way. One obvious avenue of research, therefore, would be to investigate the possibility of altering the training and/or testing procedure so that it can be administered more quickly. One testing procedure that may be of use in this regard is the Yes/No procedure also known as a "go-left go-right" (D'Amato & Worsham, 1974), or "same/different" procedure (Edwards, Jagielo, & Zentall, 1982).

An Alternative Testing Procedure

It has been suggested, that it is important to develop procedures other than the Matching To Sample (MTS) procedure in order to hasten the training and testing of derived stimulus relations (Barnes-Holmes, Barnes-Holmes, Smeets, Cullinan, & Leader, 2004). Specifically, the MTS format has been found to be unsuitable for measuring complex and highly contextually controlled relations, such as relational frames (Hayes, Barnes-Holmes, & Roche, 2001). In tests for derived relations of opposition, comparisons require the presence of a contextual cue on every test trial, in addition to a sample and multiple comparisons. For instance, to test for derived relations, a subject must choose which of three comparisons is opposite to a sample stimulus along some arbitrary continuum. A probe trial for such a relation requires a contextual cue to specify the relation applicable on that trial (e.g. Steele & Hayes, 1991). Researchers have suggested that such a format is unnecessarily convoluted for subjects and have attributed this to high failure rates using the MTS format in the context of training and testing relational frames (Barnes-Holmes, Barnes-Holmes, Smeets, Cullinan, & Leader, 2004)

For this reason researchers have attempted to develop alternative testing procedures. For instance, the relational evaluation procedure (REP; Barnes-Holmes, Barnes-Holmes, Smeets, Cullinan, & Leader, 2004; Hayes & Barnes, 1997) suggests that the empirical and theoretical analyses of stimulus equivalence and derived relations, more generally, will be enhanced considerably through the development of a wide range of experimental preparations. The Relational Evaluative Procedure demonstrates that it is possible to produce equivalence responding in adult human subjects using a respondent training procedure. The core method involves allowing subjects to evaluate, or report on, the stimulus relation or relations that are presented on a given trial. In the typical approach, subjects may confirm or deny the applicability of particular stimulus relations to other sets of stimulus relations. In this way, the focus shifts from stimulus partitioning and picking (with its class connotations) to relational specification and evaluation. An even more recent variant on the REP is known as the Relational Control Procedure (RCP; see Dymond, Roche, Forsyth, Whelan, & Rhoden, in press). While these foregoing procedures were developed in the context of training and testing highly complex relations other than equivalence, a simpler but not dissimilar procedure has been in use for decades in both a traditional matching context and a stimulus equivalence testing context. This procedure is known as the YES/NO procedure.

The YES/NO procedure is an unorthodox procedure used for testing stimulus relations in stimulus equivalence research or in other contexts. The format of the technique is as follows: Each trial in a YES/NO procedure involves the presentation of only two stimuli. A question such as “Do they go together?” remains on screen at all times. Subjects must decide if the stimuli presented are associated with each other or not by clicking on the “YES” or the “NO” box, also present on screen. On some trials, the stimuli are from the same stimulus class, in others, the stimuli are from different classes.

It has been argued that determining the formation of equivalence classes solely using the MTS method could reduce its theoretical validity and efficacy in modelling the revelation of broad range of complex human behaviours (Sidman, 1994). The YES/NO method has been deemed to be a suitable analytical tool for such investigations and can be used as an alternative procedure to MTS, which has been reported not to be necessary to establish the relations in equivalence classes (Fields & Reeve, 1997).

While the YES/NO procedure has previously shown its capability in allowing for the formation of equivalence relations (Fields, Reeve, Varelas, Rosen, & Belanich 1997). There has been no further research on the procedure in terms of assessment of utility (Barnes-Holmes, Barnes-Holmes, Smeets, Cullinan, & Leader, 2004). That is, the YES/NO procedure has not been proven as a superior method to MTS in terms of speed of acquisition or reduced failure rates. Nevertheless, the YES/NO procedure seems simpler and more appropriate to the Watt et al. procedure in so far as it seems prudent to employ the most widely used alternative to the MTS procedure to see if the Watt et al. effect can be retained . However, the current experiments do not involve a systematic comparison of the MTS and YES/NO procedure. Rather, the alternative procedure will simply be substituted for the MTS test used by Watt et al. (1991) to see if a similar effect can be established using this procedure under laboratory conditions.

Rather than simply repeat the Watt et al. paradigm with a new test procedure, there is a more substantial purpose to the first experiment presented in this chapter.

That is, Experiment 1 aims to assess Watt et al.'s intuitive conclusion that the social contingencies operating in Northern Ireland were responsible for the failure of Northern Irish subjects to respond equivalently to Protestant and Catholic stimuli. Assessing the validity of this conclusion in a laboratory analysis will allow us to move forward in the confidence that Watt et al. have indeed identified the core process underlying their reported effect.

The overall aim of the current chapter, then, is to determine if analyses of derived verbal relations can be a useful paradigm for the development of functionally understood implicit tests. The first experiment in the current study more closely examines the Watt et al. effect. Specifically, this experiment does not depend on a pre-experimentally established social history but will create the history of stimulus associations in the laboratory. Following this, subjects will be exposed to equivalence training and a YES/NO testing procedure. The YES/NO procedure will be employed as a variant on the Watt et al. MTS procedure in an attempt to streamline the procedure and possibly hasten the testing phase.

Experiment 1

Method

Subjects

Twenty-two subjects consisting of 9 males and 13 females participated in the current study. All subjects were acquaintances of the experimenter[1] and were aged between 19-57 years. Subjects were informed that the current study comprised a three-phase association test which would take approximately sixty minutes to complete.

Apparatus and Stimuli

All phases of the experiment were presented to subjects on a Dell Laptop with a 14'' display. Stimulus presentations were controlled using the software package Microsoft Visual Basic v.6 which also recorded all responses. Stimuli for the current study comprised four photographic images and six nonsense syllables. The four photographic images were taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2001) with two of the photographs classified under the category “Romance” (4677, 4660; See Figure 1 top panel) and two photographs classified under the categories “Trashcan” (9330) and “Garbage” (9290; see Figure 1 bottom panel for both images). The six nonsense syllables were Ler, Cug, Mau, Vek, Paf and Rog. These will be referred to using the alphanumerics A1, B1, C1, A2, B2, and C2 respectively.

[1] Sarah Maguire, an undergraduate student at the National University of Ireland Maynooth assisted with data collection as part of her final research project.

Figure 1: Photographic stimuli employed in Experiment 1.The top panel shows the two sexual images presented. The bottom panel shows the two disgusting images presented.

Ethics

All subjects were presented with and signed a consent form before proceeding to first phase of the experiment (See Appendix 1). Subjects were told informally that performance on the task would not allow the researcher to make any individual psychological assessments but may allow for group patterns to be identified. All subjects were informed of the true nature of the study after participation and were given the opportunity to withdraw their data at that stage.

Procedure

General experimental sequence

The current experiment consisted of three phases presented in a set sequence. Subjects sat comfortably at a standard computer desk and viewed the computer screen at a distance of approximately 70 cm and at eye level. Phase 1 consisted of a word-picture association training task and lasted approximately 10 minutes. The purpose of this phase was to establish and test for CS-US relations between arbitrary nonsense syllables and specific types of visual images (i.e., sexual or disgusting). Subjects were required to make an observation response of a space bar press following each trial during this phase. The contingency applied in Phase1 varied depending on the experimental condition in which subjects participated. Twelve of the subjects were exposed to a contingent conditioning history as described above (Condition A). However, ten further subjects were exposed to a non-contingent conditioning procedure (Condition B) in which associations between the CS and US stimuli were quasi-random.

Phase two consisted of equivalence training and was criterion dependent. Phase three consisted of equivalence YES/NO testing and lasted approximately five minutes. Subjects were required to use the computer mouse to "click on" the words "yes" or "no" in response to whether or not the pair of stimuli presented on the screen participated in an equivalence relation.

Subjects were required to respond on all trials during equivalence training and testing using the mouse and on-screen cursor. All subjects were exposed to the first two phases, while exposure to Phase 3 was contingent upon meeting the accuracy criterion in Phase 2.

Subjects who were provided with the contingent conditioning history (Condition A) were expected to experience difficulty passing the equivalence test which required them to parse pairs of stimuli that were associated in Phase 1 into separate derived relations. In contrast, subjects without this history (Condition B) should have little difficulty in demonstrating stimulus equivalence because the history provided in Phase 1 should neither enhance nor militate against forming these relations.

Phase 1: Conditioning Phase

In Phase1 subjects were exposed to a word-picture association-training procedure using a respondent conditioning preparation. Subjects were presented with the following instructions on screen after being seated in front of the computer:

> Hello and thank you for agreeing to participate in this research. In a moment some words and images will appear on this screen. Your task is to look at these items carefully and to remember what you see.
> IT IS VERY IMPORTANT THAT YOU CONTINUE TO WATCH THE SCREEN AT ALL TIMES.
> After each picture is presented you will be required to press the space bar on the computer keyboard to continue. Please make sure you know where the space bar is before you begin. If you have any questions please ask them now.
> When you are ready please click Begin

The “Begin” button comprised the word “Begin” presented in upper case Arial font 16 and appeared in a grey onscreen box below the instructions. In Condition A (contingent conditioning history) two arbitrary nonsense syllables A1 (Ler) and C2 (Rog) were associated with sexual images and two arbitrary nonsense syllables A2 (Vek) and C1 (Mau) were associated with disgusting images. One nonsense syllable and one image were associated on the screen per trial (See Figure 2 for summary). On a given trial nonsense words appeared at the top of the screen in black font and the image appeared underneath the nonsense word one second later. The image and nonsense word then remained on screen for five seconds following which the screen went blank for a random interval varying between ten and twenty seconds. The words “*Please press the space bar to continue*” then appeared in the centre of the screen and remained until the participant pressed the spacebar. This was an observation response to ensure attention to the conditioning trials. Pressing the spacebar initiated the next trial.

There were four conditioning trials for each of the four word-image associations (i.e., 16 trials in total) with no more than three consecutive exposures to each. In Condition B (non-contingent history), the same images and words were presented but there were no consistent associations between the nonsense syllables and images. Instead, a quasi-random pattern of word-picture association was applied in which each nonsense syllable appeared an equal number of times with each of the images across the block of 16 trials.

Following the Conditioning Phase, subjects were exposed to a categorisation stage. Subjects were required to categorise both images and nonsense words as sexual or non-sexual. This functioned as a screening phase to ensure familiarity with the relevant stimuli and their established associations.

The following instructions appeared on the computer screen:

> In a moment some words will appear on this screen. Your task is to choose which one of the words presented on the bottom of the screen goes with the image presented at the top of the screen. You must indicate your choice by clicking on the word at the bottom of the screen that goes with the image presented at the top of the screen. It is important that you try to make as many correct choices as possible. Please click continue when you are ready to proceed.

The images appeared in the centre of the screen one at a time and the subject was required to categorise the image as sexual or non-sexual by clicking on the appropriate category word which appeared under the image, left or right at the bottom of the screen, with positions of category words counterbalanced across trials. Subjects were then required to repeat the process in order to categorise the nonsense syllables.

Again the stimuli appeared in the centre of the screen. The same instructions appeared on the screen with the word "image" replaced with "word". When the subject clicked on the terms "sexual" or "non-sexual" the next image/ nonsense word appeared immediately. There were 16 image categorisation trials and 16 nonsense word categorisation trials. No feedback was presented on any trial or at the end of the phase.

A1 (Ler) → Sexual Image

C1 (Cug) → Disgusting Image

A2 (Ler) → Disgusting Image

C1 (Cug) → Sexual Image

Figure 2: Summary of Conditioning Phase 1

Phase 2

On completion of the word-picture association-training phase, subjects were immediately exposed to Phase 2, which consisted of equivalence training using a series of nonsense syllables as stimuli. Training led to the formation of two three-member equivalence relations, each containing one of the two nonsense syllables used during Phase 1 as "A" stimuli, one of the two nonsense syllables used during Phase 1 as "C" stimuli and two novel nonsense syllables (i.e., ler-cug-mau; vek-paf-rog; see Table 1).

Table 1: Two-three member equivalence relations used during Phase 2.

Equivalence Class 1	Equivalence Class 2
(A1) Ler	(A2) Vek
(B1) Cug	(B2) Paf
(C1) Mau	(C2) Rog

There were two baseline conditional discrimination training tasks, comprised of four matching-to-sample tasks. Training was conducted using a linear training method (i.e., A1-B1, B1-C1 and A2-B2, B2-C2, where all alphanumerics merely represent the nonsense syllables employed as per Table 1). Prior to training subjects were presented with brief instructions requesting them to use the computer mouse to click on the comparison stimulus they believed to be correct.

The following instructions appeared on the computer screen:

> In a moment some words will appear on this screen. Your task is to choose which one of the words presented on the bottom of the screen goes with the word presented at the top of the screen. You will receive feedback as to whether your answer is correct or incorrect during this stage. It is important that you try to make as many correct choices as possible. Please click CONTINUE when you are ready to proceed.

The training was conducted in a blocked fashion. That is, A-B relations were trained to criterion before B-C relations were trained. In A-B Training, when A1 was the sample the correct comparison nonsense word was B1 (see Figure 3, upper left panel) and B2 was incorrect. In contrast, when A2 was presented as the sample the correct comparison nonsense word was B2 and not B1 (Figure 3, upper right panel). The subjects received feedback after each trial. If the answer was correct then the word “correct” appeared in green font in the centre of the screen for 1500 ms. If the answer was incorrect the word “wrong” appeared in red font in the centre of the screen for 1500 ms.

A1 B1* B2	A2 B1 B2*
B1 C1* C2	B2 C1 C2*

Figure 3: Examples of trials in the training phase. * indicates the correct choice.

In B-C Training the procedure was identical to above where (B1) or (B2) were presented as the sample stimuli and (C1) and (C2) were the comparison stimuli. On these trials when B1 was the sample C1 was the correct comparison (Figure 3, lower left panel) and when B2 was the sample C2 was the correct comparison (Figure 3, lower right panel). Nonsense syllables were assigned to roles as sample and comparisons randomly by the experimenter at the outset.

There were twenty trials in both A-B and B-C training (i.e., 10 exposures to each trial). A criterion of nineteen correct responses out of twenty was required to pass A-B and B-C training, respectively. Subjects were exposed to training until they produced consistent and correct responding. If subjects failed either part of the training stage four times in succession they did not proceed to the latter stages of the training phase or to the testing stage (Phase 3).

Phase 3

If the criterion number (19/20) correct responses was achieved in the training phase subjects were subsequently exposed to the equivalence testing phase (Phase 3). Subjects were presented with the following instructions on the computer screen:

You may now take a short break. In a moment some words will appear on this screen. Your task is to choose which one of the words presented on the bottom of the screen goes with the word presented at the top of the screen. Please note that you WILL NOT receive feedback as to whether your answer is correct or incorrect during this stage. However, it is still important that you try to make as many correct choices as possible. Please click CONTINUE when you are ready to proceed.

On every trial the words "*Do they go together*?" appeared at the top of the computer screen with two nonsense syllables underneath. Subjects were required to use the computer mouse to click on either the "yes" or "no" buttons, which appeared at the bottom of the screen, depending on whether or not the nonsense syllables "go together". Figure 4 below illustrates an example of an equivalence test trial.

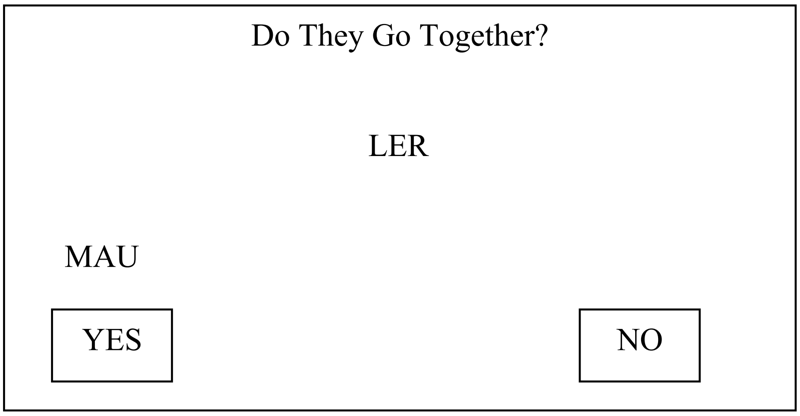


Figure 4: Sample Trial in equivalence test phase.

No feedback was given on any trial. During testing subjects were expected to match A1 to C1, C1 to A1, A2 to C2, and C2 to A2, thereby demonstrating stimulus equivalence (see Barnes, 1994; Fields, Adams, Verhave, & Newman, 1990; Sidman, 1986). This was assessed by the consistency with which subjects choose the "yes" button when the pairs A1/C1, C1/A1, A2 /C2, and C2 /A2 were presented and the "no" button when the pairs A1/C2, C1/A2, A2 /C1, and C2 /A1 were presented. Thus, there were eight trials in total with each presented four times in a quasi random order (i.e., with no more than three successive exposures to any one trial).

There were thirty-two equivalence test trials in total with four of each of the foregoing 8 stimulus pair combinations of nonsense syllables. The predicted emergent equivalence relations contained a nonsense syllable associated with sexual stimuli as well as a nonsense syllable associated with disgusting stimuli during Phase 1. In effect, the predicted equivalence relations were juxtaposed with a previous conditioning history. The number of correct responses on the equivalence test was the dependent measure of the impact of Phase 1 on test performances for subjects in both conditions.

Summary

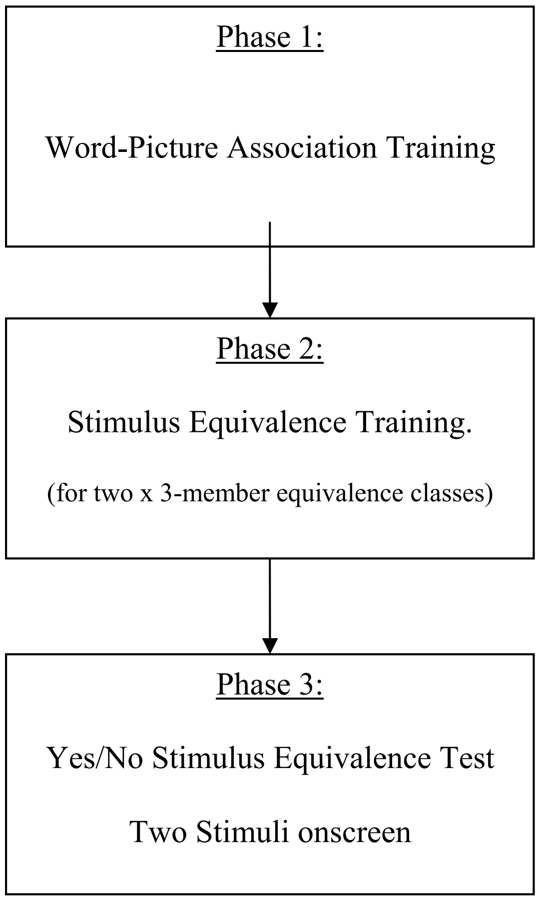


Figure 5: Procedural sequence for Experiment 1

Results and Discussion

For Phase 1 data consisted of total correct response on both categorisation tests. Criterion was set at 14 correct responses out of 16 and all subjects reached this criterion. For Phase 2 data consisted of the total number of correct responses for individual subjects on each exposure of A-B and B-C training respectively (see Table 2) and the total number of correct responses for the subjects in Conditions A and B on a single equivalence test.

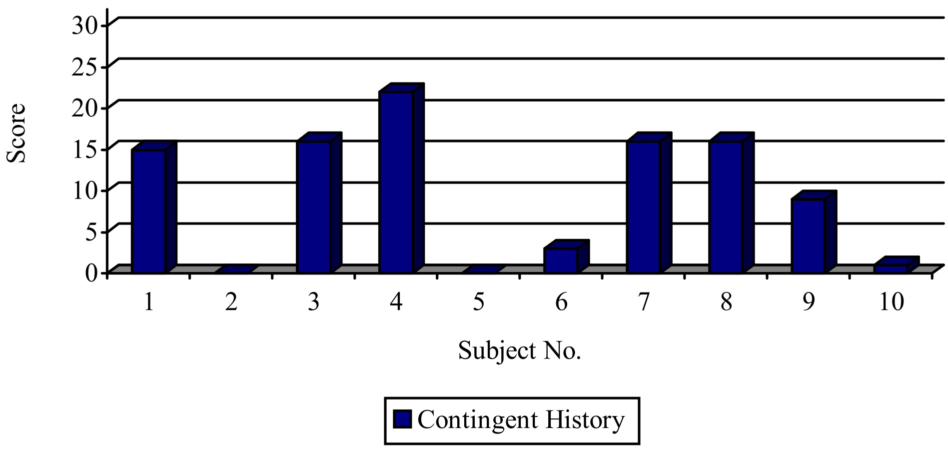
Table 2: Total number of correct responses on each exposure in the training phase

Participant No.	A-B Training Exposures 1-4				B-C Training Exposures 1-4			
	1	2	3	4	1	2	3	4
1	13	16	20	-	19	-	-	-
2	19	-	-	-	18	20	-	-
3	17	20	-	-	20	-	-	-
4	13	19	-	-	14	20	-	-
5	8	20	-	-	12	16	20	-
6	20	-	-	-	9	16	19	-
7	19	-	-	-	19	-	-	-
8	15	17	20	-	16	20	-	-
9	13	19	-	-	18	20	-	-
10	14	19	-	-	15	20	-	-
11	14	20	-	-	20	-	-	-
12	16	20	-	-	19	-	-	-
13	12	20	-	-	13	20	-	-
14	9	10	19	-	13	19	-	-
15	17	20	-	-	19	-	-	-
16	9	17	20	-	15	16	20	-
17	17	20	-	-	16	20	-	-
18	16	20	-	-	17	20	-	-
19	19	-	-	-	20	-	-	-
20	19	16	-	-	20	-	-	-
21	10	10	10	10	-	-	-	-
22	7	11	14	17	-	-	-	-

All subjects (with 2 exceptions) reached the criterion number of correct responses on the second exposure of A-B and B-C training respectively (i.e. >18 correct responses). Subjects 21 and 22 were eliminated as they failed to reach the criterion number of correct responses in the training phase.

Figure 6 below indicates the total number of correct responses for both groups of subjects on the equivalence test.

Correct responses for each subject in the Contingent History Condition



Correct responses for each subject in the Non-Contingent History Condition

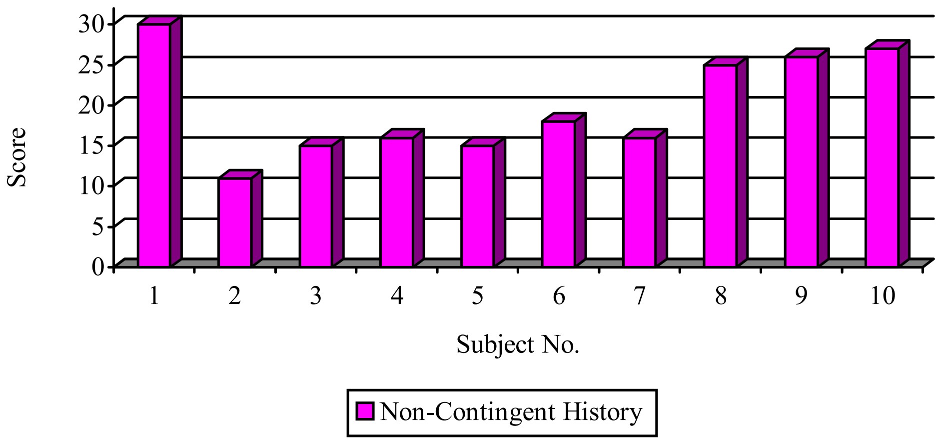


Figure 6: Total number of correct responses for all subjects in Conditions A (Contingent History; upper panel) and B (Non-contingent History; lower panel).

As predicted, correct responding was higher for the non-contingent history group than the contingent history group. The mean for the noncontingent history group (M= 20.20) was considerably higher than that of the contingent history group (M=9.70).

An independent-samples t-test was conducted to compare the equivalence test scores for the groups. There was a significant difference in scores for contingent history (M=9.70, SD=8.056) and non-contingent history groups [M=20.20, SD=6.233; ($t=3.26$, $df= 19$ $p\leq.01$)]. The magnitude of the differences in the means was large (Eta squared=.371) as classified by Cohen (1988) who reported effect sizes greater than .14 as large.

A detailed analysis was carried out to examine the patterns of responding more closely. Figure 7 below shows the mean number of correct responses per block of four successive testing trials for the contingent and non-contingent history conditions. That is, for each set of four trials completed by all subjects in the test phase an overall mean score was calculated and thus functions as a data-point on the graph.

Response Accuracies on Successive 4-Trial Blocks for all subjects

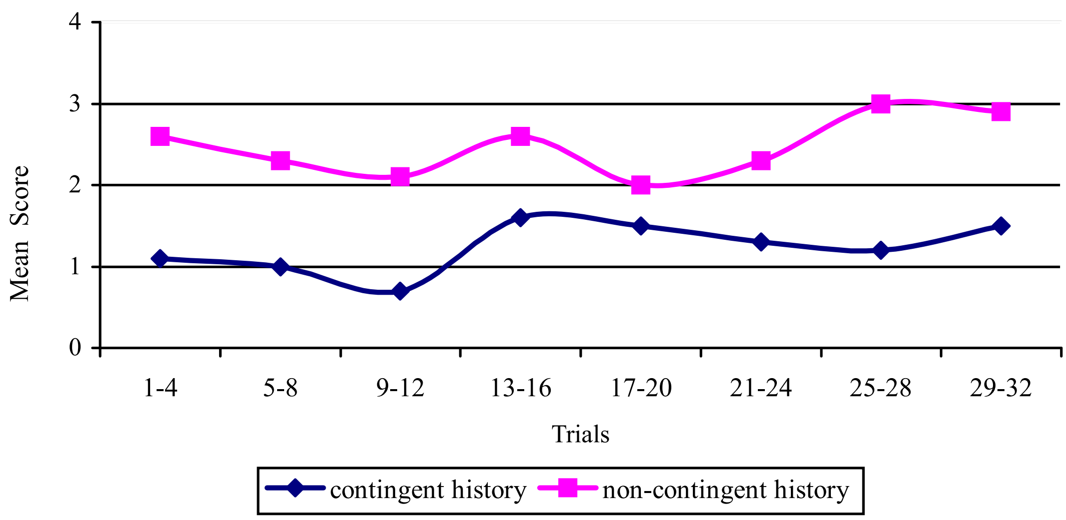


Figure 7: Mean number of correct responses per block of four successive testing trials for the contingent and non-contingent history conditions.

While the pattern of responding was similar for both groups it appears from Figure 7 that the most consistent difference in responding occurred within the first twelve trials. Thus, it would appear that the effect of history on the derivation of stimulus equivalence is most apparent during early phases of the test. Therefore, this simple analysis suggests that future uses of the test may obtain significant differences in equivalence responding across a smaller number of trials than employed here.

To see if this supposition was correct, an independent-samples t-test was conducted to compare the number of correct responses on the first twelve trials of the testing phase for both groups. There was a significant difference in scores for contingent history ($M=9.33$, $SD=2.082$) and non-contingent history groups [$M=23.67$, $SD=3.055$; $t=6.72$, $df=19$, $p<.01$]. The magnitude of the differences in the means was very large (Eta squared = .919). Thus, the difference in responding to derived equivalence relations was so significantly large across the groups that the effect can reach statistical significance within a very small number of trials.

A wave like pattern is also evident in the number of correct response produced across the test phase by the non-contingent history and contingent history groups. This may result from a natural cycle in the attention skills of the subjects. More specifically, concentration during this intense test block may wane periodically before recovering momentarily. Of course, this suggestion is, at this point, speculative in the absence of further empirical investigations. Regardless of the reasons for this cyclical pattern in accurate responding, subjects' response accuracies in both conditions appear to decrease after trials 12 and 20 and begin a steady increase after this point.

Overall, the pattern of scoring on the equivalence test was in the predicted direction, the non-contingent history condition scored higher as a group on the equivalence test than the contingent history group. The equivalence test proved sensitive to the laboratory histories created by the experimenter for the subjects. Specifically, subjects in the contingent history Condition (A) performed poorly when forming novel verbal relations which were incompatible with the laboratory history.

This demonstrates that the laboratory history interfered with the derivation of stimulus equivalence, thereby providing a process-based analysis of the Watt et al. (1991) effect. Specifically, this data shows that subjects in Condition A found it difficult to form derived relations and this would appear to be caused by a behavioural history competing with current experimental contingencies.

It may be of interest to compare the current test performances to performances on a test employing neutral and novel stimuli. In effect, such a standard equivalence test would provide a baseline measure of equivalence class formation against which to compare and analyse the current performances. In effect, this strategy would further strengthen any conclusions regarding the source of the current effects.

The foregoing suggestion notwithstanding, the demonstrated ability of this stimulus equivalence-based test to tap into the subjects' verbal histories in an apparently implicit manner provides a promising avenue of research for the development of further implicit tests based on the concept of stimulus equivalence.

Experiment 2

The foregoing experiment found the Watt et al. (1991) assertion that social history could interfere with equivalence class formation was correct. Thus, the test may be useful as a measure of social history. One interesting application of the Watt et al. procedure that may be interesting to pursue is suggested by a study conducted by Roche, Ruiz, O'Riordan, and Hand (2005).

Roche et al. (2005), attempted to identify whether or not a range of convicted sex offenders categorise children as sexual or non-sexual using the Watt et al. paradigm. The study employed a small number of sex offenders against the adult, contact sex offenders against the child, offenders convicted of child pornography offences, and male and female control subjects from the general population. Subjects were required to from equivalence relations as trained and were tested for the presence of these relations. However, the tasks were loaded with a term relevant to paedophiles and child pornographers. More specifically, the word *Lollipop* (often used to describe sexually available children and an appellation widely applied to child pornography picture sets) participated in a different equivalence relation to the word *Child*. Thus, individuals with this knowledge should be more likely to mistake the derived equivalence task for a simple choice task involving matching the word *Child* and *Lollipop* (even though this is not a derived equivalence relation). Specifically, all subjects were presented with a series of conditional discriminations on a computer screen. Initially, subjects were exposed to the following equivalence training relations; Child - Tree, Tree - Lamp, Cloud - Insect, Insect - Lollipop. Each task was presented eight times each in a quasi-random order in blocks of 32 trials. Subjects matched the comparison stimuli (e.g., Insect or Tree) to the sample (e.g., Child) by clicking on their choice using the computer mouse and cursor. All choices were cons equated by corrective feedback delivered by the computer. Subjects were exposed to training until they produced consistent and correct responding across a block of 32 training trials. Under normal testing situations this training can be expected to give rise to the derived equivalence relations; Child - Lamp and Cloud - Lollipop. Subjects were exposed to a block of 32 testing tasks, in which the four tasks were administered in a quasi-random order eight times each. The testing proceeded, without a break, in blocks of 32 trials until the subject consistently produced the correct equivalence-based matching response (i.e., Child - Lamp, Cloud - Lollipop) or until 12 blocks had been administered, whichever came first.

The dependent measure in the Roche et al. procedure was the number of blocks of 16 trials required to produce 15 or more correct responses on a single block. The test involved producing equivalence classes that did not involve matching the term *child* to the term *lollipop*, but rather was intended to assess the likelihood that subjects would be "distracted" by the availability of the term *lollipop* when presented with the sample term *child*. For some subjects their social histories may have interfered in the formation of the required equivalence relations. Results suggested that those subjects who were convicted of sexual offences against children (both contact offences and pornography offences) required more blocks of testing in order to derive the equivalence-based relations than convicted sex-offenders against the adult. In other words, when presented with a task on which a correct equivalence response could be made, these subjects tended to choose the socially inappropriate comparison stimulus more often than controls.

The authors raised several procedural concerns with the test. For instance, they reported that the Watt et al. procedure was cumbersome to administer and many subjects from a criminal population suffer from illiteracy problems that make such a complex task difficult to complete. More interestingly, however, Roche et al. (2005) noted additional data that appears to warrant further investigation. The data showed that males in the general population displayed a pattern of responding that appeared very different to that of females in the general population. Specifically, the males were more likely than the female subjects to form the inappropriate and incorrect matches on the equivalence test. In other words, it appeared that males and females from the general population displayed different social or verbal histories with regard to how they categorise and respond to child-related and sex-related stimuli. Roche et al. did not conduct a male-female comparison in their data analysis and did not investigate these interesting effects further. This finding, if replicable, raises the interesting possibility that males and females in Western culture display different fluencies with different social categories and concepts. Moreover, it would provide a fertile ground in which to further examine the application and development of the Watt et al. procedure for the detection of specific social histories.

The foregoing suggestion that males and females in Western culture may display different fluencies with different social categories and concepts is not a new one. Indeed, feminists have argued that infantilisation of women occurs when men refer to women using verbal practices associated with children (e.g., “chick”). More technically, this means that the verbal categories employed by men with which to respond to women and children may involve considerable overlap, at least in some cases. A blurring of the categorical boundaries between women and children raises obvious concerns for how men may view children and their sexuality. Furthermore, by supporting the use of these blurred discourses regarding children and adults, the wider patriarchal community may unwittingly support the continued infantilisation and oppression of women (see Greer, 1993).

However, no research to date has examined the attitudes of a *normal* sample of men and women towards sexuality and children. We can draw certain parallels between this issue and gender differences in attitudes towards rape and child sexual abuse. Specifically, gender has been shown to be a major factor in discriminating between acceptable and unacceptable sexual behaviour. A wealth of studies have shown that males are more likely than females to endorse rape myths, blame the victim, minimise the consequences of sexual assault, and exhibit less understanding of the victim (e.g., Holcomb, Holcomb, Sondag, & Williams, 1991; White and Kurpius, 1999; Xenos and Smith, 2001). In the same vein, a recent Norwegian study found that women held more negative attitudes towards child sexual abuse than men, and that male prisoners had more accepting attitudes towards rape than the other samples (Tennfjord, 2006).

Bearing the above empirical findings in mind and if the idea that men infantalise women in their discourse is a reliable one, we should indeed expect to see differences in social categorisation by men and women in the general population in the context of children and sexuality. The current Watt et al. paradigm would seem perfectly suited to the task of illuminating social categories in an effective and yet subtle manner. More importantly, in the current context, it may serve as an empirical tool to examine the verbal contingencies that form the behavioural counterpart to what feminists and post-modern writers more generally refer to as discourse (see Roche & Barnes-Holmes, 2003).

The following experiment examines the utility of the current YES/NO equivalence-based procedure to assess differences in the social categorisation of child and sexual terms by men and women in a random selection from the general population. It examines the ability of a population of adult males and females to derive the relations child - sexual and adult - playground using a standard MTS equivalence training procedure and the current Yes/No procedure during a testing phase.

Method

Subjects

Thirty subjects comprising 15 males and 15 females participated in the current study. All were acquaintances of the experimenter[2] and aged between 18 and 65 years old. Subjects were informed that they were participating in a word association test that would take approximately 30-60 minutes to complete.

Apparatus

All phases of the experiment were presented to subjects on Tecra A2 laptop with a 15” display. Stimulus presentations were controlled using the software package Microsoft Visual Basic v.6 which also recorded all responses. Stimuli for the current study comprised the words ‘child’, ‘adult’, ‘sexual’ and ‘playground’ and the nonsense syllables ‘cug’ and ‘paf’. These words appeared on the screen in black lettering, over a white background.

Ethics

All subjects were presented with and signed a consent form before proceeding to first phase of the experiment (See Appendix 2). Subjects were told informally that performance on the task would not allow the researcher to make any individual psychological assessments but may allow for group patterns to be identified. Once subjects had completed the study they were informed of the full nature of the research. Subjects were reassured that the researcher could not make any individual assessments on the basis of results and that participation was confidential. Subjects

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[2] Louise Levins, an undergraduate student at the National University of Ireland Maynooth assisted with data collection as part of her final year undergraduate research project.

were also reminded that they could withdraw their data at any time and were offered the opportunity to ask questions or express any concerns.

Procedure

General Experimental Sequence

The experiment comprised an MTS equivalence training phase and a YES/NO testing phase. Specifically, the training phase involved a linear training A-B and B-C relations in separate blocks to criterion in a manner identical to that used in Experiment 1 (see Figure 3, Experiment 1). The stimuli used are presented in Table 3 below. The table shows that in this experiment *child, cug*, and *sexual* were employed as A1, B1, C1 stimuli, respectively, whereas the words *adult*, *paf* and *playground* were employed as A2, B2 and C2 stimuli, respectively.

Table 3: Two-three member equivalence relations used during Experiment 2.

Equivalence Class 1	Equivalence Class 2
(A1) Child	(A2) Adult
(B1) Cug	(B2) Paf
(C1) Sexual	(C2) Playground

There were twenty trials in both A-B and B-C training (i.e., 10 exposures to each trial). A criterion of 19 correct responses out of 20 was required to pass A-B and B-C training, respectively. Subjects were exposed to training until they produced consistent and correct responding. If subjects failed either part of the training stage four times in succession they did not proceed to the latter stages of the training phase or to the testing stage. The training procedure was identical to that employed in Experiment 1.

Testing

If the criterion number (19/20) correct responses was achieved in the training phase subjects were subsequently exposed to the equivalence testing phase. The YES/NO test presented in Experiment 2 is identical to that employed in Phase 3 in Experiment 1. Thus, the relations probed for in the equiv test were A1-C1, C1-A1 A2-C2, and C2-A2, with the important difference being that the words Child, Sexual, Adult and Playground were employed as A1, C1, A2 and C2 stimuli, respectively. Figure 8 shows four possible trial types presented during the YES/NO testing phase of Experiment 2. As with Experiment 1, there were a total of eight trial types each appearing four times with a total of 32 testing trials. No experimental feedback was provided for this phase.

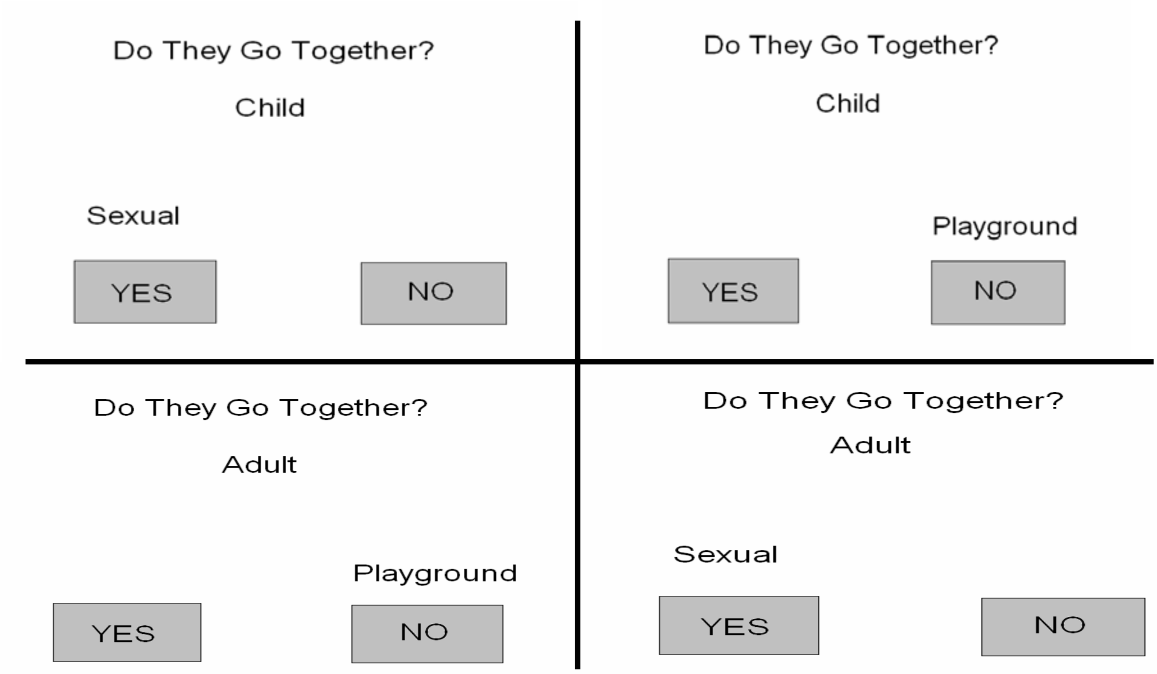


Figure 8: Four trial types presented during equivalence testing in Experiment 2.

Summary

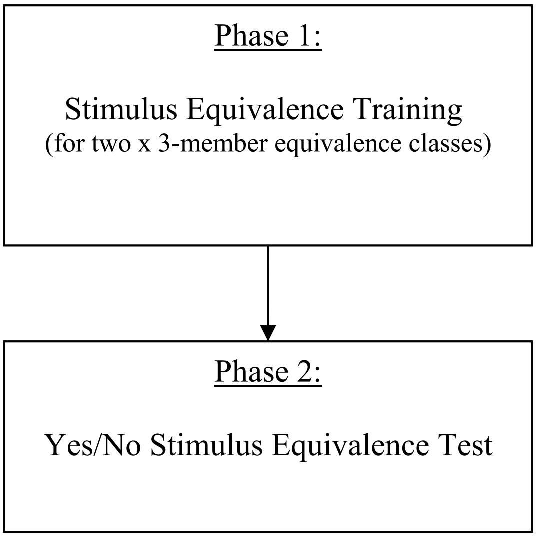


Figure 9: Procedural sequence for Experiment 2

Results and Discussion

The data for Experiment 2 consists of totals correct for all 30 subjects for both the MTS equivalence training and YES/NO testing.

Table 4: Total scores for A-B and B-C MTS equivalence training

Sub	Sex	A-B Train (1)	A-B Train (2)	A-B Train (3)	A-B Train (4)	B-C Train (1)	B-C Train (2)	B-C Train (3)	B-C Train (4)
1	F	20				19			
2	F	20				16	20		
3	F	20				17	20		
4	F	17	20			18	20		
5	F	19				18	20		
6	F	19				18	20		
7	F	19				19			
8	F	20				18	20		
9	F	20				19			
10	F	20				17	20		
11	F	13	18	20		17	19		
12	F	18	20			15	20		
13	F	18	19			16	20		
14	F	19				17	20		
15	F	20				16	19	20	
16	M	12	20			16	20		
17	M	19				18	20		
18	M	19				19			
19	M	18	20			18	18	20	
20	M	17	20			17	20		
21	M	19				19			
22	M	18	17	20		20			
23	M	15	20			18	20		
24	M	20				19			
25	M	20				19			
26	M	19				14	20		
27	M	20				16	20		
28	M	20				19			
29	M	20				19			
30	M	19				18	20		

Table 4 shows all MTS training scores for all 30 subjects in the current experiment. There are no apparent differences between male and female subjects on MTS equivalence training with four female subjects (4, 11, 12, 13) and five male subjects (16, 19, 20, 22, 23) taking more than one training block to reach criteria on

A-B training. For B-C training most subjects passed training on the second block with one male (S19) and one female (S15) requiring a third block

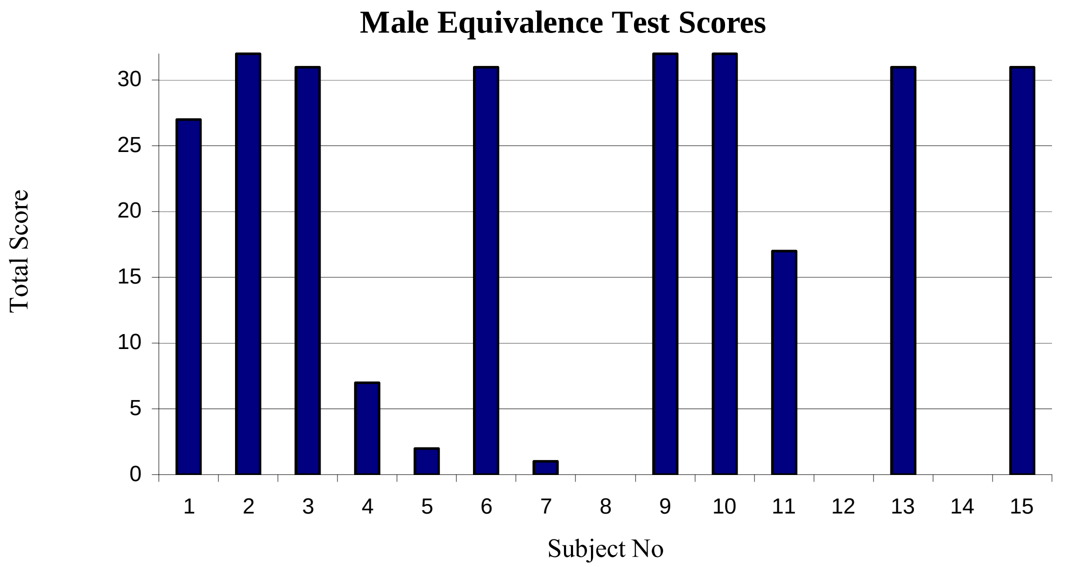
Table 5 shows the pass or fail status for each female and male on their first equivalence test. A 'pass' can be defined as 30, 31, or 32 correct answers out of 32. A 'fail' is any score of 29 or less. An 'extreme fail' can be defined as a total correct score of 0 or 1. As is clear from Table 5, 7 out of 15 (46.7%) males achieved a pass by reaching the response criterion. By contrast, only 2 females of 15 (13.33%) passed their first and only equivalence test. For the subject to have successfully derived the relations, they must be able to match the words 'child' with 'sexual' and 'adult' with 'playground', when asked 'Do these go together?'.

Table 5: Pass or fail status for Females (left) and Males (right) during testing.

Female		Male	
Sub No.	**Pass/Fail**	**Sub No.**	**Pass/Fail**
1	Pass	1	Fail
2	Fail	2	Pass
3	Extreme Fail	3	Pass
4	Pass	4	Fail
5	Extreme Fail	5	Fail
6	Fail	6	Pass
7	Extreme Fail	7	Extreme Fail
8	Extreme Fail	8	Extreme Fail
9	Extreme Fail	9	Pass
10	Fail	10	Pass
11	Extreme Fail	11	Fail
12	Fail	12	Extreme Fail
13	Fail	13	Pass
14	Extreme Fail	14	Extreme Fail
15	Extreme Fail	15	Pass

One important issue that must be highlighted in the data is the number of what will be referred to as 'extreme fails', as defined above. A total of 8 females demonstrated a complete failure to match the words 'child' and 'sexual' as predicted during the training phase. However, 4 more female subjects also approached the criterion for extreme fails (Subjects 2, 6, 12 and 13). Significantly fewer male subjects achieved an extreme fail. Subjects 7, 8, 12 and 14 demonstrated a complete failure to match the terms ‘child’ and ‘sexual’.

Figures 10: Total correct scores for males (upper panel) and females (lower panel) during testing.



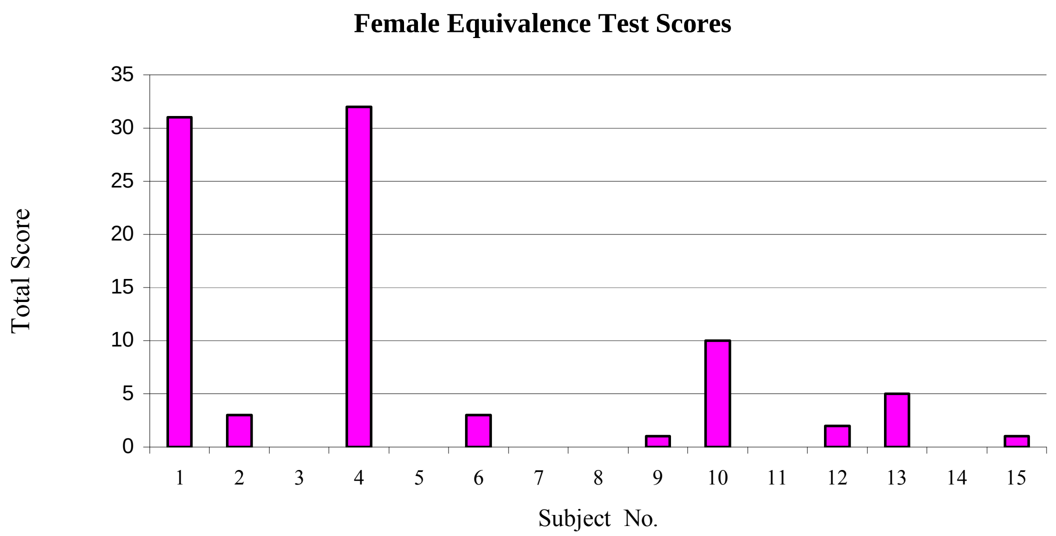


Figure 10 above highlights a large disparity between the scores achieved by males and females during their equivalence tests. Overall, males achieved higher scores on the equivalence test suggesting they were responding in accordance with the equivalence training presented during Phase 1.

The total number correct for each subject shows a tendency for females to fail to respond equivalently and to show strong consistent counter-control by the sample stimuli during testing. Their failure rate is indicative of some form of S- control or counter-control by the samples during the testing phase. In other words, there seems to have been complete equivalence relation reversal for most female subjects in the sample.

In addition, an independent t-test was used to determine if there was a statistically significant difference between the scores achieved by females and males at a group level during the testing phase. An independent t-test showed a statistically significant difference between female ($M= 5.87$, $SD=10.75$) and male ($M=18.27$, $SD=14.59$; $t = -2.649$, $p\leq.01$) scores. The magnitude of this difference was large with Eta squared = .2

The differences in behaviour pattern across the two groups is so stark, it allows a degree of predictability of female and male identity from the pass and fail rates. For instance, of the 12 extreme fails eight were produced by females. This allows for the prediction that there is a 66.6% chance that the gender of any subject producing an extreme fail is female. With regards to the combined extreme fails and fails, 13 of the twenty subjects who failed (i.e., fails and extreme fails combined) were females. Thus, we can predict with confidence that there is a 65% chance that any test fail was produced by a female.

While these predictive abilities are not sufficiently high to justify the use of this test in a clinical or forensic setting, the ability of the test to predict the gender of male subjects is more impressive. Specifically, a total of nine subjects passed the equivalence test, seven of which were males and so it is with 77.8% accuracy that we can predict the performance of male subjects on the test. In effect, this test procedure would yield over 75% accurate predictions of male gender in a blind test. This level of predictability would be considered respectable in any single subject design.

