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INCONGRUOUS STIMULUS PAIRING AND CONDITIONAL DISCRIMINATION TRAINING: EFFECTS ON RELATIONAL RESPONDING

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In Experiment 1, 5 subjects were exposed to a stimulus-pairing procedure in which two nonsense syllables, identified by a letter-number code as A1 and C2, each predicted the onset of a sexual film clip, and the nonsense syllables A2 and C1 each predicted the onset of a nonsexual film clip. Subjects were then exposed to a matching-to-sample test in which the nonsense syllables A1 and A2 were presented as sample stimuli and C1 and C2 were presented as comparison stimuli and vice versa (i.e., C stimuli as samples and A stimuli as comparisons). All subjects matched A1 with C2 and A2 with C1. Subjects were then trained on the conditional discriminations A1-B1, A2-B2, B1-C1, B2-C2, after which the matching-to-sample test was again administered. All subjects continued to match A1 with C2 and A2 with C1 in accordance with the earlier stimulus-pairing contingencies. An additional 5 subjects were exposed first to conditional discrimination training and testing before being exposed to the incongruous stimulus pairing and matching-to-sample testing. Under these conditions, 4 of the 5 subjects always matched A1 with C1 and A2 with C2. Experiment 2 replicated Experiment 1, except that a matching-to-sample test was not administered following the initial training procedure. Under these conditions, matching-to-sample test performances were controlled by the contingencies that had immediately preceded the test. Experiment 3 indicated that initial matching-to-sample test performances were unlikely to change, even after repeated exposure to incongruous training and testing. Experiment 4 demonstrated that pretraining with unrelated stimulus sets increased the sensitivity of matching-to-sample test performances to incongruous contingencies when they were similar in format to those arranged during pretraining. These data may have implications for a behavior-analytic interpretation of attitude formation and change.

Key words: conditional discrimination, stimulus pairing, incongruous contingencies, stimulus equivalence, key press, humans

When a subject is taught to select Stimulus B in the presence of Stimulus A and to select Stimulus C in the presence of B, it is likely that the subject also will select A in the presence of B (symmetry), B in the presence of C (symmetry), B in the presence of B (i.e., a partial test for reflexivity), C in the presence of A (transitivity), and A in the presence of C (combined symmetry and transitivity, or equivalence) without further training. When this occurs, the stimuli are said to participate in an equivalence relation (Sidman, 1990, 1992; see also Barnes, 1994; Fields, Adams, Verhave, & Newman, 1990). Numerous studies have examined the formation of equivalence relations (e.g., Barnes, Browne, Smeets, & Roche, 1995; Barnes & Keenan, 1993; Barnes, Lawlor, Smeets, & Roche, 1995; Barnes, McCullagh, & Keenan, 1990; Bush, Sidman, & de Rose, 1989; Cullinan, Barnes, Hampson, & Lyddy, 1994; Dube, McIlvane, Mackay, & Stoddard, 1987; Dymond & Barnes, 1994; Wulfert & Hayes, 1988), but few have examined the disruption or loss of equivalence relations following new learning experiences. In one such study, 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 emergence of two three-member equivalence relations during testing (i.e., A1-B1-C1, A2-B2-C2). Following equivalence testing, subjects received further training in which the original A-C relations were reversed (i.e., A1-B1, A2-B2, A1-C2, A2-C1). This led to alterations in the symmetry responding of 3 of

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4 subjects, but none of the subjects responded in accordance with the transitive relations that would be expected to follow from the new (reversed) conditional discriminations. In effect, equivalence test performances were not controlled by the modified conditional discrimination contingencies that were in effect, despite the fact that performances on symmetry probes were sensitive to the novel reinforcement contingencies. This finding is consistent with the results of both earlier and more recent research with adult subjects that show the resistance of equivalence relations to modification via the manipulation of baseline conditional discriminations (Pilgrim & Galizio, 1995; Saunders, Saunders, Kirby, & Spradlin, 1988; but see Pilgrim, Chambers, & Galizio, 1995, and Spradlin, Saunders, & Saunders, 1992, for evidence that equivalence responding is less resistant to change when children, rather than adults, are used as subjects).

There is yet further evidence to suggest that stimulus relations may be resistant to change by novel reinforcement contingencies, at least for adult subjects. Specifically, Watt, Keenan, Barnes, and Cairns (1991) used standard equivalence procedures to study social categorization in Northern Ireland, where many people respond to each others' names as discriminative for their religious backgrounds. In this study, Northern Irish and English subjects were trained to match three Catholic names to three nonsense syllables, and subsequently to match the three nonsense syllables to three traditionally Protestant symbols. During the equivalence test, subjects were presented with Protestant symbols as sample stimuli; the comparison stimuli were two of the Catholic names used during training and a novel Protestant name. All of the English subjects chose the Catholic names (related through equivalence to the Protestant symbols), but 12 of the 19 Northern Irish subjects chose the novel Protestant name in the presence of the Protestant symbols, thus failing to demonstrate laboratory-induced equivalence relations. On the basis of these findings, the researchers argued that the extraexperimental social contingencies that operate in Northern Ireland were responsible for the responding of the 