Despite the promising predictability rates of the Watt et al. testing paradigm, patterns of responding on the test are not clear and consistent across all subjects and so many questions remain regarding the source of control during testing. For instance, it could have been that this idiosyncratic selection of female subjects was less fluent in verbal ability or derived relational responding more generally. We cannot be sure of the existence or non-existence of interpersonal differences without extensive pre-testing of subjects for such factors as intelligence quotients. Of course, this is mere supposition that can carry little empirical weight in this context. An alternative explanation may be that of gender differences in demand characteristics (Gibbs, 1982). That is, research has shown sex differences in experiments controlled by female experimenters as in the current study. However, it is far more likely, that the gender differences can be explained in terms of differences in social history, but this question remains open to some extent and could be explored in greater detail with the inclusion of a control group in further studies. Specifically, a further group of male and female participants might be exposed to testing using a novel and neutral set of stimuli on which we might expect to see no differences in performance. The outcome of such a research condition would further inform the conclusions drawn here.

Despite the ever present possibility that significant pre-experimental differences in derived relational responding ability existed between subject groups, it remains the case that the previous experiment reported in this thesis clearly demonstrated an empirically controlled social history explanation of the current effects. Thus, while alternative explanations on sources of control will always be possible in an applied study using real world stimuli, we can be sure that the social history explanation is at least a sufficient one to explain the current findings. It will remain for further researchers to tease out other possible ameliorating or attenuating effects of additional variables on the core process studied here.

The process at work in the observed gender differences likely involves different histories in the social categorisation of the relevant experimental stimuli. However, considerable variance within subject groups was also observed, and this is more difficult to explain. Specifically, the variance observed across male subjects (i.e., four extreme fails, six fails and seven passes) renders an interpretation of sources of stimulus control difficult. That is, some of the fails and extreme fails may represent a natural baseline of failure rates rather than counter control by the samples during testing (i.e., a female type pattern). The presence of four extreme fails makes it likely that at least some of the male subjects were displaying counter control, but which subjects is beyond speculation at this point.

Interestingly, the actual pattern of gender differences between males and females who failed the test phase reflects the pattern seen across all males and females at the macro level. Specifically, of the five females who failed four (Ss 2, 6, 12, 13) produced a total number correct that approached an extreme fail. In contrast, the male subject's who failed the test (Ss 1, 4) approached a pass score. Thus, if the pass and extreme fail criteria were altered only slightly to above 85% and below 15%, respectively, then 9 males of 15 would have achieved a pass score, while 11 females of 15 would have displayed an extreme fail. In effect, by viewing the data this way the predictive power of this test is enormously increased.

It would appear that the raw scores for each subject may reveal a much greater predictive power than the pass and fail rates alone. The experimental groups differ significantly in their score patterns insofar as the majority of males (ten) score above chance levels (i.e., 16) while an even larger proportion of females score below chance levels (i.e., 13). The odds of 13 females all showing a score in that direction by chance is $0.5^{13} = 0.00012$. The same can be said for males, for whom the chance of 11 of 15 subjects scoring above 16 is $0.5^{11} = 0.00049$. So now the predictive power of gender in a blind test shows that, in terms of scores above and below the mean; 13 females of 17 subjects (76%) score below the mean while 11 males of 13 subjects (84.6%) score above the mean. This final figure suggests that we can tell with 84.6% accuracy that a score above 16 was produced by a male. This predictive ability surely approaches the levels of clinical and forensic significance required of a clinical or forensic test.

The stimulus equivalence based paradigm of human verbal behaviour has allowed us to discover an important domain of our verbal culture that may warrant further investigation using different and improved procedures of this kind. More importantly, it has also suggested the possibility of a testing paradigm that is sensitive to some aspect of the differing social histories of males and females.

General Discussion

Experiment 1 in the current chapter used a controlled experimental laboratory preparation to create and test for social histories using a stimulus equivalence based paradigm. This experiment successfully demonstrated that social histories can interfere with equivalence relations. Specifically, subjects in Condition A (contingent history) performed poorly when forming novel verbal relations which were incompatible with the laboratory history. This finding demonstrates that the laboratory history interfered with equivalent responding, thereby providing a process-based analysis of the Watt et al. (1991) effect. Experiment 2 expanded on this by applying the Watt et al. paradigm in an effort to assess the social categorisation of children and sexual terms by men and women in a random selection from the general population. This procedure successfully identified differences in the verbal practices of males and females on an individual level and may also allow for predictability of male and female behaviour during the testing phase. The results of both experiments suggest that analyses of verbal relations can be employed in future as a useful paradigm for developing functionally understood implicit tests.

It is important to understand that the process investigated in Experiment 1 is similar to that examined by previous researchers. Specifically, Pilgrim and Galizio (1990) trained adult subjects on a series of conditional discriminations (i.e., A1-B1, A2-B2, A1-C1, A2-C2) that led to the formation of two three-member equivalence relations. The presence of these relations was examined using an equivalence testing procedure (i.e., A1-B1-C1, A2-B2-C2). Following equivalence testing, subjects were re-trained on a novel series of conditional discriminations using the original stimuli. That is, subjects received further training in which the original A-C relations were reversed (i.e., A1-B1, A2-B2, A1-C2, A2-C1). Subjects were tested for the emergence of these novel relations using the same equivalence testing procedure. The results showed no reversal in equivalence relations. That is, alterations in the symmetry responding of three of four subjects was apparent, but the subjects responded in accordance with the novel set of derived transitive relations (see also Pilgrim, Chambers, & Galizio, 1995; Saunders, Saunders, Kirby, & Spradlin, 1988). In other words, it has already been shown in the literature that it is difficult to reverse emergent equivalence relations by providing training designed to lead to the emergence of incongruous relations.

However, it is worth noting that research by Smeets, Barnes-Holmes, Akpinar and Barnes-Holmes (2003), found that equivalence relations are subject to reversal under specific conditions. Those authors point out that full equivalence reversal has been reported in studies involving class specific reinforcers (e.g., Dube, McIlvane, Mackay, & Stoddard, 1987) but not in others (Pilgrim, Chambers, & Galizio, 1995; Pilgrim & Galizio, 1990; Saunders, Saunders, Kirby, & Spradlin, 1988). These latter studies showed that the reversal of baseline conditional discriminations relations often leads to a reversal of symmetry relations but not symmetric transitivity performances. Either way, it must be noted that Experiment 1 of the current chapter did not involve competition between incongruous conditional discriminations. Rather, it involved competition between functional relations established using a respondent conditioning procedure and laboratory induced equivalence relations. The experiment demonstrated that a history of stimulus associations, other than equivalence relations, is *also* sufficient to interfere with the emergence of equivalence classes and therefore lead to a Watt et al. effect. Thus, it still remains uncertain which types of historical relations are typically interfering with the emergence of laboratory equivalence relations in a typical Watt et al. paradigm (i.e., functional classes based on direct experiences of stimulus associations or derived verbal relations based on interaction with the verbal community, or both).

A further study conducted by Roche, Barnes and Smeets (1997) is also relevant to the current findings. Specifically, in that experiment, sexually arousing film clips were paired with two nonsense syllables, A1 and C2 in a respondent conditioning paradigm. Similarly, nonsexual film clips were paired with A2 and C1. Subjects were then exposed to an MTS procedure to test for the formation of A1-C2 and A2-C1 relations. Following this, subjects were exposed to a series of conditional discriminations training trials designed to lead to the emergence of A1-C1 and A2-C2 transitive relations during testing. In other words, the experimenters established incongruous sexual functions for stimuli that participated in common derived equivalence relations. The researchers found that when subjects were re-exposed to the equivalence test following conditional discrimination training they re-produced the original equivalence relations and failed to produce the predicted emergent equivalence relations. While this study comes close to identifying the process underlying the effect observed here in Experiment 1, one important difference exists between the two studies. Specifically, in the Roche et al. (1997) study, the performance that emerged during the final MTS test was in fact incongruent not only with a history of prior stimulus associations but also with a prior MTS test performance. In other words, subjects had been explicitly required to respond to the functional A1-C2 and A2-C1 relations following the respondent conditioning procedure. It was *this* test performance that the experimenters were attempting to alter using the incongruent conditional discrimination training. In contrast, the current study did not involve a test for the functional A1-C2 and A2-C1 relations following respondent conditioning. Rather, these relations remained untested but nevertheless still interfered with the acquisition of novel equivalence relations. Therefore, the current procedure demonstrates how even relations that have never been discriminated by a subject can form part of a repertoire of behaviour that can interfere with the acquisition of derived relations. This finding extends upon the existing literature in illustrating the power of the Watt et al. paradigm for examining personal and social histories that have never been discriminated by the subject taking the test (i.e., in simple terms they may lie outside conscious awareness).

The findings of Experiment 2 are particularly intriguing in terms of what they may suggest was uncovered by the equivalence testing procedure. Specifically, it appears to suggest that men respond in accordance with equivalence relations which include the terms *children* and *sexual*, while females do not respond equivalently given the same relations. These findings speak to the literature by supporting the general conclusion that males respond differently to inappropriate stimulus relations than females. This provides a major advantage over attitude research in providing an empirical test format to identify these relations without relying on verbal reports of subject. From a behaviour analytic perspective, verbal reports in attitude measurement prove problematic (Guerin, 1992; Lloyd, 1980). In fact, as discussed in the introduction to the current thesis the field of social psychology has provided evidence for the difficulties experienced in trying to equate attitudes and overt behaviour (i.e. *attitude-behaviour congruence problem*; Lloyd, 1980).

Overall, however, the findings of Experiment 2 may be open to multiple interpretations and as such it is dangerous to assume that the differences in response patterns between individuals say anything, in particular, about feelings or intentions towards interacting inappropriately with children. For instance, we have no grounds whatsoever to conclude that these varying response patterns reflect intentions or attitudes, or other hypothetical process. However, the findings clearly suggest a difference in the equivalence responding of males and females concerning the categories "children" and "sex". It may also be reasonably concluded from the data, that females are unlikely to match the word 'child' with the word 'sexual' in an equivalence test context and this strongly suggests a degree of reluctance on their part to do so rather than an inability to form equivalence relations. This resistance in forming the predicted equivalence relations, whilst observed for some males, was not common among males. Thus, it can only be suggested tentatively that the social histories of females make it likely that they will respond to child and sexual terms as not going together in a matching context, although further studies employing baseline testing conditions are required to fully examine this idea.

Overall, the findings of Experiment 2 suggest, the YES/NO test combined with the Watt et al. approach was useful as a preliminary form of behavioural implicit testing. The experiment was designed to re-examine Watt et al.'s (1991) paradigm but to improve upon it with a more easily administered test procedure. The findings of Experiment 2 show that the YES/NO procedure is highly sensitive to social categorisation and may be employed in future developments of the Watt et al. technique.

One issue that arises from the current testing procedure regards its utility on a single subject basis. An interesting finding from Experiment 2 was the evident single subject predictability yielded. Rather than seeing effects at the group level, therefore, we can also conceive of these data as single subjects, whereby effects were replicated across multiple subjects in a group (e.g., 11 of 15 males scored above chance on the equivalence test and 13 of 15 females scored below chance).

The foregoing issue also relates to the issue of what exactly the test measures aside from some differences in social/verbal history? More specifically, it is not known at this time if it is more or less sensitive to relations established across a long period of time or those that were established more recently. Also, we cannot say at this point whether or not the frequency of use of certain verbal relations or categories in the verbal community is a better or worse predictor of sensitivity to the Watt et al. procedure than relations that are established over a longer period of time but which are responded to less frequently. Furthermore, we must ask how malleable are these social relations? Can changes in an individual's social categorisations be reflected in changes in the equivalence test? These are the types of questions that a functional analysis should pose and that are pursued in the experiments that follow.

The stimuli or words used in the current studies may have a bearing on the findings obtained. To illustrate this point, imagine if Experiment 2 employed the word "arousing" in place of "sexual" and the word "school" in place of "playground". In this case, would the observed results be different? Does the effect observed in Experiment 2 depend entirely on the specific word set chosen or does it generalise across semantically related categories?

A further question arises regarding the possible outcome of Experiment 2 conducted using a different population. Would the current procedure be capable of differentiating a normal male from a child sex offender for example? These questions do not preclude the possibility that there are definitive sets of words or social categories that would allow us distinguish different social groups. But, the reliability of the test procedure on all members of these social groups and across similar stimulus sets is unknown. Interestingly, research on other implicit measures suggests that individual stimuli play a key role in the overall test effect (Dasgupta and

Greenwald, 2004; DeHouwer, 2001). Specifically, differences in responses to a set of verbal stimuli in the Implicit Association Test (Greenwald, McGhee, & Schwarz, 1998) are not necessarily obtained across semantically related sets. Research indicates that the emotional valence of words may also be a crucial factor. Of course, these findings were obtained using a very different testing procedure and do not apply directly here. Nevertheless, it is likely that investigation into the effect of word valence and such variables as frequency of use may be worthwhile in future investigations by other researchers.

Another issue requiring consideration relates to the trained and tested verbal relations in Experiment 2. Subjects were required to form the child-sex relations during the equivalence test presented in Experiment 2. That is, responding in a socially inappropriate way was actually predicted given the experimental contingencies. In contrast, Roche et al. (2005) trained a series of conditional discriminations that led to a prediction of emergent socially appropriate relations. Thus, these two preparations differ in an important way. That is, the males in the current Experiment 2 may not have been producing socially inappropriate matches of children and sexual terms due to control by pre-experimental social contingencies. Rather, they may have been simply been behaving under the controlled experimental contingencies as intended. On the other hand, it is the female subjects whose behaviour appears to be controlled by extra-experimental contingencies insofar as so few of them produced the experimentally predicted relations. In effect, the findings of Experiment 2 may tell us more about the social histories of females than it does of males. It remains to be seen what would emerge if a paradigm not unlike that employed by Roche at al. (2005) was employed here.

A final concern with the application of the Watt et al. paradigm in detecting social histories is subjects may be aware of the test and have understanding of what the test measures. In particular, students of behaviour analysis are aware of stimulus equivalence as are the readers of the current thesis. Specifically, in the current chapter the experimental tests employed were implicit in their purpose but allow for an explicit understanding by those who know behaviour analysis or those who have previously completed a stimulus equivalence based test. Understanding the purpose of a test may allow for faking of responses. Perhaps what is needed, therefore, is a test that is more implicit in what it appears to be measuring.

While the current procedures were useful in measuring social histories and provides a promising avenue of research, the reality of the cumbersome nature of the procedure is still evident. The current procedure does not lend itself to the notion of a practical easily administered measure for use on large populations. The problem of the cumbersome procedure experienced in equivalence training and testing was not overcome by YES/NO testing. In fact, in equivalence procedures in general, the training phase typically requires more time than the testing phase and is in need of modification if the test is to be streamlined for use on large populations. More specifically, here as in most studies on equivalence, the training is administered to criterion. In the current experiments this took between 10 and 30 minutes to complete. Thus, what is required is a solution to the laborious training procedure as well as the laborious testing procedure. Exploring the possibility of such a modification is the subject of the next chapter.

Chapter 3

Extending the stimulus equivalence-based testing procedure for measuring personal and social history using nonverbal stimulus pairs

The previous chapter outlined and provided evidence for the utility of the YES/NO test combined with the Watt et al. approach to identifying a social and personal history of stimulus associations. However, the cumbersome nature of that procedure needs to be addressed. One possible solution to this problem is to exploit the findings of Experiment 1 of Chapter 2 in developing a training procedure that is consistent with the identified process underlying the *Watt et al. effect.* Specifically, it has now been established that personal histories of stimulus associations *do compete and interfere* with the equivalence test procedure. Thus, it has been shown in the current thesis that differences in a personal history of stimulus association are sufficient for the generation of a Watt et al. effect.

The Yes/No procedure employed in the previous two experiments allowed for the identification of both a laboratory controlled and socially-established histories of stimulus associations. However, while the procedure was not deleterious to finding the expected Watt et al. effect, it has no obvious advantages over a traditional matching-to-sample test procedure in terms of significantly reduced testing time or dramatically enhancing testing effects. This is largely because the lengthy training procedure, rather then the testing procedure, contributes most to the overall time taken to administer the test. What is needed in order to make the test easier to administer in a very short time frame (e.g., five minutes) is to address the issue of the laborious training procedure.

One obvious way in which to reduce the time demand of the test procedure is to substitute a rule or instruction in place of the extended social history provided outside the laboratory. For instance, imagine that in the Watt et al. experiment subjects had been *instructed* to match Catholic names with Protestant symbols. Therefore, instead of receiving an equivalence training procedure designed to establish socially incongruous stimulus relations, subjects simply receive an on-screen instruction before the testing phase that tells them to "put Catholic names with Protestant symbols" (e.g. Sean Quinn with Lambeg Drum). Then, during the test phase, subjects need only follow the rule. During a further stage of the experiment, the rule would be altered so that subjects were required to follow the rule "put Catholic names with Catholic symbols". Precisely the same testing tasks would be presented as before. However, under these later instructions the performance will likely be improved such that subjects produce more correct responses. The difference in the rate of correct responses under the two sets of instructions should serve to identify which set of instructions is most congruous with the individual's personal and social history.

The foregoing idea can be easily examined using an experimental preparation. Imagine that, using a respondent conditioning preparation, you are presented with arbitrary blue shapes in the presence of sexual images and arbitrary red shapes in the presence of horrible images across a number of conditioning trials.   Now imagine you receive instructions during a subsequent testing phase telling you to *"put sexual images with blue shapes and horrible images with red shapes*". A series of trials is then presented in which pairs of stimuli appear in the centre of a computer screen. These pairs consist of all combinations of colours and image types. It is further explained to you that you should look at the word pairs and confirm whether or not they conform to the rule (e.g., a sexual image and a blue shape appear so this pairing does confirm to the rule), by clicking on the Yes or No buttons presented at the bottom of the screen.

Once you complete the required number of trials you are presented with further instructions, this time telling you to "*put sexual images with red shapes and horrible images with blue shapes*". Once again, all combinations of colours and images are presented in pairs across trials. Performance under this latter set of instructions should involve less accurate responding (i.e., more errors) than performance under the former rule, insofar, as the latter rule is incongruent with the laboratory-conditioned history of stimulus associations. Examining the utility of such a procedure forms the focus of the current chapter.

One limitation of the foregoing procedure is that it may in fact yield near 100% accurate responding under both rule conditions, despite the greater difficulty of responding under one set of rules over the other. One reason for this is that the Yes/No procedure typically employed in behavioural research and as employed in the current research does not involve any time limits on responding. Therefore, differences in fluency across trials of different kinds may not be easily recorded. In effect, the use of an unlimited response window in each trial would mask any difference in fluency across the two test phases (i.e., congruent and incongruent rules). The second reason for the potential emergence of a ceiling effect in response accuracy is that the tasks as described above do not require derived relational responding. Rather, these tasks simply involve responding to directly trained stimulus associations. Indeed, recent research in the context of other similar tests for personal history (e.g., The Implicit Association Test; IAT) has suggested that the simplicity of tasks is directly proportionate to response accuracy under different rule conditions such as those suggested above (see Rothermund & Wentura, 2004).

One possible solution to the problem of ceiling effects in subjects' performances using the procedure suggested above is to create a response window that limits response time on each trial. This should serve as an additional contingency to select between response patterns of differing fluency across the phases of the current hypothetical test procedure. In other words, when time constraints are added as a test contingency, responses that are only observed following a long response latency (i.e., are not fluent) will fail to be emitted within the constrained response window. Therefore, more errors might be expected when response times are constrained than when they are unlimited.

An obvious place to look for a suitable response window duration for the current study is other tests. Perhaps the closest comparison to the current suggested procedure is the Implicit Association Test (IAT, Greenwald, McGhee, & Schwartz, 1998; see Chapter 6 for a full description). The IAT employs a response window of 3000 ms and may therefore prove a useful place to start for the current test procedure. However, Greeenwald et al. typically enforce this response window post hoc. Essentially, the IAT involves instructing subjects to respond as quickly as possible on each trial, however, there is no time limit actually imposed on trials and all response times are recorded, regardless of duration. This strategy allows the researcher to consider their data spread statistically post-hoc and to consider outliers differently from study to study, depending on the aims of the research. Typically, IAT researchers recode all response times above 3000 ms to 3000 ms and all response times below 300 ms to 300 ms. However, allowing response times of up to 10000 ms may be also be permissible (see Devos & Banaji, 2005; Greenwald et al., 2003). The current experiment will use the response window as an actual testing contingency so as to assess its effect on all of the subjects' behaviour across time. Essentially, the inclusion of a limited response window will control subjects' responding on a trial to trial basis and not merely function as a post hoc statistical procedure.

Using the test procedure described above, the current experiment will assess a novel and efficient procedure to identify social and personal history in a laboratory controlled experiment.

Method

Participants

Ten subjects (5 males and 5 females), all acquaintances of the experimenter, aged from18 to 65 years participated in the current study. Subjects were informed that they would be participating in a two-phase picture-association test that would take approximately 15 minutes to complete.

Apparatus and Stimuli

All phases of the study were administered on an *iQon technologies* laptop computer with a 15" inch LCD monitor. Stimulus presentations were controlled using the software package Visual Basic 6 ® which also recorded all responses. For Phase 1 (colour-picture association training task) four photographic images taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999) and eight coloured shapes (four blue and four red) were employed (see Figure 1). The photographs used as sexual images were classified in the IAPS under the headings; "Romance" and "Erotic couple". The photographs used as horrible images were classified under the headings; "garbage" and "cigarettes". The images used corresponded to the slide numbers; 4660, 4677, 9290, 4830 (See Appendix 4).

For the testing phase (Phase 2) eight coloured shapes (four red and four blue) and eight photographic images taken from the IAPS were employed. The photographs used as sexual images were classified in the IAPS under the headings; "Romance" and "Erotic couple". The photographs used as horrible images were classified under the headings; "distressed fem", "garbage" and "toilet". The images used corresponded to the slide numbers; 4599, 4606, 4641, 4689, 6311, 9301, 9330, 9373 (See Appendix 5).

Ethics

All subjects were presented with and signed a consent form before proceeding to first phase of the experiment (See Appendix 3). Subjects were told informally that performance on the task would not allow the researcher to make any individual psychological assessments but may allow for group patterns to be identified. After participation, subjects were informed as to the true nature of the study and offered the opportunity to express any concerns or questions they may have. In addition, subjects were reminded that their participation was confidential and that they were free to remove their data at anytime.

Procedure

General experimental sequence

The current experiment consisted of two phases and took approximately 20 minutes to complete. Each phase was completed one at a time in a set sequence and subjects were instructed to continue through both phases until instructed to contact the experimenter at the end of the experiment. Subjects sat comfortably at a standard computer desk and viewed the computer screen at a distance of approximately 70 cm and at eyelevel. Phase 1 consisted of a colour-picture association training task and lasted approx 10 minutes. Phase 2 consisted of a rule-based equivalence test, which in turn consisted of two blocks; a congruent and an incongruent block. The congruent block involved responding under rule conditions that were congruent with the contingencies in Phase 1 (i.e., required subjects to respond to congruent stimuli as going together), while the incongruent block involved responding under rule conditions that were incongruent with the contingencies in Phase 1 (i.e., required subjects to respond to incongruent stimuli as going together).

Phase 1

In Phase 1 subjects were exposed to a colour-picture association-training procedure using a respondent conditioning preparation. That is, coloured shapes, blue and red, were paired with sexual and horrible photographic images, respectively. The shapes (cross, circle, blob and square; see Figure 1) paired with the sexual images were blue in colour, while those (cross, circle, blob and square) paired with the horrible images were red in colour. For four of the subjects these colour associations were reversed (i.e., the coloured shape paired with the sexual images was red in colour, the coloured shape paired with the horrible images was blue in colour), but for the purpose of clarity I will herein refer only to the original colour association configuration.

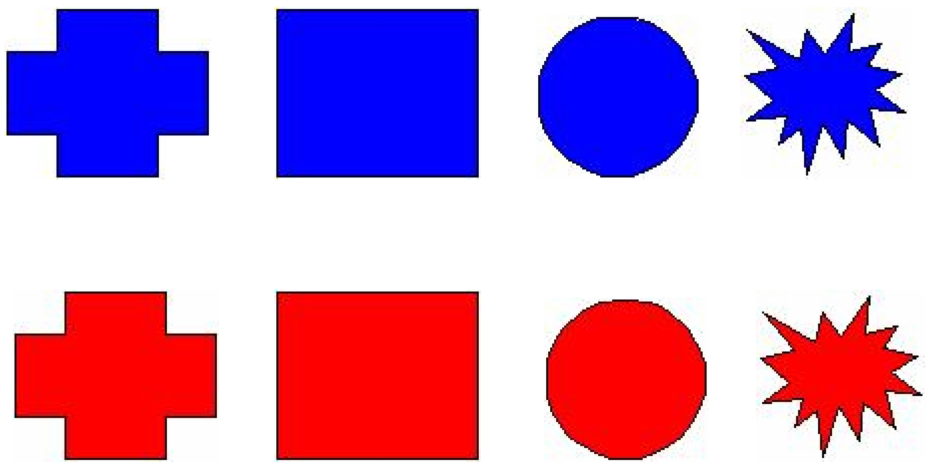


Figure 1: The coloured shapes presented in Phase 1.

Subjects were presented with the following instructions on screen after being seated in front of the computer:

> Hello and thank you for agreeing to participate in this research. In a moment some shapes and images will appear on this screen. Your task is to look at these items carefully and to remember what you see.
> IT IS VERY IMPORTANT THAT YOU CONTINUE TO WATCH THE SCREEN AT ALL TIMES
> Before each picture is presented you will be required to press the space bar on the computer keyboard to continue. Please make sure you know where the space bar is before you begin.
> If you have any questions please ask them now.
> When you are ready please click Begin.

All conditioning trials were presented on the computer screen against a white background. A trial began with the presentation of one of the four coloured shapes appearing in the top centre of the screen for a period of 1 s. After the 1 s, the relevant picture appeared in the centre of the screen for 4 s directly below the coloured shape. At the beginning of each trial the phrase; *Please press the space bar when you are ready to continue* appeared in the centre of the screen in 36 point font and remained until the subject pressed the space bar. The space bar press functioned as an observation response that both assured attention and initiated the subsequent trial.

There were 8 conditioning trials for each of the sexual and horrible images and therefore there were 16 conditioning trials in total. Each sexual image appeared once with each of the blue cross, blue circle, blue blob and blue square and each horrible image appeared once with each of the red cross, red circle, red blob and red square. Trials were separated by a random inter-trial interval of 10-20 seconds.

Phase 2

On completion of the colour-picture association-training phase, subjects were exposed to Phase 2, which consisted of a novel Yes/No equivalence testing procedure. For Phase 2 novel coloured shapes comprising a flag, an octagon, a star and a triangle each appearing in red and in blue were used (See Figure 2). Novel sexual and horrible images were also employed.

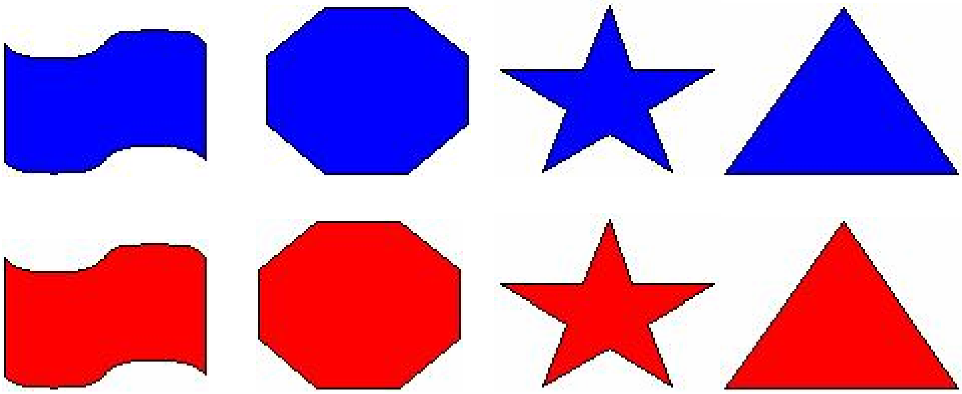


Figure 2: Coloured shapes presented in Phase 2

The test consisted of both a congruent and incongruent test block, presented in a quasi-random order across subjects. Subjects were first presented with instructions corresponding to either the congruent or incongruent block. For the congruent block subjects were told to put sexual images with blue shapes. This was congruent with the colour-picture association-training phase. For the incongruent block subjects were told to put sexual images with red shapes, which was incongruent with the colour-picture association-training phase.

For the congruent block subjects were presented with the following instructions:

> You may now take a short break. In a moment some images and shapes will appear on this screen. Your task is to decide if the image and the shape go together. It is important that you try to make as many correct choices as possible. Please put SEXUAL IMAGES with BLUE SHAPES and put HORRIBLE IMAGES with RED SHAPES. Press continue when you are ready to proceed.

For the incongruent block the following instructions were presented.

> Please put SEXUAL IMAGES with RED SHAPES and put HORRIBLE IMAGES with BLUE SHAPES.

Each trial type involved the presentation of the question "*Do They Go Together?*" in 36 point font at the top of the screen. A sexual or horrible image appeared directly under the question and a coloured shape under the image. Finally, the response buttons YES and NO appeared on the left and right at the bottom of the screen (See Figure 3). Subjects were required to respond by clicking on either the YES or NO button using the cursor and mouse. The duration of each trial was determined by the subject's response but was a maximum of 3000 ms in accordance with the predetermined response window. If a subject failed to respond within 3000 ms an incorrect response was recorded for that trial.

Figure 3: Example of an incongruent task during Phase 2

Subjects were exposed to a total of 128 trials presented in two blocks (i.e., 64 trials in each of the congruent and incongruent blocks). The order in which these blocks were presented was randomised across subjects. Each of the blocks consisted of four task-types which involved the presentations of one of the following; a sexual image with a red shape, a horrible image with a red shape, a sexual image with a blue shape, and a horrible image with a blue shape. For each of the four stimulus pairs there were 16 possible specific stimulus combinations (i.e., 4 sexual images appearing with each of 4 coloured shapes). Each of these combinations was presented once across the block of 64 trials (i.e., 16 x 4 = 64). The trial order was randomised and each trial appeared once in a block.

Subjects' responses were recorded in terms of both accuracy and latency. Trials in the current study were limited to 3000 ms duration. This was proposed to circumvent the problem of devising and negotiating arbitrary statistical procedures designed to extract a hypothetical process from the data set (see Greenwald, McGhee, & Schwartz, 1998). In effect, subjects were prevented from responding outside the 3000 ms time frame by the cessation of the trial and the presentation of the subsequent trial. A failure to respond within the 3000 ms response window was recorded as an incorrect response and the response latency was recorded as 3000 ms. Response times were recorded from the trial onset to the first emitted response on the computer keyboard, regardless of whether or not the response was correct.

Summary

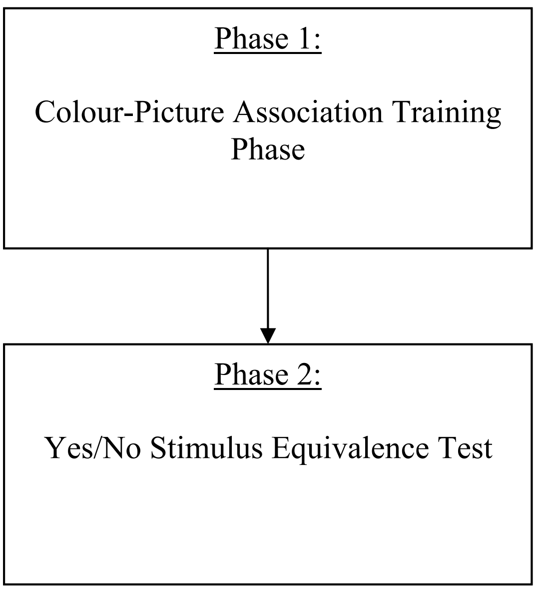


Figure 4: Procedural sequence for Experiment 3

Results

In Phase 2, all 10 subjects completed the required 128-trial equivalence test (64 congruent tasks and 64 incongruent tasks). Subjects' total numbers of correct responses were recorded for both congruent and incongruent blocks and are presented below in Figure 5.

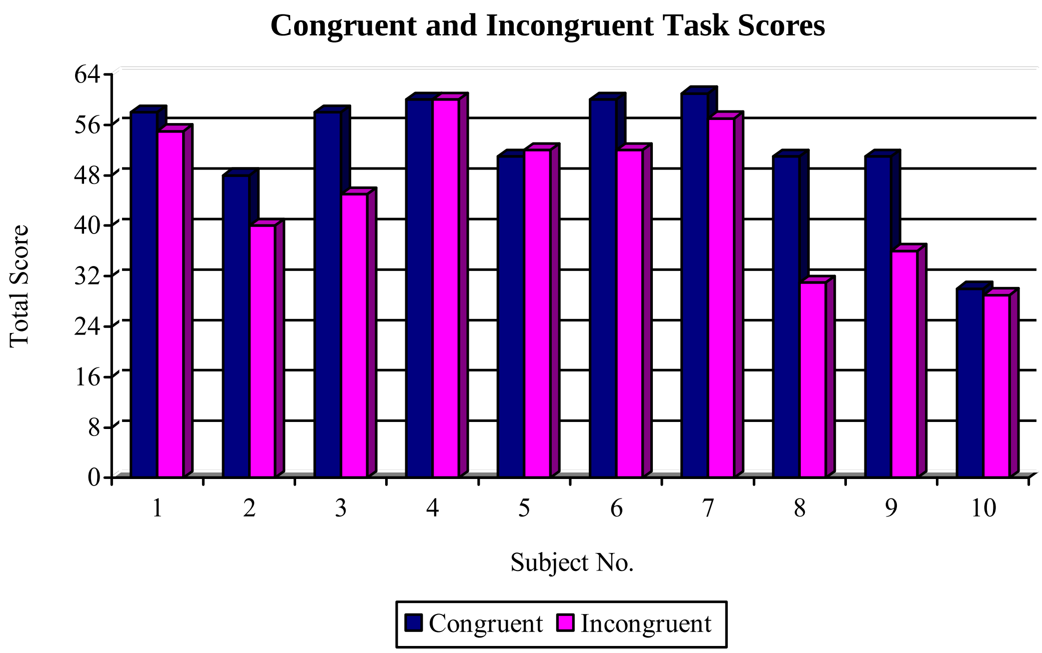


Figure 5: Total No. of correct responses for congruent and incongruent task types for each subject in Phase 2.

As is evident from Figure 5, subjects showed greater accuracy on the congruent task block (M= 53.4) than on the incongruent task block (M = 45.7), with the only exception being Subject 5. In addition, eight subjects responded above chance level (32 correct) on both task blocks with the exceptions being Subject 8 (Incongruent = 31) and Subject 10 (Congruent = 30, Incongruent = 29). A paired samples t-test was conducted to compare the test scores across the congruent and incongruent task blocks. There was a significant difference in scores for congruent

(M=53.4, SD=9.36) and incongruent [M=45.7, SD=11.16; t=3.747, df=9, p<.01] task blocks. The magnitude of the differences in the means was very large (Eta squared=.6) in accordance with Cohen (1988).

To examine the patterns of responding more closely responses were blocked into successive groups of 8 consisting in turn of 4 responses to each of the congruent and incongruent tasks (see Figure 6). For instance, the first data point on the x-axis in Figure 6 represents the mean number of correct responses for all subjects within the first four congruent and first four incongruent trials (i.e., total out of 8). The next data point represents the mean number of correct responses for all subjects within the second block of four congruent and four incongruent trials, and so on.

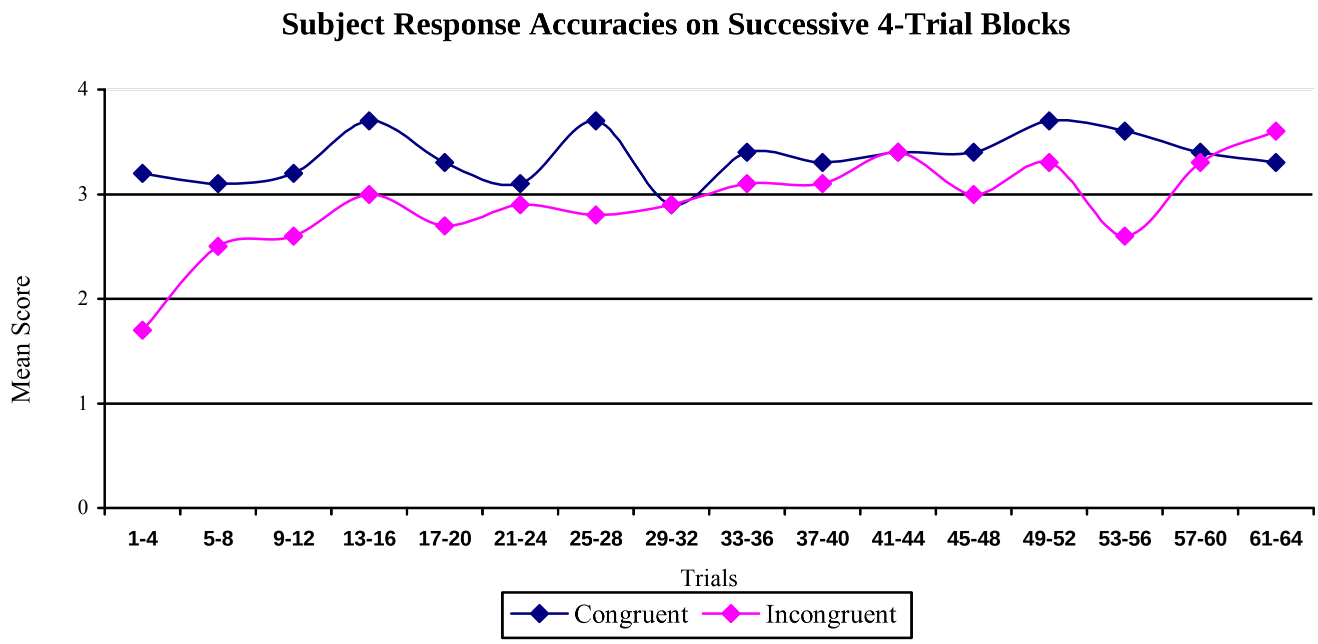


Figure 6: Mean number of correct responses per block of four successive testing trials for congruent and incongruent tasks across all 10 subjects.

While the pattern of responding was similar for both groups it appears from the graph that the largest difference in responding occurred within the first 20 trials. Thus, it would appear that the effect of history on the derivation of stimulus equivalence is most apparent during early phases of the test.

A further paired-samples t-test was conducted to compare the number of correct responses on the first twenty trials across the congruent and incongruent task blocks. There was a significant difference in scores on the congruent (M=3.32, SD=1.17) and incongruent task blocks [M=2.5, SD=1.41; t=-3.36, df= 49, p≤0.01]. The magnitude of the differences in the means was large (Eta squared = .299).

There was no evident difference between subjects' reaction times on congruent and incongruent task blocks (see Figure 7). That is, mean reaction times were calculated for each subject for the congruent and incongruent task blocks in Phase 2. A paired samples t-test was conducted to compare mean reaction time differences in these tasks across all subjects. There was no significant difference in scores for congruent (M=1.77, SD=.222) and incongruent [M=1.77, SD=.252; t=-0.061, df = 9, p=.953] task blocks.

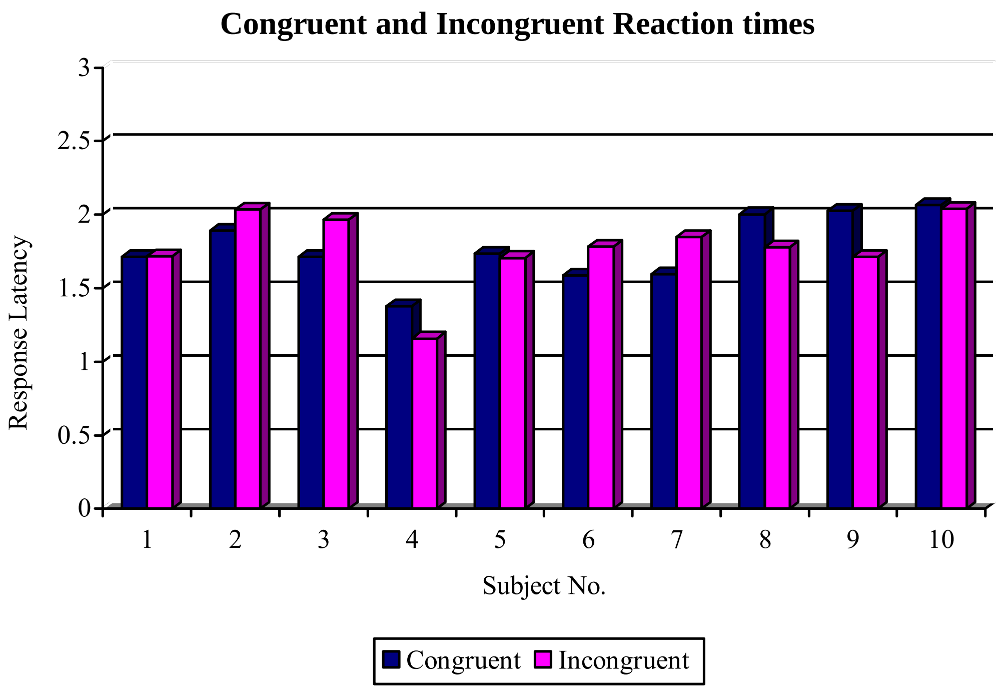


Figure 7: Reaction Times for congruent and incongruent task blocks in Phase 2

Overall the pattern of scoring on the equivalence test was in the predicted direction. That is, subjects performed with greater accuracy when the rule was congruent with their experimental history established in Phase 1. Importantly, this difference was observed in the absence of equivalence training as employed in the traditional Watt et al. paradigm. Thus, the rule based instruction technique employed here was sufficient in detecting differences in response patterns across task types and, therefore, at identifying the personal histories of subjects.

Discussion

In the current experiment subjects performed with greater accuracy when the testing rule was congruent with the experimental conditioning history established in Phase 1. That is, subjects responded with greater accuracy on the congruent task block than on the incongruent task block. There were no apparent reaction time differences between congruent and incongruent task blocks across all ten subjects.

The current experiment employed a respondent conditioning preparation to create an experimental history. The conditioning history did not involve verbal relations in that no relations were derived in the current study. Instead, all stimulus relations in Phase 1 were explicitly conditioned. However, stimulus non-arbitrary generalisation was demonstrated in the test phase insofar as novel pictures and shapes were employed as stimuli. The only explanation for the observation of an interference effect on equivalence class formation using novel stimuli, therefore, is that the novel stimuli participated in functional classes with those used during training. While it is easy to see how the shapes employed may well have formed a functional class due to their physical similarities, it may not be so obvious that this is the case for the sexual images. More specifically, while some topographical features are shared across the sexual images (e.g., the appearance of human bodies, skin colour tones, etc) it may also be the case that the images form part of a pre-experimentally established verbal class. That is, the large variance in the topographies of the sexual images employed across Phases 1 and 2 suggest that these stimuli may in fact represent an equivalence relation controlled by the term “sexual”. Indeed, given the ubiquity of human verbal behaviour it is likely that humans respond to all nonverbal relations verbally at least some of the time (see Hayes, Gifford, Townsend, & Barnes-Holmes, 2001).

In the real world, association history may take many forms, such as fortuitous pairings of emotional stimuli, words in texts, images and words in the media, and so on. Any of these association modalities should also be sufficient to produce the effects observed in the current study. While this idea is impossible to prove without further experimentation, it is worth considering that the current procedure may in fact have involved the demonstration of interference in equivalence class formation by both functional (i.e., coloured shapes) and equivalence relations (i.e., verbal class of sexual stimuli). Likely both processes play a role and indeed both processes may interact in a way that makes separating them a false dichotomy. As a practical example, consider an individual who derives an equivalence relation consisting of the spoken word "stop", a stop-sign, and a gesture from a crossing guard to stop. Later, she may learn that when her teacher says "stop", it is time to stop and wait for oncoming traffic. Subsequently, the stop-sign and the crossing-guard's gesture may occasion similar behaviour on the part of the individual. This transformation of functions is based on the behavioural function of "stop" and the derived equivalence relation between the spoken word and the gesture or the sign (Dymond & Rehfeldt, 2000). Thus it would be almost impossible to try to separate these two processes in an ecologically valid analysis, but it is possible to separate them in a laboratory analysis to see if either or both are sufficient to produce a Watt et al. type effect. Indeed, both of these options will be explored in the current thesis. Regardless of which process is dominant it remains the case that we now have a better understanding of what processes were involved in the Watt et al. experiment. The current procedure demonstrates a basic process that can be employed in a novel test format to examine social and personal histories. Thus, while further experiments pursuing these issues will be outlined in later chapters, the purpose of the current experiment was to explore the merits of a procedure that can substitute for equivalence training.

The key issue in the current chapter is that an easily and rapidly administered test that does not require a lengthy training procedure has been developed. Liberties may appear to be taken with the training phase of the current test. That is, it is not fully understood how the experimental rules (e.g., *Put blue shapes with sexual images*) function in the same way as a social history. Thus, the author remains mindful that the reliability of this procedure must be continually revisited in future studies and compared to the Watt et al. and similar procedure used with real world stimuli. Indeed, this is the very purpose of the detailed analyses of various testing procedures that will be employed in the forthcoming chapters.

An important note to make is that, in the context of the current experiment, the stimuli presented were arbitrary novel images and coloured shapes. When the stimuli involve a controlled laboratory history and are arbitrary (as in the current experiment) the problem of socially desirability bias does not arise. However, this procedure when applied to real-world stimuli may not be capable of overcoming social desirability biases. That is, if the stimuli employed in an experiment have a previous social history subjects may respond socially and social responding may often result in a social desirability bias (Keillor, Owens, & Pettijohn, 2001). One possible control in place in the current procedure is that of the time constraint. The 3000 ms response window in the current procedure should limit the ability of a subject to consciously produce socially desired responses. Experimentally controlled responding (3000 ms response window) should allow subtle differences in history to emerge in the context of future research.

Take, for instance, a similar study with socially relevant stimuli. The presence of a conditioning history would neither be necessary nor employed as the stimuli would be appropriate to an individual's real-life social history. As such an application of the current procedure may begin with the subjects being presented with a rule saying "Put Catholic Names with Protestant Symbols". Using this rule, subjects may respond in a socially desirable way in an attempt to conform to their expectations of the experiment (e.g., put Catholic Names with Protestant Symbols, despite an extended history of not doing so outside the laboratory). Of course, if subjects are instructed to put Catholic with Protestant they become aware of the controlling contingencies (i.e. what they are responding to) and so may be able to control responding on a trial-to-trial basis. However, the inclusion of a brief response window and the use of multiple trial types, each repeated numerous times, allows for the measurement of a more naturalistic response pattern that becomes clear and stable across time. In other words, we might expect that a subject would have great difficulty controlling a response pattern given the multiple task types presented for a brief period under varying rule conditions. The emergence of such a complex and reliable pattern of behaviour as a mere form of counter-control, by demand features of the experiment, would be highly unlikely given a concerted effort to produce such a pattern through a laboratory history of reinforcement. In effect, the response patterns that are observed using the current procedure might be referred to as implicit, insofar as they are difficult for the subject to contrive.

The exact definition of *implicit* has recently come under scrutiny (DeHouwer, 2006). Researchers have suggested that contrary to explicit measures, implicit measures are those in which subjects; (1) are not aware of the attitude being measured (e.g., Brunel, Tietje, & Greenwald, 2004); (2) do not have conscious access to the attitude being measured (e.g., Asendorpf, Banse, & Mucke, 2002), or; (3) have no control over the measurement outcome (e.g., Fazio & Olson, 2003). This latter definition of *implicit* perhaps comes closest to describing the type of implicitness achieved in the current procedure. This issue of implicit testing will be revisited in forthcoming chapters.

No effect was observed for response times using the current procedure. However, it should not be seen as in any way a challenge to the utility of the current procedure that reaction times differences have not been observed. Indeed, reaction times have not traditionally held a particularly high status in behavioural psychology. Even if response time differentials can be generated using our equivalence-based model, it remains the case that behavioural measures do not typically emphasize response latencies (see Bentall, Dickins, & Fox, 1993; Spencer & Chase, 1996; Steele & Hayes, 1991; Wulfert & Hayes, 1988). This is because response latency is subject to a wide range of interpretations. In particular, Behavior analysts are cautious of reaction times measures as they can be used mistakenly as an explanatory mechanism or as evidence of mediating cognitive processes (e.g., attitudes; see Johnston & Pennypacker, 1993; see also O'Hora, Roche, Barnes-Holmes, & Smeets , 2002; Roche, Linehan, Ward, Dymond & Rehfeldt, 2004). In line with behavioural tradition, the current study emphasized accuracy over response time as a measure of the acquisition of the operant tasks presented in the current test procedure.

In sum, the current procedure explored the possibility of assessing differences in verbal behaviour when using a novel rule-based relational test. The test measure was capable of identifying subjects' laboratory histories on the basis of response accuracy differentials across the test blocks. This greatly modified and extended Watt et al. procedure does not require equivalence training but nevertheless taps into a subject's social and personal history. To further examine this novel test procedure a logical next step is to apply the procedure in a real world setting to examine socially sensitive stimulus relations.

Chapter 4

Real-world extensions and applications of the stimulus equivalence testing procedure

The main aim of the previous chapter was to develop a novel test for assessing histories of verbal and social interaction. The test measure was found to be capable of identifying subjects' laboratory histories on the basis of response accuracy differentials across the test blocks. This greatly modified and extended Watt et al. procedure does not require a laborious equivalence training phase but nevertheless allows the experimenter to tap into a subject's social and personal history. The current chapter aims to apply this modified procedure in a real world setting to examine and identify the use of socially sensitive verbal relations on a series of different populations.

One area of social sensitivity that would appear to represent a suitable testing ground for the newly developed procedure is the area of sexual orientation. For instance, we might expect to observe cultural differences in verbal behaviour regarding homosexuality, and these differences should be measurable using the test procedure developed here. Current literature suggests that attitudes towards homosexuals have been changing rapidly in the United States of America (Hicks & Lee, 2006; Newport, 2001). Research conducted by Hicks and Lee (2006) indicated that in the USA attitudinal trends, tracing changes in opinion polls on homosexuals between 1977 and 2003, showed that public opinion of this minority group has become more positive over time. Similarly, the most recent opinion poll (Newport, 2001) carried out by the Gallup organisation regarding North American attitudes towards homosexuality suggests that 52% of North Americans believe that homosexuality should be considered an alternative lifestyle compared with 34% in

1977. If this can be relied upon, then these changes should be reflected in changes in social discourse and social categorisation regarding homosexuality, at least in the USA.

To date in Ireland, very little research has explored attitudes towards homosexuality. However, there exists an obvious time lag in changes in the treatment of Irish homosexuals by the state compared to the USA. For instance, decriminalisation of homosexuality began in the USA in 1961 compared with 1993 in Ireland. Thus, we might expect to observe differences in social categorisation of homosexuals by members of the wider community across these two jurisdictions. The current experiment will apply a modified version of the test procedure developed in the previous chapter to examine differences in social categorisation of homosexual and heterosexual stimuli by a group of Irish and North American homosexual males.

For the sake of experimental control it would be ideal to keep the test format identical to Experiment 3. However, the current research has specific goals involving the development of a powerful and easy to administer test for social/personal history. Thus, it is necessary to continue to develop the current test format even as we progress with its application. In this vein, a modest alteration will be made to the test that may not have significant functional consequences but may provide a more streamlined and simpler presentation format for the subject. Specifically, in place of the *yes/no* words presented on screen, subjects could be required to simply press coloured keys on a keyboard. The keys would have a fixed location, so that the tasks on the test simply require subjects to press different coloured keys (e.g., red and blue), or, in effect, to press left or right keys, depending on the location of the colours on the keyboard. However, for the sake of experimental control it may be important to continue to randomise the position of these response buttons by placing them on the computer screen rather than on the keyboard. This will allow the experiment to move the response keys in a quasi-random fashion through test blocks, thereby precluding the possibility of positional or stereotypic responding. Furthermore, such a move retains the functional similarity of the test format employed in the previous chapter. This is important in allowing us to make judgements about the relative utility of the test measure as it evolves.

A similar test method to that employed in Chapter 3 was applied here to assess a social history of categorising homosexual and heterosexual stimuli. The test once again compares responses to word-pairs under two rule conditions. The pairs consist of homosexual or heterosexual stimuli presented with positive and negative verbal stimuli. The rules instruct subjects to *"put gay words with positive words, and straight words with negative words"* during the congruent task block and to "*put gay words with negative words, and straight words with positive words"*, during the incongruent task block. The test works by comparing subject's accuracy in responding across the test blocks. Higher response accuracy on one block over the other will indicate that the relevant block is congruent with the subject's social/verbal history. Essentially, the testing procedure is identical to that employed in Experiment 3, with the single modification that Blue and Red response buttons are presented onscreen in place of the Yes and NO buttons.

Method

Subjects

Fifteen self-reported homosexual Irish males between the ages of 18 and 30 and ten self-reported North American homosexual males between the ages of 18 and 30 participated in the study. Subjects were approached by an assistant to the study who also collected the data[3]. Subjects were either known homosexual friends of the assistant or volunteered for the study as a result of requests by former subjects. Volunteers were simply asked directly to confirm their sexual orientation and all agreed that they were exclusively homosexual. The Irish subjects were resident in the greater Dublin area. The North American subjects consisted of individuals from two demographic areas within the US (Washington, DC and Memphis, TN areas). Subjects were informed that they would be participating in a three-phase word-association test, which would take approximately ten to fifteen minutes to complete.

Apparatus and Stimuli

All phases of the experiment were presented to subjects on a Dell Inspiron Laptop computer with 17-inch display. Stimulus presentations were controlled using the software package Microsoft Visual Basic v.6.0 which also recorded all response accuracies and latencies. Sixteen verbal stimuli in total were employed, all comprising words in the English language. Four stimuli were chosen as members of each of the following verbal categories; gay, straight, good and bad (see Table 1). These stimuli were identified during a "brainstorming" session between the experimenter and her research supervisor. Word frequency counts, number of letters, number of syllables,

[3] Jason Dowling, an undergraduate student at the National University of Ireland Maynooth assisted with data collection.

or other features of the stimuli were not considered. The only criterion for the inclusion of any word in one of the verbal categories was that it should represent a recognisable instance of that category to most verbally able adults. This idea was checked during the word categorisation phases of the test (see below).

Table 1: Experimental stimuli employed

Straight	**Gay**	**Good**	**Bad**
Heterosexual	Homosexual	Joy	Agony
Hetero	Homo	Peace	Hurt
Straight	Gay	Wonderful	Awful
Womaniser	Queer	Happy	Nasty

Ethics

All subjects were presented with and signed an electronic consent form before proceeding to first phase of the experiment (See Appendix 6). Subjects were informed casually that performance on the task would not allow the researcher to make any psychological assessment of individual subjects but may allow for group patterns to be identified. After participation subjects were fully debriefed as to the true nature of the study and were offered the opportunity to express any concerns or ask any questions they may have. Subjects were reminded that participation was confidential and that they were free to remove their data at any time.

General Experimental Sequence

Procedure

The current experiment consisted of three phases presented in a set sequence. Subjects sat comfortably at a standard computer desk and viewed the computer screen at a distance of approximately 70 cm and at eyelevel. Phases 1 and 2 (categorisation tasks) were presented in sequence. The aim of the categorisation task was to ensure familiarity with all stimuli.

Phase 3 consisted of a relational test which was almost identical to that employed on the previous chapter. That is, the test required subjects to respond to pairs of stimuli as “going together” or as “not going together”, based on rules presented on the instruction screen prior to the commencement of both test blocks. This phase presented a congruent task block (i.e., subjects were required to put gay words with good words) and an incongruent task block (i.e., subjects were required to put straight words with bad words). The congruent tasks were congruent from the perspective of the homosexual subject.

Phase 1

For Phase 1 a set of instructions were presented on screen which read as follows:

> In a moment some words will appear on this screen. Your task is to choose which one of the words presented on the bottom of the screen goes with the word presented at the top of the screen. It is important that you try to make as many correct choices as possible. Please click continue when you are ready to proceed.

The “continue” button was a grey rectangle labelled *Continue.* During each trial of the first categorisation test, subjects were presented with a single word that represented one of the two concept stimuli; heterosexual or homosexual (See Table 1 for stimuli used). This word appeared at the top centre of the screen in Arial point 36 font. Subjects were required to categorise each stimulus by clicking on a button labelled as either *gay* or *straight*. The gay or straight category labels appeared as grey shaded rectangles in the bottom left and right sides of the screen (see Figure 1), with positions counterbalanced across trials.

All of the stimuli were presented in a quasi-random order, with each of the eight stimuli appeared twice in a block of 16 trials. No time constraints were placed on responses during this phase. The aim of this process was to establish whether subjects were already familiar with the stimuli being used and whether this familiarity applied to using them in accordance with the appropriate category (i.e., gay or straight) as defined by the experimenter. Feedback was not provided during any of the trials during this phase and subjects proceeded to the next phase regardless of their score. The results from this phase were analysed and subjects with scores lower than 14 out of the 16 trials were highlighted. Scores lower than 14 may indicate a problem with word recognition and therefore this would be taken into account when considering those subjects results.

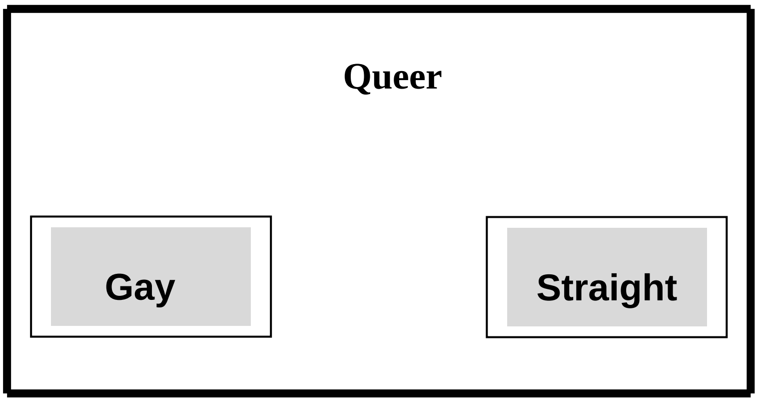


Figure 1: Sample task from the concept categorisation phase

Phase 2

This categorisation task was identical to Phase 1 with the exception that the stimuli were replaced with the verbal stimuli representative of the attributes “*good*” and “*bad*” (See Table 1). The onscreen instructions for this task were presented immediately following the concept categorisation task (Phase 1) and were identical to those in Phase 1. A sample task from the attribute categorisation phase is shown in Figure 2.

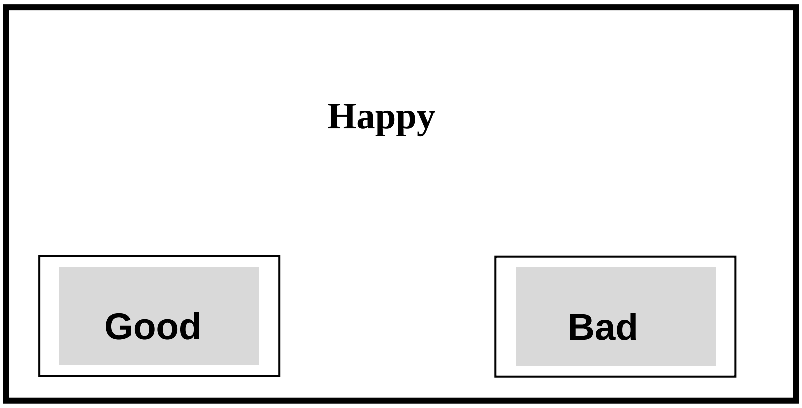


Figure 2: Sample task from the attribute categorisation phase

Phase 3: The Relational Test

Phase 3 consisted of 128 relational test trials presented across two task blocks. One task block was congruent with the verbal history of subjects *(put gay words with positive words, put straight words with negative words)* and the second task block was incongruent with the verbal history of subjects *(put gay words with negative words, put straight with positive words).*

Each task block was presented in a counterbalanced order, with a separate set of instructions which contained the applicable rules for the tasks. The subjects were required to respond with a mouse click (i.e., using the left mouse button) on their chosen response button/label within a 3-second response window. If subjects did not respond within the response window then the trial ended and the next trial began immediately. In this instance the response was recorded as incorrect and the maximum response time of 3000 ms was recorded for that trial. Feedback was not given during the test trials.

Each task block consisted of 64 trials in which the subject responded to pairs of words presented in the centre of the screen as either *going together* or *not going together* based on the rules given in the following set of instructions displayed onscreen:

> In a moment some words will appear on this screen. Your task is to first look at the instructions presented at the top of the screen. You must then look at the word presented in the centre of the screen and then the word presented at the bottom of the screen. You must click on either the Red key or the Blue key depending on the instructions given. Each word has a correct classification.
>
> REMEMBER TO USE THE INSTRUCTIONS AT THE TOP OF THE SCREEN TO HELP YOU DECIDE WHICH KEY TO PRESS.
>
> PLEASE TRY TO GO AS FAST AS POSSIBLE and expect to make a few mistakes because of going fast. That's OK.

A final paragraph of instructional text was varied depending on the task block phase being presented subsequently. For the congruent task block this final paragraph read;

> In this phase you must remember PUT GAY WORDS WITH POSITIVE WORDS and PUT STRAIGHT WORDS WITH NEGATIVE WORDS

For the incongruent task block this final paragraph read;

> In this phase you must remember PUT GAY WORDS WITH NEGATIVE WORDS and PUT STRAIGHT WORDS WITH POSITIVE WORDS

Once the subject read and understood the instructions they clicked on a grey rectangle labelled *Begin* to proceed with the task. The word pairs consisted of a concept word (Gay/Straight stimuli) and an attribute word (Good/Bad; See Table 1 for Experimental stimuli employed). During every trial of the task block, a second set of instructions remained on the screen positioned in the centre top of the screen in Arial 16 point font. These read; *"Press Blue If They Go Together. Press Red If They Do Not Go Together"*. The subjects responded by clicking on the blue rectangle in the bottom right of the screen if the words went together according to the initial rule.

Similarly, they clicked on the red rectangle if the words in the word pair did not go together according to the rule (See Figure 3). The left and right positions of the coloured keys were counterbalanced across trials.

During the congruent trial block responses were based on the rule; *"Put Gay words with Positive Words and Straight words with Negative words"*. During the incongruent trial block responses were based on the rule; *"Put Gay words with Negative Words and Straight words with Positive words"*. Both blocks consisted of 64 trials. During each block all four possible combinations of concept and attribute pairs were presented leading to four task types. Each task type was presented 16 times in a quasi-random order. There was no inter-trial interval: tasks were presented immediately upon the production of a response or the end of the 3000ms response window, whichever came first.

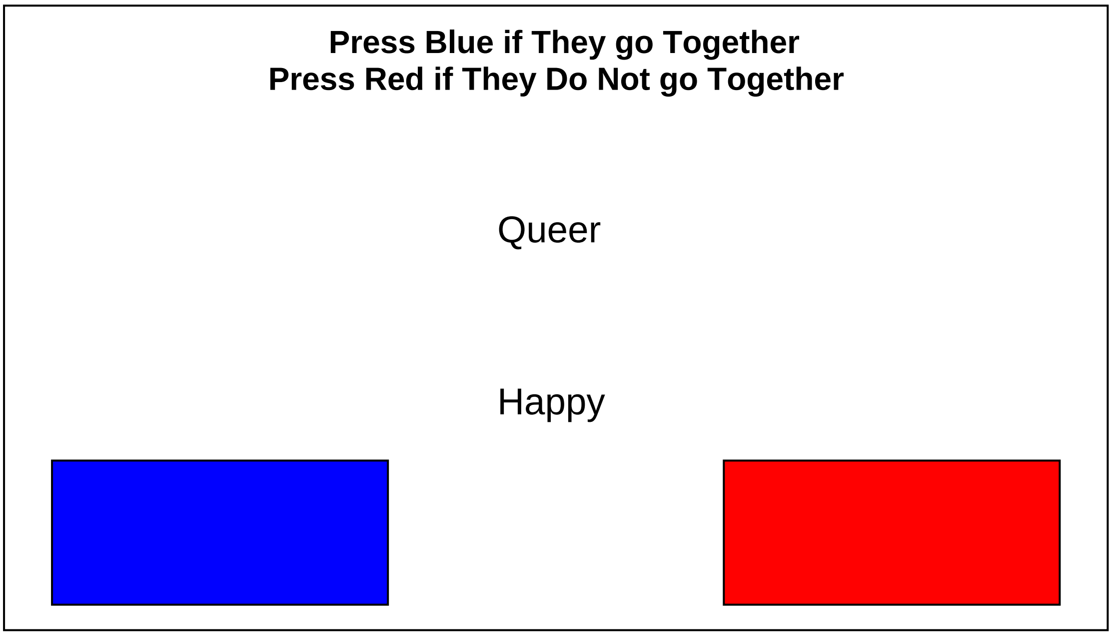


Figure 3: Sample of a relational test task from Phase 3.

The current study predicted that homosexual subjects might produce more correct responses during congruent task block over the incongruent task block.

Moreover, it was expected that there may exist differences in this pattern across the two demographic groups due to the differing cultures of Ireland and North America.

Summary

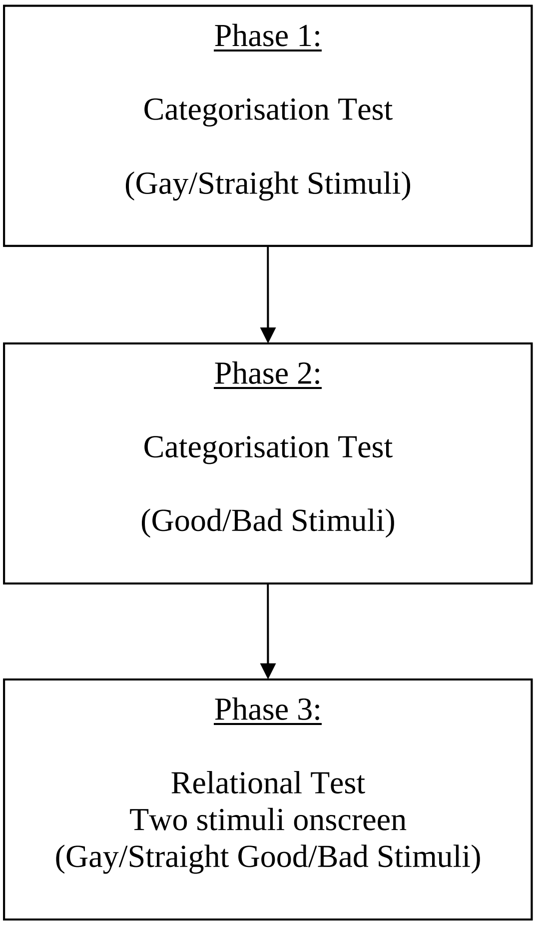


Figure 4: Procedural sequence for Experiment 4

Results and Discussion

Data for the current experiment comprised of response accuracies for Phases 1 and 2 and response accuracies on both the congruent and incongruent task blocks for Phase 3. For Phase 1 and 2 all subjects completed the initial categorisation tasks successfully thus indicating an understanding of the experimental stimuli. For Phase 3 all subjects (Homosexual Irish males N=15, Homosexual North American males N=10) completed the required test trials (64 congruent tasks and 64 incongruent tasks). No real differences were apparent in the mean total correct responses for the Irish homosexual group across the congruent (M= 37.73) and incongruent (M= 37.27) tasks (See Figure 5). Nine of the fifteen subjects (S1, S7, S9, S10, S11, S12, S13, S14, and S15) displayed higher scores on the congruent task block when compared with the incongruent task block, while the remaining six scored higher on the incongruent task block. This suggests variability in social categorisation of the experimental stimuli within the Irish homosexual group. A paired samples t-test comparing subjects across congruent and incongruent response accuracies showed no significant differences where (t=.123, df=14, p=.904).

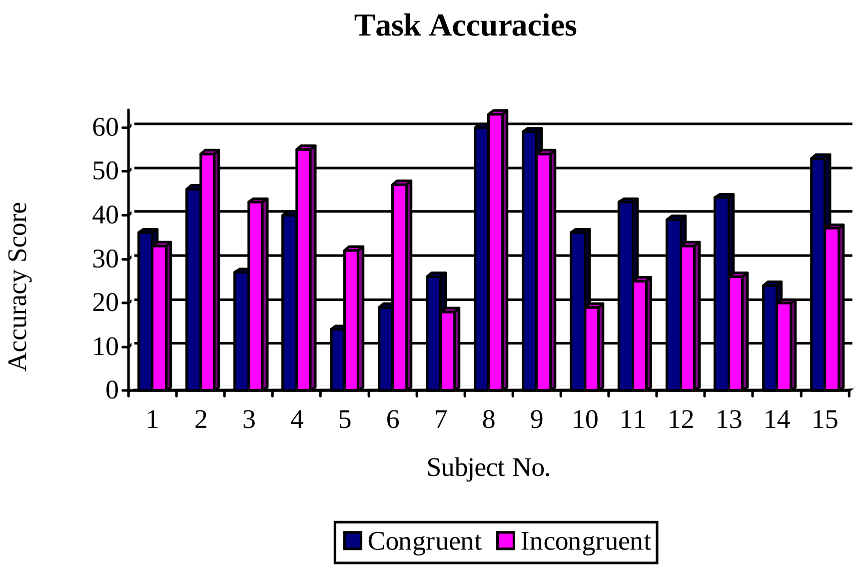


Figure 5: Response accuracies for subjects in the Irish group

For the North American homosexual group there were differences in the mean total correct across the two task blocks (See Figure 6). This indicates that the North American subjects found the congruent task (M= 45.3) easier than the incongruent (M= 38.8) task. A paired samples t-test comparing subjects across congruent and incongruent task response accuracies showed a significant difference where ($t=3.266$, $df=9$, $p<0.01$). Indeed, all of the North Americans (N=10) responded with equal or greater accuracy in the congruent task than the incongruent task. Such an extremely consistent effect was not exhibited for the Irish subjects.

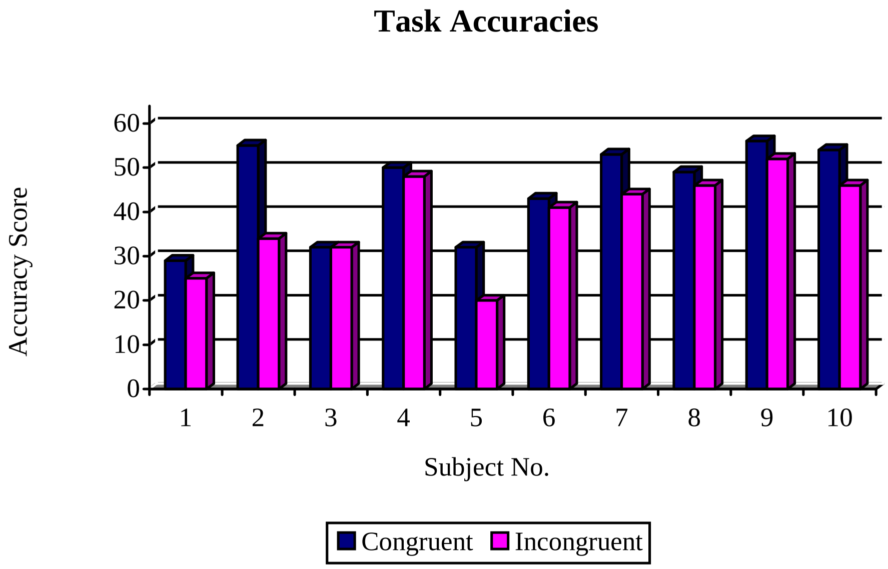


Figure 6: Response accuracies for subjects in the North American group

The purpose of the current test procedure was to compare performance on congruent and incongruent relational task blocks across two social groups. For the Irish homosexual group variability in performances across subjects was high. In contrast, the North American homosexual group showed a consistent pattern of achieving higher mean scores on the congruent task block over the incongruent task block. This suggests that the test appears to be sensitive to social differences across the groups. More specifically, the tendency to demonstrate greater fluency in responding correctly to one set of relations over another was replicated across all subjects within the North American homosexual group, but only sometimes observed for Irish homosexual subjects.

Paradoxically, within the Irish homosexual subject group six subjects displayed performances that were atypical of the North American subjects. In other words, these subjects showed more fluency in responding correctly to incongruent relations (i.e., put gay with negative/put straight with positive) than congruent relations. This pattern of responding was not observed at all for any of the North American subjects. This suggests that there are cultural differences between these two groups in terms of how each categorises the relevant experimental stimuli. Furthermore, the current test appears to have been useful in distinguishing the two experimental groups on this basis.

Given the foregoing, there is a certain degree of predictive ability based on the current findings. A visual inspection of Figures 5 and 6 shows a total of 19 subjects responding more accurately on the congruent task block (i.e., greater response accuracy on congruent task block). What is interesting here is that of the six subjects that responded otherwise, all six were Irish Homosexuals. That is, these data allow us to make a prediction with 100% confidence that any subject who responds with greater accuracy on the incongruent task block over the congruent task block is Irish. On the other hand, little can be said of subjects scoring more highly on the congruent task block. In other words, the current test has a high rate of false positive identification for North American homosexuals, but a low rate of false positive identification of Irish homosexuals. Conversely, the current test has a high rate of false negative identification for Irish homosexuals (i.e., identifying a subject as not Irish) but a low rate of false negative identification of North American homosexuals (i.e., identifying a subject as not North American). Given the powerful reliability of the test as a measure of Irish identity among homosexuals it would appear that the test may be of interest to clinician and forensic scientists as a potential tool with a wide range of uses.

However, a caveat must be placed here as there as all possible causes of for this cultural difference have not been explored. There is a possibility that Irish homosexual males may perform better on equivalence tests than North American homosexual males. To explore this possibility, future researchers should employ a control study where the performance of Irish Homosexual males on equivalence tests is compared to that of North American Homosexual males in a controlled laboratory setting.

The reader may assume that because a group comparison was being made in the current experiment a statistical analysis of the difference between groups may be warranted. However, it is important to understand that current test is a comparison of fluency rates for a given subject across two different domains of categorisation or relational responding. As such, the observed effect is a within-subject effect and could in theory be applied to an individual subject in a single-subject design. While levels of reliability and validity for the test have yet to be established, one of the aims of the current research is to develop tests that can be used in forensic or clinical settings on individuals. Thus, the test has been conceived ab initio as a single-subject test. Multiple subjects have been employed only as a means of observing the replication of single-subject effects across individuals. Whereas it is possible to conduct statistically meaningful comparisons of individual phases of the test across groups, such analyses would be psychologically meaningless and likely focus research attention on less important features of the test. That is, the search for group differences across single phases of the test may divert attention from the endeavour to establish control over individual performances and identify behavioural process instead of merely demonstrate behavioural effects.

The purpose of the current test procedure was to compare performance on congruent and incongruent relational task blocks across two social groups. For the Irish homosexual group variability in performances across subjects was high. In contrast, the North American homosexual group showed a consistent pattern of achieving higher mean scores on the congruent task over the incongruent tasks. This suggests that the test appears to be sensitive to social differences across the groups. However, the test format is still cumbersome and requires more rigorous experimental control to reduce the high error rates. Some subjects reported struggling with the complexity of the response format in particular the presentation of multiple rules during each phase. This may have lead to a lower overall decrease in response accuracies thereby obscuring any differences due to juxtaposition of rules with the subjects' histories. The following experiment seeks to examine and address this issue.

Experiment 5

The experimental procedure employed in Experiment 4 was effective in assessing social and personal history in a relatively unobtrusive and time efficient manner. However, it is important to note there were high error rates observed for many subjects in both groups. Specifically, subjects could potentially score 64 responses correct in both congruent and incongruent task blocks in Experiment 4. However, across experimental task blocks the percentage accuracy scores obtained for Irish Homosexual males were just above chance with congruent (59%) and incongruent (58%). This suggests that while Experiment 4 showed an effect for North American subjects, some or even many errors for both Irish and North American subjects may be due to the test format itself. Essentially, this test format requires subjects to remember two sets of rules while performing a demanding operant task. More specifically, subjects were initially instructed to "*Put gay words with positive words and put straight words with negative words*" alongside the rules "Press Blue if they go together" and "Press Red if they do not go together". In effect, such complex multiple contingencies may have increased the error rate across the board, thereby obscuring the actual behavioural effect of interest. While the main point of the current test measure is to assess and compare error rates, these errors are intended to result only from responding incorrectly to relations that are incongruent with the subject's personal/social history.

In the current test procedure, the presence of two sets of rules may have resulted in huge behavioural demand in responding to multiple features of the test at once, only one of which was designed to asses the fluency of the relations under examination. Thus, errors due to the complexity of the test format may be suppressing differences in scores across test phases. Of course, it is not yet known what precise effect this task complexity is having on individual subjects performances. That is, the task complexity may not have linear effects that apply equally to all task types. Moreover, the effect may also differ across subjects depending on their personal history. Therefore, it would appear necessary to increase the level of stimulus control in the test format and thereby reduce errors due to extraneous sources.

One obvious solution to the foregoing problem is to not to randomise the position of response buttons anymore. As mentioned in the introduction to the current chapter, this randomisation was intended to control for possible positional responding. However, while it may in theory be beneficial to retain this procedure, control against positional responding already exists in the general test format itself. That is, the experimental rules already change across blocks of the test. Thus, even if response buttons were to remain static, positional responding (e.g., always responding to the button on the left of the screen) can never produce a reliable correct scoring pattern. More specifically, positional responding in this case will lead to a perfect score of 50% (i.e., chance) across all tasks on both test blocks. Therefore, an effect can never be recorded for a subject who adopts that strategy.   In any case, such a strategy would be apparent in the data produced by the subject insofar as such stereotypic responding would be easily discernible. Therefore, Experiment 5 involves moving the response buttons to the computer keyboard so that they function as static response keys. In effect, the colours function as left and right response buttons that do not move across trials. However, in an effort keep the procedure of Experiment 5 as similar as possible to that employed in Experiment 4 the response keys were coloured blue and red as before.

Experiment 5 was designed to test fluency in responding to congruent and incongruent relations as before but with a less demanding procedure that will still produce sufficient error differentials across phases to identify differences in fluency in subjects’ categorisations of the relevant stimuli. It was not possible to return to the USA to conduct another experiment and consequently the issue of homosexuality was not pursued in Experiment 5.   Instead, the current experiment returns to the issue of *Child/Sexual* verbal relations as explored in Experiment 2. Experiment 5 was designed to assess subjects' fluency in associating terms related to sexuality with words associated with children compared to words associated with adults. That is, the experiment was designed to assess the social categorisation of children and sexual terms in a random selection from the general population. For this experiment, no males were recruited. It was decided that perhaps the counter-control towards producing child-sex relations in Experiment 2 (see Discussion section) was of greater interest than the conformity of males to the experimental paradigm. Recall that in Experiment 2 the majority (86.7%) of female subjects failed to respond equivalently to the child and sexual terms compared to 53.3% of males. It was suggested in Experiment 2 that men can respond equivalently when the terms *child* and *sexual* participate in a relation together whereas females cannot. However, less variability was observed across the response patterns of the female subjects, suggesting that their social history was producing greater interference in the task than that of male subjects. This issue may now be explored once again using the current relations test. This will allow us to ascertain if this interesting pattern also emerges with this new procedure.

The current study applied the evolving test measure to a group of 10 female subjects using a similar procedure to that applied in Experiment 4. An important difference, however, is that categories of stimuli relating to adults, children, sexual and nonsexual terms were used as stimuli. Furthermore, the test format differed from that employed in Experiment 4 insofar as the coloured response buttons were not present on screen but were in fixed positions on the computer keyboard.

Method

Subjects

Ten Irish females between the ages of 18 and 62 participated in the study. Subjects comprised acquaintances of the experimenter and were not paid for their participation. Subjects were informed that they would be participating in a three-phase word-association test, which would take approximately ten to fifteen minutes to complete.

Apparatus and Stimuli

All three phases of the experiment were presented to subjects on an iQon Laptop computer with a 15-inch display. Stimulus presentations were controlled using the software package Microsoft Visual Basic v.6.0 which also recorded all response accuracies and latencies. Sixteen stimuli in total were employed all comprising words in the English language. These were assigned to one of four groups; adult, child, sexual and non-sexual (see Table 2).

These stimuli were identified during a “brainstorming” session between the experimenter and her research supervisor. Word frequency counts, number of letters, number of syllables, or other features of the stimuli were not considered. The only criterion for the inclusion of any word in one of the verbal categories was that it should represent a recognisable instance of that category to most verbally able adults. This idea was checked during the word categorisation phases of the test (see below).

Table 2: Experimental stimuli employed.

Adult	Child	Sexual	Non-sexual
Senior	Minor	Erection	Lamp
Grown-up	Infant	Horny	Tree
Mature	Kid	Foreplay	Stone
Old	Young	Aroused	Cloud

Ethics

All subjects were presented with and signed a consent form before proceeding to first phase of the experiment (See Appendix 7). Subjects were informed casually that performance on the task would not allow the researcher to make any individual psychological assessments but may allow for group patterns to be identified. After participation subjects were fully debriefed as to the true nature of the study and were offered the opportunity to express any concerns or ask any questions they may have. Subjects were reminded that participation was confidential and that they were free to remove their data at any time.

General Experimental Sequence

Procedure

Experiment 5 was comprised of three phases. Procedurally, Phases 1 and 2 were identical to those in Experiment 4, with the difference that the categories of words; Adult, Child, Sexual and Nonsexual were used in the place of the categories; Gay, Straight, Good and Bad, respectively. Accordingly, the response buttons present during Phase 1 were labelled *child* and *adult*. Similarly, the response buttons present during Phase 2 were labelled *sexual* and *nonsexual*.

In Phase 3, subjects were presented with the relational test across two phases the order of which was counter-balanced. Procedurally, Phase 3 in this experiment was very similar to that of Experiment 4 but with the important difference that the locations of the response buttons were fixed on the computer keyboard (see Figure 7). That is, for the current experiment, subjects responded to the onscreen stimuli by pressing a key on the computer keyboard which was colour coded. To create these keys a blue sticker was placed over the *Z* key and a red sticker was placed over the *M* key.

Press Blue If They Go Together
Press Red If They Do Not Go Together

Erection

Child

Figure 7: Sample of a task from Phase 3

Phase 3 consisted of 128 trials across two task blocks. One task block was congruent with the verbal history of subjects *(Put child words with nonsexual words, put adult words with sexual words)* and the second task block was incongruent with the verbal history of subjects *(Put child words with sexual words, put adult words with nonsexual words).* Each task block was presented in a counterbalanced order, with a separate set of instructions which contained the applicable rules for the tasks. The subjects were required to respond with a mouse click (i.e., using the left mouse button) on their chosen response button/label within a 3-second response window. If subjects did not respond within the response window, the trial ended and the next trial began immediately. In this instance, the response was recorded as incorrect and the maximum response time of 3000 ms was recorded for that trial. Feedback was not given during the test trials. Subjects received the following experimental instructions for the congruent task block

> In a moment some words will appear on this screen. Your task is to first look at the instructions presented at the top of the screen. You must then look at the word presented in the centre of the screen and then the word presented at the bottom of the screen. You must press either the Red key or the Blue key depending on the instructions given. Each word has a correct classification.
>
> REMEMBER TO USE THE INSTRUCTIONS AT THE TOP OF THE SCREEN TO HELP YOU DECIDE WHICH KEY TO PRESS.
>
> PLEASE TRY TO GO AS FAST AS POSSIBLE and expect to make a few mistakes because of going fast. That's OK. Now place your index fingers over the blue and red keys.
>
> In this phase you must remember to PUT CHILD WORDS WITH NONSEXUAL WORDS and PUT ADULT WORDS WITH SEXUAL WORDS

For the incongruent phase of the test the following paragraph appeared at the end of the instructions in place of the final paragraph above.

> In this phase you must remember to PUT CHILD WORDS WITH SEXUAL WORDS and PUT ADULT WORDS WITH NONSEXUAL WORDS

Once the subject read and understood the instructions they clicked on a grey rectangle labelled *Begin* to proceed with the task. The word pairs consisted of a concept word (Child/Adult stimuli) and an attribute word (Sexual/Nonsexual). During every trial of the task block, a second set of instructions remained on the screen positioned in the centre top pf the screen in Arial 16 point font. These read; *"Press Blue If They Go Together. Press Red If They Do Not Go Together"*. The subjects responded by clicking on the blue key if the words went together according to the initial rule. Similarly, they clicked on the red key if the words in the word pair did not go together according to the rule (See Figure 6).

During the congruent trial block responses were based on the rule; *"Put Child words with Nonsexual Words and Adult words with Sexual words"*. During the incongruent trial block responses were based on the rule; *"Put Child words with Sexual Words and Adult words with Nonsexual words"*. Both blocks consisted of 64 trials. During each block, all four possible combinations of concept and attribute pairs were presented leading to four task types. Each task type was presented 16 times in a quasi-random order. There was no inter-trial interval: tasks were presented immediately upon the production of a response or the end of the 3000ms response window, whichever came first.

Summary

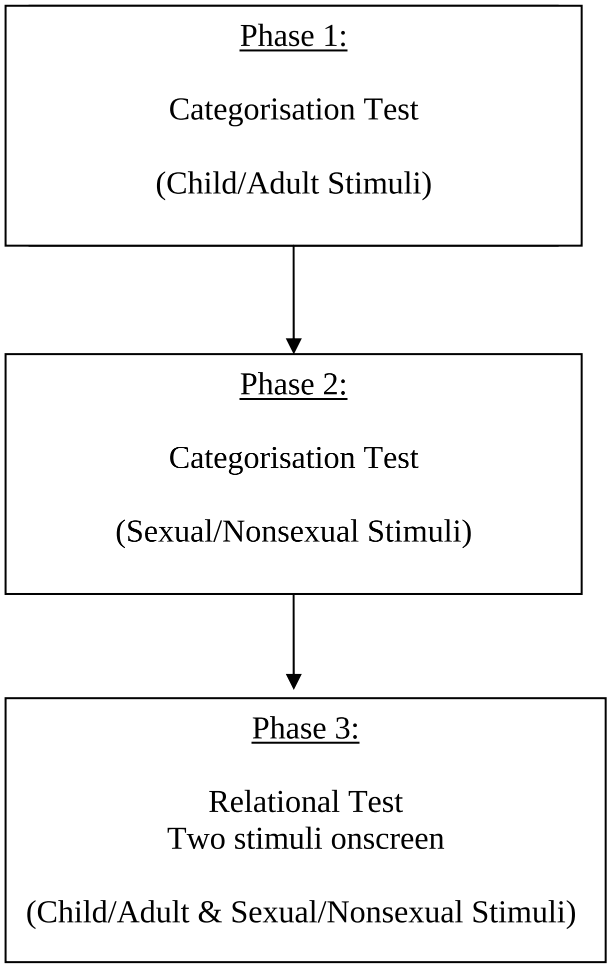


Figure 8: Procedural sequence for Experiment 5

Results and Discussion

Data for the current experiment comprised of response accuracies and latencies on both the congruent and incongruent task blocks. All subjects successfully reached criterion in the categorisation tasks (i.e., 14 correct responses on each task) thereby demonstrating recognition and successful categorisation of the experimental stimuli. All subjects successfully completed the required relational test blocks (64 congruent tasks and 64 incongruent tasks).

Subjects' total number of correct responses were calculated for both congruent and incongruent task blocks (see Figure 9). Subjects responded with 68.6% accuracy on the congruent task block (M= 43.9; Sd = 5.13) and with 50.3% accuracy on incongruent task block (M = 32.2; Sd = 14.23). The lowest score on congruent task blocks was recorded as 33/64 and the lowest score on incongruent task blocks was16/64 (both scores from subject 6). A statistical analysis of response accuracies across congruent and incongruent task blocks showed a significant difference ($t= 2.703$, $df= 9$, $p<0.01$). The effect size for this difference was large with Eta squared = 0.44.

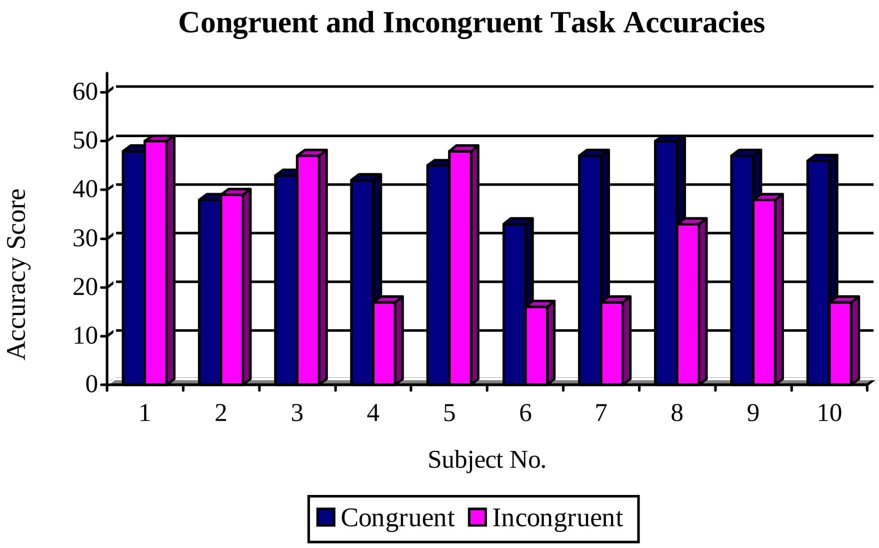


Figure 9: Response accuracies on congruent and incongruent task blocks for all subjects.

Response latencies were also examined. Eight subjects showed a greater mean response latency in completing the incongruent task than the congruent task (see Figure 10). The lowest mean response latency for congruent tasks was 1.28s (S10) and the lowest mean response latency for incongruent tasks was 1.58 s (S4). In contrast, the highest response latency for congruent tasks was 1.903 s (S2) and for incongruent tasks was 2.12 s (S10). However, response latencies did not differ significantly between congruent (M =1.69s) and incongruent (M = 1.8s) tasks where t= -2.166, df= 9, p=.06.

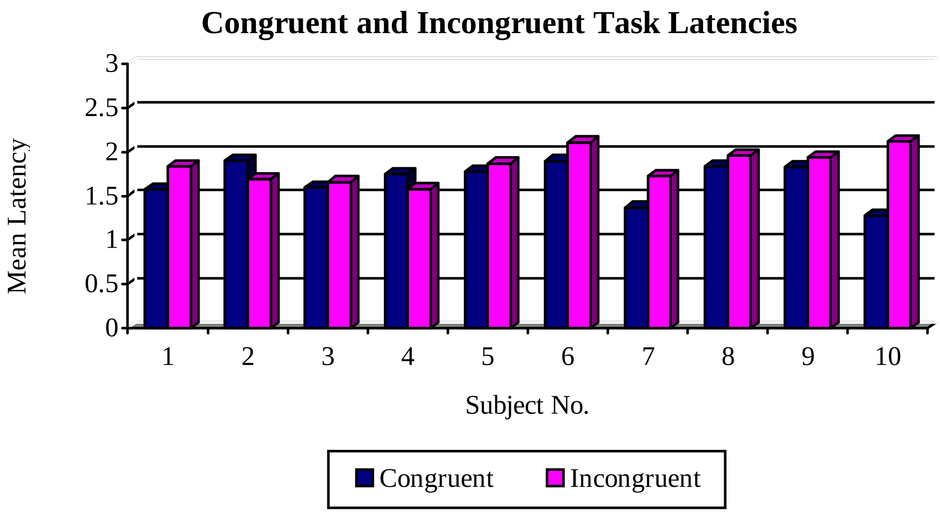


Figure 10: Response Latencies on congruent and incongruent task blocks for all subjects.

Response accuracies were examined more closely using a short trial block-by-trial block analysis. That is, responding was broken into blocks of 8 successive trials in order to examine any learning curves across the overall testing blocks of 64 trials. Figure 11 highlights a response acquisition difference between the congruent and incongruent task blocks. That is, the congruent task block learning curve shows a steep incline from trials 17-40 whereas the incongruent task learning curve levelled off during this period. Otherwise the rates of accurate responding are consistently stable across the 64 trials of the two task blocks.

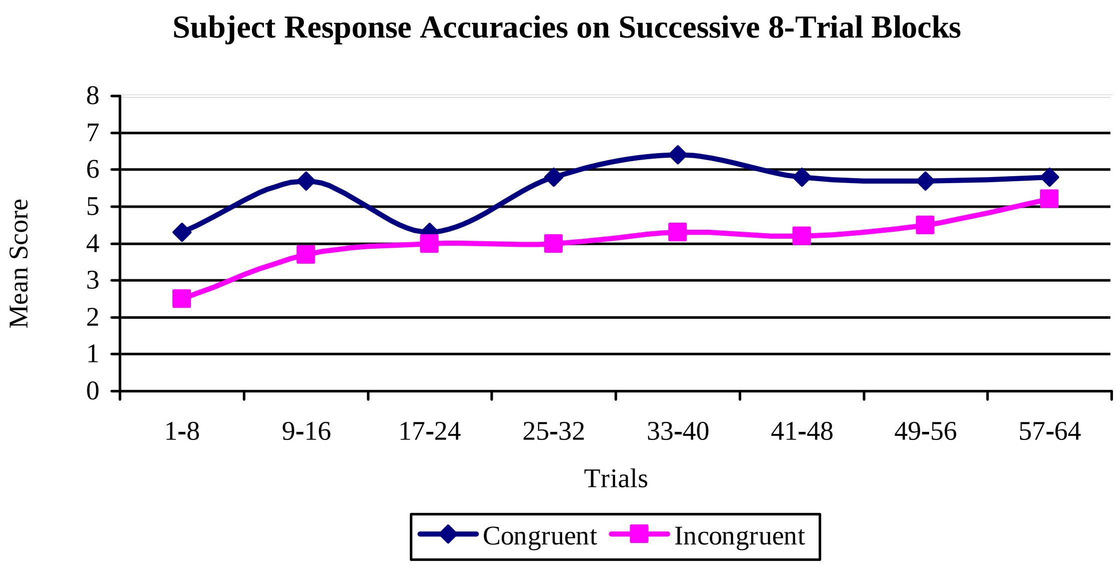


Figure 11: Shows mean congruent and incongruent task accuracies for all subjects for each block of eight trials.

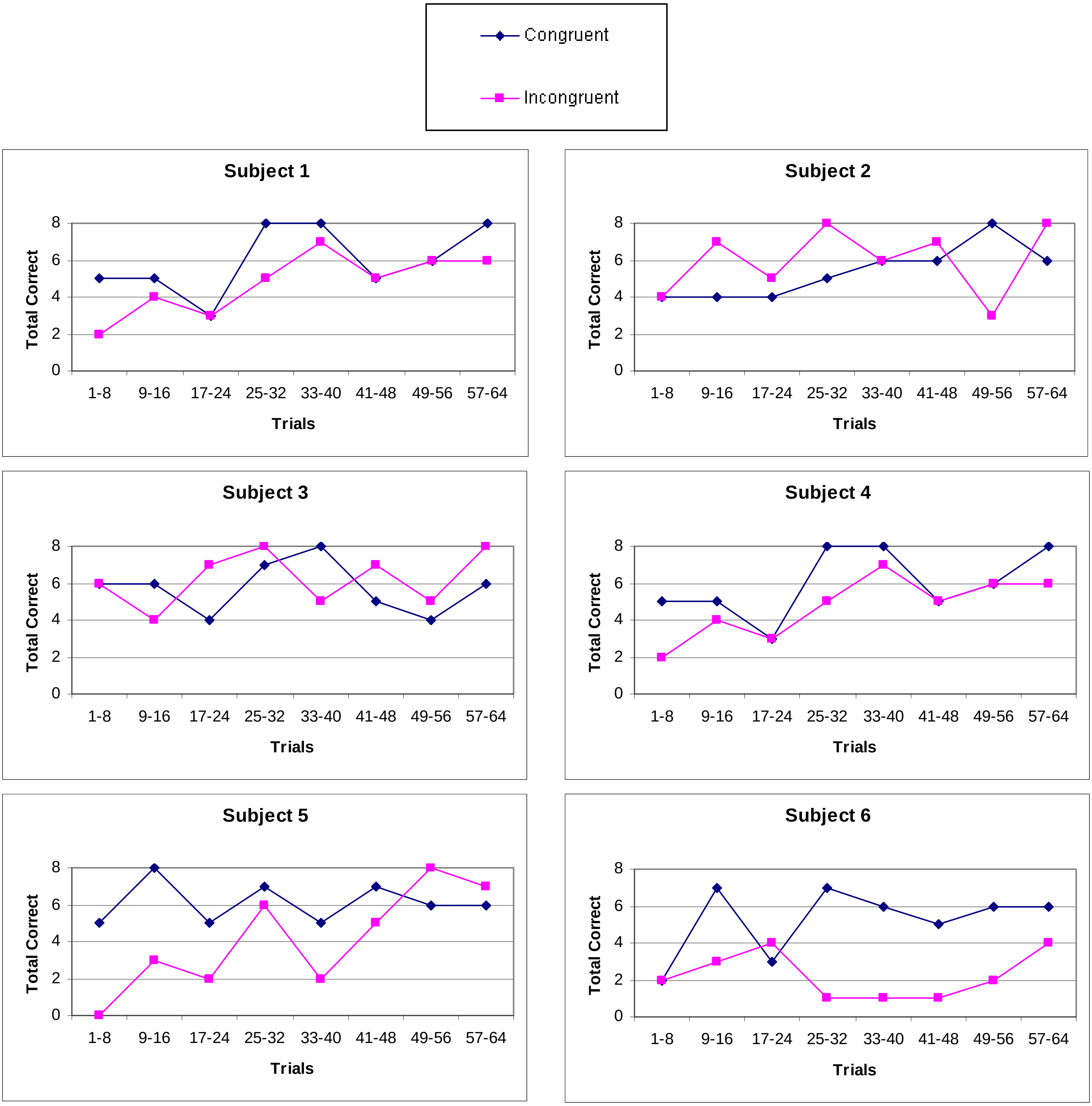
The above data was explored inferentially to see whether or not differences in response accuracy were significant across any of the pairs of 8-trial blocks. The analysis revealed that the first block of congruent tasks (trials 1-8) involved significantly more accurate responding than was observed during the first 8 incongruent tasks. This difference was also observed during the fifth block (trials 33-40; see Table 3). The second block approached a significant difference between congruent and incongruent response accuracies. The remaining blocks appear to involve more or less equal amounts of correct responding on the congruent and incongruent tasks.

A series of inferential statistical analyses were conducted and are presented in Table 3 below. The analyses suggest that congruent and incongruent tasks differed significantly across trials 1-8 and trials 33-40 with trials 9-16 approaching significance.

Table 3: Differences in response accuracies across successive blocks of 8 congruent and incongruent tasks.

Trial No.	T value	df	P value
1-8	3.417	9	.008**
9-16	2.111	9	.064
17-24	.213	9	.836
25-32	1.784	9	.108
33-40	3.706	9	.005**
41-48	1.649	9	.134
49-56	1.647	9	.34
57-64	1.539	9	.158

In addition, response patterns across blocks of trials were examined on an individual subject basis (See Figure 12). For seven of the ten females, the individual response patterns reflect those of the group insofar as the accuracies on congruent tasks (i.e., putting child words with nonsexual words and adult words with sexual words) was consistently higher than accuracies during incongruent tasks (i.e., putting child words with sexual words and adult words with nonsexual words) across blocks of eight trials. In addition, the differences are most apparent during the first three testing blocks (trials 1-24) across congruent and incongruent tasks. Three subjects responded with greater accuracy on the incongruent task blocks. More specifically, two subjects (S2, S3) responded with greater accuracy on incongruent tasks during five blocks of 8 trials and S10 responded with greater accuracy on incongruent tasks during three blocks of 8 trials


Congruent
Incongruent
Subject 1
Subject 2
Subject 3
Subject 4
Subject 5
Subject 6
Total Correct
0
2
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
57-64
Trials

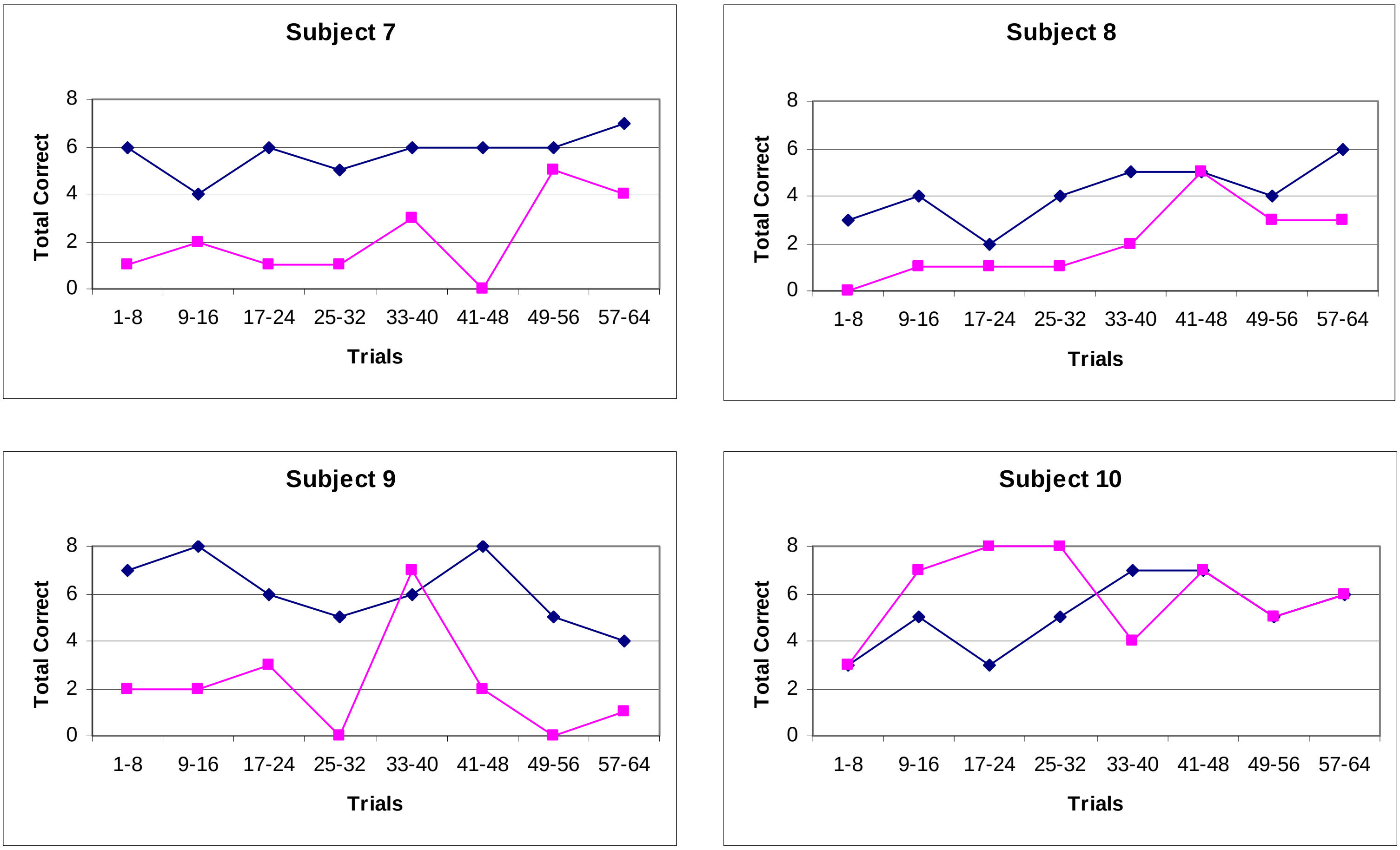


Figure 12: Total correct responses on successive blocks of 8 trials for all subjects on both congruent and incongruent tasks.

Experiment 5 sought to explore the categorisation of child words and sexual words for female subjects. Reconsidering some of the data obtained in Experiment 2 of the current thesis may be worthwhile at this point. Specifically, in Experiment 2 subjects had to respond to child-sexual stimulus relations by clicking on a yes or no response button. Females in that experiment showed clear counter control by failing respond equivalently to the child/sexual relation. In the current study, subjects were required to press a *yes* key (i.e., the blue key) for child and sexual word pairs in the incongruent task type and to press a *no* key (i.e., the red key) for child and nonsexual word pairs in the incongruent task type. Female subjects demonstrated a difference in response accuracies across congruent and incongruent task types. That is, the female subjects responded with greater accuracy on the congruent task block (i.e., "*Put child words with nonsexual words, put adult words with sexual words*"). This illustrates that the female subjects' pre-experimental histories were more congruent with the congruent task block than the incongruent task block, as predicted. In effect, the current test was sensitive to the social history of female subjects and the experimenter was correct in predicting their test performance.

The current preparation differed from Experiment 2 insofar as it involved four verbal relations under analysis, not two. That is, the congruent task block consisted of two separate relations (child/nonsexual, adult/sexual, child/sexual and adult/nonsexual) as did the incongruent task block (child/nonsexual, adult/sexual, child/sexual and adult/nonsexual). Thus, a breakdown of the data in terms of these individual task types may reveal patterns of responding within phases of the test that shed light on the precise categorisation pattern leading to the overall scores across test phases.

An Alternative Scoring Method

The data analysis technique employed to date in the current experiment assesses differences across task types (i.e. congruent compared with incongruent). However, it is questionable how meaningful this is within the context of the current procedure. More specifically, the current test measured the ease with which a subject confirms that child terms *go with* nonsexual terms compared to the ease with which they confirm child terms *go with* sexual terms (as instructed). Specifically, the congruent task block requires subjects to confirm two sets of relations; *child terms-nonsexual terms* and *adult terms-sexual terms*, and to disconfirm two sets of relations; *child terms-sexual terms* and *adult terms-nonsexual terms*. Similarly, for the incongruent task block subjects are required to confirm two sets of relations (i.e., *child terms-sexual terms and adult terms- nonsexual terms*), and to disconfirm two sets of relations (i.e., *child terms-nonsexual terms* and *adult terms-sexual terms*). Thus, there is no way of knowing how any score on the congruent or incongruent blocks is constituted. Specifically, it may, for example, involve high accuracy on "child-nonsexual" relations and low accuracy on "adult-sexual" relations, or be equally accurate on both. To explore the above effects it was necessary to separate the data into the four possible relations for both the congruent and incongruent task blocks.

In total there were 16 presentations of each task type within a task block: child/sexual, adult/nonsexual, child/nonsexual, adult/sexual. Specifically, within a task block of 64 trials, 16 trials required subjects to respond to a specific stimulus pairing (e.g., for a congruent task block there were 16 trials where a child word appeared onscreen with a nonsexual word, 16 trials where an adult word appeared onscreen with a sexual word, 16 trials where a child word appeared onscreen with a sexual word and16 trials where an adult word appeared onscreen with a nonsexual word). Within the congruent task block subjects were responding to child/nonsexual and adult/sexual stimulus pairs as *going together* and to child/sexual and adult/nonsexual stimulus pairs as *not going together*.

In contrast, during the incongruent task block subjects were responding to child/sexual and adult nonsexual stimulus pairings as *going together* and to child/nonsexual and adult/sexual stimulus pairs as *not going together*. Responses for each of these four pairings were calculated in terms of mean number correct across all subjects for the 16 possible trials and are presented in Table 4 (Left panel; congruent and right panel; incongruent) below.

Table 4: Mean correct and standard deviation scores for actual trials involving congruent (left) and incongruent (right) pairs.

Congruent Task Block Pairing	Mean Correct	Standard Deviation
Child/Nonsexual	7	5.6
Adult/Sexual	12	4
Child/Sexual	13.2	2.0
Adult/Nonsexual	11.4	4.4

Incongruent Task Block Pairing	Mean Correct	Standard Deviation
Child/Nonsexual	10.2	3.8
Adult/Sexual	9.2	4.6
Child/Sexual	8.6	6
Adult/Nonsexual	4.5	5.4

Inferential statistics were employed to examine these effects at a group level. Specifically, responses were examined *across* task blocks to assess for any significant differences. Firstly, Child/Nonsexual pairs were compared across congruent (M= 7) and incongruent (M=10.2) task blocks where no significant differences were observed with $t = -1.288$, $df = 9$, $p = .230$. This suggests that subjects responded with equal accuracy when the pairing Child/Nonsexual had to be confirmed and disconfirmed. Similarly, Adult/Sexual pairs were compared across congruent (M= 12) and incongruent (M=9.2) task blocks where no significant differences were observed with $t = 1.88$, $df = 9$, $p = .093$. This suggests that subjects responded with equal accuracy when the pairing Adult/Sexual had to be confirmed and disconfirmed.

In contrast, however, a significant difference was observed when the pairing of Child/Sexual terms was compared across congruent (M= 13.2) and incongruent (M= 8.6) task blocks where $t = -2.438$, $df = 9$, $p <.05$. This suggests that subjects responded with greater accuracy to the pairing of Child/Sexual terms on congruent task trials than on incongruent task trials. Specifically, subjects performed with greater accuracy when confirming that child and sexual do not go together (i.e., pressing red on the congruent tasks) than when confirming that child and sexual do go together (i.e., pressing blue on the incongruent task block). This suggests that females have difficulty parsing the terms child and sexual even when experimentally instructed to do so.

In a similar manner, females subjects performed with greater accuracy when confirming that adult and nonsexual do not go together (i.e., pressing red on the congruent tasks) than when confirming that adult and nonsexual do go together (i.e., pressing blue on the incongruent task block). That is, there was a significant difference in performances on the congruent (M= 11.4) and the incongruent (M= 4.5) task blocks for adult/nonsexual stimuli where $t = -3.609$, $df = 9$, $p<.01$. Again, this suggests that females have difficulty parsing the terms adult and nonsexual even when experimentally instructed to do so.

In sum, the current procedure proved useful in extending and building upon the Watt et al. Paradigm. That is, this revised relational testing procedure is a functionally understood test that also relies on juxtaposing experimental contingencies with personal history in an attempt to ascertain fluency with specific verbal relations or categories. More importantly, it has validated the findings of Experiment 2 in showing that females have a resistance to forming verbal relations with child and sexual stimuli. In addition, it highlighted a similar resistance in females to forming verbal relations with adult and nonsexual stimuli. In theory, experimental effects cannot be compared directly across Experiments 2 and 5 as the procedures are different. That said, the findings of Experiments 2 and 5 reflect a similar cultural phenomenon with the current relations test allowing a more detailed analysis of verbal behaviour than the Watt et al. paradigm.

General Discussion

Experiment 4 in the current chapter examined the utility of the current testing procedure in detecting cultural differences with regard to the categorisation of homosexual and heterosexual stimuli. Findings suggest that the current test measure is capable of highlighting a difference across both groups at a cultural level. This difference is synonymous with the respective group fluencies in categorising word pairs in a particular way. That is, North America has been shown as progressive in changing attitudes towards homosexuality (Hicks & Lee, 2006; Newport, 2001). Most recently, Hicks & Lee (2006) indicated that in US attitudes towards homosexuals have become more positive over time. Similarly, Newport (2001) found North American attitudes towards homosexuality as positive with 52% of North Americans believing that homosexuality should be considered an alternative lifestyle. The findings of Experiment 4 suggest that these changes are reflected in different associations between homosexuality and positive words. Paradoxically, Irish attitudes towards homosexuality have proven less progressive (Kelley, 2001) as is supported by the variability in Irish responding in Experiment 4. Such complex social issues can be teased out in further research by both experimental and social psychologists. However, the important point here is not the social meaning of what the test data represents but the nature of the phenomenon in question (i.e., verbal categorisation) and the behavioural processes involved. As mentioned in Experiment 4, however, a further exploration of the performance of Irish Homosexual males on equivalence tests compared to that of North American Homosexual males is required here.

It may be considered curious that low accuracy does not accompany long reaction times but this relationship is a complex one in the social cognitive literature (Greenwald, Nosek, & Banaji, 2003) and will be addressed in later chapters. In any case it is worth noting that the consistency with which these accuracy effects are emerging in the absence of clear latency effects.

Experiment 5 used a modified version of this procedure with female subjects only. The overall aim of Experiment 5 was to assess female subjects' fluency in associating terms related to sexuality with terms associated with children as compared to words associated with adults. Subjects responded with greater accuracy on the congruent tasks where child terms were paired with nonsexual terms and adult terms were paired with sexual terms than on the incongruent tasks where child terms were paired with sexual terms and adult terms were paired with nonsexual terms. A further analysis of the data showed that females have a resistance to forming verbal relations with child and sexual stimuli and with adult and nonsexual stimuli. These findings support those of Experiment 2 in the current thesis and although we cannot compare findings across different procedures it is apparent that the current revised Watt et al. measure is as sensitive, if not more so, to social and personal histories as was the case in Experiment 2.

While the current relational test measure has proven successful in identifying differences within experimental groups, a few concerns must be addressed. Firstly, the issue of experimental control must be brought to the fore. As previously discussed in Experiment 4, response accuracies on both congruent and incongruent task blocks were lower than might be expected and even reach chance levels on some blocks for some subjects. While response accuracies improved for Experiment 5 the error rates were still notably high. Specifically, the pattern of responding shown in Figure 11 (Experiment 5) shows the response accuracy level-off for both task blocks (i.e., congruent and incongruent) between 5 and 6 out of a block of 8 trials. In fact, responding during incongruent tasks was shown to be just above chance level and responding on congruent tasks was just above 66%. Such a large error rate on both task types suggests that the test procedure itself may still be proving somewhat difficult and perhaps needs revising. Procedurally, the findings of Experiment 5 showed a modest decline in error rates. This modest reduction in error responses may be immaterial but in the very least a source of extraneous stimulus control has been removed. In any case, it is still likely an improvement to reduce demand wherever possible. But any further possible amendments need to be explored.

One solution to the foregoing demand issue may be to reduce number of stimuli presented on any trial. This would further reduce behavioural demand on subjects but, more notably, would radically change the nature of the current test. Specifically, at present two stimuli are presented simultaneously onscreen and subjects are asked to respond to the stimuli in terms of an association as instructed. This in turn requires two sets of rules to be presented; one rule to control the response topography and one to specify the relations in operation during the relevant phase. A strategy in which only a simple response to a single stimulus is being made would be considerably less demanding on subjects and may prove fruitful to explore.

Interestingly, such a modification would alter the process in use during the testing phase. Subjects would no longer be required to explicitly match the stimuli in relation to each other. To this extent, any move towards the use of a single stimulus on the screen represents a radical departure from the current procedure and potentially a new behavioural process. Thus, the current test procedure may have been taken as far as it can go, short of continued modifications within the constraints of maintaining it as a matching test. In the interest of covering ground in terms of developing a novel and even more easily administered test format for identifying personal and social history, the next chapter explores the conceptual implications of a novel test format.

Chapter 5

A novel stimulus function acquisition test for measuring socially established verbal relations

Chapter four of the current thesis suggested the development of an entirely novel approach to behavioural implicit testing. The process of stimulus equivalence and deriving relations were demonstrated explicitly in Experiments 1 and 2, where they were referred to as exemplifying a Watt et al. approach. Specifically, Experiments 1 and 2 showed that both laboratory and social histories interfere with derived relations. That is, subjects failed to derive predicted equivalence classes when these classes were incongruent with either the laboratory created history or their pre-experimental social history.

Experiments 3, 4, and 5 extended this technique to a format in which subjects were required to respond to verbal stimulus relations under different instructions. These different instructions had differing levels of control over the relational response, depending on the history of the subject. In this way, the stimulus matching approach of Watt et al. was also employed in these later experiments. However, the previous chapter suggested that even further simplifications of the technique are necessary. There, it was suggested that a possible solution may be to reduce number of stimuli presented on any trial. This would further reduce behavioural demand on subjects but, more notably, would radically change the nature of the current test. Specifically, in Experiments 3, 4 and 5 two stimuli were presented simultaneously onscreen and subjects were asked to respond to the stimuli in terms of an association as instructed. This, in turn, required two sets of rules to be presented; one rule to control the response topography and one to specify the relations in operation during the relevant phase. A strategy in which only a simple response to a single stimulus is being made would be considerably less demanding on subjects and may prove fruitful to explore. Such a modification would alter the process in use during the testing phase as subjects would no longer be required to explicitly match the stimuli in relation to each other.

To illustrate the possibility of this new approach, imagine a trial in which only one stimulus is presented. In this case, there would be no relation to respond to. The subject would be required in some way to discriminate the stimulus but not to relate it to another. It is difficult to see how the type of test format employed so far could be of relevance to the presentation of single stimuli (i.e., there are no relations to assess and no comparison stimuli to choose). However, a clue as to how a test involving single stimulus presentations might be built, but that still measures the congruence and incongruence between stimuli in a subject's history, is provided by a small body of literature from within the file of the Experimental Analysis of Human Behaviour (EAHB). In order to fully appreciate the conceptual implications of presenting only one stimulus on screen per trial it is necessary to first review this relevant literature on the relationship between stimulus function and stimulus class structure.

Previous research has shown that the emergence of derived equivalence relations is affected by both stimulus functions (Roche, Barnes, & Smeets, 1997) and the functional classes in which the relevant stimuli participate (Tyndall, Roche & James, 2004). In the first of these studies, Roche et al. (1997) trained subjects on a matching-to-sample procedure, using nonsense syllables, that led to the formation of two three-member equivalence relations (i.e., A1-B1-C1 and A2-B2-C2). The authors then tested for these relations. The experimenters then paired sexually arousing film clips with two of the nonsense syllables (i.e., A1 and C2) in a respondent conditioning paradigm. Similarly, the experimenters paired nonsexual film clips with A2 and C1. Specifically, this established incongruous sexual functions for stimuli that participated in common derived equivalence relations. Subjects were then re-exposed to the equivalence test procedure. The results showed that subjects reproduced the original equivalence relations during the second equivalence test. The relations even failed to shift following several exposures to the incongruous stimulus pairing procedure. These findings suggest that the derived stimulus relations were robust and not subject to alteration following experiences that provided a simple basis on which to match stimuli other than in accordance with derived relations (i.e., commonality of sexual function). To further test this, Roche et al. (1997) exposed subjects to the respondent conditioning preparation first followed by the equivalence training and testing procedure. They found that the subsequent incongruous stimulus equivalence training failed to produce equivalence relations. Instead, subjects matched stimuli during the equivalence test on the basis of their sexual or nonsexual functions (i.e., match A1 with C2 and A2 with C1) that were established at the outset of the experiment. This allows for the assumption that once a functional stimulus relation has been established between two stimuli using a respondent conditioning procedure to create common stimulus functions, it is difficult to disrupt that functional relation by attempting to reorganise the relevant stimuli into distinct equivalence relations. On the other hand, when a derived relation is formed it dominates over any succeeding functional relations established.

In the second of the relevant studies, Tyndall et al., (2004) found that the emergence of derived relations is affected by the functional classes in which the relevant stimuli participate. Tyndall et al. tested this idea by exposing subjects to a discrimination-training procedure followed by equivalence training and testing. For the discrimination-training, Tyndall et al. established six S+ functions (click on the stimulus using the computer mouse) for six arbitrary nonsense stimuli and six S- functions (i.e., respond away) for a further six nonsense stimuli. The experimenters then exposed subjects to one of two equivalence training procedures. In the first equivalence training procedure subjects were trained to form two three-member equivalence relations using the six S+ stimuli. In the second equivalence training procedure, subjects were trained to form two three-member equivalence relations using the six S- and tested for same. The findings suggested that subjects required more testing trials to form equivalence relations when the stimuli involved were functionally similar and salient (i.e., S+ stimuli) rather than functionally different (i.e., S- stimuli). In addition, subjects required more test trials to form equivalence relations when novel arbitrary stimuli, rather than functionally distinct stimuli, were used as samples and comparisons

The foregoing findings reflect a small body of research illustrating that functional and derived stimulus relations are generally resistant to reorganisation (Dube, McIlvane, Mackay, & Stoddard, 1987; Pilgrim, Chambers, & Galizio, 1995; Saunders, Saunders, Kirby, & Spradlin, 1988; Spradlin, Saunders, & Saunders, 1992; Wirth & Chase, 2002; see also Chapter 2 General Discussion.). More importantly, however, this research suggests a novel approach to developing a behavioural test for a history of stimulus relations which I will now consider.

An altogether different strategy to behavioural testing harnesses the ideas in the literature presented above by focussing explicitly on the interference between functional and equivalence classes. This contrasts with the explicit focus of previous tests which appear to have relied on the interference between two verbal relations (one established pre-experimentally and one established in the laboratory). The current novel procedure will rely upon an implication of the current research which has never been shown in any empirical study but towards which the reviewed research findings all converge. More specifically, the previous findings by Roche et al. (1997) and Tyndall et al. (2004) suggest that the acquisition of stimulus equivalence is impeded when classes involve the reorganisation of previously established functional classes. More importantly, the Roche et al. study also found that functional classes are more difficult to establish when forming the class involves the disruption of a previously established equivalence relation. However, what no study to date has done is directly examine the rate of acquisition of common stimulus functions by members of distinct verbal relations. The literature strongly suggests, however, that we should expect to see a slower acquisition of stimulus functions for members of distinct verbal relations (i.e., class competition) compared to common verbal relations (i.e., no class competition). Conversely, we should expect to see slower acquisition of distinct stimulus functions for members of common verbal relations than for members of distinct verbal relations. This, in essence, is the key to developing a behavioural test based on the congruence and incongruence of stimulus relations, whilst also allowing for a test format that will present only one stimulus per trial to subjects.

Imagine, for instance, that you are presented with two tasks in succession. Each involves the presentation of one verbal stimulus. Imagine that these stimuli are the words Protestant and Catholic. Now imagine that your task is to respond in the same way to these two socially exclusive stimuli by pressing a red key on the keyboard. Your response latency and accuracy to the task is recorded by the computer on which the trials are presented. Now imagine an alternative pair of tasks on which the same two stimuli are presented on separate trials. However, in this case your task is to respond in different ways to the two stimuli. Specifically, you are instructed that when you see Protestant stimuli you should press the red key but when you see Catholic stimuli you should press a blue key on the computer keyboard. Response accuracy and latency are again recorded. Which task do you think you will find easier? Clearly, for most people resident in Ireland, the latter task should yield more fluent responding insofar as the response functions established are congruent with the pre-experimentally established verbal relations in which Protestant and Catholic stimuli are mutually exclusive. Moreover, we should expect to see different trajectories in the learning curves across repeated presentations of these two tasks with the former reaching any preset fluency criteria slower than the latter. This, in essence, is the test preparation and analysis technique that is employed in Experiment 6 of the current chapter.

One exciting feature of the new proposed methodology is that it seems to allow us to move closer to developing an implicit behavioural measure in accordance with the definition of the term used thus far. In order to appreciate how this is achieved it is first necessary to recapitulate on the process at work in the previous experiments. The previous test measures examined the fluency with which subjects' responded to explicitly presented stimulus relations across a number of trials. These relations were either congruent or incongruent (or neither) with the subjects personal history of stimulus associations. The level of congruence was tested by juxtaposing two rules for responding to the stimulus pairs across two blocks of testing. The rule which produced the higher rate of correct responding was indicative of which types of stimulus relations had been formed in the subject's history.

The stimulus relations formed in the world outside the laboratory can be formed in one of two ways. Firstly, they may have been formed as verbal or derived relations through speaking, reading, writing etc. Alternatively, they may have been formed as functional relations through direct experience with stimulus associations (e.g., Protestant and Catholic stimuli rarely or never being encountered together). Thus, it may not be necessary to have verbal interaction with a community in order for an individual to respond to stimulus relations that are socially sensitive. Of course, the formation of all stimulus relations likely involves both processes and is more than likely established by a combination of verbal interaction with the community and by direct experience (see Hayes et al., 2001). Bearing this in mind, however, it is difficult to know for sure what type of relations the previous tests were measuring (e.g., derived or directly trained stimulus associations).

It is difficult to know in any one application of the previous tests in a real world setting whether the relations interfering with the acquisition of laboratory induced equivalence relations or relational evaluations of stimulus pairs are themselves functional or derived. However, there are two grounds on which it might be argued that these relations are likely verbal relations. Firstly, it is likely, due to the complex verbal format of these tests (e.g., verbally presented rules are involved at all stages and all stimuli were English words) that they were measuring verbal (i.e., derived) relations between verbal stimuli, but this is far from certain. Secondly, the former tests presented either a sample stimulus and two comparison stimuli or a stimulus pair on all trials. It is reasonable to assume that this set of stimuli functioned as a discriminative stimulus for categorising pairs of stimuli. In fact, in the current extensions of the Watt et al. procedure the rule told subjects that each pair represented an opportunity to respond to the stimuli as "going together" or not. This procedure not only explicitly evokes a history of verbal relations but is far from subtle in that subjects are likely aware of both the relation being responded to in the experiment and possibly whether or not these relations are congruent or incongruent with relations established in their own personal history. While the subject may not be able to reduce their error rates across the two rule conditions, it is still likely that their behaviour is under some sort of social control to produce desirable responses (e.g., not to respond to gay and bad terms as going together even when instructed to do so).

The foregoing issues conspire to suggesting that the proposed novel test format may allow us to measure relations that are perhaps more fluid, nonverbal and even unconscious for the individual subject. Specifically, the new test will not require the subject to categorise stimuli in relation to each other and therefore will not measure any specific socially conscious verbal relations. Moreover, this move away from the presentation of word pairs should reduce social desirability biases. Thus, there are fewer demand characteristics in this new strategy and so this test may be viewed as more subtle and consequently more implicit. Finally, because explicit verbal relations need not be responded to on any one trial the test format may allow for the measurement of congruence between stimuli that have never been responded to before in stimulus relations. For example, a subject who has never before given any thought as to whether or not Protestant and Catholic stimuli are congruent may nevertheless, demonstrate a slow acquisition of common stimulus functions to Catholic and Protestant stimuli compared to two distinct Catholic or two distinct Protestant stimuli. Similarly, without ever consciously responding to the Catholic-Protestant verbal relation, the subject may demonstrate slower acquisition of distinct stimulus functions to two different Catholic or two different Protestant stimuli, compared with Catholic and Protestant stimuli. In effect, the experimenters will be alerted to a history of stimulus associations that is tantamount to a sectarian pattern of social categorisation, without ever alerting the subject to the nature of the task. Of course, proving that subjects are truly "unconscious" of the contingencies controlling their own performance on a trial to trial basis is a difficult and perhaps ultimately impossible endeavour. Moreover, it does not behove the behavioural experimenter to demonstrate implicitness in terms defined by those outside the field. Nevertheless, it is interesting to note at this point that the increased sensitivity of the proposed new procedure approaches the type of testing format that many researchers have referred to as implicit (Blake & Weinberger, 2006; DeHouwer, 2003a; Greenwald, McGhee, & Schwartz, 1998: Nosek & Banaji, 2001).

In summary, by removing discriminative stimuli for social categorisation in the test format, the proposed procedure likely masks what the experimenter is testing. Such a test could be more accurate at revealing a history of verbal or functional relations in the subjects' repertoire and may also identify histories that support stimulus relations that the subject themselves may never previously have discriminated (i.e., they are unaware of them). Essentially, subjects will find it harder to tact which stimuli are being categorised in relation to which other stimuli in this new test format.

One important point to note with the proposed test procedure is that unlike in Roche et al.'s (1997) study the functions in the current experiment will not be established using a respondent procedure. Instead, they will be established through verbal instruction for sake of experimental convenience and speed. While this may not be as powerful or reliable a method as a respondent procedure or one in which explicit reinforcement is provided we must remain mindful of the exigencies of the current research endeavour. That is, to construct an easy to administer test that can provide an insight into subjects' behavioural histories in as short a time as possible.

Experiment 6 builds upon the research questions of Experiment 5 purely as a vehicle to examine socially sensitive relations that are easily accessed by a novel test in an early stage of development. Experiment 5 found that female subjects responded with greater accuracy on the congruent tasks where child terms were paired with nonsexual terms and adult terms were paired with sexual terms than on the incongruent tasks where child terms were paired with sexual terms and adult terms were paired with nonsexual terms. Specifically, Experiment 5 also showed that females have a resistance to forming verbal relations with child and sexual stimuli and with adult and nonsexual stimuli. This test will examine the same stimulus relations but use the novel procedure outlined above.

The current test preparation aims to assess any differences across gender in the categorisation of sexual and child-related stimuli. Ten heterosexual males and 10 heterosexual females (N=20) were exposed to a categorisation task where they categorised words in terms of their association with *adults* or *children*. The subjects then completed a second categorisation task where they classified the stimuli in terms of being either *sexual* or *nonsexual*. Finally, subjects were required to complete a test in which they responded to individual child, adult, sexual and nonsexual stimuli in one of two ways. That is, for two sets of stimuli subjects were required to respond with a red key press, while for the other two sets of stimuli subjects were required to respond with a blue key press. In another block of testing the requirements were juxtaposed so that the combination of stimuli requiring a common key response was altered. This technique allowed the experimenter to asses the congruence of the various stimuli across trials rather than within trials, by comparing rates of acquisition of common response functions across the test blocks.

Method

Subjects

Twenty self reported heterosexual Irish subjects (ten males and ten females) between the ages of 18 and 65 participated in the study. All subjects were acquaintances of the experimenter. Subjects were informed that they would be participating in a three-phase word-association test, which would take approximately ten to fifteen minutes to complete. All subjects signed a consent form before the experiment commenced.

Apparatus and Stimuli

All three phases of the experiment were presented to subjects on an *iQon technologies* Laptop computer with a 15inch display. Stimulus presentations were controlled using the software package Microsoft Visual Basic v.6.0 which also recorded all response accuracies and latencies. Sixteen stimuli in total were employed all comprising words in the English language. These were assigned to one of four groups; adult, child, sexual and non-sexual (see Table 1).

These stimuli were identified during a "brainstorming" session between the experimenter and her research supervisor. Word frequency counts, number of letters, number of syllables, or other features of the stimuli were not considered. The only criterion for the inclusion of any word in one of the verbal categories was that it should represent a recognisable instance of that category to most verbally able adults. This idea was checked during the word categorisation phases of the test (see below).

Table 1: Experimental stimuli employed.

Adult	Child	Sexual	Non-sexual
Senior	Minor	Erection	Lamp
Grown-up	Infant	Horny	Tree
Mature	Kid	Foreplay	Stone
Old	Young	Aroused	Cloud

Ethics

All subjects were presented with and signed a consent form before proceeding to first phase of the experiment (See Appendix 8). Subjects were assured that performance on the task would not allow the researcher to make any individual psychological assessments but may allow for group patterns to be identified. After participation subjects were fully debriefed as to the true nature of the study and were offered the opportunity to express any concerns or ask any questions they may have. Subjects were reminded that participation was confidential and that they were free to remove their data at any time.

General Experimental Sequence

Procedure

A single-subject design was employed to assess the within-subject test effect. The behavioural outcome on the test did not involve statistical abstraction or other forms of mathematical extraction. Thus, the effect, in terms of response differentials across phases of the test, should be immediately visually apparent with individual subjects as per the behavioural tradition.

Phases 1 and 2 (categorisation tasks) were presented in sequence. The aim of the categorisation task was to ensure familiarity with all stimuli. Subjects sat comfortably at a standard computer desk and viewed the computer screen at eyelevel from a distance of 70 cm. Phases 1 and 2 were general categorisation tasks in which stimuli were presented in one of 4 groups; Child, Adult, Sexual, Nonsexual.

Phase 3 of the program consisted of a novel test format which required subjects to respond to individual stimuli based on rules presented onscreen during the phase. This phase comprised of two task blocks; congruent and incongruent. For the congruent task block stimuli that were consistent with one another shared a common response function (i.e. key press) and for the incongruent task block stimuli that were inconsistent with one another shared a common response function. Phase 3 was presented in a counterbalanced fashion with half of the subjects taking the congruent task block first and the other half of the subjects taking the incongruent task first

Phase 1

For Phase 1 a set of instructions were presented on screen which read as follows:

> *In a moment some words will appear on this screen. Your task is to choose which one of the words presented on the bottom of the screen goes with the word presented at the top of the screen. It is important that you try to make as many correct choices as possible. Please click continue when you are ready to proceed.*

During this first categorisation test, subjects were presented with a word that verbally represented one of the two concept stimuli groups (child and adult) at the top of the screen. They were then asked to categorise each stimulus by selecting a button labelled as either *child* or *adult*. The child or adult category labels appeared as grey shaded rectangles in either the bottom left or right side of the screen and selection was operationalised by left-clicking the mouse on the chosen rectangle.

All of the stimuli were presented in a quasi-random order with subjects being exposed to each stimulus twice across the total of 16 trials that made up this phase of the test. There were no time constraints on these initial categorisation tasks. The aim of this process was to establish whether subjects were already both familiar with the stimuli and this familiarity extended to the appropriate category (child or adult) for the purpose of this research. Subjects proceeded to the next task regardless of their score on this phase. The results from this phase were analysed and subjects with scores lower than 14 out of the 16 trials were highlighted. Scores lower than 14 may indicate a problem with word recognition and therefore this would be taken into account when considering those subjects results. This phase was displayed on screen as shown in Figure 1.

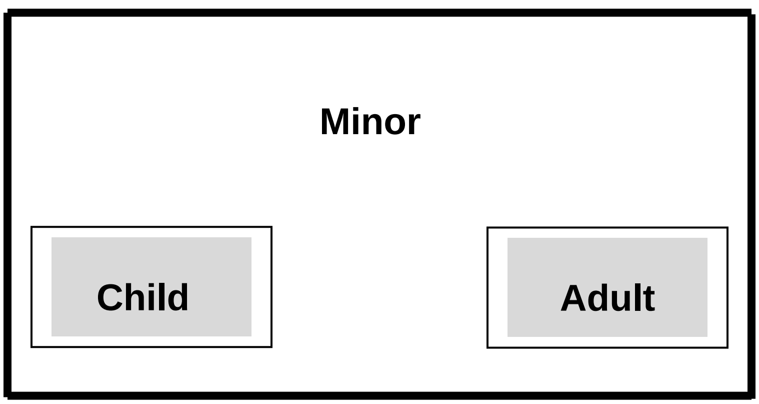


Figure 1: Sample task from the concept categorisation phase

Phase 2

This categorisation task was almost identical to the first categorisation task other than the stimuli had been replaced with words representative of the verbal concepts of "*sexual*" and "*nonsexual*". The onscreen instructions for this task were presented following the concept categorisation task and were identical to the previous instructions.

All of the stimuli were presented in a quasi-random order with subjects being exposed to each stimulus twice across the total of 16 trials that made up this phase of the test. The subject was to differentiate between the attribute stimuli and separate them into "sexual" and "nonsexual" by selecting the buttons labelled *sexual* or *nonsexual* displayed as grey boxes on the lower left and right of the screen using the left key press on the mouse. Again, no time constraints were imposed on this categorisation phase. The appearance on screen for the attribute categorisation trial was as shown in Figure 2.

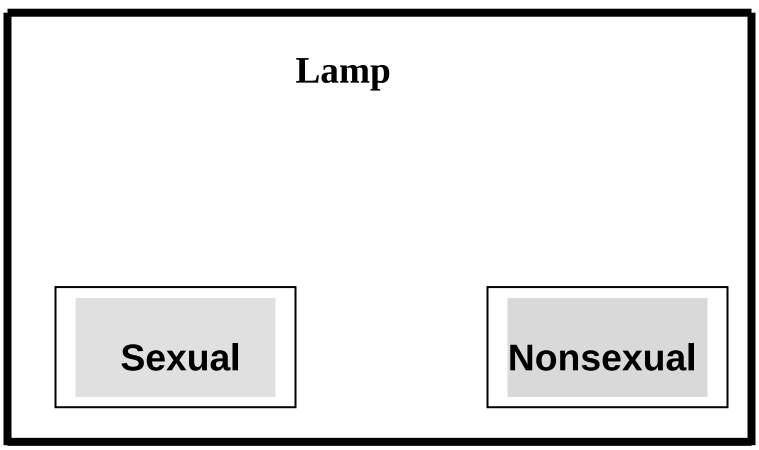


Figure 2: Sample task from the attribute categorisation phase

Phase 3

Phase 3 consisted of 160 trials across two task blocks (80 trials in each block). One task block was expected to be congruent with the verbal history of the normal subjects (i.e., *Press Blue for Child and Nonsexual, Press Red for Adult and Sexual*) and the second task block was predicted to be incongruent with the verbal history of the normal subjects (i.e., *Press Blue for Child and Sexual, Press Red for Adult and Nonsexual*; See Figure 3). Subjects responded to the onscreen stimuli by pressing a key on the computer keyboard which was colour coded. The keys coloured blue and red were the ‘Z’ and ‘M’ keys respectively.

The congruent tasks in the current experiment comprised the *child* and *nonsexual* words sharing a response key (blue) and the *adult* and *sexual* words sharing a response key (red). For the incongruent tasks the *child* and *sexual* words shared a response key (blue) and the *adult* and *nonsexual* words shared a response key (red).

Each of the blocks consisted of four task-types which involved the presentations of one of the following stimuli; child word, adult word, sexual word, or nonsexual word. These four tasks were presented once each in a random order in a block of four trials. There were 20 successive presentations of these 4-trial blocks (i.e., 80 trials).

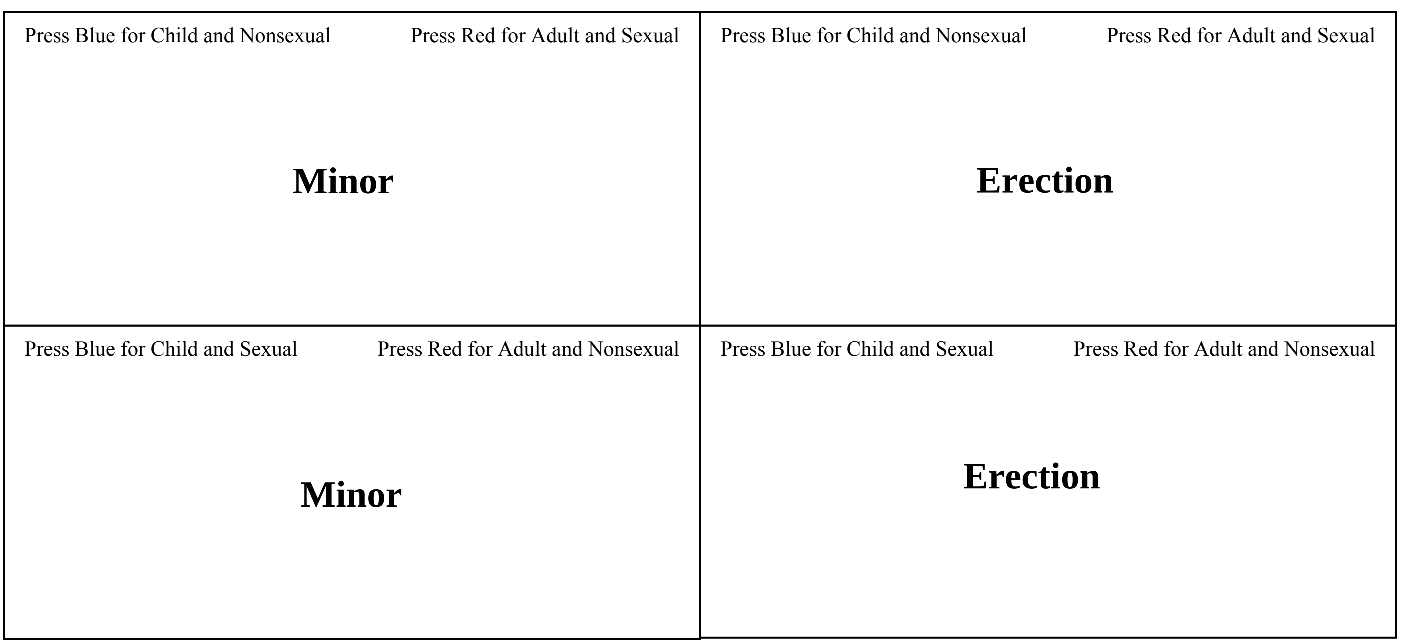


Figure 3: Four sample tasks presented to subjects during Phase 3; the upper panels show sample congruent task types and the lower panels show sample incongruent task types

The congruent and incongruent task blocks were presented in a randomised order. Subjects responded with either a blue or red key press within a 3000 ms response window. If subjects did not respond within the response window then the trial ended and the next trial began immediately. In this instance, the response was recorded as incorrect and the maximum response time of 3000 ms was recorded for that trial. Feedback was not given during the test trials. Subjects received the following experimental instructions for both the congruent and incongruent task blocks:

> In a moment some items will appear on this screen. Your task is to learn to press a blue or a red key on the keyboard when you see each of these items. Check the keyboard now to make sure you know where they are.
>
> You should use the instructions that will be presented at the top of this screen to help you decide which key to press.
>
> So, you should first look at the item in the centre of the screen and then use the rule at the top of the screen to help you make the correct response (i.e., press the blue or red key).
>
> Your object is to make as many correct responses as possible. You have only three seconds to respond to each item or your response will be recorded as incorrect, so you need to work fast!
>
> If you have any questions please ask the experimenter now.

Once the subject read and understood the instructions they clicked on a grey rectangle labelled *Begin* to proceed with the task. There was no inter-trial interval: tasks were presented immediately upon the production of a response or the end of the 3000ms response window, whichever came first.

Summary

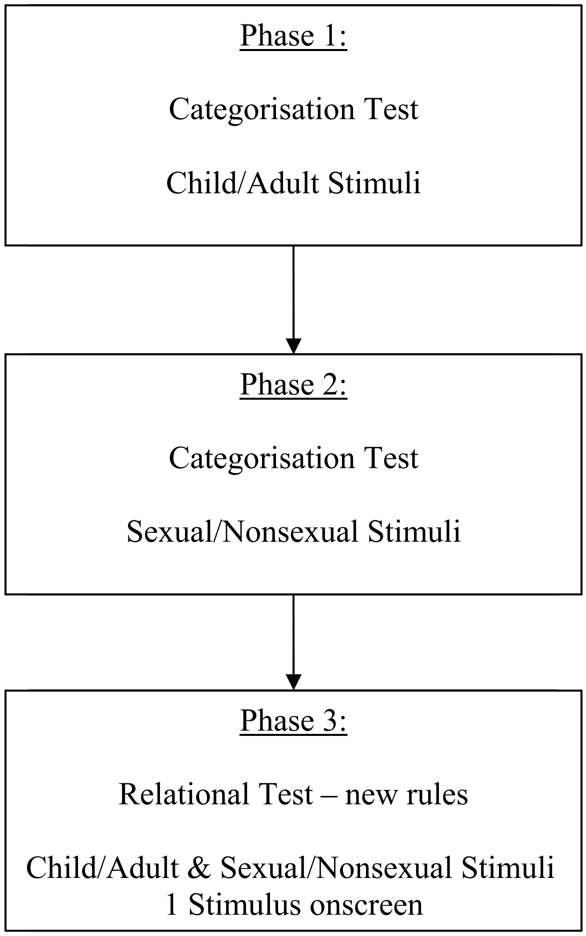


Figure 4: Procedure summary for Experiment 6

Results

Data consists of subjects' total accuracies and response latencies for both the congruent and incongruent task blocks of Phase 3. All subjects successfully reached criterion in the categorisation tasks (i.e., 14 correct responses on each task) thereby demonstrating recognition and successful categorisation of the experimental stimuli.

In Phase 3, all 20 subjects completed the required 160-trial test (80 congruent tasks and 80 incongruent tasks). Initially, the data for all subjects (male and female combined) was examined to explore an overall effect for all subjects. Figure 5 below shows the total response accuracies for all subjects on congruent and incongruent trials.

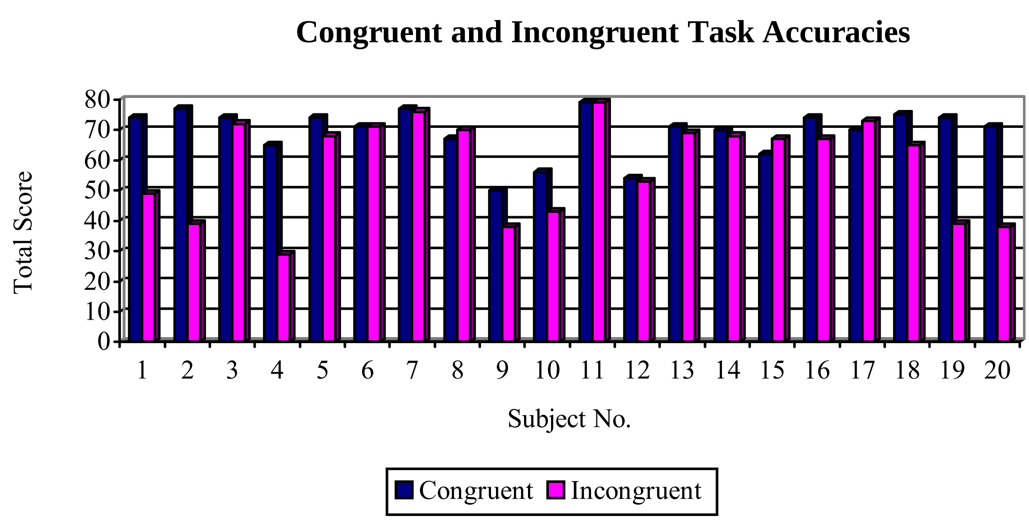


Figure 5: Total Response accuracies on congruent and incongruent task blocks for females (1-10) and males (11-20).

For the congruent task block the highest score was 79 (S1l; Male) while the lowest score was 50 (S9; Female). For the incongruent trials the highest score was 79 (again form S11; Male) and lowest was 29 (S4; Female). Seventeen of the 20 subjects scored higher on the congruent task block than on the incongruent task block. Of the three subjects who responded with greater accuracy on the incongruent task block, one subject was female (S8) and two were male (S's 15 & 17).The mean, for N=20, was M=67.75 for the congruent task block and M= 58.65 for the incongruent task block.

Overall, male response accuracies appear more consistent across congruent and incongruent task blocks as 8 males score above the group mean on the congruent task block and 7 males score above the group mean on the incongruent task block. Female response accuracies appear more varied across task blocks with 7 females scoring above the group mean on congruent task blocks and only five responding above the group mean on incongruent task blocks. A paired-samples t-test revealed a significant difference between congruent (M=69.75, Sd =7) and incongruent (M= 58.6, Sd =15.76) response accuracies for all subjects, where t= -3.375, df= 19, p<0.01.

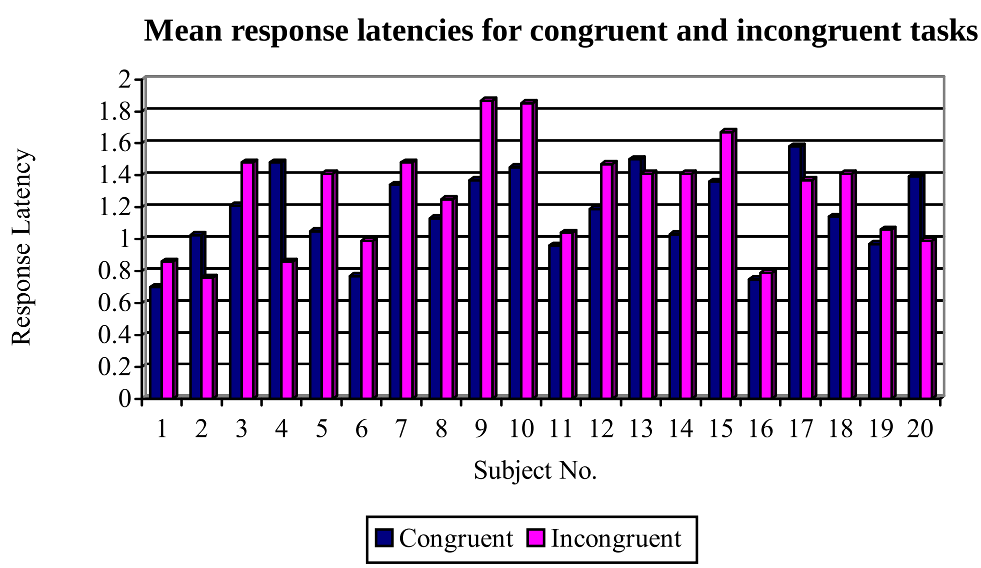


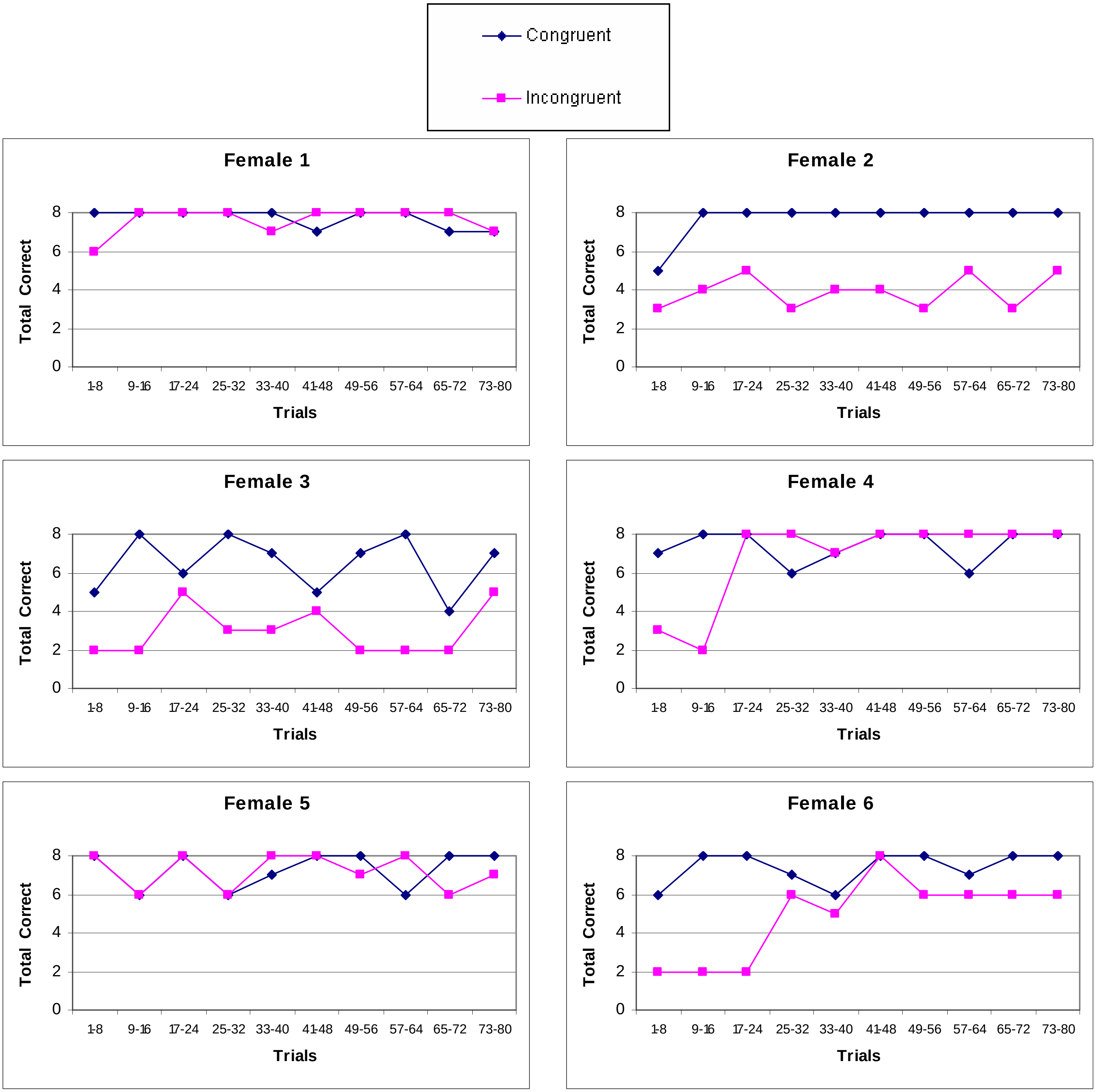
Figure 6: Mean congruent and incongruent task response latencies for females (1-10) and males (11-20).

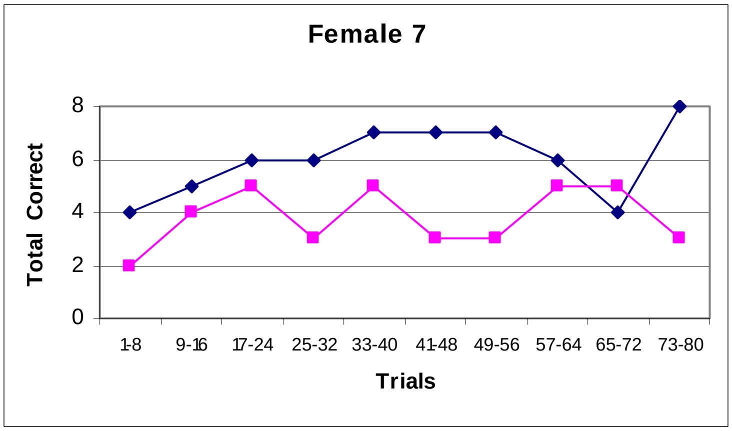
Figure 6 (above) shows the mean response latencies for all subjects on congruent and incongruent trial blocks. For the congruent trials the longest mean latency was 1.58 s

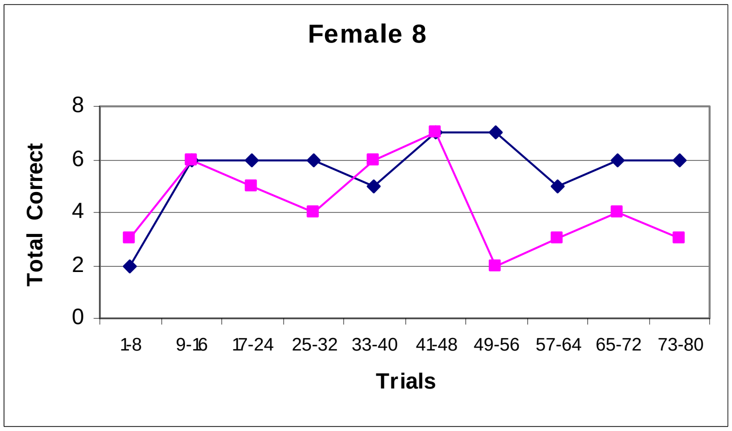
(S17; male) and shortest mean latency was 0.7 s (S1; female). For the incongruent task block the longest mean latency was 1.87 s (S9; male) while the shortest mean latency was .76 s (S2; female). Overall, 15 subjects showed a faster mean latency on the congruent task block than on the incongruent task block, with eight of these subjects being female and seven being male. However, a paired-samples t-test revealed no significant differences between congruent (M=1.17s, Sd=.26) and incongruent (M= 1.27s, Sd=.34) response latencies where t= 1.532, df= 19, p=.142.

Data was separated according to gender in order to determine if functional differences existed between the congruent and incongruent task blocks for either or both of these groups. For females, a paired-samples t test revealed a significant difference between congruent (M=69.5, Sd=7.3) and incongruent (M= 55.6, Sd=17.6) task response accuracies, where t= -2.893, df = 9 , $p \leq 0.05$. That is, females responded with greater accuracy on the congruent task block than on the incongruent task block. However males showed no differences in response accuracy congruent (M=70, Sd =7.1) and incongruent (M= 61.8, Sd=13.9) task blocks, where t= -1.817, df = 9, p=.103.

Response accuracies were examined more closely using a short trial block-by-trial block analysis. That is, responding was broken into blocks of 8 successive trials for each subject (See Figure 7 below). This allowed for an examination of any learning curves across congruent and incongruent task blocks for each individual subject.


Congruent
Incongruent
Female 1
Female 2
Female 3
Female 4
Female 5
Female 6
Total Correct
0 2 4 6 8
1-8 9-16 17-24 25-32 33-40 41-48 49-56 57-64 65-72 73-80
Trials


Female 7
Total Correct
0
2
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
57-64
65-72
73-80
Trials


Female 8
Total Correct
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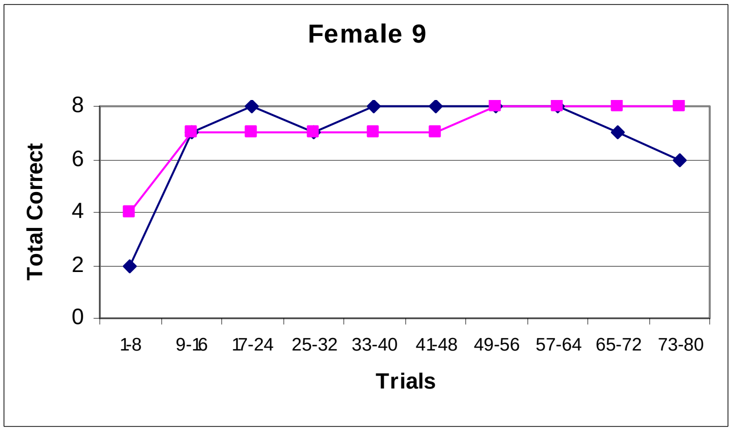
2
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
57-64
65-72
73-80
Trials


Female 9
Total Correct
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2
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
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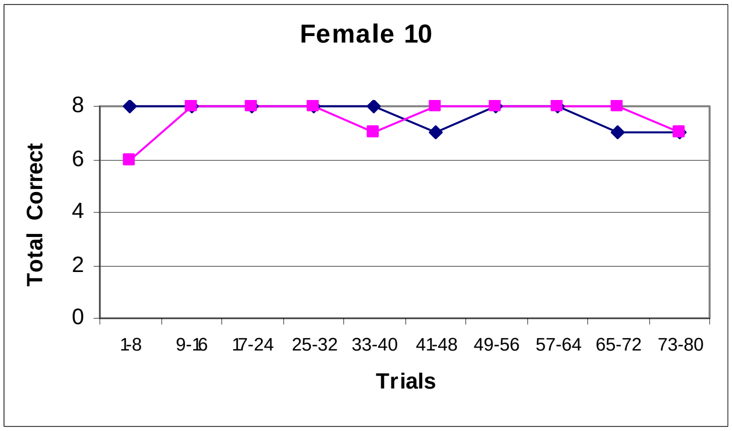
65-72
73-80
Trials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Total Correct
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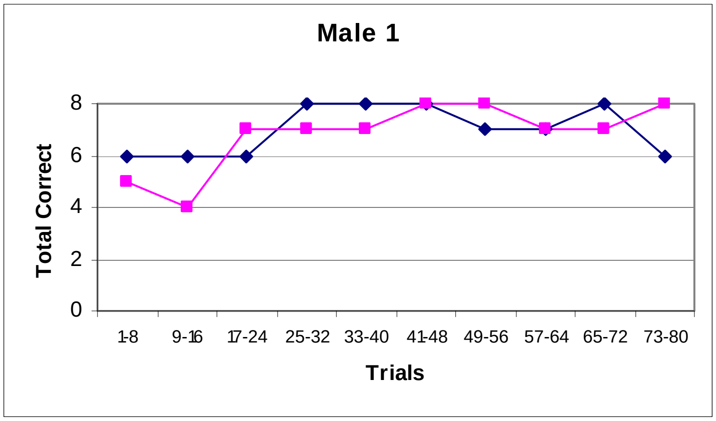
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
57-64
65-72
73-80
Trials


Male 1
Total Correct
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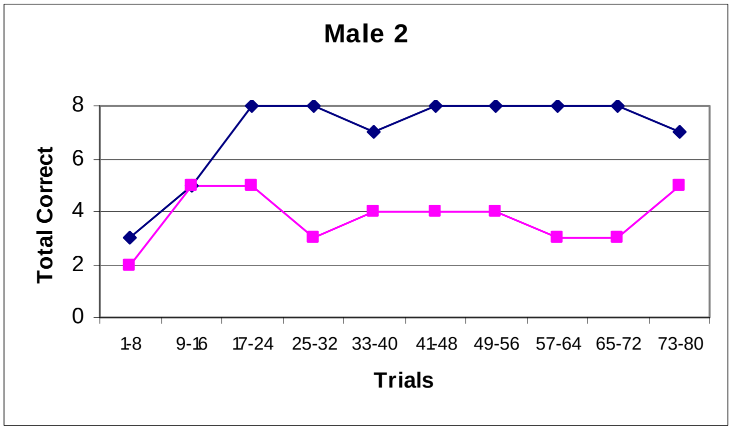
2
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
57-64
65-72
73-80
Trials


Male 2
Total Correct
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6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
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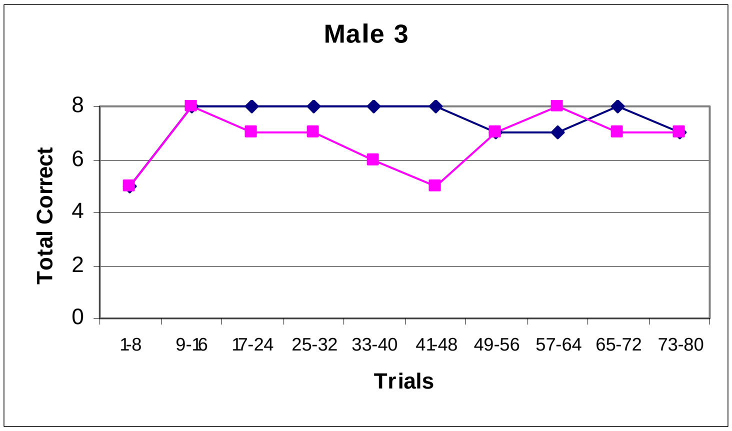
65-72
73-80
Trials


Male 3
Total Correct
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8
1-8
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17-24
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49-56
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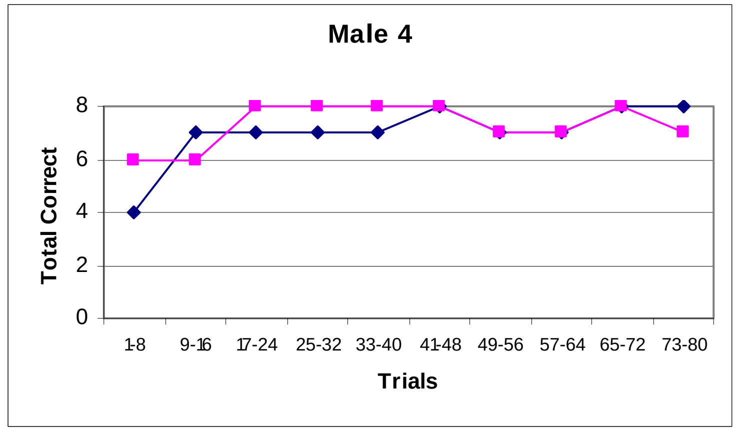
65-72
73-80
Trials


Male 4
Total Correct
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2
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
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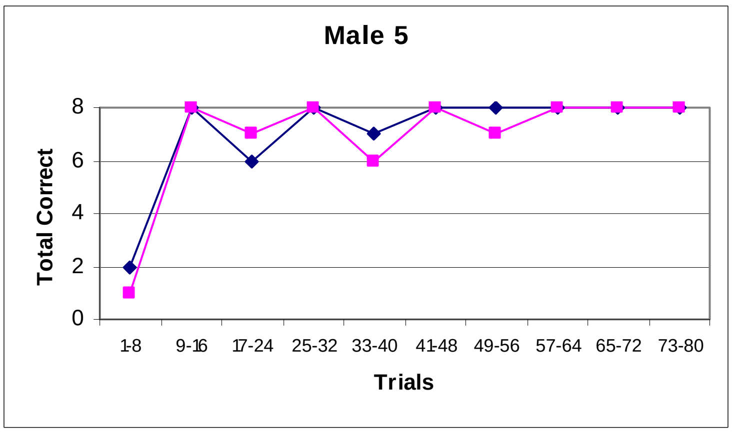
65-72
73-80
Trials


Male 5
Total Correct
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2
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
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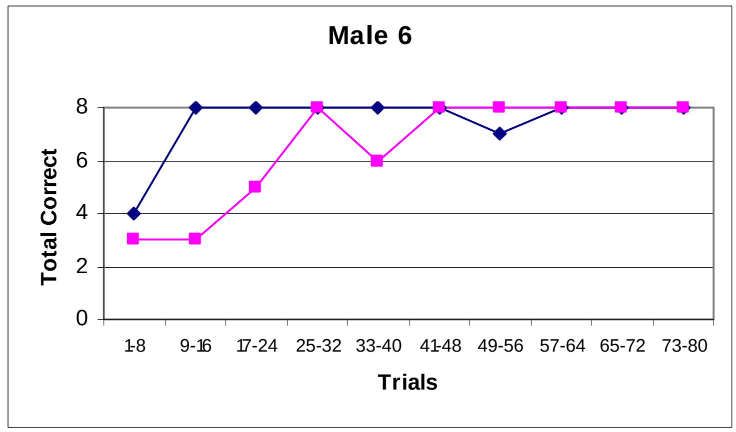
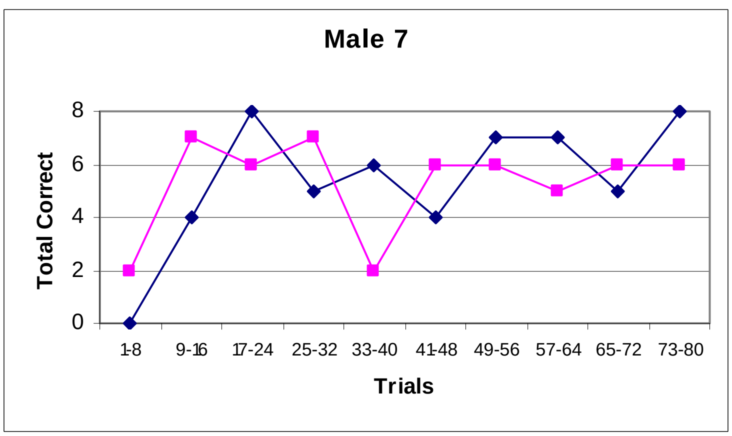
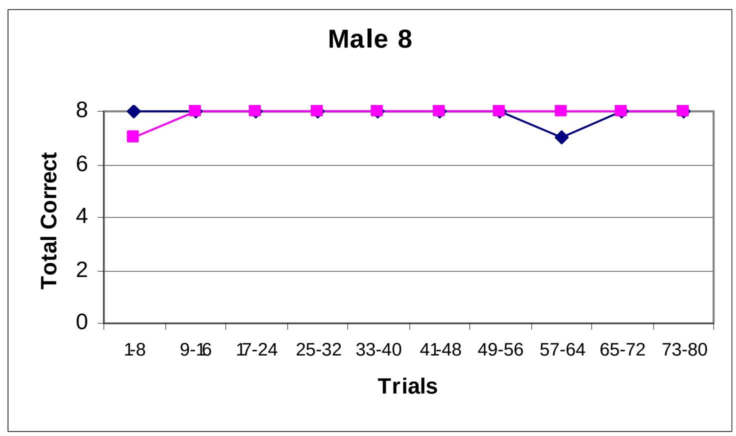
65-72
73-80
Trials


Male 6
Total Correct
0
2
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
57-64
65-72
73-80
Trials


Male 7
Total Correct
0
2
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
57-64
65-72
73-80
Trials


Male 8
Total Correct
0
2
4
6
8
1-8
9-16
17-24
25-32
33-40
41-48
49-56
57-64
65-72
73-80
Trials

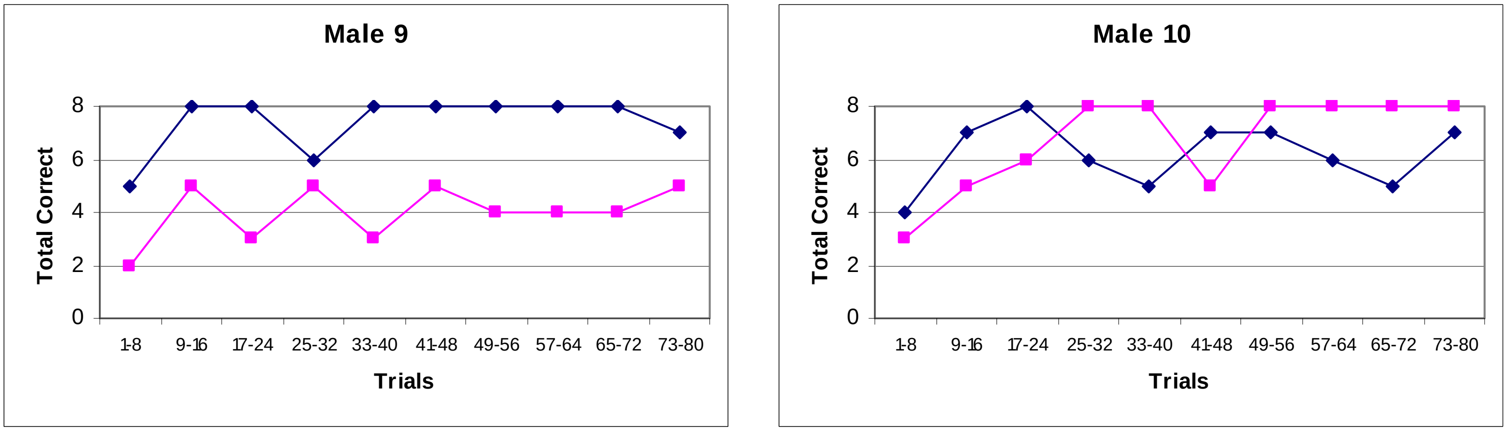


Figure 7: Total correct responses for successive eight-trial blocks for all subjects (Females 1-10 and Males 1-10) on both congruent and incongruent task blocks.

The individual response patterns shown in Figure 7 highlight that the majority of females (S1; S2; S3; S4; S6; S7; S8; S9; S10) and over half the males (S2; S3; S5; S6; S8; S9) demonstrate more accurate responding on congruent task blocks than on incongruent task blocks. Overall, the steepest curve in accurate responding occurs, for both congruent and incongruent blocks, between trials 1-24 for most subjects. However, the pattern of response acquisition appears to suggest that the congruent task trials steady out at a faster pace. For example, Female 9 shows consistent responding across both blocks but there is a steep learning curve evident for trials 1-16 on the congruent task block and trials 1-24 on the incongruent task block. For both males and females response accuracy appears to steady out around trial 40 with no major curves appearing thereafter. It can be suggested, on the basis of the individual response patterns, that the rate of acquisition was slowest for both congruent and incongruent task blocks during the first trial blocks. That is, these tasks involved the highest error rate, as might be expected of any early trials during an acquisition task.

Response acquisition patterns were also analysed for male and female groups on successive blocks of eight congruent and incongruent trials (see Figures 8A & 8B). That is, each eight trial block score was totalled for females and the mean calculated. Similarly, male scores were totalled for blocks of eight trials and the mean obtained.

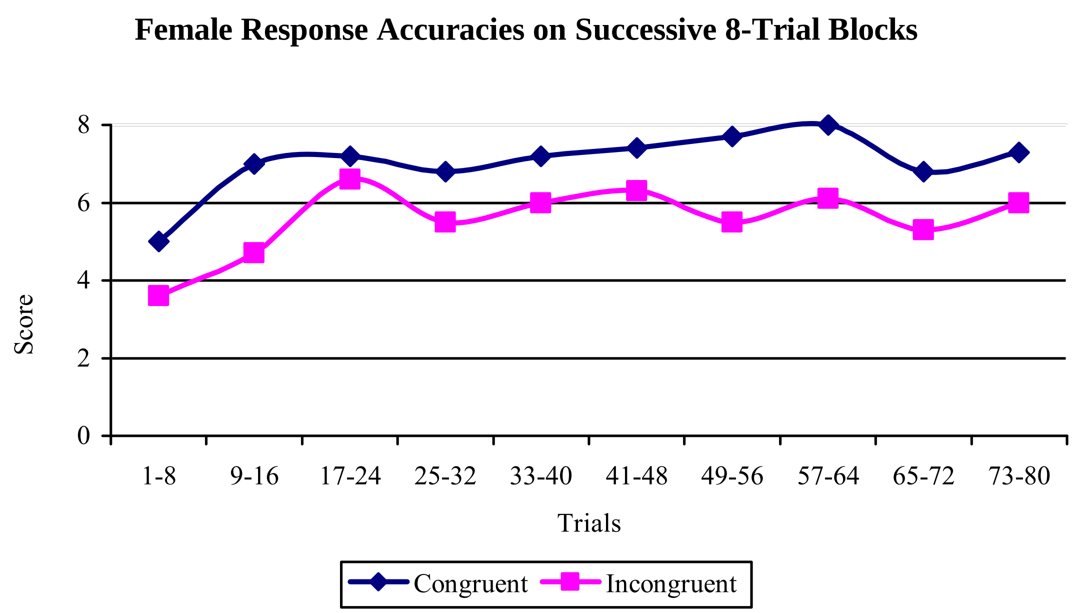


Figure 8A: Mean total congruent and incongruent task accuracies for females for each successive block of eight trials.

Figure 8A shows the mean congruent and incongruent task accuracies for all females in successive eight trial blocks. The pattern of responding appears consistent for both experimental blocks insofar as response accuracy on congruent task block was greater than response accuracy on incongruent task block. The sharpest increase in responding occurred for the congruent block from trials 1-16 and for the incongruent block between trials 1-24, as might be expected for early trials in any acquisition task. Trials 25-33 show a decline in accurate responding for both task blocks as do trials 65-72.

Male Response Accuracies on Successive 8-Trial Blocks

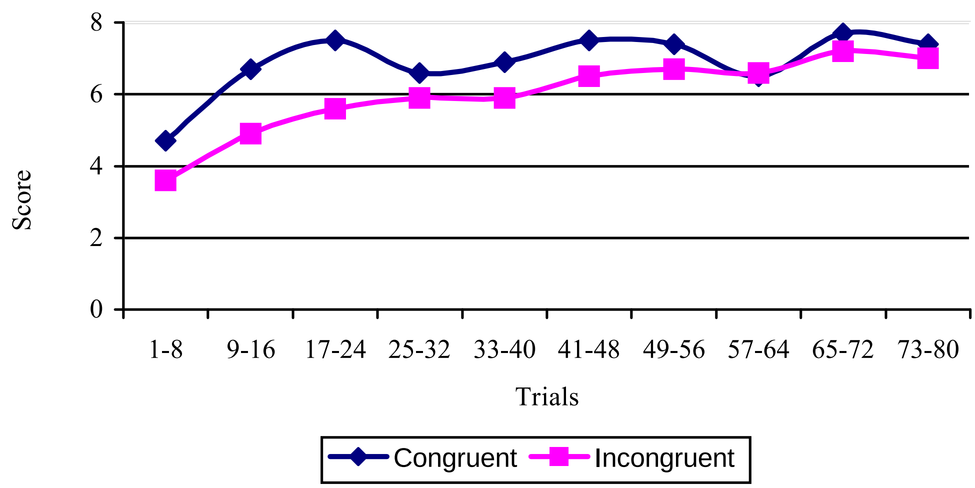


Figure 8B: Mean total congruent and incongruent task accuracies for males for each successive block of eight trials.

The figure above (Figure 8B) shows the acquisition of responses for males on the congruent and incongruent task blocks. Overall, for males, response accuracy on congruent trials was greater than response accuracy on incongruent trials. However, response patterns varied between congruent and incongruent task types. More specifically, several decreases in accuracy were seen during responses to the congruent task types. This indicates an inconsistent acquisition of responding on the congruent task block. However, accuracies on the incongruent task block improved steadily across the testing period with an initial sharp learning curve (i.e., trials 1-24) followed by a steady response acquisition.

Figure 9 highlights a response acquisition difference between the congruent and incongruent task blocks for all twenty subjects. The pattern of responding appears stable across time for both experimental blocks. Moreover, response accuracy on congruent trials is consistently greater than response accuracy on incongruent trials. The steepest curve in accurate responding occurs for both congruent and incongruent blocks between trials 1-24. Trials 25-33 show a decline in accurate responding before a smaller increase in accuracy and a plateau around trial 48. Clearly these acquisition rates parallel each other closely across the two task blocks indicating little functional difference between the task blocks for male and female subjects combined.

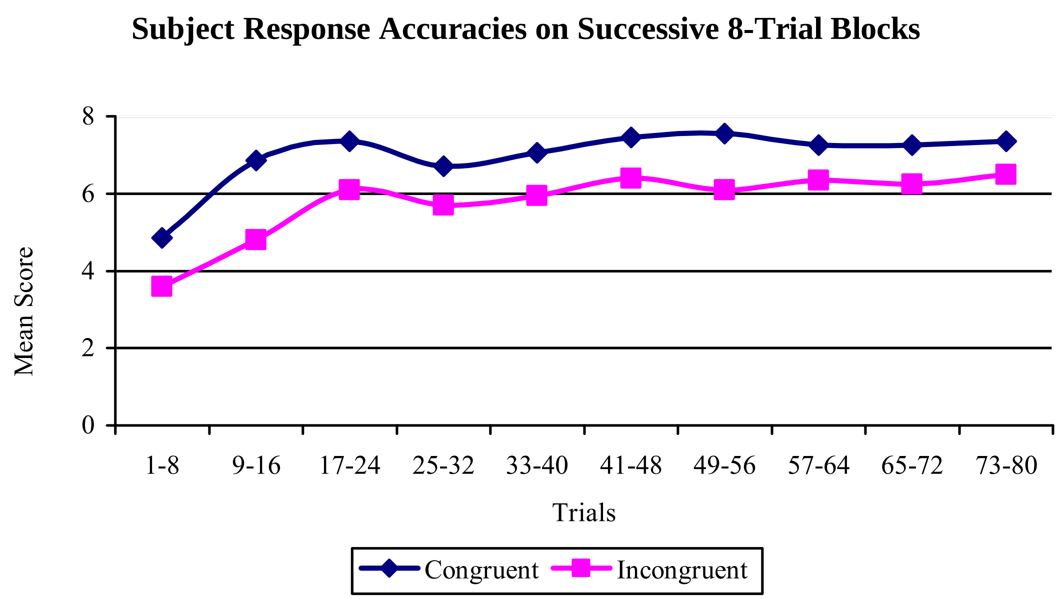


Figure 9: Mean total congruent and incongruent task accuracies for all subjects for each successive block of eight trials.

In the current experiment, response accuracies were also explored in terms of individual stimulus sets. Specifically, within a task block of 80 trials, 20 trials required subjects to respond to a single stimulus set directly. That is, for a congruent task block there were 20 trials where a child word appeared onscreen, 20 trials where an adult word appeared onscreen, 20 trials where a sexual word appeared onscreen and 20 trials where a nonsexual word appeared onscreen. Similarly, for an incongruent task block there were 20 trials where a child word appeared onscreen, 20 trials where an adult word appeared onscreen, 20 trials where a sexual word appeared onscreen and 20 trials where a nonsexual word appeared onscreen. Response accuracies for each of these individual stimulus trials were totalled for all subjects and the mean total calculated for female and male groups (See Tables 2A & 2B).

Table 2A & 2B: Total mean correct responses out of 20 for each of the individual stimulus items across congruent and incongruent task blocks for female and male subjects.

Female

Stimulus in Congruent Task Block	Mean Correct	Standard Deviation	Stimulus in Incongruent Task Block	Mean Correct	Standard Deviation
Child	18.6	1.17	Child	15.3	6.14
Adult	19.9	6.08	Adult	16.8	3.88
Sexual	18.2	1.31	Sexual	11.2	7.43
Nonsexual	16.8	2.39	Nonsexual	12.4	7.15

Male

Stimulus in Congruent Task Block	Mean Correct	Standard Deviation	Stimulus in Incongruent Task Block	Mean Correct	Standard Deviation
Child	18.8	1.31	Child	14.8	6.54
Adult	16.5	4.22	Adult	17.9	1.91
Sexual	18.1	1.66	Sexual	13.3	7.24
Nonsexual	15.8	5.41	Nonsexual	16.6	1.78

Table 2A above shows the response accuracies for each of the four individual stimulus sets across congruent and incongruent task blocks for females. As is apparent from the table, females responded with greater accuracy on all of child, adult, sexual and nonsexual stimulus tasks on the congruent task block than on the incongruent task block. The most notable of these differences was apparent with sexual stimuli where M = 18.2 for the congruent task block and M= 12.2 on the incongruent task block. That is, when females were asked to respond to a sexual stimulus, and sexual and adult shared a common response function, females responded with greater accuracy than when they were asked to respond to a sexual stimulus and sexual and child shared a common response function.

Similarly, Table 2B above shows the response accuracies for each of the four individual stimulus sets across congruent and incongruent task blocks for males. As is apparent from the table, males responded with greater accuracy on the congruent task block for child stimulus tasks and sexual stimulus tasks than on the incongruent task block. However, males responded with greater accuracy to adult stimuli and nonsexual stimuli during the incongruent task blocks. That is, when males were asked to respond to a nonsexual stimulus, and nonsexual and adult shared a common response function, males responded with greater accuracy than when they were asked to respond to a nonsexual stimulus and nonsexual and child shared a common response function. Similarly, when males were asked to respond to an adult stimulus, and adult and nonsexual shared a common response function, males responded with greater accuracy than when they were asked to respond to an adult stimulus and adult and sexual shared a common response function.

In addition to the above analysis of responses to individual stimuli, response accuracies to the individual stimuli comprising a rule can be combined to achieve an overall response accuracy for both tasks relating to that rule. For example, for a congruent rule (i.e., Press blue for child and nonsexual) we can total the response accuracies to all child and all nonsexual stimulus tasks for that rule and compare that total to response accuracies to the same stimuli combined under an incongruent rule (i.e., response accuracies to all child and nonsexual stimulus trials under the rule “Press blue for child and sexual). This technique allows us to examine the combined acquisition rate of a common response function to pairs of congruous and incongruous stimuli. It should be noted, that this strategy allows us to extract fluency rates for the implicit association of two stimuli (vis-à-vis sharing a common response function) that was immediately apparent in earlier version of this test (e.g., the Watt et al. paradigm). For instance, in order to examine the compatibility of child and sexual stimuli for subjects we can compare response accuracies to child and sexual terms combined in one task block compared to combined response accuracies to the same two stimuli in the other task block. Similarly, to examine the compatibility of child and nonsexual stimuli for subjects we can compare response accuracies to child and nonsexual terms combined in one task block compared to combined response accuracies to the same two stimuli in the other task block. This technique also allows for the examination of the compatibility of adult and nonsexual terms across task blocks and adult and sexual terms across task blocks. This analysis is presented for males and females in Tables 3A and 3B below.

Table 3A & 3B: Mean responses for combined stimuli comprising a rule across congruent and incongruent task blocks for male and female subjects.

Female

Combined Stimuli Congruent Task Block	Mean Correct	Standard Deviation	Combined Stimuli Incongruent Task Block	Mean Correct	Standard Deviation
Child/sexual	36	3.46	Child/sexual	26.3	12.17
Child/nonsexual	33.6	6.64	Child/nonsexual	27.7	9.82
Adult/sexual	34.2	6.51	Adult/sexual	28	8.83
Adult/nonsexual	32.7	6.7	Adult/nonsexual	29.4	9.7

Male

Combined Stimuli Congruent Task Block	Mean Correct	Standard Deviation	Combined Stimuli Incongruent Task Block	Mean Correct	Standard Deviation
Child/sexual	36.9	2.7	Child/sexual	28.3	11.9
Child/nonsexual	35.6	2.2	Child/nonsexual	30.9	7.8
Adult/sexual	34.6	5.4	Adult/sexual	31.1	6.7
Adult/nonsexual	32.2	6.3	Adult/nonsexual	33.7	5.6

As is evident from Table 3A, females responded with greater accuracy for all of the combined stimuli (i.e., child/sexual, child/nonsexual, adult/sexual and adult/nonsexual) on the congruent rule task block than on the incongruent rule task block. The differences across task blocks for these combined stimuli were analysed statistically. Females showed a significant difference in responding when the child and sexual stimuli were combined on the congruent task block (M= 36) compared to the child and sexual stimuli on the incongruent task block where (M= 26.3; $t = 2.413$, $df = 9$, $p<0.05$). This suggests that when a sexual or a child stimulus appeared under the rules "Press blue for child and nonsexual, press red for adult and sexual" females responded with greater accuracy than when a sexual or a child stimulus appeared under the rules "Press blue for child and sexual, press red for adult and nonsexual". No significant differences were observed for any of the remaining combined stimuli when compared across task blocks.

For males (see Table 3B), responses for the combined stimuli; child/sexual, child/nonsexual and adult/sexual, were greater on the congruent rule task block than on the incongruent rule task block. Responses to the combined stimuli adult and nonsexual were more accurate during the in congruent task block. Again, all differences across task blocks for these combined stimuli were analysed statistically, but no differences emerged.

In sum, the findings of Experiment 6 suggest that there was more effective acquisition of common response functions on congruent task blocks than on incongruent task blocks. More specifically, there was more effective acquisition of common response functions to child and nonsexual stimuli than to child and sexual stimuli. Similarly, there was more effective acquisition of common response functions to adult and sexual stimuli than to adult and nonsexual stimuli. Conversely, there was more effective acquisition of different response functions to child and nonsexual stimuli than to child and sexual stimuli. Finally, there was more effective acquisition of different response functions to adult and nonsexual stimuli than to adult and sexual stimuli. This pattern of responding was precisely what was predicted in light of the literature reviewed in the introduction and suggest that this process may indeed form the basis for a new form of behavioural testing. However, while overall differences were apparent for response accuracy across task blocks there were no emergent differences between response latencies on congruent and incongruent relations.

Gender differences were also apparent in the current study as females responded with significantly greater accuracy on the congruent task block than on the incongruent task block where males showed no differences. In addition, females demonstrated differences in response accuracies to the combined individual stimuli comprising a rule. That is, when a sexual or a child stimulus appeared under the congruent task rule females responded with greater accuracy than when a sexual or a child stimulus appeared under the incongruent task rule. Such differences were not evident in male response patterns. These findings were also expected given the apparent differences in male and female verbal discourse that emerged in Experiments 2 and 5 of the current thesis.

Discussion

The current experiment sought to assess rate of acquisition of common response function to words considered compatible for a normal population compared to words considered incompatible for a normal population. Put simply, the current procedure examined the rate of acquisition of different response functions for word considered incompatible compared to those considered compatible. The findings of the current study suggest that, overall, that there was more effective acquisition of common response functions on congruent task blocks than on incongruent task blocks. More specifically, there was more effective acquisition of common response functions to child and nonsexual stimuli than to child and sexual stimuli. Similarly, there was more effective acquisition of common response functions to adult and sexual stimuli than to adult and nonsexual stimuli. Conversely, there was more effective acquisition of different response functions to child and nonsexual stimuli than to child and sexual stimuli. Finally, there was more effective acquisition of different response functions to adult and nonsexual stimuli than to adult and sexual stimuli. These findings were expected in light of the relevant literature on the topic (See Roche et al., 1997: and Tyndall et al., 2004). That is, we should expect to see a slower acquisition of stimulus functions for members of distinct verbal relations (i.e., child stimuli and sexual stimuli) compared to common verbal relations (i.e., child stimuli and nonsexual stimuli).

There were apparent gender differences found using the current test procedure. That is, females responded with significantly greater accuracy when the rules instructed subjects to “press blue for child and nonsexual, press red for adult and sexual” than when the rules instructed subjects to “Press blue for child and sexual, press red for adult and nonsexual". Male response patterns were examined across congruent and incongruent task blocks but no differences emerged. Given that females showed differences in responding across task blocks and males did not, it is likely that the overall group effect (N=20) for differences across congruent and incongruent task blocks may be primarily as a result of female response patterns.

Furthermore, females demonstrated differences in response accuracies to the combined individual stimuli comprising a rule. That is, when a sexual or a child stimulus appeared under the congruent task rule females responded with greater accuracy than when a sexual or a child stimulus appeared under the incongruent task rule. Such differences were not evident in male response patterns. Experiments 2 and 5 of the current thesis have suggested that females may have difficulty combining the words child and sexual in their verbal repertoires. More specifically, Experiment 2 showed that females could not easily derive an equivalence relation in which the words *child* and *sexual* participated. Perhaps it is not surprising, therefore, that Experiment 5 showed that females responded with greater accuracy to where child terms were paired with nonsexual terms than where child terms were paired with sexual terms. Although we cannot compare findings across different procedures it possible that the current test measure appears sensitive to social and personal histories also measured in Experiment 2 using a more cumbersome procedure.

One criticism of the current procedure is that it could have, and perhaps should have, been developed in laboratory analogues as in previous experiments, before being employed in a more applied study. A laboratory analysis allows for clearer inspection of the controlling variables and eliminates extraneous sources of control that can be expected when dealing with real world stimuli. More specifically, there is no way of knowing what functions the particular word stimuli had for the subjects employed here. At best the experimenter could guess at the probable meanings of the words. The categorisation test merely checks for correct classification of the words but cannot check for the emotional functions or other relational properties of the stimuli. This is always the case for real world stimuli and it is precisely why previous experiments reported here often relied on laboratory analogues to observe behavioural processes. With clear control over non-socially established stimuli individual stimulus effects should prove more apparent. In the next chapter, such an analogue is pursued in order to see if clearer effects can be observed for this test.

The novel test format presented in the current experiment also showed a marked improvement in accuracy by comparison to the previous experiments in the current thesis. That is, Experiment 6 showed the mean congruent task response accuracy to be 86.5% across all twenty subjects. Recall from Experiment 5, the mean congruent task response accuracy was just above two thirds at 68.6%. Of course, we cannot make a true comparison across test measures as they differ somewhat in format and even in process. Nevertheless, an 86.5% accuracy rate would appear acceptably distant from chance levels to constitute clear stimulus control over responding.

Also of note is the fact that the current novel test format is topographically similar to that of the Implicit Association Test (IAT; Greenwald, McGhee & Schwartz, 1998). In the IAT, a subject responds to a series of items that can be classified into four categories; usually two representing a concept and two representing an attribute. In the context of the current stimuli, *child* and *adult* would represent concepts with *sexual* and *nonsexual* representing attributes. Subjects are asked to respond rapidly with a right-hand key press to items representing one concept and one attribute (e.g., child and nonsexual), and with a left-hand key press to items from the remaining two categories (e.g., adults and sexual). Subjects then perform a second task in which the requirements are switched (e.g., such that child and sexual share a response and adult and nonsexual share a response). The IAT records the latencies and accuracies of responses to these two tasks. These measures are interpreted in terms of association strengths by assuming that subjects respond more rapidly when the concept and attribute sharing the same response are pre-experimentally strongly associated (e.g., child and nonsexual) than when they are weakly associated (e.g., child and sexual). The IAT claims to measure hidden prejudices regarding race, age and gender, etc., by recording the speed with which subjects' associate words and images when responding to them on a computer screen.

Many criticisms have been levelled at the IAT and most of which will be discussed at length in the following chapters. Most topically, however, is the criticism surrounding the core processes of the IAT. That is, the IAT is not considered to be functionally understood and many questions remain regarding its core processes (De Houwer, 2001; Govan & Williams, 2004; Steffens & Plewe, 2001). On the other hand, the current test format has its roots planted firmly within a behavioural framework with known behavioural processes. Given the topographical similarity between the IAT and the current test, we are now in a position to directly examine the IAT in terms of the process identified here. The next chapter addresses this issue whilst also providing a laboratory analogue of the current test procedure using arbitrary laboratory created stimuli.

Chapter 6

Testing a behavioural model of the Implicit Association Test

Experiment 6 of the current thesis presented a subtle, easily-administered test measure based on functional-analytic research. In addition, the current novel test format is topographically similar to that of the Implicit Association Test (IAT; Greenwald, et al., 1998). Therefore, the current chapter seeks to directly examine the IAT in terms of behavioural processes whilst also providing a laboratory analogue of the current test procedure using arbitrary laboratory created stimuli. Firstly, a detailed account of the IAT as a measure of implicit attitudes will be provided.

The Implicit Association Test (IAT) was designed to determine implicit attitudes believed to be beneath our awareness. In contrast to the vast number of explicit attitude measures, the IAT was thought capable of overcoming social-desirability biases often presented when questioning individuals on their prejudicial attitudes. Therefore the IAT is said to measure hidden prejudices regarding race, age and gender, etc., by recording the speed with which subjects associate words and images when forced to respond to them on a computer screen. Specifically, a subject responds to a series of items that can be classified into four categories; usually two representing a concept, such as flowers and insects, and two representing an attribute, such as pleasant and unpleasant. Subjects are asked to respond rapidly with a right-hand key press to items representing one concept and one attribute (e.g., insects and pleasant), and with a left-hand key press to items from the remaining two categories (e.g., flowers and unpleasant). Subjects then perform a second task in which the requirements are switched (e.g., such that flowers and pleasant share a response and insects and unpleasant share a response). The IAT records the latencies and accuracies of responses to these two tasks. These measures are interpreted in terms of association strengths by assuming that subjects respond more rapidly when the concept and attribute sharing the same response are pre-experimentally strongly associated (e.g., flowers and pleasant) than when they are weakly associated (e.g., insects and pleasant).

Greenwald et al. (1998) suggested the following thought experiment to help illustrate the IAT procedure. Imagine an experiment in which a series of male and female faces are shown, and to which the subject must respond as rapidly as possible by saying "hello" if the face is male and "goodbye" if it is female. Now imagine a second task in which the subject is shown a series of male and female names, to which he or she must respond rapidly with "hello" for male names and "goodbye" for female names. The faces and names are unambiguously male or female and so the tasks are relatively easy. However, now imagine that the subject is asked to perform both of these discriminations alternately. That is, a series of alternating faces and names would be shown, and the subject must respond "hello" if the face or name is male and "goodbye" if the face or name is female. This (congruent) task is somewhat more difficult, but not as difficult as one remaining task type. Specifically, a small variation of the foregoing task is then administered in which the first component is the same as before (e.g., "hello" to male faces, "goodbye" to female faces), but the second component is reversed. That is, subjects are now required to respond "goodbye" for male names, "hello" for female names. While these two latter task types are on their own relatively easy, when all four tasks are combined (i.e., "hello" to male face or female name and "goodbye" to female face or male name), the resultant (incongruent) task is extremely difficult. Subjects make more errors on these latter task types and in an attempt to reduce errors subjects respond considerably more slowly. Greenwald and colleagues assert that the expected difficulty of the task with the reversed second discrimination follows from the likely existence of strong pre-experimental associations of male names with male faces and female names with female faces. The attempt to map the same two responses ("hello" and "goodbye") in opposite ways onto the two genders is resisted by well-established associations that link the face and name domains.

Greenwald et al., (1998) have used the IAT to detect evaluative differences (e.g., flower vs. insect), expected individual differences in evaluative associations (Japanese and pleasant vs. Korean and pleasant for Japanese vs. Korean subjects), and consciously “repressed” evaluative differences (Black and pleasant vs. White and pleasant for self-described unprejudiced White subjects). However, the IAT is shrouded in controversy concerning its core processes. Specifically, the creator of the test insists that the test measures unconscious (implicit) biases towards stimulus items, but this claim is made in the absence of empirical data. In addition, since its advent only nine years ago both the validity and reliability of this measure have gradually been called into question even by those most in favour of its use (DeHouwer, 2006). Despite this, researchers continue to work within a hypothetico-deductive social-cognitive paradigm, rather than a functional-analytic experimental one.

Although the IAT is well established in the literature, it may be best suited to particular types of research questions. Specifically, in their original presentation of the IAT, Greenwald et al. (1998) recognised that the IAT offers a good measure of implicit cognition for dichotomous concepts such as race (e.g., Black vs. White) but is less well suited for measuring attitudes about target concepts that are not dichotomous (Nosek & Banaji, 2001). In addition, even for dichotomous concepts, interpreting IAT results is often difficult. As Brendl, Markman and Messiner (2001) indicated, it is difficult to determine if an IAT score reflects a positive attitude towards the target concept or a negative attitude towards the comparison concept. For example, consider a person who responds faster when responding in the same way to "White" and "Good" and also to "Black" and "Bad" compared to the speed at which they respond in the same way to "White" and "Bad" and "Black" and "Good". The question now arises as to whether this person could be considered to hold a pro-White attitude or an anti-Black attitude? One way in which to examine sources of control in such a test performance is to examine response patterns to each of the task types on a trial by trial basis. However, the IAT scoring algorithms (Greenwald, Nosek, & Banaji, 2003) do not recommend such a strategy. Thus, social cognitivists employing the IAT are unlikely to ask fundamental questions regarding such stimulus control issues.

Divergence between IAT and explicit attitude measures suggests that the IAT may be a useful new tool for assessing implicit verbal practices. However, concerns have been raised with regard to the absence of a theoretical account of the core processes at work in the IAT (De Houwer, 2001, 2006; Karpsinki & Hilton, 2001; Steffens, & Plewe, 2001). Furthermore, the correlation between the IAT and other implicit measures (e.g., stroop tasks; Stroop, 1935; the Simon task; DeHouwer, 2003) has been called in to question (e.g., Karpinski & Hilton, 2001; Olson & Fazio, 2003). Another concern relates to the ability of the IAT to predict overt behaviour as well as explicit measures of a single attitudinal construct (Karpinski & Hilton, 2001; Olson & Fazio, 2003). Furthermore, the familiarity of the stimuli employed has been identified as a possible confound (Brendl, Markman, & Messner, 2001; Dasgupta, McGhee, Greenwald, & Banaji, 2000). Specifically, Brendl, Markman and Messner (2001) found that participants more readily associated unpleasant words with non-words than insects (thought to be largely negative for most people). The authors suggested that participants more readily associate pleasantness with familiar items. This may perhaps account for why many, though not all African Americans exhibit an implicit evaluative preference for whites relative to blacks (Livingston, 2002). That is, most Americans live in a society where the media predominantly portrays whites as the dominant class and provides more white than black role models for the youth of the nation. Thus, familiarity with white culture may result in some black people showing an unconscious preference for white over black in an IAT. The current behavioural research may reveal some clues as to the core processes involved in IAT performances and in so doing help to address many of the foregoing issues from a behavioural perspective.

The current chapter aims to construct a functional-analytic model of the Implicit Association Test. A suggested approach to the IAT based on the concept of derived relations was first proposed by Roche et al., (2005). These authors suggested that from a behavioural perspective the IAT is a measure of subjects' fluency with the relevant verbal categories and their degree of experience at juxtaposing members of those verbal categories. More specifically, the four verbal categories employed in a typical IAT are conceived as equivalence classes containing everyday words and objects. It is argued that higher order equivalence relations (see Wulfert, Greenway, & Dougher, 1994) or relations between equivalence relations (see Stewart, Barnes-Holmes, Roche, & Smeets,

2001) often obtain in the natural environment. For instance, for a black racist individual the verbal classes *White* and *Bad* might participate in a further higher order equivalence relation that we may call “things I don’t like”. According to Roche et al., (2005) the IAT works by measuring the ease with which a common response function (e.g., press the left key) can be established for two or more members of this higher-order equivalence relation compared to members of different and unrelated equivalence relations (e.g., *White* and *Good*). From this perspective, the IAT functions as a subtle or implicit test for derived relations.

It may help the reader at this point to consider a detailed example of verbal fluency as conceived in the equivalence-based approach to the IAT. Consider, the example of an experienced civil rights lawyer who has sufficient knowledge of both black and white offenders (e.g., incarcerated individuals, members of the Ku Klux Klan) and non offenders (e.g., professional colleagues, friends). For this individual, many pleasant and unpleasant examples of both white and black persons are accessible in their language repertoire. Thus, this individual may develop a level of verbal skill in responding to black and white people of all kinds that he or she may well be competent at juxtaposing unpleasant/pleasant and black/white verbal classes with equal fluency and accuracy on an IAT (e.g., the term 'good’ can be associated with either a black or white face with equal ease and speed). However, an individual displaying a racist bias will likely find it very difficult to classify a given race in any other way than a negative one (e.g., a white face may be easily associated with 'bad' but not with 'good'). A test such as the IAT that assesses categorisations of this kind may be sensitive to an individual’s skills at various verbal categorisations, and may therefore be used as an indicator of past (verbal) behaviour. Importantly, this behaviour may or may not reflect personal attitudes or affective states or dispositions, but merely verbal practices or social categorisation more generally. Thus, a behavioural analysis shifts the core IAT processes from the mysterious unconscious of the individual into a history of verbal and social interaction. This shift renders the implicit explicit and may now shed light on the core processes that are at work in the IAT.

One previous behavioural study has been published that attempted to generate an account of the IAT in terms of respondent processes and the juxtaposition of unrelated stimulus classes in the IAT test format. Specifically, Mitchell, Anderson, and Lovibond (2003) taught a group of subjects the 'meanings' of four non-words. Two of these meanings were affectively positive, and two were affectively negative. The researchers found evidence for the transfer of affect in an IAT. That is, the non-words given pleasant meanings in training were more easily categorized with pleasant than unpleasant personality characteristics, compared to non-words given unpleasant meanings.

More recently, O' Toole, Barnes-Holmes and Smyth (in press) have applied the IAT as a tool for measuring the phenomenon known as the transfer of functions effect. This effect refers to the widely observed fact that when a particular behavioural function is established for one of the stimuli in an equivalence relation, the function often transfers to the remaining class members without further training (Barnes, 1994). For instance, if a stimulus C in an equivalence relation is paired with an aversive stimulus such as electric shock, then the B and A stimuli in that relation may also elicit similar responses (see Dougher, Auguston, Markham, Greenway, & Wulfert, 1994, for empirical evidence). This transfer of functions effect has been demonstrated with a wide range of operant and respondent behaviour (e.g., Barnes & Keenan, 1993; deRose, McIlvane, Dube, Galpin, & Stoddard, 1988; Dougher et al., 1994; Dougher, Perkins, Greenway, Koons, & Chiasson, 2002; Hayes, Kohlenberg, & Hayes, 1991; Roche & Barnes, 1997; Roche, Barnes-Holmes, Smeets, Barnes-Holmes, & McGeady, 2000).

In the O'Toole et al. study, subjects were trained to form four, four-member equivalence classes (i.e., A1- B1- C1-D1; A2- B2- C2- D2; A3- B3- C3- D3; A4- B4- C4- D4). During equivalence training, positive and negative evaluative functions were attached to the four A stimuli (A1, A2, A3, A4). A negative evaluative function was established for A1/A2 and a positive evaluative function was established for A3/A4. The transfer of evaluative functions to directly and indirectly related members of the equivalence classes (i.e. B, C, and D stimuli) was measured using an Implicit Association Test (IAT). During congruent test blocks, subjects were required to press the same response key for target words that were related to those A stimuli that possessed similar evaluative functions (A1/A2-left key & A3/A4-right key). During incongruent test blocks, subjects were required to press the same response key for target words that were unrelated to those A stimuli and that possessed different evaluative functions (A1/A4-left key & A2/A3-right key). Results showed that all eight participants, who passed a matching-to-sample equivalence test following the IAT, responded more rapidly on congruent relative to incongruent test blocks. Their findings suggest that an IAT effect may emerge from formally untrained relations. However, O' Toole et al. failed to provide a functional analysis of the processes underlying the IAT insofar as real words were employed as stimuli and the IAT merely measured the extension of the IAT effect through equivalence relations. In effect, the O'Toole et al. study did not generate an IAT effect from the ground up using entirely laboratory based stimuli and stimulus functions.

The current chapter adopts an inductive functional-analytic approach to modelling the IAT effect from the ground up. Subjects were exposed to a series of arbitrary stimulus associations and training in a network of derived relations before being exposed to a version of the IAT using these stimuli. Such a strategy will establish whether or not an IAT test result can be obtained simply on the basis of relations and stimulus functions established by the experimenters. If this were to be the case this outcome would further strengthen the current position that the IAT does not measure attitudes or biases per se but rather a history of stimulus associations.

To achieve this, the first experiment exposed fifteen subjects to a respondent conditioning procedure in which each of two nonsense syllables printed in blue and red font will be paired with a sexual or aversive visual image, respectively. Subjects were then exposed to an equivalence training procedure leading to the formation of two three-member equivalence relations, each containing one of the conditioned stimuli as A stimuli. An IAT-type test consisting of red, blue, sexual, and aversive images was then presented to subjects to determine if an IAT-type effect can be established using respondent processes alone. Subjects were then exposed to a more complex equivalence-based IAT-type test consisting of sexual and aversive images and all members of the trained equivalence relations presented in black font. In the following experiments, attempts were made to examine the possibility that the IAT effect is malleable through the manipulation of the relevant verbal relations. A final experiment tested the idea that the IAT effect can be generated using the current model even when subjects are not required to explicitly derive relations following equivalence training.

Method

Subjects

Fifteen subjects (6 males and 9 females) all acquaintances of the experimenter, aged from18 – 62 years participated in the current study. Subjects were informed that they would be participating in a four-phase word-association test, which would take approximately one hour to complete.

Apparatus and Stimuli

All four phases of the experiment were presented to subjects on an Apple iMac 400 MHz with a 15” monitor. Stimulus presentations were controlled using the software package Psyscope® (Cohen, MacWhinney, Flatt, & Provost, 1993) which also recorded all response accuracies and latencies. Two coloured abstract shapes and 12 photographic images taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999) were employed during the conditioning phase (See Appendix 10). The photographs to be used as sexual images were classified in the IAPS under the headings; “Romance”, “Erotic couple”, and “Couple”. The photographs to be used as aversive images were classified under the headings; “Roaches”, “Attack dog”, “Disabled”, “Electric Chair”, “Distressed Fem”, and “Attack”. The images used corresponded to the slide numbers; 4599, 4601, 4606, 4608, 4609, 4623, 1274, 1525, 3300, 6020, 6311, 6510. Finally, six nonsense syllables were employed as stimuli during the equivalence phase. These were; Ler, Cug, Mau, Vek, Paf, and Rog.

Ethics

All subjects were presented with and signed a consent form before proceeding to first phase of the experiment (See Appendix 9). Subjects were told informally that performance on the task would not allow the researcher to make any individual psychological assessments but may allow for group patterns to be identified. After participation subjects were fully debriefed as to the true nature of the study and were offered the opportunity to express any concerns or ask any questions they may have. Subjects were reminded that participation was confidential and that they were free to remove their data at any time.

Procedure

General Experimental Sequence

The current experiment consisted of four phases. Phases 1 through 4 were presented consecutively on the computer. Each phase was completed one at a time and subjects were instructed to contact the experimenter at the end of each phase. The experimenter then initiated the next phase manually. Subjects sat comfortably at a standard computer desk and viewed the computer screen at a distance of approximately 70 cm and at eyelevel. Phase 1 consisted of a word-picture association training task and lasted approx 10 minutes. Phase 2 consisted of Equivalence training and testing with subjects using the cursor and mouse. Completion of equivalence training was dependent on the subject reaching a criterion of 15/16 responses correct in a trial block (93.75%). This was followed by equivalence testing (Phase 2) which lasted approximately 10 minutes. Phase 3, the colour IAT-type test, was presented next and took approximately 9 minutes to complete. Subjects responded with the left forefinger (using the Z key) and the right forefinger (using the M key). Phase 4, the Equivalence IAT-type test was the final phase and took approximately 10 minutes to complete. As in the previous phase subjects responded using their left and right forefingers to press keys on a computer keyboard.

Phase 1

In Phase 1 subjects were exposed to a word-picture association-training procedure using a respondent conditioning preparation. That is, two arbitrary nonsense syllables (A1, Ler; A2, Vek) were paired with sexual and aversive photographic images, respectively. The nonsense syllable paired with the sexual images was blue in colour, while that paired with the aversive images was red in colour. For five of the subjects these colour associations were reversed (i.e., Ler was red in colour, Vek was blue in colour), but for the purpose of clarity I will herein refer only to the original colour association configuration.

Subjects were presented with the following instructions on screen after being seated in front of the computer:

> In a moment some words and images will appear on this screen
> Your task is to look at these items carefully and to remember what you see
> IT IS VERY IMPORTANT THAT YOU CONTINUE TO WATCH THE SCREEN AT ALL TIMES
> After each picture has been presented you will be required to press the space bar on the computer to continue. Please make sure you know where the space bar is before you begin.
> REMEMBER – IT IS VERY IMPORTANT THAT YOU PLAY CLOSE ATTENTION TO WHAT IS HAPPENING ON THE COMPUTER SCREEN.
> If you have any questions please ask them now.
> When you are ready please click the mouse button.

All conditioning trials were presented on the computer screen against a black background. A trial began with the presentation of one of the two nonsense words appearing in the centre of the screen for a period of two seconds followed by an interval of one second wherein the screen remained blank. After the 1s interval the relevant picture appeared in the centre of the screen for 4s. One second after the onset of the image the nonsense syllable was re-presented in the top left of the screen for the remainder of the trial (i.e., 3 s). In effect, the word-picture association phase employed both a trace and a simultaneous conditioning procedure. At the end of each trial the phrase "*Press the space bar*" appeared in the centre of the screen in 20 point font and remained until the subject pressed the space bar. The space bar press functioned as an observation response that initiated the subsequent trial.

There were 10 conditioning trials for each of the two word-picture associations, with no more than two consecutive exposures to either association. Trials were separated by a randomised inter-trial interval between 12- 20 seconds.

Phase 2

On completion of the word-picture association-training phase, subjects were immediately exposed to Phase 2, which consisted of equivalence training followed by testing. Training led to the formation of two three-member equivalence relations, each containing one of the two nonsense syllables used during Phase 1 as A stimuli, and two novel nonsense syllables.

There were two baseline conditional discrimination training tasks, comprised of four matching-to-sample tasks. Training was conducted using a linear training method (i.e., A1-B1, B1-C1 and A2-B2, B2-C2). Prior to training, subjects were presented with brief instructions requesting them to use the computer mouse to click on the comparison stimulus they believed to be correct. Tasks were presented in a random order in blocks of

16 trials (i.e., four times each). Subjects matched the comparison stimuli (e.g., B1, B2) to the sample (e.g., A1, A2) by clicking on their choice using the computer mouse and cursor. All choices were followed by corrective feedback delivered by the computer. Experimental feedback was provided and informed subjects as to whether their choice was correct or incorrect. Subjects were exposed to the training conditions until they responded correctly on all four tasks across a block of 16 training trials (i.e., four exposures to each task) and met the criterion of 93.75 percent (15/16 correct responses in a trial block) . That is, when A1 (Ler) was the sample the subject had to choose B1 (Cug), but given A2 (Vek) as the sample the subject had to choose B2 (Paf) as the comparison. The computer presented feedback on performance after each trial. On two further tasks, either B1 (Cug) or B2 (Paf) was presented as a sample, and two additional stimuli, C1 (Mau) and C2 (Rog), were presented as comparisons. On these trials the subject had to choose C1 (Mau) when B1 (Cug) was the sample, and choose C2 (Rog) when B2 (Paf) was the sample.

After reaching criterion subjects were exposed to a block of 16 testing tasks presented in quasi-random order. Subjects did not receive corrective feedback during this testing period. The testing proceeded, without a break, in blocks of 16 trials until the subject reached the 93.75% correct response criterion in a single block or until 16 blocks had been administered. During testing subjects were expected to match A1 to C1, C1 to A1, A2 to C2, and C2 to A2, thereby demonstrating stimulus equivalence (Barnes, 1994; Fields, Adams, Verhave, & Newman, 1990; Sidman, 1986).Subjects were required to pass the testing phase in order to proceed to Phase 3. All 15 subjects in the current study met the criterion in both the both training and testing stages of Phase 2.

Phase 3

In Phase 3, subjects were exposed to a colour IAT-type test consisting of red, blue, sexual and aversive images. The sexual and aversive images comprised those images presented during Phase 1 while the colour images were simply red and blue blobs (see Figure 1). The congruent (i.e., easy) task consisted of a blue blob and sexual images sharing a left-hand key press (i.e., the ‘Z’ key on the keyboard) and a red blob and aversive images sharing a right-hand key press (i.e., the ‘M’ key on the keyboard). For the incongruent (i.e., difficult) tasks red and sexual stimuli shared a right-hand key press (‘M’) and blue and aversive stimuli shared a left-hand key press (‘Z’). Prior to exposure to this phase, subjects were again presented with on-screen instructions. These instructions emphasized to subjects that responses to stimuli (using the ‘Z’ and ‘M’ keys) should be as quick and as accurate as possible. Subjects were exposed to a total of 180 trials presented in two blocks (i.e., 90 trials in each block). The order in which these blocks were presented was randomised across subjects. Each of the blocks consisted of four task-types which involved the presentations of one of the following stimuli; sexual images, aversive images, blue blobs and red blobs. These four tasks were presented once each in a random order in a block of four trials. There were 22 successive presentations of these 4-trial blocks (i.e., 88 trials) followed by two trials chosen randomly by the computer software (i.e., 88 + 2 = 90).

Subjects’ responses were recorded in terms of both accuracy and latency. However, in contrast to Greenwald’s (1998) method of recoding response latencies above 3000 ms as 3000, trials in the current study were limited to 3000ms duration. This was intended to circumvent the problem of devising and negotiating arbitrary statistical procedures designed to extract a hypothetical process from the data set (See Greenwald et al., 1998). In effect, subjects were prevented from responding outside the 3000ms time frame by the cessation of the trial and the presentation of the subsequent trial. A failure to respond within the 3000 ms response window was recorded as an incorrect response and the response latency was recorded as 3000ms. Response times were recorded from the trial onset to the first emitted response on the computer keyboard, regardless of whether or not it was correct.

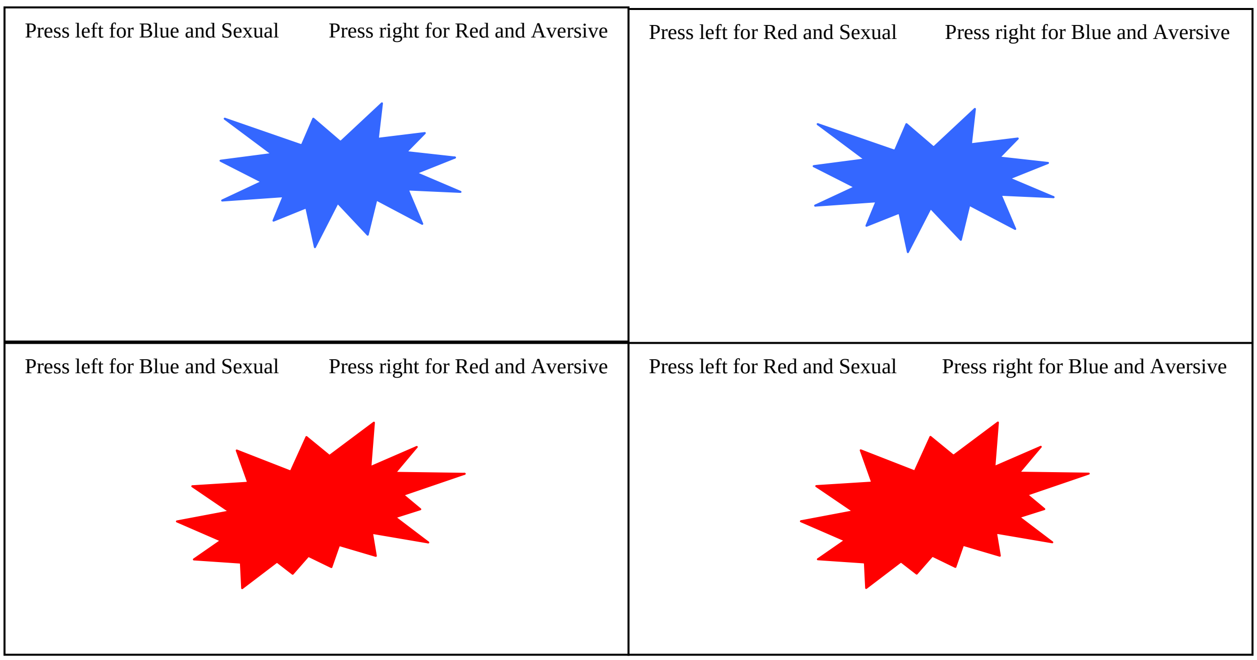


Figure 1: Four sample tasks presented to subjects during Phase 3. Left panel shows congruent tasks; right panel shows incongruent tasks.

Phase 4

In Phase 4, subjects were exposed to an equivalence-based IAT-type test consisting of sexual and aversive images and all members of the trained equivalence relations as stimuli. Recall that in Phase 1, Ler (presented in blue) was paired with sexual images and Vek (presented in red) was paired with aversive images. Thus, during the congruent (easy) task block, blue and sexual images shared a left-hand key press and red and aversive images shared a right-hand key press. In contrast, during the incongruent (hard) task block, red and sexual images shared a left-hand key press and blue and aversive images shared a right-hand key press (See Figure 2). It is important to note, however, that during Phase 4 all nonsense syllables were presented in black, and so any colour functions elicited by the B and C stimuli was derived by virtue of the transfer of functions effect. That is, in Phase 1, A1 was presented in blue and so blue colour functions should transfer to the B1 and C1 stimuli for most subjects. Similarly, A2 was presented in red and so red colour functions should transfer to the B2 and C3 stimuli for most subjects.

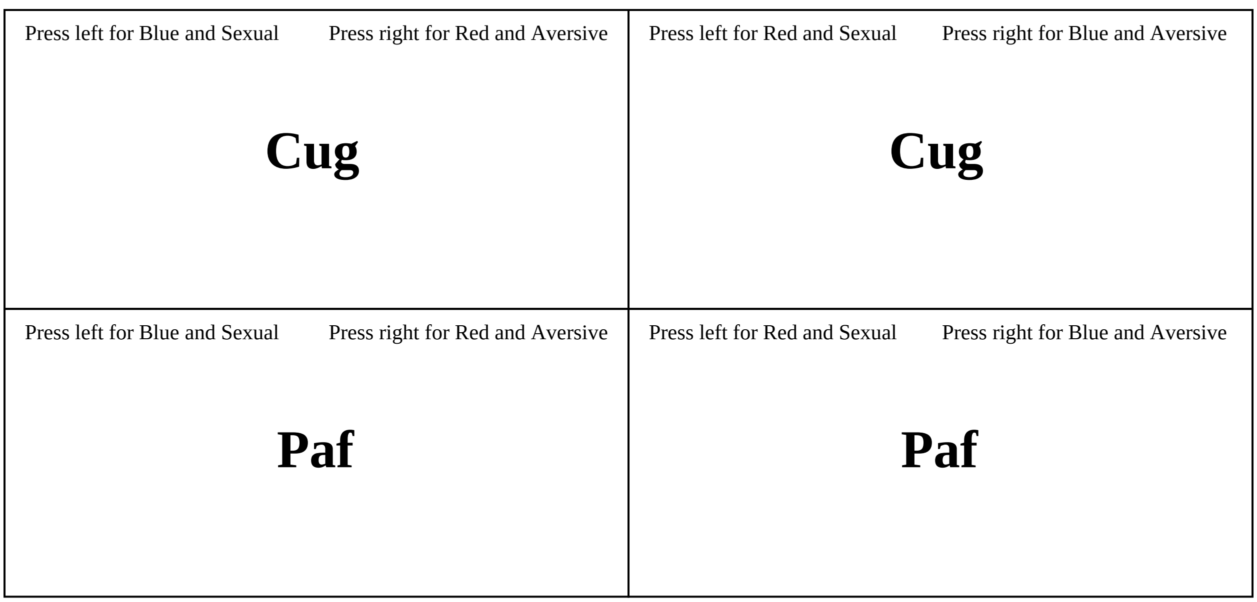


Figure 2: Four sample tasks presented to subjects during Phase 4. Left panel shows congruent tasks; right panel shows incongruent tasks.

Once again, subjects were exposed to a total of 180 trials presented in two blocks. That is, the congruent block and the incongruent block included 90 trials each as in Phase

3. The order in which these blocks were presented was randomised across subjects. In effect, Phase 4 was almost identical to Phase 3 except that nonsense syllables presented in black font replaced the coloured blobs.

Accuracy and latency of responses were recorded in Phase 4. Subjects were prevented from responding outside a 3000 ms time frame by the cessation of trials at 3000ms. Responses with latencies above 3000 ms were again recorded as incorrect. Response times were recorded from the trial onset to the first emitted response on the computer keyboard, regardless of whether or not the response was correct.

Summary

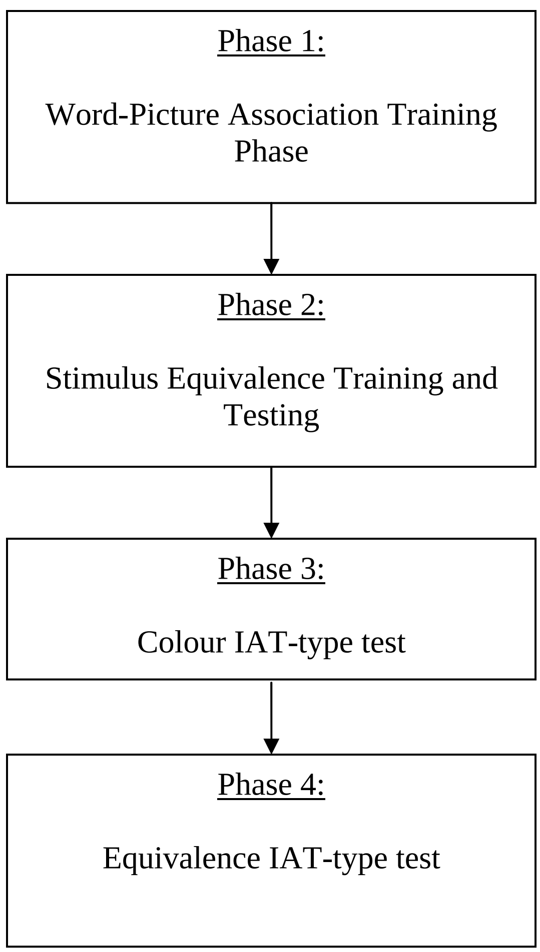


Figure 3: Procedure summary for Experiment 7

Results and Discussion

All subjects completed Phase1, which did not require a response criterion. During Phase 2 subjects required between 2 and 10 blocks of training in order to reach criterion, with the majority of subject requiring 6 blocks or less. During testing subjects required between 1 and 13 blocks in order to reach criterion, with the majority reaching criterion within 7 blocks.

For the purpose of data analysis, response times and accuracies were left in their raw state and not transformed in accordance with any of the IAT algorithms (Greenwald et al., 2003). Response times were limited to 3000 ms by test trial durations. In Phase 3, all 15 subjects completed the required 180-trial Colour IAT (90 incongruent tasks and 90 congruent tasks). Subjects' total number of correct responses were calculated for both congruent and incongruent task blocks (see Figure 4). By and large, subjects responded consistently and correctly on both the congruent (M= 87.8) and incongruent task blocks (M = 87.3), and the lowest score recorded was 77 correct responses out of 90 (Subject 13, incongruent task block).

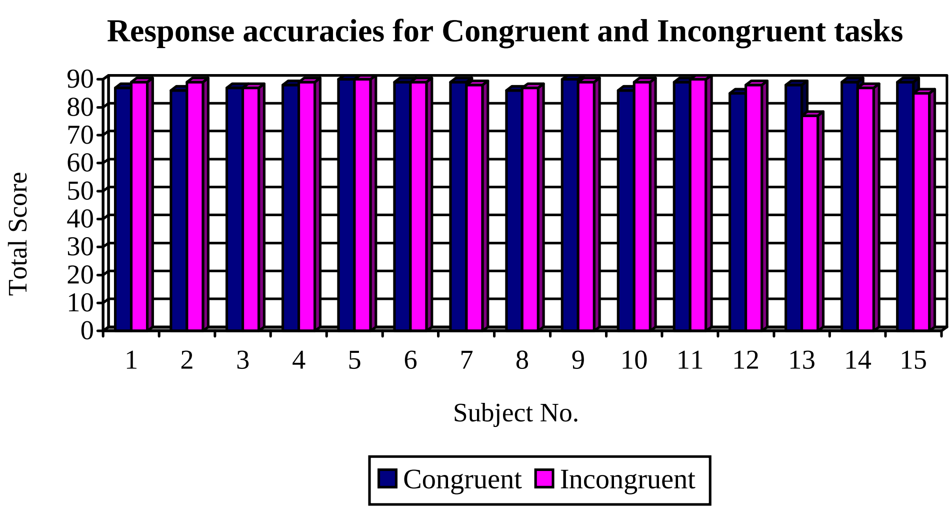


Figure 4: Individual subject response accuracies for the Colour IAT-type test (Phase 3)

However, there does not appear to be any particular differences emerging in the patterns of responding across subjects for congruent and incongruent task blocks. What is very notable, however, is the high number of accurate responses for all subjects across both blocks. In effect, a ceiling effect is evident in the data. A statistical analysis of the subjects' response accuracies, comparing congruent and incongruent task blocks, confirms this ceiling effect. That is, no significant differences were apparent across congruent and incongruent task blocks where, $t = .365$, $df = 14$, $p>0.05$.

Similarly, response latencies did not show any apparent differences across congruent ($M = 1028.2$ ms) and incongruent ($M = 1071.2$ ms) task blocks. A paired-sample t-test confirmed this, showing no significant differences across blocks where, ($t = 0.205$, $df = 14$, $p>0.05$).

In Phase 4, all subjects successfully completed the required 180-trial Equivalence-based IAT-type test. Once again, subjects' total number of correct responses were calculated for both congruent ($M = 76.5$) and incongruent ($M = 54.6$) task blocks (see Figure 5). There was considerably more variance observed in subjects' total number of correct responses on both the congruent and incongruent task blocks. Specifically, Subject 8 scored well below chance levels on both the congruent (21) and the incongruent (12) task block. Seven additional subjects (S2, S3, S5, S6, S11, S12, and S15) also scored at or below chance levels on the incongruent task block. However, 14 of the 15 subjects (excluding S8) scored above chance levels on the congruent task block, with the lowest of these scores being 60. This suggests that there is a very consistent trend of higher accuracies on congruent over incongruent tasks on the equivalence- based IAT-type test.

Response accuracies for Congruent and Incongruent tasks

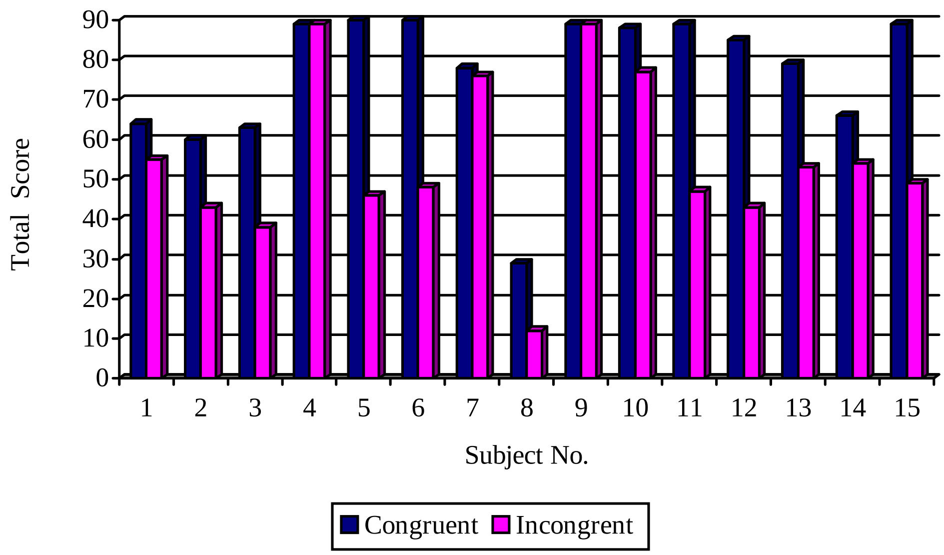


Figure 5: Individual subject response accuracies for the Equivalence IAT-type test (Phase 4)

An inferential statistical analysis showed that congruent and incongruent accuracies differed significantly during Phase 4 ($t= 5.129$, $df= 14$, $p<0.01$). This confirms that subjects did indeed respond with greater accuracy on the congruent task blocks than on the incongruent task blocks.

Response latencies, however, did not show any apparent differences across task blocks. That is, for congruent ($M = 1128.2$ms) and incongruent ($M = 1176.65$ms) task block, subjects responded with similar accuracy ($t= 0.099$, $df= 14$, $p>0.05$).

One important feature of the current data is the clear visibility of individual subject effects across the various performances. In other words, the simulated IAT effect was established not just across a group but for most members of the subject population. Specifically, thirteen of the fifteen subjects responded with greater accuracy on the congruent task block. Moreover, eight of the subjects responded at or below chance levels on the incongruent task block, while three further subjects responded only marginally above chance level on these tasks. Thus, there was a clear and replicated IAT effect observed for the majority of subjects in the experiment.

The subjects' accuracy scores in the Colour IAT-type test presented in Phase 3 showed no significant differences between the congruent and incongruent task. The ceiling effect observed in accuracy scores minimized differences in performance across these task types. Thus, it would appear that the congruent and incongruent task blocks were both equally un-demanding and so yielded similarly high scores. The most parsimonious explanation for the overall high accuracy scores during Phase 3 relates to the fact that subjects could respond directly to the stimulus on each task. In effect, the Phase 3 IAT-type test may have functioned as a matching test. As mentioned previously, Rothermund and Wentura (2004) found similar effects using arbitrary stimuli (colour strings) and salient and non-salient concepts. That is, subjects were presented with multicoloured and single-coloured strings as attribute stimuli and old and young names as concept stimuli. When the multicoloured strings were paired with the young names and the single coloured strings with the adult names subjects responded with greater accuracy/latency. The reasoning suggested for this was that subjects place stimuli that are congruent with their history together. Rothermund and Wentura have thus suggested that the simplicity of an IAT task is inversely related to response accuracy.

There were no effects observed for response times using the current experimental model. However, it is important to understand that this effect was unlikely to have been obtained without the use of the response correction procedure. More specifically, Greenwald and his collaborators employ a response correction technique that produces a hybrid IAT score combining response time and response accuracy in ways not functionally understood. This issue of response correction will be returned to in greater detail in the discussion of the current chapter.

In summary, in the current experiment incongruent tasks proved significantly more difficult than congruent tasks in an equivalence-based IAT-type test which included the equivalence relation members as stimuli and the sexual and aversive images. These findings suggest that the laboratory history of respondent conditioning and derived relational responding was sufficient in generating an IAT effect in this study. In addition, and perhaps more importantly, this IAT-type test result was obtained simply on the basis of associations established for subjects by the experimenters, rather than as a result of attitudes towards the test items. In effect, the IAT has been proven to be sensitive to the laboratory-controlled histories and consequently the core processes of the IAT can be accounted for using the current behavioural framework.

Given the clarity of the foregoing effect and the clear controlled exerted over it, the question that now arises as to the stability of the observed behaviour pattern. Attempting to gain further control over behavioural phenomena by exploiting their stability over time and under various conditions is practically a defining feature of the experimental analysis of behaviour. More specifically, the boundary conditions for any given behavioural phenomena often tell us more about the phenomenon than any number of demonstrations under generic conditions. According to Sidman (1960), once a new phenomenon or effect is demonstrated in the laboratory, it behoves the experimental analyst of behaviour to integrate that phenomenon with other known process and theories.

In Sidman's (1960) words, "The process of discovering the conditions under which a phenomenon occurs constitutes the first step of integration" (Sidman, 1960, p. 33). Thus, in line with this behavioural tradition the next experiment tested the boundary conditions of the laboratory generated IAT effect. Specifically, the stability of the emergent IAT effect across time, under conditions of re-arranged baseline equivalence relations were examined. Subjects were exposed to the same procedure observed in Experiment 7 to generate a fully controlled IAT effect. They were then re-exposed to equivalence training using the same stimuli as before. However, during re-training, one of the baseline conditional discriminations was altered so that novel equivalence classes emerged among the stimulus set. Subjects were then re-exposed to an equivalence IAT-type test to see if the IAT effect had been retained, had altered or had disappeared.

Experiment 8

Experiment 7 showed that a laboratory history of respondent conditioning and derived relational responding is sufficient in generating an IAT effect. More importantly, this IAT-type test result was obtained simply on the basis of associations established for subjects by the experimenters, rather than as a result of attitudes towards the test items.

The current behavioural account provides a reasonable explanation for the IAT effect. However, it is important to extend this understanding to include information about the malleability of the phenomenon. In simple terms, we need to know if the IAT effect as measured using real words is open to change following brief novel social experiences that run counter to an individual's extended behavioural history. For instance, imagine a Protestant person living in Northern Ireland and growing up in a Protestant household, living in a Protestant area and attending a Protestant school during the height of *the Troubles* in Northern Ireland (Hewstone, Cairns, Voci, Hamberger, & Niens, 2006). Imagine this person heard only negative words used to describe Catholic people in Northern Ireland and was witness to atrocities committed by the Catholic paramilitaries during this time. Consequently, this person's history of stimulus association involving Catholics predominantly involves negative stimuli. We might expect such a person to show an IAT effect on a IAT-type test involving Protestant and Catholic stimuli and positive and negative words. Now imagine that many years later, following decommissioning of arms by paramilitaries and the signing of various peace agreements, this person finds themselves coming into contact with Catholic people in everyday situations. Can these novel and non-aversive experiences reverse the long-established verbal relations involving Catholics and therefore undermine or eliminate any previously observed IAT effect involving Catholic and Protestant stimuli? Moreover, how much contact with Catholics in a non-aversive context is required to shift social categorisation and the attendant IAT effect? This idea can be examined in a laboratory analogue involving a reversal of the baseline conditional discriminations used to establish a verbal network following a laboratory generated IAT-type effect.

The reversal of baseline conditional discrimination is sometimes implemented in an attempt to alter already-established derived relations. For example, two three-member equivalence relations maybe trained and tested for in the laboratory using the normal MTS procedure. That is, subjects may be trained to select B1 in the presence of A1 and B2 in the presence of A2. In the second phase of equivalence training subjects may be trained to select C1 in the presence of B1 and C2 in the presence of B2. This linear training method gives rise to the formation of two three-member equivalence relation (A1-B1-C1 and A2-B2-C2).

Once these relations have been firmly established (e.g., passing equivalence testing at criterion level) then the contingencies controlling these relations can be reversed. That is, one of the baseline conditional discriminations can be altered such that subjects are now required to choose B2 (not B1) in the presence of A1 and to choose B1 (not B2) in the presence of A2. Such a reversal should lead to the emergence of the new equivalence relation A1-B2-C2 and A2-B1-C1. The current experiment aims to assess whether the IAT-type test is sensitive to the reorganisation of underlying verbal categories in a subject's recent history. Subjects will be exposed to the same procedure observed in Experiment 7 to generate a fully controlled IAT effect. They will then be re-exposed to equivalence training using the same stimuli as before. However, during re-training one of the baseline conditional discriminations will be altered so that novel equivalence classes emerge among the stimulus set. Subjects will then be re-exposed to an equivalence IAT-type test to see if the IAT effect has been retained, has altered or has disappeared.

Method

Subjects

Ten subjects (5 males and 5 females) all acquaintances of the experimenter, aged from 18 – 34 years participated in the current study. Subjects were informed that they would be participating in a five-phase word-association test which would take approximately one hour to complete.

Apparatus and Stimuli

All five phases of the experiment were presented to subjects on an Apple iMac 400 MHz with a 15” monitor. Stimulus presentations were controlled using the software package Psyscope® (Cohen, MacWhinney, Flatt, & Provost, 1993) which also recorded all responses. Twelve photographic images taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999) were employed during the conditioning phase. The photographs to be used as sexual images were classified in the IAPS under the headings; “Romance”, “Erotic couple”, and “Couple”. The photographs to be used as aversive images were classified under the headings; “Roaches”, “Attack Dog”, “Disabled”, “Electric chair”, “Distressed Fem”, and “Attack”. The images used corresponded to the slide numbers; 4599, 4601, 4606, 4608, 4609, 4623, 1274, 1525, 3300, 6020, 6311, 6510 (See Appendix 10). Finally, six nonsense syllables were employed as stimuli during the equivalence phases. These were; Ler, Cug, Mau, Vek, Paf, and Rog.

Ethics

All subjects were presented with and signed a consent form before proceeding to first phase of the experiment (See Appendix 9). Subjects were told informally that performance on the task would not allow the researcher to make any individual psychological assessments but may allow for group patterns to be identified. After participation subjects were fully debriefed as to the true nature of the study and were offered the opportunity to express any concerns or ask any questions they may have. Subjects were reminded that participation was confidential and that they were free to remove their data at any time.

Procedure

General Experimental Sequence

The current experiment comprised five phases. All phases were presented on the Apple Pc and appeared chronologically. Each phase appeared independently whereby subjects were instructed to contact the experimenter at the end of each phase and the experimenter then initiated each phase manually. Subjects sat comfortably at a standard computer desk and viewed the computer screen at a distance of around 70 cm and at eyelevel. Phase 1 comprised a word-picture association training task and lasted approx 10 minutes in duration. Phase 2 comprised equivalence training and testing and was criterion dependent with the duration varying between 4-30 minutes. Subjects responded to this phase using the cursor and mouse. The first IAT-type test (Phase 3; Baseline) was completed next. Responses on this phase were given using the left forefinger (using the Z key) and the right forefinger (using the M key) and took approximately 9 minutes to complete. The fourth phase comprised exposure to novel equivalence training and testing and was criterion dependent with the duration varying between 4-30 minutes. Subjects responded to this phase using the cursor and mouse. Phase 4 differed from Phase 2 above in that the baseline conditional discriminations were reversed in training and subsequently testing. The Phase 5 (IAT-type test 2, post-intervention) was identical to Phase 3 above and required subjects to respond using their left and right forefingers and lasted for approximately 9 minutes.

Phase 1

Phase 1 was identical to Phase 1 presented in Experiment 7.

Phase 2

On completion of the word-picture association-training phase, subjects were immediately exposed to Phase 2, which comprised of an equivalence training and testing procedure. This phase is identical to Phase 2 as outlined in Experiment 7.

Phase 3

In Phase 3 of the current experiment subjects were exposed to a complex IAT-type test consisting of sexual and aversive images, and all members of the trained equivalence relations (A1-B1-C1; A2-B2-C2.). Recall A1 (Ler) was paired with sexual images and A2 (Vek) with aversive images during Phase 1. This Phase is an experimental replica of Phase 4 in Experiment 7. This test constituted a baseline IAT-type test against which the post-intervention (i.e., Phase 4) performance (Phase 5) could be compared.

Phase 4

Subjects were immediately exposed to Phase 4 on completion of the first IAT-type test. This phase comprised of a second equivalence training and testing procedure. Phase 4 constituted an intervention designed to alter the laboratory controlled IAT effect observed in Phase 3.

Training was designed to lead to the formation of two three-member equivalence relations, each containing three of nonsense syllables used during Phase 2. However, the equivalence classes were intended to be of a different configuration to those established in Phase 3, but involving the same stimuli. Specifically, when A1 (Ler) was the sample the subject had to choose B2 (Paf), but given A2 (Vek) as a sample they had to choose the B1 (Cug) comparison. The computer presented feedback on performance after each trial. On two further tasks either B2 (Paf) or B1 (Cug) was presented as a sample, but two further stimuli, C2 (Rog) and C1 (Mau), were presented as comparisons. On these trials the subject had to choose C1 (Mau) when B1 (Cug) was the sample, and choose C2 (Rog) when B2 (Paf) was the sample (i.e., the B-C relations were not altered from those trained in Phase 2).

Phase 4 comprised both training and testing periods. Prior to both training and testing periods, subjects were presented with brief instructions requesting they use the computer mouse to click on the word they believed to be correct. For the training period, each task was presented in a random order in blocks of 16 trials. Subjects matched the comparison stimuli (e.g., B2, B1) to the sample (e.g., A1, A2) by clicking on their choice using the computer mouse and cursor. All choices were again followed by corrective feedback delivered by the computer. Subjects were exposed to training until they produced consistent and correct responding on all four tasks across a block of 16 training trials (i.e., four exposures to each task). Criterion for Phase 4 was identical to that of Phase 2 as was progression from training to testing stage of this Phase. Subjects did not receive corrective feedback during this testing period. The testing proceeded, without a break, in blocks of 16 trials until the subject consistently produced the correct equivalence-based matching response (i.e., C1 – A2, C2 – A1) or until 16 blocks had been administered, whichever came first. Subjects were required to pass the testing phase in order to proceed to Phase 5. The experimenters decided pre-experimentally, as a control measure, that any subject who failed to meet criterion for passing either the training or testing phases would not proceed to Phase 3. All 10 subjects in the current study met the criterion in both the both training and testing stages of Phase Four.

Phase 5

Phase 5 comprised of an identical IAT-type test to that employed in Phase 3. Phase 5 constituted a post-intervention test to examine any changes in the laboratory controlled IAT effect generated in Phase 3.

Summary

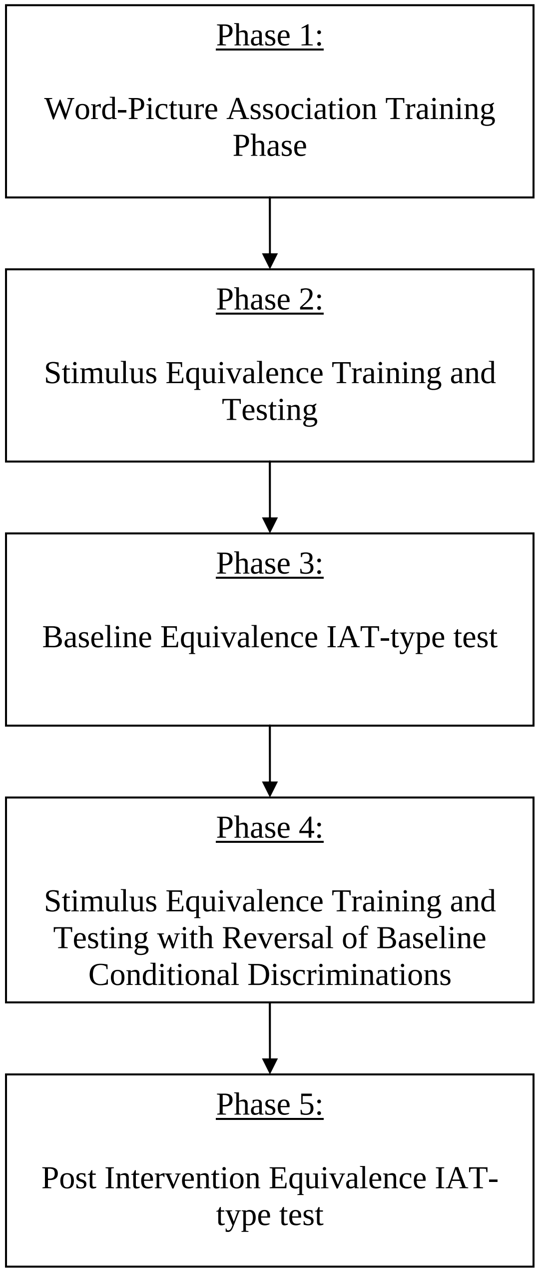


Figure 6: Procedure summary for Experiment 8

Results and Discussion

All subjects completed Phase1, which did not require a response criterion. During Phase 2 subjects required between 1 and 9 blocks of training in order to reach criterion, with the majority of subject requiring 5 blocks or less. During testing, subjects required between 1 and 8 blocks in order to reach criterion, with the majority of subjects reaching criterion within 2 blocks. In Phase 3, all 10 subjects completed the required 180-trial IAT-type test (90 incongruent tasks and 90 congruent tasks). Subjects' total number of correct responses were calculated for both congruent and incongruent class task blocks (see Figure 7).

Response Accuracies for Congruent and Incongruent Tasks.

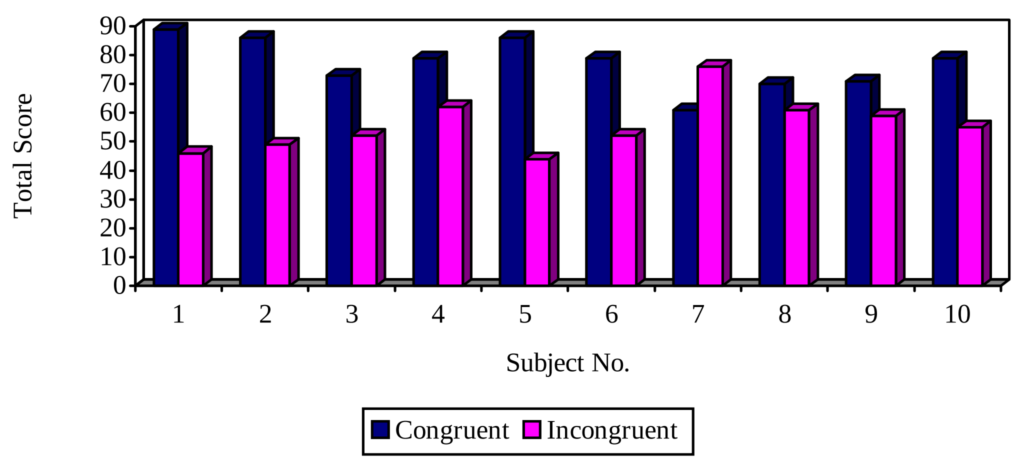


Figure 7: Individual Subject Response Accuracies for the baseline IAT-type in Phase 3

By and large, subjects showed greater accuracy on the congruent task block (M= 77.3) than the incongruent task block (M = 55.6), with the only exception being Subject 7. Subjects' accuracies differed significantly between congruent and incongruent task blocks ($t= 3.920$, $df= 9$, $p<0.01$). However, response latencies did not differ significantly between congruent (M =999.08ms) and incongruent (M = 972.6ms) task blocks (t= 0.283, df= 9, p>0.05).

Responses across trials were further analysed in terms of responses to pairs of A stimuli, B stimuli and C stimuli in order to ascertain any variances in stimulus control across the original conditioned stimuli (A), the symmetrically related stimuli (B) and the transitively related stimuli (C).

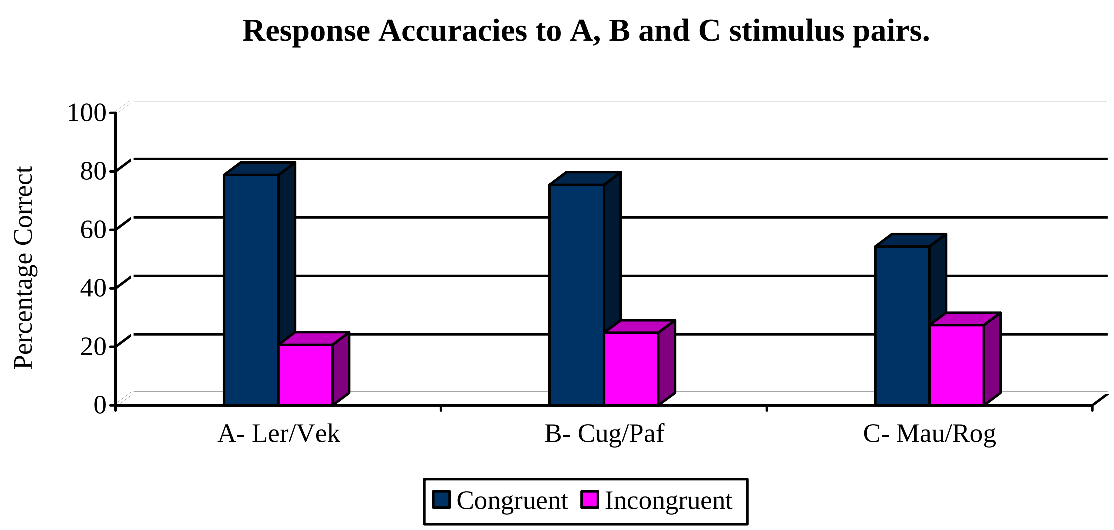


Figure 8: Percentage correct responses to each of the A, B and C stimulus pairs during Phase 3

Figure 8 above shows that, for each of the A, B and C stimulus pairs, the accuracy effects were in the predicated direction. That is, subjects responded with greater accuracy on the congruent task blocks than on the incongruent task blocks. Both A and C stimuli differed significantly across congruent and incongruent task blocks (t= 8.83, df= 9, p<0.01 and t= 2.488, df= 9, p<0.01, respectively). The B stimuli showed no significant differences in accuracy of responses across experimental task block (t= .531, df= 9, p=0.609; See Table 1).

An analysis of the response accuracy to all tasks involving only A, B and C stimulus pairings (i.e., excluding responses to all trials with images as stimuli) compared across experimental task blocks showed that subjects responded with significantly greater accuracy on the congruent task block over the incongruent task block. It is perhaps, not surprising, that there is a significant overall difference in subjects' response accuracies to the A, B and C stimuli combined, given the particularly powerful IAT effect observed for A stimuli alone. This in turn could have been expected given that the image and colour functions were established directly for these stimuli. In contrast, the functions of the B and C stimuli are derived and may therefore be expected to produce weaker IAT effects given the greater variability in their response functions and their salience across subjects. Thus, a further analysis was conducted to assess any overall differences across congruent and incongruent task blocks in subjects' response accuracies to the B and C stimuli combined. This analysis suggested no apparent differences were evident across congruent and incongruent task bocks for the combined B and C stimuli (See Table 1).

Table 1: Significance values for differences in response accuracies to the A, B and C stimuli and combinations of these stimuli, across task blocks for Phase 3

Stimuli	IAT-type test 1
A + B + C	0.004**
B + C	0.103
A	0.000**
B	0.609
C	0.035**

For Phase 4 data was comprised of equivalence training and testing data. Subjects required between 1 and 11 blocks of training in order to reach criterion, with the majority of subject requiring 2 blocks or less. During testing, subjects required between 1 and 11 blocks in order to reach criterion, with the majority reaching criterion within 1 block.

In Phase 5 all subjects successfully completed the required 180-trial IAT-type test. It must be noted, that for Phase 5 the label "Congruent" refers to tasks which are congruent with the *new equivalence relations* established in Phase 4. Similarly, the label "Incongruent" refers to tasks which are incongruent with the *new equivalence relations* established in Phase 4.

Once again, subjects' total number of correct responses were calculated for both congruent (M =76.2) and incongruent (M =60) task blocks (see Figure 7). Seven subjects scored a greater accuracy on the congruent task block than on the incongruent task block. Overall, the current experimental results provide evidence for a clear IAT effect insofar as the majority of subjects showed an effect in the predicted direction whereby they responded with greater accuracy on the congruent task block.

Response Accuracies for Congruent and Incongruent Tasks.

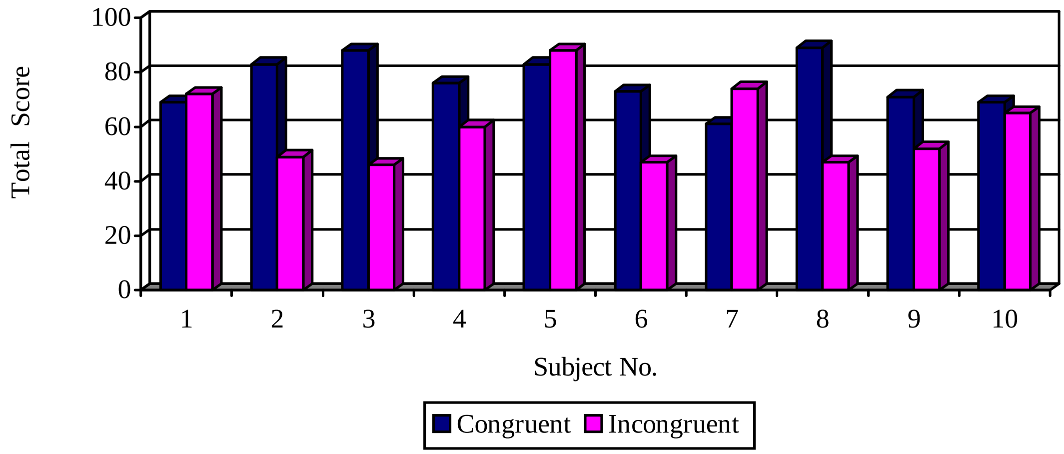


Figure 9: Individual Subject Response Accuracies for the post-Intervention IAT-type test Note: The label *congruent* refers to tasks which are congruent with the *new equivalence relations* established in Phase 4. Similarly, the label *incongruent* refers to tasks which are incongruent with the *new equivalence relations* established in Phase 4

An inferential statistical analysis showed that response accuracies differed across congruent and incongruent task blocks for the post-intervention IAT-type test. That is, congruent and incongruent accuracies differed significantly during Phase 5 ($t= 2.572$, $df= 9$, $p<0.05$). A subsequent analysis showed that response latencies did not differ significantly between congruent (M = 905.2ms) and incongruent (M = 835.09ms) task blocks ($t= 1.30$, $df= 9$, $p>0.05$).

As mentioned above, it is important to understand that the current definition of congruent as employed in Figure 9, refers to congruence with the new equivalence relations. Nevertheless, an overall IAT effect in which subjects respond with greater accuracy on the new congruent tasks still emerged. However, we must remember that the functions of the A stimuli (i.e., Colour and Sexual functions) did not alter across Phases 3 and 5. Thus, the A stimuli continued to produce correct responding without an alteration in the response defined as congruent across phases. That is, for the A stimuli, correct responses during Phase 3 were still correct in Phase 5 in both the congruent and incongruent task blocks. Thus, subjects simply continued to respond as before in Phase 5 and the differential in accuracy across the A1 and A2 stimulus tasks in Phase 5 may have been sufficient to carry an overall IAT effect for that entire Phase 5 test. In contrast, the derived functions of the B and C stimuli should be more variable insofar as the relations between these stimuli and A has been undermined during Phase 4. Thus, subjects could not respond as in Phase 3 to the B and C stimuli and still produce a performance considered to be congruent. Only an altered response pattern could lead to this description.

To explore the possibility that the A stimulus pairs alone may have been sufficient in generating the observed IAT effect, responses across trials were further analysed in terms of responses to pairs of A stimuli, B stimuli and C stimuli. This breakdown also allowed the experimenter to ascertain if there were any variances in stimulus control across the original conditioned stimuli (A), the symmetrically related stimuli (B) and the transitively related stimuli (C).

Percentage Response Accuracies to A, B and C stimulus pairs.

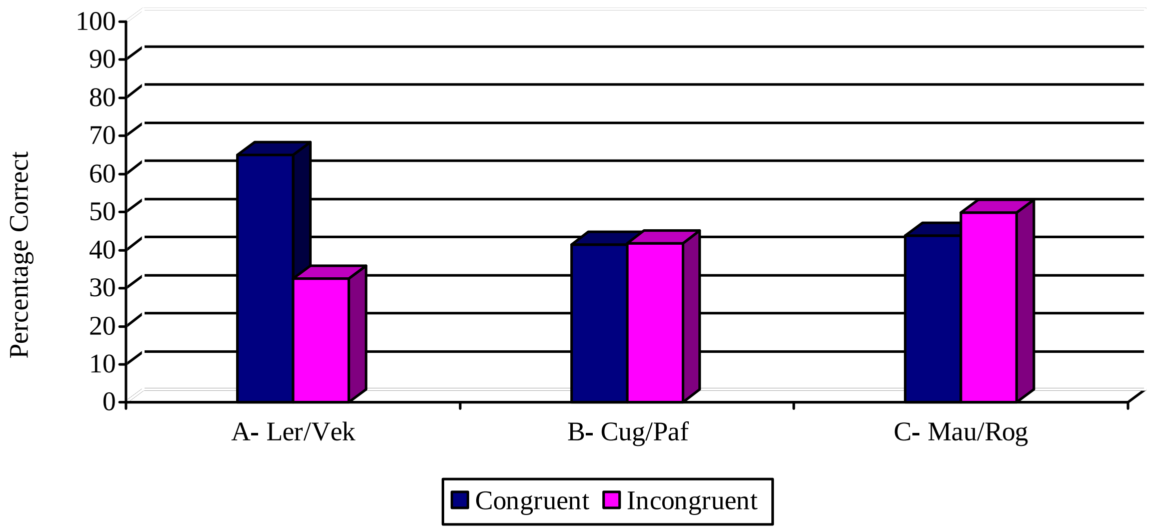


Figure 10: Percentage Individual correct responses to each of the A, B and C stimulus pairs during Phase 5.

Figure 10 shows that for the A stimulus pairings subjects responded with greater accuracy on the congruent task block. For the B and C stimulus pairings subjects responded with near equal accuracy across task blocks. In fact, although modest, subjects responded with a greater accuracy on the incongruent task block for the C stimulus pairings. Overall, only the A stimuli differed significantly on congruent and incongruent task blocks in Phase 5 where ($t= 4.643$, $df= 9$, $p<0.01$; See Table 2). As mentioned above, however, this response differential was consistent across Phase 3 and 5 insofar as the A stimuli retained their function across these phases (i.e., they were not reconditioned in Phase 4). Neither B nor C stimulus pairings differed significantly across experimental task blocks in Phase 5 ($t= .460$, $df= 9$, $p=.656$ and $t= .792$, $df= 9$, $p=.449$ respectively). As with Phase 3, it is not surprising that there is a significant overall difference in subjects response accuracies to the A, B and C stimuli combined given the particularly powerful IAT effect observed for A stimuli alone. Conversely, an analysis of differences across congruent and incongruent task blocks in subjects' response accuracies to the B and C stimuli combined yielded no such significant differences (See Table 2).

Table 2: Significance values for all stimuli for Phase 5 (IAT–type test 2)

Stimuli	Post -Intervention IAT-type test
A + B + C	0.030**
B + C	0.547
A	0.001**
B	0.656
C	0.449

Overall, these results suggest that this IAT-type test is sensitive to the respondent conditioning history employed in Phase one and the verbal relations established by the experimenter in Phase 2. Neither responses to the B or C stimuli were reversed in Phase 5 of the current Experiment but the intervention in Phase 4 weakened the overall IAT effect observed, and eliminated it for the C stimuli. This is promising in terms of advancing our knowledge of the basic processes that may be involved in social interventions to change attitudes or verbal behaviour (Roche et al., 1997). In effect, only a modest alteration in verbal relations was required to undermine the IAT effect for the derived stimuli. Presumably, reconditioning the functions of the A stimuli may have led to the elimination of an IAT effect in responses to these stimuli also, but this an empirical question that needs to addressed in future research. In summary, the current intervention appears to have shown that it is relatively easy to shift responses to derived stimuli during an IAT-type test, even if a complete reversal in performance (i.e., an effect in the opposite direction) is not immediate.

Bearing in mind the potential social applications of the current measure, it may be beneficial to explore more powerful techniques for altering the IAT effect observed in Phase 3. In other words, it would appear to be a logical next step in the current research to attempt a more complete eradication or reversal of the IAT effect from baseline to follow-up. Interestingly, the literature on derived relations suggests some important clues as to how to proceed. Specifically, the literature suggests that equivalence (i.e., transitive) relations will often persist across equivalence tests despite attempts to undermine those relations through the reversal of baseline conditional discriminations (Pilgrim & Galizio, 1990, 1995; see also Roche et al., 1997), although there is disagreement over the conditions under which reversals in transitive relations can be more easily achieved (Pilgrim, Chambers & Galizio, 1995; Smeets, Barnes-Holmes, Akpinar, & Barnes Holmes, 2003). Although a reversal in transitive relations was seen readily here in Phase 4, Pilgrim and Galizio (1990, 1995) have shown, in a series of studies for both adults and children, that following a reversal of baseline conditional discriminations, performances on transitive trials remained consistent with the initial baselines or equivalence classes. In contrast, on symmetry trials, the baseline conditional discriminations were reversed in accordance with the new equivalence classes. In 1995, the same authors (Pilgrim, Chambers, & Galizio, 1995) showed that for some children equivalence class performances may be more easily disrupted particularly in the presence of symmetry testing. Smeets et al., 2003 also found that in a series of studies, equivalence reversal was almost always demonstrated for children but noted that the training protocol was key in reversing theses relations as was the inclusion of symmetry and transitivity testing. These findings suggest that the use of symmetry testing during Phase 2 and 4 equivalence training may make the baseline and reversed equivalence relations more robust. As a result, the intervention may be effective at eradicating or completely reversing the IAT effect generated in Phase 3. The next experiment explored this possibility.

Experiment 9

The current experiment aims to more effectively reverse baseline conditional discriminations in an attempt to more completely alter the IAT effect from experimental Phases 3 to 5. This will be achieved by including symmetry relations in the testing phase of the equivalence procedure employed in both Phases 2 and 4. While Experiment 8 maintained an IAT effect for the second IAT-type test (Phase 5), a breakdown of the data and subsequent statistical analysis revealed that the IAT effect was being generated by the A stimuli alone. However, given that the appropriate responses to A in the congruent and incongruent task blocks had not changed from Phase 3 to 5 this result was not as interesting at it seemed at first. Nevertheless, while a significant IAT effect was obtained for the C stimuli alone in Phase 3, the same effect was eliminated in Phase 5. As such, the derived stimuli (C) did not appear to have the functions of the A stimuli following the reversal of the baseline conditional discriminations. The current study is designed to replicate Experiment 8 with the addition of symmetry testing alongside transitivity testing at all stages, in order to strengthen the intervention effort in Phase 4.

Subjects were exposed to an experimental sequence identical to Experiment 8 with the only exceptions being for Phases 2 and 4. During these phases subjects were exposed to an equivalence training and testing task as before, but with the addition of symmetry testing.

Method

Subjects

Five subjects (3 males and 2 females) all acquaintances of the experimenter, aged from 18 – 30 years participated in the current study. Subjects were informed that they would be participating in a five-phase word-association test which would take approximately one hour to complete.

Apparatus and Stimuli

All apparatus and stimuli were identical to those employed in Experiment 8.

Ethics

All subjects were presented with and signed a consent form before proceeding to first phase of the experiment (See Appendix 9). Subjects were informed casually that performance on the task would not allow the researcher to make any individual psychological assessments but may allow for group patterns to be identified. After participation subjects were fully debriefed as to the true nature of the study and were offered the opportunity to express any concerns or ask any questions they may have. Subjects were reminded that participation was confidential and that they were free to remove their data at any time.

Procedure

General Experimental Sequence

The experiment consisted of 5 phases. Phases 1 through 5 were presented consecutively on a Macintosh computer. Each phase was completed one at a time and subjects were instructed to contact the experimenter at the end of each phase. Phases 1 through 5 were an experimental replica of Experiment 8 with the notable addition of symmetry testing in Phases 2 and 4.

Phase 1

Phase 1 of the current experiment is identical to Phase 1 in Experiment 7.

Phase 2

On completion of the word-picture association-training phase, subjects were immediately exposed to Phase 2, which consisted of equivalence training followed by testing. Training led to the formation of two three-member equivalence relations, each containing one of the two nonsense syllables used during Phase 1 as A stimuli, and two novel nonsense syllables.

There were two baseline conditional discrimination training tasks, comprised of four matching-to-sample tasks. Training was conducted using a linear training method (i.e., A1-B1, B1-C1 and A2-B2, B2-C2). Prior to training subjects were presented with brief instructions requesting them to use the computer mouse to click on the comparison stimulus they believed to be correct. Tasks were presented in a random order in blocks of 16 trials (i.e., four times each). Subjects matched the comparison stimuli (e.g., B1, B2) to the sample (e.g., A1, A2) by clicking on their choice using the computer mouse and cursor. All choices were followed by corrective feedback delivered by the computer.

Feedback informed subjects as to whether their choice was correct or incorrect. Subjects were exposed to the training conditions until they responded correctly on all four tasks across a block of 16 training trials (i.e., four exposures to each task) and met the criterion of 93.75 percent (15/16 correct responses in a trial block) . That is, when A1 (Ler) was the sample the subject had to choose B1 (Cug), but given A2 (Vek) as the sample the subject had to choose B2 (Paf) as the comparison. The computer presented feedback on performance after each trial. On two further tasks either B1 (Cug) or B2 (Paf) was presented as a sample, and two additional stimuli, C1 (Mau) and C2 (Rog), were presented as comparisons. On these trials the subject had to choose C1 (Mau) when B1 (Cug) was the sample, and choose C2 (Rog) when B2 (Paf) was the sample.

After reaching criterion subjects were exposed to a block of 16 testing tasks presented in quasi-random order. Subjects did not receive corrective feedback during this testing period. The testing proceeded, without a break, in blocks of 16 trials until the subject reached the 93.75% correct response criterion in a single block or until 16 blocks had been administered. During testing, subjects were expected to produce the transitive relations A1 to C1, C1 to A1, A2 to C2, C2 to A2, as well the symmetrical relations; C1 - B1, C2 - B2, B1 - A1, and B2 - A2, thereby more fully satisfying the optimal test for stimulus equivalence relations (See Barnes, 1994; Fields, Adams, Verhave, & Newman, 1990; Sidman, 1986). All 5 subjects met the criterion in both the training and testing stages of Phase Two.

Phase 3

Phase 3 was identical to Phase 3 of Experiment 8.

Phase 4

Subjects were immediately exposed to Phase 4 on completion of the first IAT-type test. This phase comprised of a second equivalence training and testing procedure. Training led to the formation of two three-member equivalence relations, each containing three of nonsense syllables used during Phase 2. However, for experimental purposes the equivalence classes were formed using a reversal of the baseline conditional discriminations from Phase 2. Syllables were juxtaposed from their original sequence in Phase 2 to form new relations which trained using a linear training method. That is, the A1-B1-C1 and A2-B2-C2 relations were reorganised as A1 -B2-C2 and A2-B1-C1. As with Phase 2 of the current experiment Equivalence testing also included symmetry testing. The same testing sequence and criteria were employed as in Phase 2.

Phase 5

Phase 5 comprised an identical IAT-type test to Phase 5 in Experiment 8.

Summary

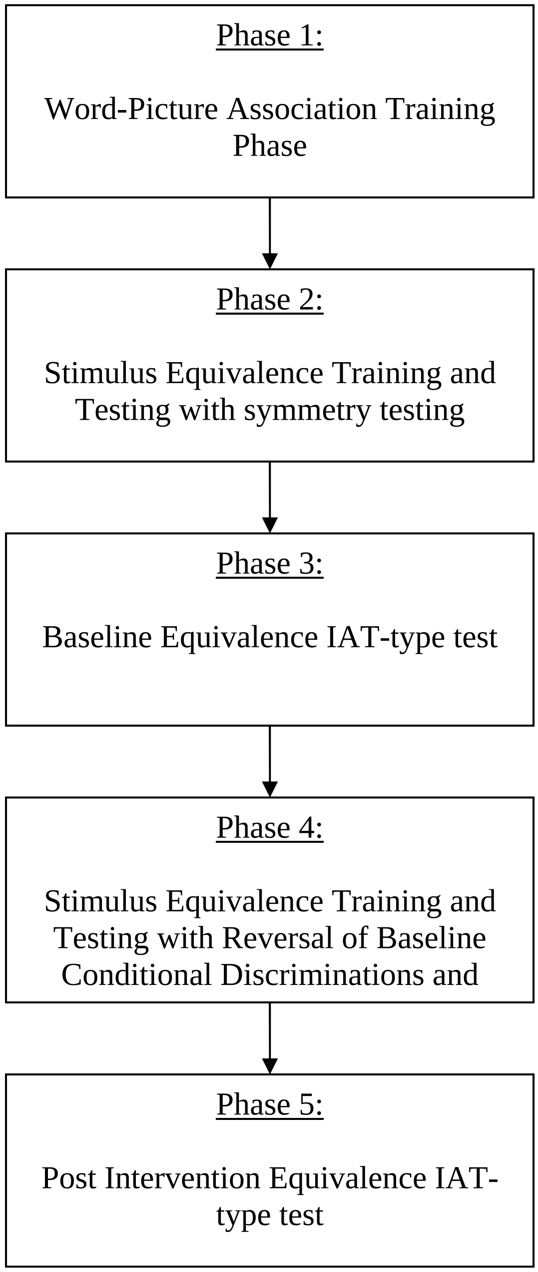


Figure 11: Procedure summary for Experiment 9

Results and Discussion

All subjects completed Phase1, which did not require a response criterion. During Phase 2 subjects required between 1 and 6 blocks of training in order to reach criterion, with the majority of subject requiring 3 blocks or less. During testing, subjects required between 1 and 2 blocks in order to reach criterion, with the majority reaching criterion within 1 block. In Phase 3, all 5 subjects completed the required 180-trial Equivalence IAT (90 incongruent tasks and 90 congruent tasks). Subjects' total number of correct responses were calculated for both congruent and incongruent task blocks. By and large, subjects responded consistently and correctly on the congruent (M= 85) task blocks. The incongruent task response accuracies were greater than half with (M=54.2). The lowest score recorded was at chance level with 45 correct responses out 90 (Subject 4, incongruent task blocks; see Figure 12).

Response Accuracies for Congruent and Incongruent Tasks.

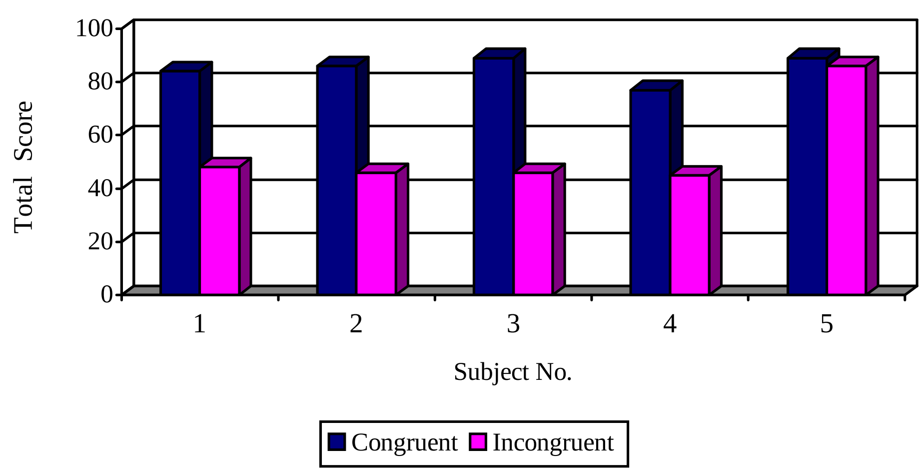


Figure 12: Individual Subject Response Accuracies for the baseline IAT-type in Phase 3

A visual analysis of the subjects' response accuracies across congruent and incongruent task blocks, suggests a difference. That is, all five subjects score higher on the congruent task when compared to the incongruent task blocks, most notably Ss 1, 2, 3 and 4. However response latencies do not appear to differ between congruent (M =848ms) and incongruent (M = 955ms) task blocks.

Responses across trials were further analysed in terms of responses to pairs of A stimuli, B stimuli and C stimuli in order to ascertain any variances in stimulus control across the original conditioned stimuli (A), the symmetrically related stimuli (B) and the transitively related stimuli (C).

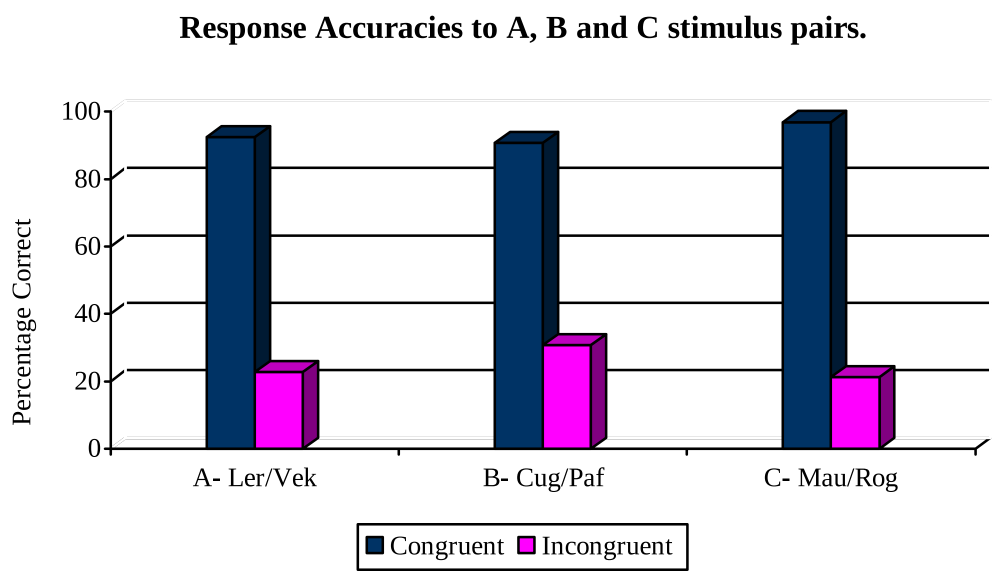


Figure 13: Percentage correct responses to each of the A, B and C stimulus pairs during Phase 3.

Figure 13 above, shows that for each of the A, B and C stimulus pairs the accuracy effects were in the predicated direction. That is, subjects responded with greater accuracy on the congruent task block compared to the incongruent task block. More specifically, for the A stimuli subjects responded with an accuracy of 92.4% on congruent task blocks and 22.78% on incongruent task blocks. For B stimuli subjects responded with an accuracy of 90.7% on congruent task blocks and 30.73% on incongruent task blocks. Finally, for C stimuli, subjects responded with an accuracy of 96.9% on congruent task blocks and 21.25% on incongruent task blocks. This pattern reflects the clear IAT effect demonstrated overall for all experimental stimuli across task blocks.

For Phase 4, data comprised equivalence training and testing data. Subjects required between 1 and 4 blocks of training in order to reach criterion, with the majority of subject requiring 3 blocks or less. During testing, subjects required between 1 and 2 blocks in order to reach criterion.

In Phase 5, all subjects successfully completed the required 180-trial IAT. It must be noted that for Phase 5 the label "Congruent" refers to tasks which are congruent with the *new equivalence relations* established in Phase 4. Similarly, the label "Incongruent" refers to tasks which are incongruent with the *new equivalence relations* established in Phase 4.

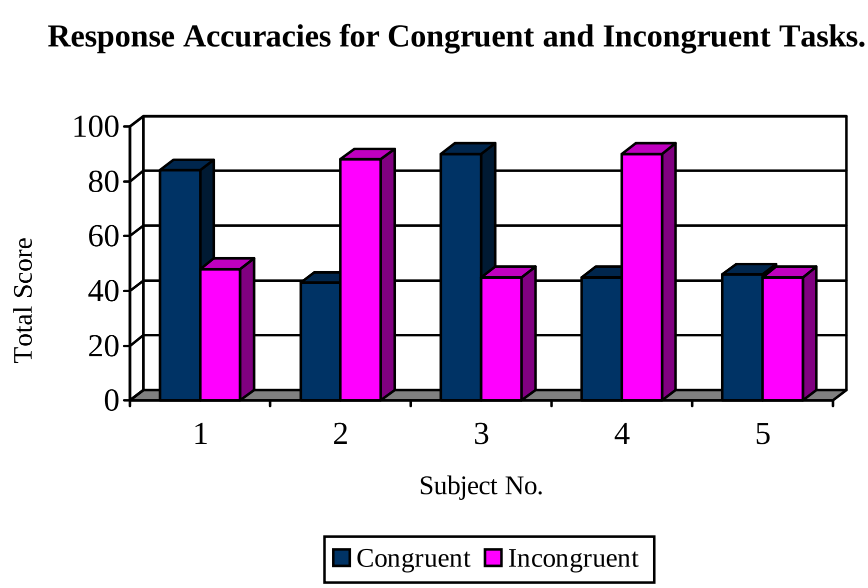


Figure 14: Individual Subject Response Accuracies for the post-Intervention IAT-type test

Note: The label *congruent* refers to tasks which are congruent with the *new equivalence relations* established in Phase 4. Similarly, the label *incongruent* refers to tasks which are incongruent with the *new equivalence relations* established in Phase 4

Subjects' total number of correct responses were calculated for both congruent (M =53.8) and incongruent (M =71.2) task blocks (see Figure 14). There was considerably more variance observed in subjects' total number of correct responses on both the congruent and incongruent task blocks. Specifically, Subject 5 scored at chance levels on both the congruent (46) and the incongruent (45) task blocks while Subject 3 produced 45 correct responses on the congruent tasks and 90 correct on the incongruent task blocks and Subject 2 the inverse (i.e., Subject 2 scored 90 correct responses on the congruent and 45 correct on the incongruent task blocks). Overall, however, the current results provide evidence that Phase 4 undermined the IAT effect modelled in Phase 3 for most subjects. In summary, the effects of the Phase 4 intervention varied across subjects but undermined the clear laboratory generated IAT effect across subjects. Again, response latencies did not appear to differ between the congruent (M = 641ms) and incongruent (M = 676ms) task blocks.

Responses across trials were further analysed in terms of responses to pairs of A stimuli, B stimuli and C stimuli in order to ascertain any variances in stimulus control across the original conditioned stimuli (A), the symmetrically related stimuli (B) and the transitively related stimuli (C; See Figure 15). Figure 12 shows that for the each of the A, B and C stimulus pairs subjects responded with greater accuracy on the incongruent task block than on the congruent task block. More specifically, for the A stimuli, subjects responded with an accuracy of 24.3% on congruent task blocks and 60% on incongruent task blocks. For B stimuli, subjects responded with an accuracy of 20% on congruent task blocks and 58.57% on incongruent task blocks. Finally, for C stimuli, subjects responded with an accuracy of 21.4% on congruent task blocks and 58.7% on incongruent task blocks. This suggests that the IAT effect was not successfully reversed for any of the arbitrary experimental stimuli.

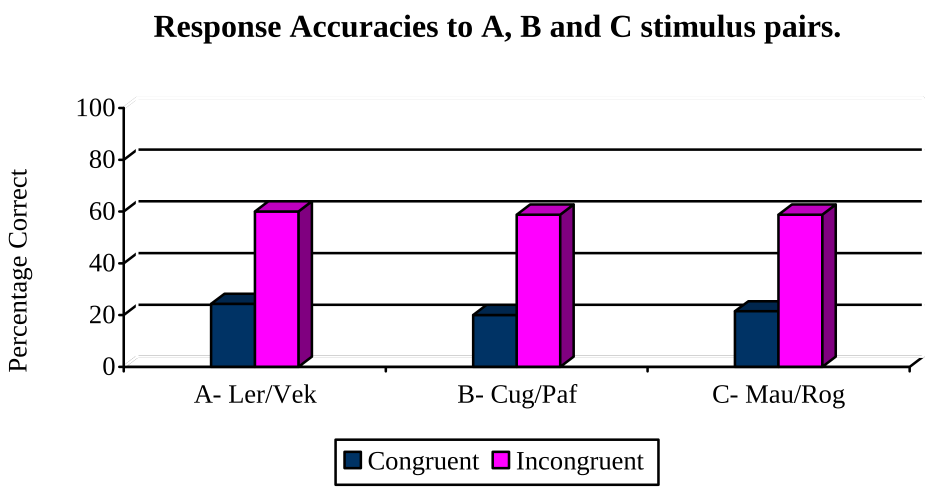


Figure 15: Percentage correct responses to each of the A, B and C stimulus pairs during Phase 5

The results of Experiment 9 indicate that the baseline IAT-type test is sensitive to the respondent conditioning history employed in Phase 1 and the verbal relations established by the experimenter in Phase 2. In effect, an IAT effect was successfully modelled for the third time in this chapter. As with Experiments 7 and 8, the laboratory history of respondent conditioning and derived relational responding was sufficient to generate IAT effects in the current study. These IAT effect were obtained in relation to response accuracies and not response latencies. However, the IAT does not appear to be sensitive to the reorganisation of verbal categories (i.e., when the baseline conditional discriminations are reversed; Phases 4 and 5) at the level of individual subjects (overall IAT effect) or individual stimuli.

One reason why a failure to undermine IAT effect was observed again, may have to do with the symmetry testing used to aid in this endeavour. Ironically, while intended to strengthen the reversed relations in Phase 4, it likely had the same effect on relations in Phase 2. That is, the relations being undermined in Phase 4 were even more robust and so any observed reversals during equivalence testing may not have generalised to a novel testing context (i.e., IAT-type test). In effect, far from failing to achieve a great shift in the final IAT effect, the opposite was achieved. That is, subjects responded with greater accuracy on the incongruent task blocks over the congruent task blocks.

It is important to understand that the incongruent relations in the intervention phase (Phase 5) were defined as the congruent relations in the baseline phase (Phase 3). Thus, the current study has demonstrated a failure to shift the response pattern observed on the IAT-type test from Phase 3 to 5.

Given that the move towards strengthening the relations was not effective perhaps the opposite strategy is required. That is, perhaps one way in which laboratory modelled IAT effects are susceptible to manipulation is when they emerge from relations that are not over-trained. Thus, one way in which we might reverse the IAT effect in Phase 5 is to train relations in Phase 2 to a lower standard but nevertheless to criterion. Such a standard needs to be enough to form the basis for the IAT effect in Phase 3 but weak enough that these relations can be reversed, with an accompanying generalisation of these reversals to the IAT-type test, in Phase 5. One practical way in which to do this is to eliminate equivalence testing from both Phases 2 and 4. This would mean that subjects are never required to explicitly derive the relations that will form the basis of the IAT effect in Phase 3. The next experiment explored this possibility by replicating Experiment 8 with the notable removal of equivalence testing from Phases 2 and 4.

Experiment 10

The overall aim of Experiment 10 was two-fold. Firstly, it was to see if equivalence testing was required to show an effect on the IAT-type test. Secondly, it was to examine the idea that untested relations might lead to more malleable IAT effects.

The removal of an explicit equivalence test after equivalence training will have the added benefit of testing a simple behavioural idea of how the term implicit might be appropriately applied. That is, researchers commonly use the term implicit to refer to what might be loosely called *unconscious*. The term *Unconscious*, in cognitive literature, may be defined as attitudes and beliefs that are outside an individual's awareness or conscious control (Greenwald et al., 1998).

However, to the behaviour analyst, implicit may mean that the contingencies controlling responding in the test are not verbally discriminable by the subject (i.e., they are outside conscious awareness). Rather, the contingencies lie largely outside the experimental preparation, which serves only as a current context to bring pre-experimentally established behaviour to bear. Therefore, the removal of an equivalence test following training represents an operational manipulation of subjects' consciousness' of the relations that will form the basis of the IAT effect. In other words, the test will be rendered more implicit as it will examine a history of stimulus associations that lead to the emergence of derived relations during the IAT-type test but not before. This seems to be parallel to what researchers refer to as an *implicit measure* (DeHouwer, 2006) wherein the subject does not even know what is being tested for.

This proposed testing method may allow the researcher to glean specific information about a subject's history without running the risk of producing experimental demand, social desirability or forms of counter-control through the use of explicit questionnaires or interview methods. In forming abstract verbal histories in the laboratory we can ascertain whether the subject is responding to them explicitly or implicitly. Therefore, in order to examine another method of altering laboratory generated IAT effects the current experiment will replicate Experiment 8 with the notable exclusion of equivalence testing from Phases 2 and 4.

Method

Subjects

Five subjects (4 males and 1 female) all acquaintances of the experimenter, aged from 18 – 35 years participated in the current study. Subjects were informed that they would be participating in a five-phase word-association test which would take approximately one hour to complete.

Apparatus and Stimuli

All apparatus and stimuli employed were identical to those in Experiment 8.

Ethics

All subjects were presented with and signed a consent form before proceeding to first phase of the experiment (See Appendix 9). Subjects were informed casually that performance on the task would not allow the researcher to make any individual psychological assessments but may allow for group patterns to be identified. After participation subjects were fully debriefed as to the true nature of the study and were offered the opportunity to express any concerns or ask any questions they may have. Subjects were reminded that participation was confidential and that they were free to remove their data at any time.

Procedure

General Experimental Sequence

The general experimental sequence of Experiment 10 was similar to that of Experiment 8 whereby the experiment consisted of 5 phases. Phases 1, 3, and 5 were identical to Experiment 8. Phase 2 comprised of equivalence training identical to Experiment 8 with linear transitivity equivalence training. However, unlike Experiment 8 no equivalence test presented in the current procedure. That is, subjects proceeded directly to Phase 3 once they had reached criteria in the equivalence training phase (criterion being 93.75 percent or 15/16 correct responses in a trial block). Similarly, Phase 4 equivalence training in the current experiment was identical to that in Phase 4 in Experiment 8 and comprised equivalence training where criterion was met before subjects could proceed to Phase 5. However, there was no equivalence testing during Phase 4 of Experiment 10. Essentially the general experimental sequence was: Phase 1 (Word picture association task); Phase 2 (Equivalence training); Phase 3 (Baseline IAT-type test); Phase 4 (Equivalence training with reversal of baseline conditional discriminations) and Phase 5 (Post-intervention IAT-type test).

Summary

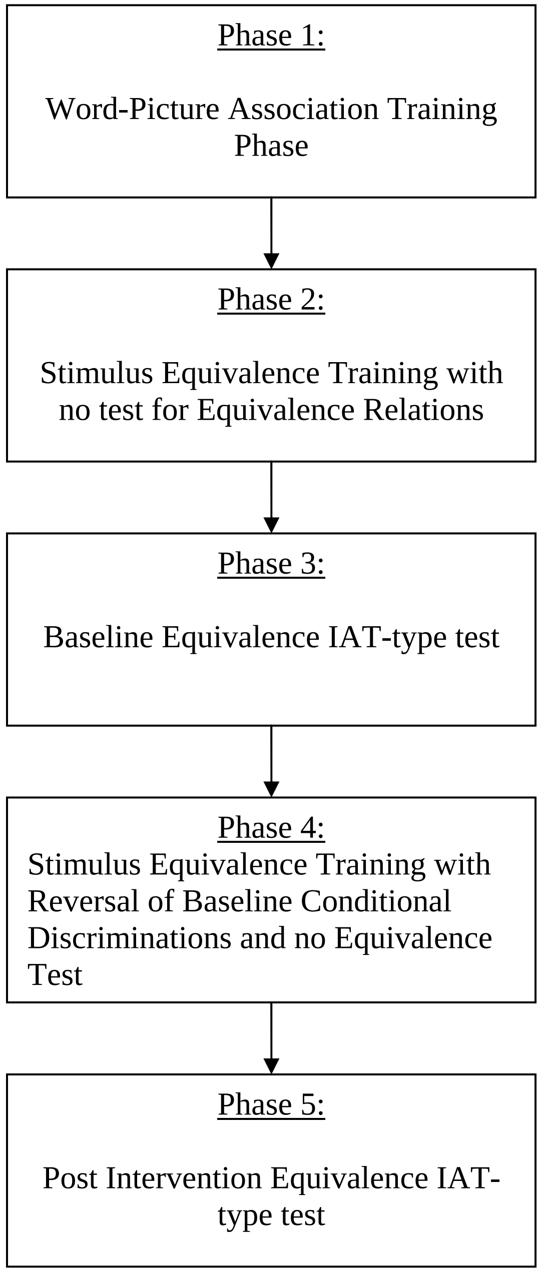


Figure 16: Procedure summary for Experiment 10

Results and Discussion

All subjects completed Phase1, which did not require a response criterion. During Phase 2 subjects required between 1 and 6 blocks of training in order to reach criterion, with the majority of subject requiring 4 blocks or less.

In Phase 3, all 5 subjects completed the required 180-trial Equivalence IAT (90 incongruent tasks and 90 congruent tasks). Subjects' total number of correct responses were calculated for both congruent and incongruent task blocks. Subjects scored 82% accuracy the congruent (M= 73.8) task block. The incongruent task block response accuracies were lower for Experiment 10 with (M=54) or 60% accuracy. The lowest score recorded was below chance level with 43 correct responses out 90 (Subject 2, incongruent task block; see Figure 17). These findings are suggestive of a modest IAT effect in the predicted direction where all five subjects responded with greater accuracy on the congruent task block. A comparison of mean response latencies suggests no differences between congruent (M =910 ms) and incongruent (M = 850ms) task blocks.

Response Accuracies for Congruent and Incongruent Tasks.

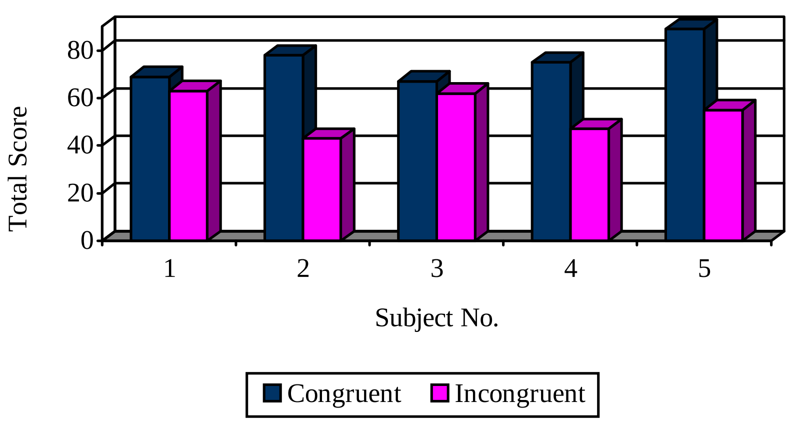


Figure 17: Individual Subject Response Accuracies for the baseline IAT-type in Phase 3

Responses across trials were further analysed in terms of responses to pairs of A stimuli, B stimuli and C stimuli in order to ascertain any variances in stimulus control across the original conditioned stimuli (A), the symmetrically related stimuli (B) and the transitively related stimuli (C; See Figure 18).

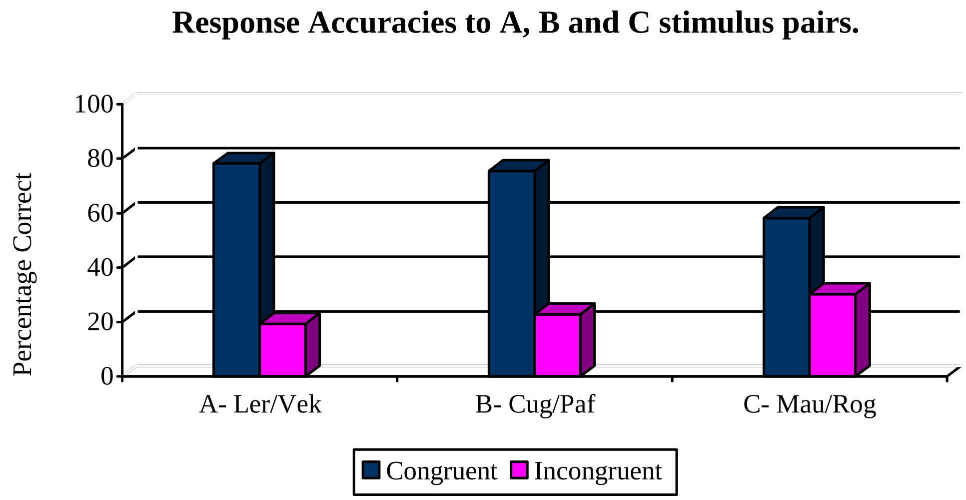


Figure 18: Percentage correct responses to each of the A, B and C stimulus pairs during Phase 3

Figure 18 shows that for the each of the A, B and C stimulus pairs subjects responded with greater accuracy on the congruent task block than on the incongruent task block. More specifically, for the A stimuli, subjects responded with an accuracy of 78.3% on congruent task blocks and 19.3% on incongruent task blocks. For B stimuli, subjects responded with an accuracy of 75.5% on congruent task blocks and 22.9% on incongruent task blocks. Finally, for C stimuli, subjects responded with an accuracy of 58.2% on congruent task blocks and 30.3% on incongruent task blocks. This pattern reflects the clear IAT effect demonstrated overall for all experimental stimuli across task blocks.

For Phase 4, data comprised equivalence training and testing data. Subjects required between 1 and 4 blocks of training in order to reach criterion.

In Phase 5 of Experiment 10, all five subjects completed the required 180-trial IAT (90 congruent tasks and 90 incongruent tasks) and subjects' total number of correct responses were calculated for both congruent and incongruent task blocks. It must be noted that for Phase 5 the label "Congruent" refers to tasks which are congruent with the *new equivalence relations* established in Phase 4. Similarly, the label "Incongruent" refers to tasks which are incongruent with the *new equivalence relations* established in Phase 4.

Subjects' responses appeared inconsistent and variable on the congruent task block (M= 63.2) with responses being of similar variance and accuracy on the incongruent task block (M=62.4). Specifically, two subjects demonstrated effects in the predicted direction (i.e., greater response accuracy on the congruent tasks) and the remaining three subjects responded in the opposite direction (i.e., greater response accuracy on the incongruent tasks). However, response accuracies on both congruent and incongruent class task blocks were above chance level for all subjects (see Figure 19).

Response Accuracies for Congruent and Incongruent Tasks.

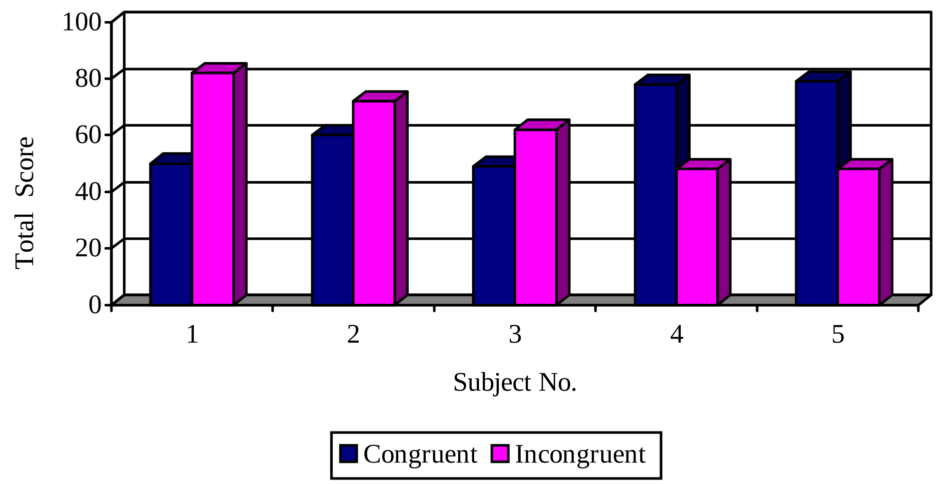


Figure 19: Individual Subject Response Accuracies for the post-Intervention IAT-type test Note: The label *congruent* refers to tasks which are congruent with the *new equivalence relations* established in Phase 4. Similarly, the label *incongruent* refers to tasks which are incongruent with the *new equivalence relations* established in Phase 4

A mean comparison of subject response accuracies in Phase 5, comparing congruent (M= 63.2) and incongruent (M= 62.4) task blocks, showed no apparent difference between tasks. Response latencies did not differ noticeably between congruent (M =721 ms) and incongruent (M = 778ms) task blocks.

Responses across trials were further analysed in terms of responses to pairs of A stimuli, B stimuli and C stimuli in order to ascertain any variances in stimulus control across the original conditioned stimuli (A), the symmetrically related stimuli (B) and the transitively related stimuli (C). Figure 20 shows that for the each of the A, B and C stimulus pairs subjects responded with greater accuracy on the congruent task block than on the incongruent task block. More specifically, for the A stimuli, subjects responded with an accuracy of 61.6% on congruent task blocks and 39% on incongruent task blocks. For B stimuli, subjects responded with an accuracy of 43% on congruent task blocks and 41% on incongruent task blocks. Finally, for C stimuli, subjects responded with an accuracy of 62.1% on congruent task blocks and 49.2% on incongruent task blocks. This suggests that the IAT effect was successfully removed for all of the arbitrary experimental stimuli.

Taking into consideration that the C stimuli are truly derived in the current paper, it can be said that Phase 5 showed a reversal of the IAT effect witnessed in Phase 3. As such, further relations were examined to asses the role of the derived stimuli (B and C) independent of the explicitly trained A stimuli. For Phase 5, a modest difference was observed between congruent and incongruent tasks when the A stimuli were excluded and the B and C stimuli were combined showing 52.56% accuracy on the congruent task blocks and 45.05% accuracy on the incongruent task blocks.

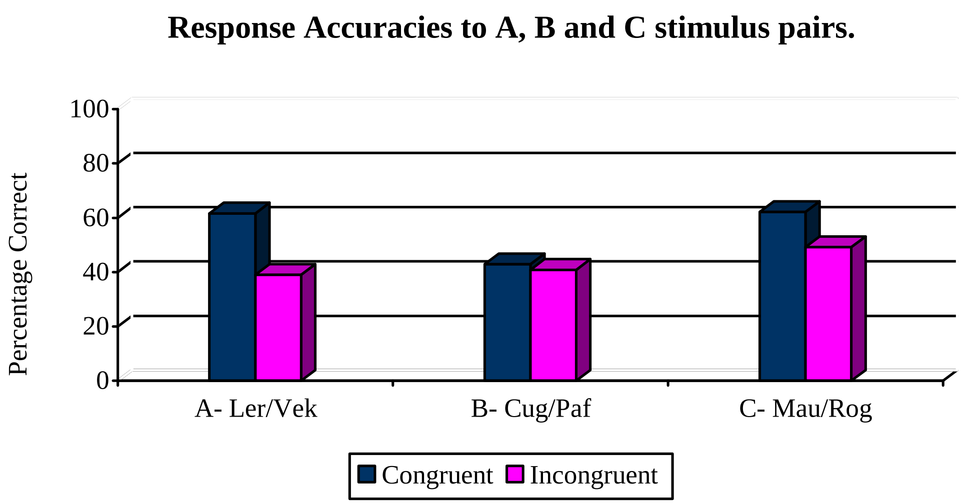


Figure 20: Percentage correct responses to each of the A, B and C stimulus pairs during Phase 5

The findings of Experiment 10 appear to suggest, in accordance with the findings of Experiment 9, that the baseline IAT effect is sensitive to the respondent conditioning history employed in Phase 1 and the verbal relations established by the experimenter in Phase 2 even in the absence of equivalence testing. In addition, the reversal of baseline conditional discriminations (Phases 4 and 5) resulted in an eradication of the IAT effect.

On initial inspection, the IAT effect appeared to be eradicated as responses were varied and inconsistent across subjects. However, an analysis of the individual stimulus pairings (i.e., A, B & C) suggests that the IAT effect may have reversed significantly for both A and C stimuli. This suggests that responses to the equivalence stimuli on the IAT-type test reversed and effects for B stimuli were eliminated.

These findings suggest that equivalence testing may not be required to generate an IAT effect. In addition, in the absence of equivalence testing the IAT effect may prove more malleable. Specifically, the current experiment found an IAT effect for Phase 3 in the absence of equivalence training. Following a reversal of baseline conditional discriminations, the current experiment found the IAT effect was eradicated. However, this effect was reversed for both A and C stimulus pairings suggesting that the original IAT effect was malleable. That is, the current experiment finally gained control over the IAT effect and its reversal. Therefore, at least one of the experimental conditions for the reversal of IAT effects is based on relations that are not tested explicitly an issue that will be discussed further in the General Discussion section.

General Discussion

In the current chapter, Experiment 7 showed that a laboratory history of respondent conditioning and derived relational responding is ample in generating an IAT effect. That is, the incongruent task block proved significantly more difficult than the congruent task block in an IAT-type test which included the equivalence stimuli and the sexual and aversive images presented by the experimenter. Most importantly, this IAT effect was obtained simply on the basis of associations established for subjects by the experimenter. In effect, the IAT was proven to be sensitive to the laboratory-controlled histories and consequently the core processes of the IAT can be accounted for using the current behavioural framework.

Having generated an IAT effect using experimentally established associations, Experiment 8 was designed to test the malleability of this IAT effect. The first half of Experiment 8 replicated the findings of Experiment 7 while the second half reversed the baseline conditional discriminations for the equivalence classes and administered an intervention IAT-type test. While Experiment 8 maintained an IAT effect for the intervention IAT-type test (Phase 5) a breakdown of the data and subsequent statistical analysis revealed that the IAT effect was being generated by the A stimuli. That is, while a significant IAT effect was obtained for the C stimuli in Phase 3 the same effect diminished in Phase 5. As such the purely derived stimuli (C) did not take on the functions of the A stimuli following the reversal of the baseline conditional discriminations. Essentially, this reversal of the baseline conditional discriminations was not sufficient in reversing the actual equivalence classes for subjects.

For Experiment 9, symmetry testing was included in the equivalence test phases (Phases 2 and 4) to ascertain if a more robust testing procedure would help reverse the IAT effect for Phase 5. The results here suggested that the IAT effect could not be maintained once the baseline conditional discriminations were disrupted. Specifically, while an IAT effect emerged in Phase 3 the reversal of baseline conditional discriminations failed to shift the IAT effect for the intervention IAT-type test. The data here suggests that IAT outcomes are sensitive to respondent conditioning histories, but given adequate training and fluency with stimuli original IAT effects can prove longer lasting. This suggests that the *initial* word association embedded in an individual over a long period of time may prove arduous to reverse or reduce even if the intervention association is trained using an identical procedure.

Finally, Experiment 10 of the current chapter suggested that equivalence testing may not be required to generate an IAT effect. In addition, in the absence of equivalence testing the IAT effect may prove more malleable. Specifically, the current experiment found an IAT effect for Phase 3 in the absence of equivalence training but following a reversal of baseline conditional discriminations the IAT effect was eradicated. On closer inspection, however, this effect was reversed for both A and C stimulus pairings suggesting that the original IAT effect was malleable.

The current studies demonstrated that IAT effect based on untested equivalence relations are easier to shift (Experiment 10). The idea here is that the relations are consolidated by equivalence testing, in particular symmetry and transitivity testing (Experiment 9), and through testing the relations seem to become robust and difficult to shift. Clearly, more research is needed here as this issue only refers to the shifting of the

IAT effect on the intervention phase and is evidently not concerned with the problem of simply shifting derived relations themselves as this proved no difficulty in the current research. The interesting issue is the generalisation of those shifted relations to other testing contexts and this proved even more difficult than shifting the derived relations in the first instance.

The findings of Experiment 10 suggest that verbal relations need not be consolidated through explicit matching tests or their functional equivalent in order for IAT effects to become rigid. Conversely, O'Toole et al. (in press) did not use equivalence testing prior to IAT test performance and subsequently eight of their subjects did not produce an IAT effect. These researchers claimed that IAT effects could not be produced with novel relations in the absence of an equivalence test yet Experiment 10 found it. It is unclear why Experiment 10 found an IAT effect but a possible suggestion might be that the current procedure had more control over the functions, and indeed the whole network, as they were established in the laboratory. In addition, there were also fewer stimuli involved in Experiment 10 and so the IAT effect was more likely to emerge with less of a demand from subjects.

In the real world, we may expect that relations are often over rehearsed. Return to the example of a Protestant person living in Northern Ireland and growing up in a Protestant household, living in a Protestant area and attending a Protestant school during the height of *the Troubles* in Northern Ireland. We might expect such a person to show an IAT effect on an IAT-type test involving Protestant and Catholic stimuli and positive and negative words. For this person, a brief intervention involving reversing relations is unlikely to remove an IAT effect. It is for this reason that IAT researchers are excited over its robustness. But that assertion is made in the absence of a known process. With the current findings, you begin to uncover that process and find that the consolidation of relations with stimulus fluency makes the IAT effect rigid. In fact, future studies could intervene with fluency training. That is, not only reverse relations but reverse them back again and back again and back again until subjects are highly fluent at matching them in various ways. It is highly unlikely that an IAT effect would emerge after such an intervention but this is more extended than perhaps may have been first assumed. According to Roche et al. (1997), this is exactly the problem facing those trying to change attitudes and discourse in the real world. That is, too much over training of relations has occurred and mere contradictions of baseline relations will not necessarily lead to generalised changes in others relations or relational performances. They also suggested the use of pre-experimental fluency training not unlike that suggested here. Thus, while an IAT effect may easily become rigid this should not be exploited by those with a psychometric research agenda in order to make the test result even more difficult to alter across time. Rather, they should be searching for the conditions under which the effect is diminished. Only that strategy will lead to a functional understanding of the test and the processes underlying subjects' performances on it.

The current studies failed to find a difference in response latencies between the congruent and incongruent task blocks. Thus, no IAT effect was found using reaction time measures in all of Experiments 7, 8, 9 and 10. That is, across four experiments, with four novel subject samples Response Time differences did not emerge. This suggests that varied response time across tasks is a robust and stable feature of IAT type test performance. In addition, it is important to understand that behavioural measures in the field of derived relations do not typically emphasize response latencies (but see Bentall, Dickins, & Fox, 1993; Steele & Hayes, 1991; Wulfert & Hayes, 1988). Response latency may be considered a useful concurrent measure of relational responding performances, or even a preferred measure for differentiating performances when response accuracy has stabilised (see Spencer & Chase, 1996). However, from a behavioural perspective the use of the response latency measure cannot be used reliably as an explanatory mechanism or evidence of mediating cognitive processes (e.g., attitudes; see O'Hora, Roche, Barnes-Holmes, & Smeets , 2002; see also Roche, Linehan, Ward, Dymond, & Rehfeldt, 2004). Thus, while the response latency measure is by no means popular amongst behaviour analysts, Spencer and Chase (1996) have argued that response latency can be considered a useful measure of relational responding when response accuracy has reached 100 percent. For these foregoing reasons, response latency was not employed in the current study as a primary dependent measure.

Another important issue arising from the current study regarding response latency measures relates to the various scoring systems and algorithms that may be used. Specifically, Greeenwald, Nosek, and Banaji (2003) engineered a scoring algorithm which relies on a corrective feedback procedure whereby a red 'X' is presented to subjects when an incorrect response is given on a trial. Subjects are required to re-respond to the same stimulus until the correct response is recorded. Latencies on error trials therefore always included the added time required for subjects to make the required response. Consequentially, this technique calculates reaction times based on correct responses only (as all trials require a correct response). Bearing this in mind, and given that responses over 3000 ms are recoded to 3000 ms, the resulting effect is that all trials on which subjects first produce an incorrect response before emitting the correct one have a calculated RT approaching or equal to 3000ms. Thus, in the current study significant time differences would have been observed if the experimenters had used such a scoring technique. Specifically, all of the reaction times in the current study included those recorded for incorrect responses on the first emitted trial. This is far more conservative measure than used by Greeenwald, Nosek and Banaji (2003) and Devos and Banaji (2005).

This is relevant to another important issue regarding the ways in which Behavior Analyst's handle reaction time data of this kind. That is, sometimes the effect can obscure the process when behaviour analysts get caught up in techniques and algorithms as above. The current study excludes reaction times as the primary for the following three reasons. Firstly, reaction times are neither a typical nor traditional behavioural measure and are thus not regarded as holding weight outside a cognitive setting; secondly, reaction times do not boast consistency in that they are not robust (huge inconsistency has been noted across subjects); and thirdly, the variability of the reaction times is questionable as they are not directly related to our experimental contingencies. Thus, Behavior Analysts need to keep their eye on the process not the effect. For instance, if rapid responding is important for a test then why allow subjects long response windows? Responding should be constrained as was presented in the current study. In addition, given the single subject nature of the current research design and the traditional suspicion with which Behavior Analysts view inferential statistics it would seem strange to get excited about a technique such as the IAT whose empirical outcome depends on statistical inference and the obfuscation of the phenomenon of interest. With this in mind, the current experimental model and IAT-type test outcome represents an approach to implicit testing that can be conceived as a behavioural test for derived implicit relations and is probably best not confused with the IAT technique. The point is, that the current research agenda is interested in a process (i.e., derived implicit relational testing) where the IAT is at present, more of a poorly understood technique.

The findings of this chapter suggest that the IAT is sensitive to the respondent conditioning history and the verbal relations employed in the current study. Put simply, the laboratory history of respondent conditioning and derived relational responding was sufficient to generate an IAT effect in the each of the current studies. The reorganisation of verbal categories produced an IAT effect for Phase 5 of Experiment 8 suggesting malleability of IAT effects. However, this effect was due to the powerful nature of the conditioned “A” stimuli remaining constant throughout the Phase 2 and Phase 4 equivalence class formations. The reversal of baseline conditional discriminations subsequently failed to create an intervention IAT effect in Phase 5 of Experiments 9 and 10. However, the role of different equivalence procedures on the IAT-type test has been highlighted here. Specifically, if an initial relation has a well established history (e.g., combined symmetry and transitivity testing) then the resulting IAT effect will prove robust and will not lend itself to change even when the baseline conditional discriminations are changed. In contrast, if the initial relation or association held by an individual is not well established and has never been confirmed, such as the absence of an equivalence test, then the resulting IAT effect will prove malleable.

The current research shows that IAT effects can be observed in the absence of bias and attitudes. More importantly, our findings allow for the suggestion that an IAT effect can be altered, reversed or remain constant depending on how verbal relations are reorganised. If these findings extend to real world settings it can be assumed that the possibility of reorganising implicit attitudes exists. Of course, to behaviour analysis an attitude can be conceived of as a network of derived and explicitly reinforced stimulus relations according to which the functions of events are transformed (Grey & Barnes, 1996). To this extent, the IAT as is stands may indeed measure attitudes but the current study makes a significant contribution by demonstrating convincingly that the effect can in principle be generated by virtue of a establishing an appropriate network of derived relations and establishing response functions for a small number of these and consequently that a reorganisation of this network may result in the demonstration of new or novel attitudes in an individual.

Given the foregoing data, it would now seem possible to create behavioural interventions that directly alter modes of discourse. We might do so by targeting the emotional functions of stimuli in equivalence classes and increasing participants' fluency with the relevant verbal relations. For instance, it would take little ingenuity to develop an intervention in which white police officers are trained to respond to both *black* and *white* faces as both *good* and *bad* across a series of tasks with increasing fluency and accuracy until a bias in either direction has been over-ridden. We can then easily assess the impact of such an intervention using traditional explicit and implicit attitude measures and direct behavioural observation. Of course, to be truly effective on a large scale the wider social contingencies need to support these fluency practices. For instance, children ideally need to be taught fluency and flexibility in their verbal relations regarding their own and other races. In the long run, for these aspirations to become reality, it will be necessary for social scientists to put forth a wide ranging and concerted effort. But for the immediate future, a first step can be taken by illuminating the verbal relations involved in prejudicial cultural practices, and identifying clues about the controlling verbal practices that maintain them.

Chapter 7

Summary and conclusion

The over-riding concern of the current thesis was to provide a functional-analytic account of a behavioural approach to implicit testing. To achieve this goal, the ten experiments reported herein systematically and methodologically created a pathway from the known paradigm of stimulus equivalence to a functionally understood model of implicit association testing. That is to say, a clear account of the underlying behavioural processes in the Watt et al. (1991) procedure and the Implicit Association Test (Greenwald et al., 1998) has been provided. This account explains the processes involved in these tests and points more precisely to the phenomena these tests measure. More importantly, however, the identification of these processes should allow researchers to build even more reliable and valid measures for attitudes, affect, linguistic categories or any aspect of an individual's behavioural history.

In the final chapter of the thesis, I will discuss the experimental findings from each of the previous chapters. In doing so, some broader concerns and applications arising from the current research program will be discussed. These discussions will also provide the opportunity to consider future behavioural research into implicit testing and the role of behaviour analysis in allowing for a functional account of these measures and their potential application in clinical and forensic settings.

The current thesis began with a review of the behavioural literature concerned with stimulus equivalence and deriving relations. Murray Sidman's (1971) theoretical account of stimulus equivalence was outlined before a variety of papers that applied derived relations in a real world setting were explored. These papers explored issues such as prejudice (Watt, Keenan, Barnes, & Cairns, 1991), terrorism (Dixon, Dymond, Rehfeldt, Roche, & Zlomke, 2003) and sexuality (Barnes, & Roche, 1997; McGlinchey, Keenan, & Dillenburger, 2000; Roche, Ruiz, O'Riordan, & Hand 2005), to name a few. These studies suggested that the exciting possibility of developing implicit relational tests based on the concept of stimulus equivalence has arrived. More than fifteen years ago, a seminal study by Watt, Keenan, Barnes and Cairns (1991) used a simple stimulus equivalence paradigm to take advantage of the fact that people in Northern Ireland often respond to each other's names as indicative of religious background. The current research program stemmed from this crucial finding that subjects' personal and social histories interfere with their ability to derive specific equivalence relations in the laboratory.

The first empirical chapter tested the applicability of the Watt et al. paradigm as a tool for assessing personal and social histories. A novel Yes/No procedure was employed using a controlled experimental laboratory preparation to create and test for social histories in Experiment 1. This experiment was the first to empirically support the original suggestion by Watt et al. (1991) that social histories can interfere with the formation of equivalence relations. Specifically, subjects in the contingent history condition (A) performed poorly when forming novel verbal relations which were incompatible with the laboratory history. This demonstrates that the laboratory history interfered with the derivation of stimulus equivalence, thereby providing a process-based analysis of the Watt et al. (1991) effect. Experiment 2 expanded on this by applying this novel Yes/No version of the Watt et al. paradigm in an effort to assess the social categorisation of children and sexual terms by men and women in a random selection from the general population. This procedure successfully identified differences in the verbal practices of males and females on an individual level and also allowed for predictability of male and female behaviour during the testing phase.

The results of both experiments suggest that analyses of verbal relations can be employed in future as a useful paradigm for developing functionally understood implicit tests.

However, a series of concerns arose within Chapter 2. Firstly, the cumbersome nature of the procedure was noted. More specifically, the training and test procedure took anything from 20 minutes to one hour to complete, as is typical with stimulus equivalence training and testing methods. In effect, the Watt et al. paradigm does not function as a practical and easily administered measure for use on large populations. This concern was addressed directly in Experiment 3 (Chapter 3). Specifically, it was decided to reduce the time required to complete the Watt et al. test paradigm. This was achieved by substituting an instruction in place of the equivalence training typically provided in the laboratory. That is, subjects were presented with onscreen instructions informing them which stimuli to put together. Subjects were then presented with two test blocks on which differing experimental instructions were provided. One set of rules was congruent with the subject's personal/social history and the other set was incongruent with the subject's personal/social history. The provision of rules in place of equivalence training successfully reduced the participation time as subjects were only required to complete a testing phase and not a training phase.

Secondly, the explicitness of the Watt et al. paradigm may have been apparent from the subjects' point of view. That is, subjects may have been aware of what the test was intended to measure. This could have occurred because of the use of relational terms in the instructions. More specifically, terms such as "with' served not only as discriminative stimuli for matching the current stimuli but as discriminative stimuli for matching in general, as they do in daily verbal interactions. The generalised matching context produced by these terms may have led directly to a tact of the experimental setting as one in which word-associations were being examined. Once such a tact has been made, it may have served as an additional contingency for the matching responses, thereby leading to less predictable outcomes or even "intentional" responding controlled by further verbal rules produced by the subject. While this possibility needs to be addressed, it must be remembered that the behavioural patterns observed in Chapter 2 do not suggest that such additional verbal contingencies were operating for most subjects.

In order to address the foregoing issue, Chapter 3 introduced a response window to limit the response time on each trial of the test. That is, a 3000ms response window was introduced to limit the ability of a subject to consciously produce socially desired responses. Such an experimentally controlled response window (3000ms response window) allowed subtle differences in history to emerge through an increased number of errors made under the more demanding contingencies of the test.

Chapter 3 explored the possibility of assessing differences in verbal behaviour when using a novel instruction-based relational test. The test measure was capable of identifying subjects' laboratory created histories on the basis of response accuracy differentials across the test blocks. This greatly modified and extended Watt et al. procedure did not require equivalence training but nevertheless tapped into subjects' social and personal histories. However, the relations employed in that experiment were not verbal relations but simple conditioned associations. Thus, in Experiment 3 only non-arbitrary generalisation was demonstrated in the test phase insofar as novel pictures and shapes were employed as stimuli in place of the directly conditioned stimuli established at the outset. The explanation for the observation of an interference effect on equivalence class formation using novel stimuli, therefore, is simply that the novel stimuli participated in functional (rather than equivalence) classes with those used during training.

While it is easy to see how the shapes employed may well have formed a functional class due to their physical similarities, it may not be so obvious that a functional class may also have formed for the sexual images in Experiment 3. More specifically, while some topographical features are shared across the sexual images (e.g., the appearance of human bodies, skin colour tones, etc) it may also be the case that the images form part of a pre-experimentally established verbal class. That is, the large variance in the topographies of the sexual images employed across the experimental phases suggests that these stimuli may in fact represent an equivalence relation controlled by the term “sexual”. Indeed, given the ubiquity of human verbal behaviour it is likely that humans respond to all nonverbal relations verbally at least some of the time (see Hayes, Gifford, Townsend, & Barnes-Holmes, 2001).

In the real world association history may take many forms, such as fortuitous pairings of emotional stimuli, words in texts, images and words in the media, and so on. Any of these association modalities should also be sufficient to produce the effects observed in the current study. While this idea is impossible to prove without further experimentation it is worth considering that the current procedure may in fact have involved the demonstration of interference in equivalence class formation by both functional (i.e., coloured shapes) and equivalence relations (i.e., verbal class of sexual stimuli). Likely both processes played a role and indeed both processes may interact in a way that makes separating them a false dichotomy. As a practical example, consider an individual who derives an equivalence relation consisting of the spoken word “stop”, a stop-sign, and a gesture from a crossing guard to stop. Later, she may learn that when her teacher says “stop”, it is time to stop and wait for oncoming traffic. Subsequently, the stop-sign and the crossing-guard’s gesture may result in similar behaviour on the part of the individual. This transformation of functions is based on the behavioural function of “stop” and the derived equivalence relation between the spoken word and the gesture or the sign (Dymond & Rehfeldt, 2000). Over time the gesture and sign will control behaviour in ways that are not easily identified as verbal. In other words, the derived transformation of function and the direct consequences of responding appropriately to the various stimuli combine to produce an effective repertoire that has both verbal and non verbal components. Thus, it would be almost impossible to try to separate these two processes in an ecologically valid analysis. Regardless of which process (verbal or functional) is dominant, it remains the case that Chapter 3 provided a better understanding of the Watt et al. paradigm.

In Chapter 4 the relational test procedure was modified slightly and applied in a real world setting to examine and identify the use of socially sensitive verbal relations on a series of different populations. Experiment 4 in the current chapter examined the utility of the current testing procedure in detecting cultural differences with regard to the categorisation of homosexual and heterosexual stimuli. Here, North American Homosexual males demonstrated a consistent pattern of achieving higher mean scores on the congruent task block over the incongruent task block whereas Irish Homosexual males showed an inconsistent pattern of responding across task blocks. That is, Experiment 4 was successful in detecting cultural differences with regard to the categorisation of homosexual and heterosexual stimuli.

The overall aim of Experiment 5 was to assess female subjects' fluency in associating terms related to *sexuality* with words associated with *children* as compared to words associated with *adults*. The findings from Experiment 5 showed females responded with greater accuracy on the congruent tasks where *child* terms were paired with *nonsexual* terms and *adult* terms were paired with *sexual* terms than on the incongruent tasks where *child* terms were paired with *sexual* terms and *adult* terms were paired with *nonsexual* terms.

While this test measure applied in Chapter 4 proved successful in identifying differences within experimental groups, response accuracies on both congruent and incongruent task blocks were lower than might be expected, and even reached chance levels on the task blocks for some subjects in Experiment 4. While response accuracies improved for Experiment 5, the error rates were still considerably high. Such a large error rate on both task types suggested that the test procedure itself may have been proving somewhat difficult and perhaps was placing an unnecessary demand on subjects.

It was suggested in Chapter 4 that a solution to the foregoing demand issue was to reduce the number of stimuli presented on any trial. It was believed that this would further reduce behavioural demand on subjects but, more notably, would radically change the nature of the current test. Specifically, in Experiments 4 and 5, two stimuli were presented simultaneously onscreen and subjects were asked to respond to the stimuli in terms of an association as instructed. This, in turn, required two sets of rules to be presented; one rule to control the response topography and one to specify the relations in operation during the relevant phase. A strategy in which only a simple response to a single stimulus was being made was believed to be considerably less demanding on subjects. To this extent, any move towards the use of a single stimulus on the screen represented a radical departure from the test procedure in Chapter 4 and, potentially, a new behavioural process.

It was suggested in Chapter 5, that a test in which only one stimulus is presented on each trial required a new conceptual analysis in terms of the underlying processes involved. Specifically, two studies conducted by Roche, Barnes and Smeets (1997) and Tyndall, Roche and James (2004) were considered in an attempt to conceive of the newly suggested test format in functional terms. These research papers were concerned with the relationship between functional and equivalence classes rather than the relations between equivalence relations alone. This literature provided the conceptual basis for the procedural departure from the Watt et al. and the subsequent stimulus matching paradigm developed here. More specifically, the findings of Roche et al. (1997) and Tyndall et al. (2004) suggested that the acquisition of stimulus equivalence is impeded when classes involve the disruption of previously established functional classes. More importantly, the Roche et al. study also found that functional classes are more difficult to establish when forming the class involves the disruption of a previously established equivalence relation. However, what no study to date had directly examined was the rate of acquisition of common stimulus functions by members of distinct verbal relations. The literature strongly suggested, however, that a slower acquisition of stimulus functions for members of distinct verbal relations (i.e., class competition) compared to common verbal relations (i.e., no class competition) should be observed. Conversely, a slower acquisition of distinct stimulus functions for members of common verbal relations than for members of distinct verbal relations should also be apparent.

In Chapter 5, subjects were no longer required to explicitly match the stimuli in relation to each other. Instead, Experiment 6 sought to assess the rate of acquisition of common response function to words considered compatible for a normal population compared to words considered incompatible for a normal population. Put simply, Experiment 6 examined the rate of acquisition of different response functions for words considered incompatible compared to those considered compatible. That is, subjects were required to complete a test in which they responded to individual *child*, *adult*, *sexual* and *nonsexual* stimuli in one of two ways. That is, for two sets of stimuli subjects were required to respond with a red key press, while for the other two sets of stimuli subjects were required to respond with a blue key press. In another block of testing the requirements were juxtaposed so that the combination of stimuli requiring a common key response was altered. As expected, the findings of Experiment 6 reflected the above suggestion. That is, when this single-stimulus test was used to assess differences across gender in the categorisation of *sexual* and *child*-related stimuli, a more effective acquisition of common response functions on congruent task blocks than on incongruent task blocks was observed. More specifically, there was more effective acquisition of common response functions to *child* and *nonsexual* stimuli than to child and *sexual* stimuli. Similarly, there was more effective acquisition of common response functions to *adult* and *sexual* stimuli than to *adult* and *nonsexual* stimuli.

One possible limitation of Experiment 6 was that the procedure could have been developed entirely in laboratory analogues as in previous experiments. A complete laboratory analogue allows for clearer inspection of the controlling variables and eliminates extraneous sources of control that can be expected when dealing with real world stimuli. More specifically, we have no way of knowing what functions the particular word stimuli had for the subjects employed in Experiment 6 of Chapter 5. In Chapter 6, such an analogue was pursued in order to see if clearer effects would be observed as with clear control over non-socially established stimuli individual stimulus effects would prove more apparent.

In Chapter 6 a laboratory analogue of the new single stimulus test procedure was developed. This was developed in tandem with a behavioural analysis of the Implicit Association Test due to the topographical similarity of both measures. Specifically, Chapter 6 sought to directly examine the IAT in terms of behavioural processes whilst also providing a laboratory analysis of the current test procedure using arbitrary laboratory created stimuli. In Experiment 7, subjects were exposed to a respondent conditioning procedure in which each of two nonsense syllables printed in blue and red font was paired with a sexual or aversive visual image, respectively. Subjects were then exposed to an equivalence training procedure leading to the formation of two three-member equivalence relations, each containing one of the conditioned stimuli as A stimuli. An IAT-type test consisting of red, blue, sexual, and aversive images was then presented to subjects to establish an IAT-type effect using respondent processes alone. Subjects were then exposed to a more complex equivalence-based IAT-type test consisting of sexual and aversive images and all members of the trained equivalence relations presented in black font. In Experiments 8 and 9 a similar procedure was used to examine the malleability of the IAT effect through the manipulation of relevant verbal relations. The final experiment tested the idea that the IAT effect could be generated using the test model demonstrated in Experiment 7 even when subjects were not required to explicitly derive relations following equivalence training.

The findings of Experiment 7 of Chapter 6 showed that a laboratory history of respondent conditioning and derived relational responding was sufficient in generating an IAT effect. In addition, Experiment 8 showed that reversing the baseline conditional discriminations of the equivalence classes was not sufficient to reverse the baseline IAT effect while Experiment 9 showed that an addition of symmetry testing to the equivalence testing phase only served to strengthen the baseline IAT effect observed and subsequently produce a failure to observe an IAT effect in the post-intervention IAT. Finally, Experiment 10 in Chapter 6 showed that equivalence testing may not be required to generate an IAT effect and IAT effects observed in the absence of equivalence testing may prove more malleable. Specifically, Experiment 10 found an IAT effect for a baseline IAT in the absence of equivalence training but following a reversal of baseline conditional discriminations a post-intervention IAT showed that the IAT effect was eradicated. On closer inspection, however, this effect was actually reversed for both A and C stimulus pairings suggesting that the original IAT effect was malleable and even reversible.

One prevailing concern presented in Chapter 6 was the absence of response latency differences across task bocks. That is, across four experiments, with four novel subject samples Response Time differences did not emerge. This suggests that highly variable response times across tasks is a robust and stable feature of IAT-type test performance. However, response latencies are consistently found to differ across task blocks on actual IAT performances (Greenwald et al., 1998). This failure to observe response time differences will be addressed in the general issues of the current thesis.

General Issues

Several recurring general issues of relevance to the current research agenda arose in many of the foregoing chapters. These issues include; the interpretation of response time differentials; the relevance of the experimental stimuli employed; and the concept of *implicitness* as a commonly employed term. These issues will be addressed in turn in the following sections.

Response Time Differentials

One of the key issues that emerged in the current thesis concerned the response latencies. The current studies failed to find a difference in response times across the congruent and incongruent task blocks. Specifically, no latency differences were found using reaction time measures in all of Experiments 3, 4, 5, 6, 7, 8, 9 and 10 (Experiments 1 and 2 did not record response latencies). This suggests that variable response times across tasks is a robust and stable feature of the behavioural test performances shown here.

From the perspective of the experimental analyst of behaviour this is not a perturbing or even surprising result. That is, behavioural measures do not typically emphasise response latencies (but see Bentall, Dickins, & Fox, 1993; Spencer & Chase, 1996; Steele & Hayes, 1991; Wulfert & Hayes, 1988). This is because response latency is subject to a wide range of interpretations. In particular, behaviour analysts are cautious of reaction times measures as they can be used mistakenly as an explanatory mechanism or as evidence of mediating cognitive processes (e.g., attitudes; see Johnston & Pennypacker, 1993; see also O'Hora, Roche, Barnes-Holmes, & Smeets, 2002; Roche, Linehan, Ward, Dymond, & Rehfeldt, 2004).

The current researcher takes the view that the reaction time measure may not be sufficiently sensitive to reflect any differences in stimulus control employed across the two task types employed in these tests, even though subjects clearly found one task type easier than the latter. Indeed, it is likely for this reason that Greenwald and colleagues have developed a response correction procedure that inflates response time differentials. That is, the original IAT procedure involves forcing subjects to produce a correct response to terminate each trial. Response times are recorded from the trial onset to the start of the first correct response. This has the effect of artificially inflating response time measures *for incorrect responses only* (i.e., in the direction that fits with the hypotheses of the IAT). One important consequence of this measurement choice is that subjects' real response times are buried in algorithmic treatments of the scores (see Devos and Banaji, 2005; Greenwald, Nosek, & Banaji, 2003). Thus, by ignoring and even reversing actual observed response time patterns, the response correction procedure limits the extent to which the controlling features of a subject's performance can be observed and makes a functional-analysis of the behaviour ever more difficult. In effect, it is entirely possible that the widely reported IAT response time effect is in fact a mathematical construction emerging from the complex IAT administration and scoring technique rather than a true behavioural effect. The response correction procedure, along with various scoring algorithms, the presence of arbitrary numbers of practice trials, and arbitrary response time truncation all move the IAT further from a functional analysis in behavioural terms. Only by removing these features can the core processes of the IAT be known and understood.

The IAT is not alone in its use of scoring algorithms. In fact, most cognitive measures rely heavily on response latency effects as their primary measure (e.g., the Go/No Go Task; Nosek & Banaji, 2001: semantic priming; Faust, Balota, Spieler, & Ferraro, 1999: the Stroop task; Stroop, 1935) and so often introduce response correction procedures and algorithms to aid in the retrieval of effects. For instance, the renowned Stroop effect (1935) is a demonstration of interference in the reaction time of a task. When the name of a colour is printed in that colour ink subjects can accurately and quickly name the colour. However, when a colour differing from the colour expressed by the word's semantic meaning is presented, a delay occurs in the processing of the word's colour. This second task type leads to slower test reaction time and an increase in response errors. On a Stroop task, subjects are required to self-correct where they have incorrectly identified the colour. The scoring technique devised by Stroop involved adding twice the average response time per item to a subject's total for every uncorrected error, a procedure Stroop admitted was "arbitrary" (See MacLeod, 1991). That is, in Stroop's first experiment the incongruent colour condition was not significantly different to the congruent colour condition. However, for Stroop's second experiment twice the average response time per item was added to a subject's total for every uncorrected error, which lead to the incongruent colour condition being significantly slower then the congruent colour condition. As was expected from the congruent and incongruent conditions, differences in response accuracies were apparent. However, as per the cognitive tradition Stroop penalised subjects' failure to correct incorrect responses by adding an "arbitrary" time penalty that was sufficient to create his eponymous effect.

According to Lane, Nosek, Banaji and Greenwald (2007) the crucial role of response latency in cognitive psychology research stems from an idea first proposed by Donders (1868). According to Donders, it is possible to bring order to understanding invisible thought processes by computing the time that elapses between stimulus presentation and response production. Such analyses necessarily involve interpretation and deduction based on reaction time measures, in order to ascertain extant processes within the organism. Indeed, it is not surprising, therefore, that cognitive psychology is largely a deductive enterprise. This is very different from the behavioural perspective wherein induction takes the place of deduction (Sidman, 1961). Moreover, the measurement scales used in an investigation function not as extant entities but as rules that serve to bring the scientist's behaviour under the control of aspects of the behaviour of interest (Johnston & Pennypacker, 1993). Thus, the analytic methodology limits the response variability of the scientist. To this extent, the radical behaviourist prefers the inductive method (Sidman, 1960) and freedom from the constraints of theory to as great an extent as possible (Skinner, 1950).

The relevance of the experimental stimuli employed

In Chapter 2, the issue of experimental stimuli was first raised. That is, would the outcome of Experiment 2 have differed is a different stimulus set was employed? Recall in Experiment 2, the Watt et al. paradigm was applied in an effort to assess the social categorisation of *children* and *sexual* terms by men and women in a random selection from the general population. Specifically, if Experiment 2 employed the word “arousing” in place of “sexual” and the word “school” in place of “playground” would the observed results have been different? Does the effect observed in Experiment 2 depend entirely on the specific word set chosen or does it generalise across semantically related categories? These questions do not preclude the possibility that there are specific and definitive sets of words or social categories that would allow us distinguish different social groups. Nevertheless, the reliability of the test procedure on other members of these and other social groups using the same and novel stimulus sets was unknown.

Interestingly, research on other implicit measures suggests that individual stimuli play a key role in the overall test effect (Dasgupta and Greenwald, 2004; DeHouwer, 2001; Lane et al., 2007). Specifically, differences in responses to a set of verbal stimuli in the Implicit Association Test are not necessarily obtained across semantically related sets (Dasgupta & Greenwald, 2004). Research indicates that the emotional valence of words may also be a crucial factor in the overall test effect (Govan & Williams, 2004). That is, Govan and Williams (2004) conducted a series of studies that showed by changing the affective valence of the stimulus items used in the test, the IAT effect may be eradicated or reversed depending on the categories being examined. In their first study, Govan and Williams administered a typical Insect/Flower IAT to one group and an atypical IAT to a second group. That is, the first group received a typical IAT where the categories were *Insect* and *Flower* and the attributes were *pleasant* and *unpleasant*. The regular insect stimulus items for this category include *bee* and *wasp* and other negative insects just as the regular flower stimuli include *rose* and *tulip* and other positive exemplars of flowers. As mentioned, *bee* and *wasp* are not only insects but negative exemplars of insects and as such confound the attribute variable *unpleasant* with the target category *insect* as they are also unpleasant stimuli. Similarly, the *pleasant* flower exemplars are also confounding stimuli. The authors suggest that this predicament may be overcome by reversing the stimulus selection such that unpleasant flowers were selected (e.g. nettle) alongside positive insects (e.g. butterfly). This should reverse the IAT effect previously observed in the insect/flower IAT. This second or atypical IAT was presented to the second group of subjects. In line with previous findings, those who completed the typical IAT responded quicker when flower and pleasant shared a response key. However, as Govan and Williams (2004) predicted participants who completed the atypical IAT responded faster when pleasant and insect shared a response key.

The authors then repeated the study using both a typical and an atypical Black/White IAT where *Black* and *White* faces and names were used as the category variables and *pleasant* and *unpleasant* words were used as attribute variables. Here, the atypical IAT employed stimulus items to portray admired Black individuals and disliked White individuals. As with previous studies participants who completed the typical IAT responded faster when *White* and *positive* shared a response key.

However, participants who completed the atypical IAT were no faster when *White* and *pleasant* shared a response key than when *Black* and *pleasant* shared a response key. That is, presenting positive Black exemplars and negative White exemplars of the category variables resulted in an eradication of the IAT effect. Of course, these findings were obtained using an actual IAT test. Nevertheless, it is likely that investigation into the effect of word valence, and such variables as frequency of use, may be worthwhile in future investigations into the behavioural IAT-type test developed in the current thesis.

The Nature of "Implicit" in Implicit Testing

The main impetus behind the current increased interest in implicit testing methods lies in the need to develop tests of attitude that are not subject to social desirability or demand characteristics. While it is possible to ask an individual *how they feel or think* about certain objects, persons or situations, such explicit or overt attitude measures may be subject to social desirability biases (Keillor, Owens, & Pettijohn, 2001). What is required, therefore, is a more discreet way of identifying feelings, thoughts and actions in relation to important issues such as racism, prejudice, and so on. As outlined in Chapter 1 of the current thesis, derived relations have been applied in an effort to conceive such tests within behaviour analysis. Indeed, one previously published study has identified correlations between explicit attitude measures and the outcomes of a Watt et al. test (see Merwin & Wilson, 2005). Thus, it would appear that the Watt et al. procedure represented a suitable starting point for developing behavioural tests of personal history that also allowed for the development of more discrete or "implicit" testing formats. These more discrete methods were developed and examined in the latter chapters of the current thesis. These tests formats proved to be useful across a range of basic and applied studies. However, it is important to understand that the utility of these tests and the contribution of these investigations to the literature is not impacted upon greatly by whether or not the tests achieve the status of "implicit tests" by those outside the field. Specifically, there is considerable debate within the social-cognitive literature on the meaning of the term "implicit". Moreover, it is a term borrowed from the vernacular and poses all the same problems such terms present the Behavior Analyst when psychologists attempt to use these terms in scientific analyses (see Chiesa, 1994). Nevertheless, it may be worthwhile to consider the extent to which the current tests meet the various criteria commonly employed in defining implicit tests.

Implicit attitudes can be characterised as the automatic association people have between an object and evaluation (whether it is *good* or *bad*). In contrast, explicit attitudes may reflect more thoughtful or deliberative responding (Rudman, 2004). Not surprisingly, a wealth of implicit test measures have emerged in an effort to test for these implicit attitudes. Such measures work on the premise that controlling the latency in which a subject responds should yield evaluations that are unlikely to be under the subject's control. That is, the subject's attention is focused not on the attitude object, but on performing an objective task. The implicit attitudes are then inferred from systematic variations in task performance. For example, a Protestant subject would show a Pro-Protestant bias by responding with greater accuracy and latency when categorising Protestant words with positively evaluated words than with negatively evaluated words. Similarly, the same Protestant subject may show an Anti-Catholic bias by responding with greater accuracy and latency when categorising Catholic words with negatively evaluated words than with positively evaluated words.

However, the final testing procedure developed here represents just one of many in the fields of social, behavioural and cognitive psychology. During the past 15 years, a number of reaction time/accuracy tasks have been developed that potentially allow researchers to study and assess attitudes indirectly (see De Houwer, 2006; Fazio & Olson, 2003, for reviews). Amongst other things, such indirect measures can and have been used as a tool; (a) to test general theories of attitudes (e.g., Fazio, Sanbonmatsu, Powell, & Kardes, 1986); (b) to study the way in which groups of people differ in the attitudes that they hold (e.g., de Jong, 2002), and; (c) to measure individual differences in attitudes (e.g., McConnell & Leibold, 2001). Such measures include: the Extrinsic Affective Simon Task (EAST; DeHouwer, 2003); the Emotional Stroop Task (Williams, Matthews, & MacLeod, 1996); the Go/No Go task (GNAT; Nosek & Banaji, 2001); the Implicit Association Test (IAT; Greenwald et al., 1998); and the Implicit Relational Assessment Procedure (IRAP; Barnes-Holmes, Barnes-Holmes, Power, Hayden, Milne, & Stewart, 2006). These measures all function in the absence of functional-analytic accounts. That is, while the aforementioned measures may all be capable of producing significant effects across experimental conditions (e.g., congruent and incongruent) it is unclear how they do so. Specifically, the core behavioural processes of the above measures have yet to be identified. This should be a concern in light of the fact that some researchers have begun to employ these implicit measures as diagnostic indicators (e.g., Egloff, & Schmukle, 2002)

While the previous chapters provided functional-analytic accounts of various behavioural testing methods, it is unclear whether or not any of these tests might be considered “implicit”. Of course, this issue will always be a definitional one rather than empirical one. However, even for cognitive psychologists, the exact definition of the term *implicit* has only recently come under scrutiny (DeHouwer, 2006). Indeed, several different definitions of the term have been proposed by different researchers. Thus, I will briefly consider these definitions and related issues in an attempt to relate the tests developed in the current thesis to more popular implicit tests reported in the psychological literature.

Researchers have suggested that contrary to explicit measures, implicit measures are those in which subjects; (1) are not aware of the attitude being measured (e.g., Brunel, Tietje, & Greenwald, 2004); (2) do not have conscious access to the attitude being measured (e.g., Asendorpf, Banse, & Mucke, 2002), or; (3) have no control over the measurement outcome (e.g., Fazio & Olson, 2003). The IAT-type test developed in Chapter 6 of the current thesis would appear to conform to all three of these definitions simultaneously and therefore may be described as an implicit test by those outside the field.

With regard to the first definition, the IAT-type test does not require the subject to explicitly categorise stimuli in relation to each other and therefore does not measure any specific verbal relations. That is, subjects are not explicitly responding to two stimuli in relation to each other on any one trial. Essentially, subjects likely find it harder to tact which stimuli are being categorised in relation to which other stimuli in the current test format. Thus, this move away from the presentation of word pairs achieved in the IAT-type test should reduce social desirability biases. In effect, there are likely fewer demand characteristics present in this new test strategy. The IAT test may be considered an implicit test based on the first of the three definitions provided above.

The second definition of the term "implicit" refers to subjects not having conscious access to the attitude being measured. In other words, subjects may not be able to tact the over-arching pattern of verbal associations that have been established across their lifetime. Nevertheless, these patterns may be described as representative of a particular attitude (e.g., racism). In the current IAT-type test measure, the explicit verbal relations need not be responded to on any one trial and so, the test format may allow for the measurement of congruence between stimuli that have never been responded to before in stimulus relations. For example, as described in Chapter 5, a subject who has never before given any thought as to whether or not Protestant and Catholic stimuli are congruent may nevertheless demonstrate a slow acquisition of common stimulus functions to Catholic and Protestant stimuli compared to two distinct Catholic or two distinct Protestant stimuli. Similarly, without ever consciously responding (i.e., tacting) to the Catholic-Protestant verbal relation, the subject may demonstrate slow acquisition of common response functions for Catholic and Protestant stimuli. In contrast, the subject may demonstrate rapid acquisition of common response functions for two Catholic stimuli. In effect, the experimenters will be alerted to a history of stimulus associations that is tantamount to a sectarian pattern of social categorisation, without the subject ever having tacted such a history in the past (i.e., the subject is unaware that they display sectarian categorisation patterns). Of course, proving that subjects are truly “unconscious” of the contingencies controlling their own performance on a trial to trial basis is a difficult and perhaps ultimately impossible endeavour. However, the current test appears to fulfil the second definition of the term *implicit*.

Finally, the third definition of implicit states, that in order to be implicit, a test must not allow subjects to have control over the measurement outcome. The current test method employs two control measures to prevent subjects controlling their test outcome. The first is the use of a time constraint on each task. The 3000ms response window in the current procedure could be expected to limit the ability of a subject to consciously produce socially desired responses. By ensuring a higher error rate across tasks, this time demand allows subtle differences in subjects' personal and social histories to emerge across experimental conditions. The second control is the inherent preclusion of positional responding as a means to determine a particular test outcome (e.g., to demonstrate a racist response pattern when the subject does not normally do so). That is, even if subjects tried to *explicitly* control responses using positional responding (e.g., always responding to the button on the left of the screen) they can never produce a reliable correct scoring pattern. More specifically, positional responding leads to a perfect score of 50% (i.e., chance) across all tasks on both test blocks in the current procedure. Therefore, an effect can never be recorded for a subject who adopts an explicit response strategy. In addition, such a strategy would be apparent in the data produced by the subject insofar as such stereotypic responding would be easily discernible. Thus, the current test would appear to fulfil the third definition of the term "implicit" provided in the literature.

It is important to understand, that while the above definitions of *implicit* do seem to apply to the current test procedure, it does not behove the behavioural experimenter to demonstrate implicitness in terms defined by those outside the field. Nevertheless, it is interesting to note at this point that the increased subtlety of the IAT-type test procedure developed here approaches the type of testing format that many researchers have referred to as implicit (Blake & Weinberger, 2006; DeHouwer, 2003; Greenwald, McGhee, & Schwartz, 1998: Nosek & Banaji, 2001).

Conclusion

The development of the current implicit test model constitutes a real contribution the experimental analysis of behaviour and is the next logical step in a line of theoretical inquiry now spanning the best part of a decade. The current research represents a significant contribution to the burgeoning implicit testing literature. Furthermore, information gleaned in developing a behavioural model of implicit testing can be used to supplement the well-established behavioural literature on derived relations. Finally, and most importantly, the development of a behavioural screening test has its most exciting application in the daily work of those relying on behavioural assessment methodologies in the forensic and clinical fields.

Currently, no reliable and functionally understood screening test exists that can be used to assess individuals' behavioural dispositions (e.g., potential for sex offending) without their awareness. For instance, explicit paper and pencil tests allow subjects to respond in a socially desirable way and often do not reflect actual beliefs and behaviours (Crowne & Marlowe, 1960). Responding to this need for an effective and functionally understood screening tool, the current research has built upon previous research in the development of a promising behavioural screening method. This development is particularly exciting for those applying behavioural assessment methodologies in the forensic field as it may allow for the identification of knowledge or attitudes held by an individual which might be concealed in overt paper and pencil tests. For example, a paedophile population may wish to hide their unchanged sexual attitude towards children following a therapeutic intervention for fear of legal sanctions. Alternatively, they may wish to fake more acceptable attitudes as part of an assessment procedure that may increase chances of parole or other privileges. The current test, however, offers a functionally understood means by which to assess the individual's history of relational responding. How this history relates to other aspects of the behavioural repertoire or the likelihood of offending in the future is for upcoming researchers to determine. However, the current thesis has served its purpose well if it could provide even the most basic test format to researchers with which to begin analysing such applied issues. Regardless of the contribution these experiments will make to the literature on implicit testing, they have considerably extended the literature on derived stimulus relations by examining the boundary conditions for the formation of stimulus equivalence and functional stimulus classes, the relationship of these classes to each other and a novel application of the derived stimulus paradigm.

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Appendix 1

The study in which you are being asked to participate is being conducted by Amanda Gavin at the Department of Psychology at the National University of Ireland, Maynooth.

The research forms part of ongoing programme that is attempting to establish new and simple forms of computer-based psychological assessment that can be used for a very wide range of purposes to test a wide variety of skills, knowledge and attitudes. This study is a pilot project and the data gathered from it are being used for research purposes only. Your performance in the study will be entirely confidential and you will be identified in our records only by a number. We will have no other record of your identity and nobody besides the researcher will have access to data concerning your performance in the study.

The results of the study will not allow us to make psychological assessments of any one person but may allow us to distinguish the performances of various social groups in the general public.

The study consists of a series of images being presented with words followed by matching a series of words to one another on a computer screen. The study as a whole should take around 30 - 60 minutes, depending on how fast you work at each of the tasks that will be presented to you.

You will be given full instructions by the computer before you begin and you may also ask questions of the researcher before and after the study at which time much more detail can be provided about the nature of the tasks used in the experiment.

If you consent to participate in the study you are free to withdraw at any stage if you so wish.

By agreeing to participate in the study you are confirming that you are over 18 years of age.

I understand that as a requirement of participating in the study I will be exposed to images which some people may find distasteful or sexually suggestive. I further understand that none of the images presented will contain nudity.

Any concerns you may have after the study is completed will be dealt with by Amanda Gavin at the Department of Psychology at the National University of Ireland, Maynooth. Amanda.Gavin@nuim.ie

Signed

____

Date ________________________________

Appendix 2

The study in which you are about to participate is being conducted by Amanda Gavin at the Department of Psychology at the National University of Ireland, Maynooth.

The research forms part of an ongoing programme that is attempting to establish new and simple forms of computer-based psychological assessment that can be used for a very wide range of purposes to test a wide variety of skills, knowledge and attitudes. This study is a pilot project and the data gathered from it are being used for research purposes only. Your performance in the study will be entirely confidential and you will be identified in our records only by a number. We will have no other record of your identity and nobody besides our researchers will have access to data concerning your performance in the study.

The study consists of matching a series of words to one another on a computer screen. The study as a whole should take around 30-60 minutes, depending on how fast you work. You will be given full instructions by the computer before you begin and you may also ask questions of the researcher before and after the study, at which time much more detail can be provided about the nature of the tasks used in the experiment.

If you consent to participate in the study you are free to withdraw at any stage if you so wish.

Please be aware that some of the words that will appear on screen during the tasks will be sexual in nature. If you are not comfortable viewing sexually explicit words, please do not participate in the study.

By agreeing to participate in the study, you are confirming that you are over 18 years of age. You are also agreeing that you are aware that the experiment in which you are about to participate in does not allow experimenters to make any judgements about your character, but is intended only to allow them to make judgements about the population as a whole.

Any concerns you may have after the study is completed will be dealt with by Amanda Gavin at the Department of Psychology at the National University of Ireland, Maynooth. E-mail: Amanda.Gavin@nuim.ie.

I have read and understood the above and I give my consent to the experimenter to use the data I provide for the purpose of their research.

Signed ______________________

Date _____________________

Appendix 3

The study in which you are being asked to participate is being conducted by Amanda Gavin at the Department of Psychology at the National University of Ireland, Maynooth.

The research forms part of ongoing programme that is attempting to establish new and simple forms of computer-based psychological assessment that can be used for a very wide range of purposes to test a wide variety of skills, knowledge and attitudes. This study is a pilot project and the data gathered from it are being used for research purposes only. Your performance in the study will be entirely confidential and you will be identified in our records only by a number. We will have no other record of your identity and nobody besides the researcher will have access to data concerning your performance in the study.

The results of the study will not allow us to make psychological assessments of any one person but may allow us to distinguish the performances of various social groups in the general public.

The study consists of matching a series of shapes to images on a computer screen. The study as a whole should take around 20 minutes.

You will be given full instructions by the computer before you begin and you may also ask questions of the researcher before and after the study at which time much more detail can be provided about the nature of the tasks used in the experiment.

If you consent to participate in the study you are free to withdraw at any stage if you so wish.

By agreeing to participate in the study you are confirming that you are over 18 years of age.

I understand that as a requirement of participating in the study I will be exposed to images which some people may find distasteful or sexually suggestive. I further understand that none of the images presented will contain nudity.

Any concerns you may have after the study is completed will be dealt with by Amanda Gavin at the Department of Psychology at the National University of Ireland, Maynooth. Amanda.Gavin@nuim.ie

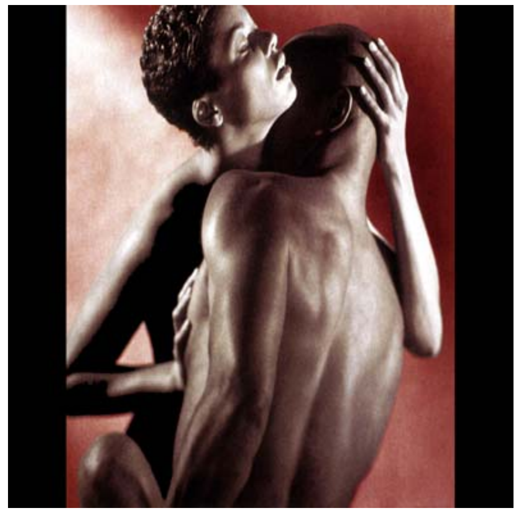
Signed ________________________________

Date ________________________________

Appendix 4

Experiment 3

Phase 1 Photographic Stimuli



Appendix 5

Experiment 3 Phase 2 Photographic Stimuli








Appendix 6

The study in which you are being asked to participate is being conducted by Jason Dowling under the supervision of Dr. Bryan Roche at the Department of Psychology at the National University of Ireland, Maynooth.

The research forms part of ongoing programme that is attempting to establish a new and simple form of computer-based psychological assessment that can be used for a very wide range of purposes to test a wide variety of skills, knowledge and attitudes.

Your performance in the study will be entirely confidential and you will be identified in our records only by reference number. We will have no other record of your identity and nobody besides the researchers will have access to data concerning your performance.

The results of the study will not allow us to make psychological assessments of any one person but may allow us to distinguish the performance of various social groups in the general public.

The study consists of matching a series of words to one another on a computer screen. The study as a whole should take around 10 - 15 minutes depending on how fast you work at each of the tasks that will be presented to you.

You will be given full instructions by the computer before you begin and you may also ask questions of the researcher before and after the study at which time much more detail can be provided about the nature of the tasks used in the experiment.

If you consent to participate in the study you are free to withdraw at any stage if you so wish. By agreeing to participate in the study you are confirming that you are over 18 years of age.

Please be aware that some of the words that will appear on the screen during the tasks may be of a sexual or derogatory in nature. If you are not comfortable viewing this material please do not participate in the study and contact the researcher.

Any concerns you may have after the study is completed will be dealt with by Dr. Bryan Roche at the Department of Psychology at the National University of Ireland, Maynooth. Tel (01) 7086026 or Bryan.T.Roche@nuim.ie. If you wish to continue, please enter your name below for consent purposes and click the button.

Name

Click here if you wish to continue with the experiment

Appendix 7

The study in which you are about to participate is being conducted by Amanda Gavin at the Department of Psychology at the National University of Ireland, Maynooth.

The research forms part of an ongoing programme that is attempting to establish new and simple forms of computer-based psychological assessment that can be used for a very wide range of purposes to test a wide variety of skills, knowledge and attitudes. This study is a pilot project and the data gathered from it are being used for research purposes only. Your performance in the study will be entirely confidential and you will be identified in our records only by a number. We will have no other record of your identity and nobody besides our researchers will have access to data concerning your performance in the study.

The study consists of matching a series of words to one another on a computer screen. The study as a whole should take around 20 minutes You will be given full instructions by the computer before you begin and you may also ask questions of the researcher before and after the study, at which time much more detail can be provided about the nature of the tasks used in the experiment.

If you consent to participate in the study you are free to withdraw at any stage if you so wish.

Please be aware that some of the words that will appear on screen during the tasks will be sexual in nature. If you are not comfortable viewing sexually explicit words, please do not participate in the study.

By agreeing to participate in the study, you are confirming that you are over 18 years of age. You are also agreeing that you are aware that the experiment in which you are about to participate in does not allow experimenters to make any judgements about your character, but is intended only to allow them to make judgements about the population as a whole.

Any concerns you may have after the study is completed will be dealt with by Amanda Gavin at the Department of Psychology at the National University of Ireland, Maynooth. E-mail: Amanda.Gavin@nuim.ie.

I have read and understood the above and I give my consent to the experimenter to use the data I provide for the purpose of their research.

Signed ______________________

Date _____________________

Appendix 8

The study in which you are about to participate is being conducted by Amanda Gavin at the Department of Psychology at the National University of Ireland, Maynooth.

The research forms part of an ongoing programme that is attempting to establish new and simple forms of computer-based psychological assessment that can be used for a very wide range of purposes to test a wide variety of skills, knowledge and attitudes. This study is a pilot project and the data gathered from it are being used for research purposes only. Your performance in the study will be entirely confidential and you will be identified in our records only by a number. We will have no other record of your identity and nobody besides our researchers will have access to data concerning your performance in the study.

The study consists of matching a series of words to one another on a computer screen. The study as a whole should take around 20 minutes. You will be given full instructions by the computer before you begin and you may also ask questions of the researcher before and after the study, at which time much more detail can be provided about the nature of the tasks used in the experiment.

If you consent to participate in the study you are free to withdraw at any stage if you so wish.

Please be aware that some of the words that will appear on screen during the tasks will be sexual in nature. If you are not comfortable viewing sexually explicit words, please do not participate in the study.

By agreeing to participate in the study, you are confirming that you are over 18 years of age.

You are also agreeing that you are aware that the experiment in which you are about to participate in does not allow experimenters to make any judgements about your character, but is intended only to allow them to make judgements about the population as a whole.

Any concerns you may have after the study is completed will be dealt with by Amanda Gavin at the Department of Psychology at the National University of Ireland, Maynooth. E-mail: Amanda.Gavin@nuim.ie.

I have read and understood the above and I give my consent to the experimenter to use the data I provide for the purpose of their research.

Signed ______________________

Date _____________________

Appendix 9

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

This research is being conducted by Amanda Gavin at the Department of Psychology, National University of Ireland Maynooth. It is the responsibility of Ms. Gavin to adhere to ethical guidelines in her 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 distasteful or sexually suggestive. I further understand that none of the images presented will contain nudity.

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 10

Experiments 7, 8, 9 and 10 Photographic Stimuli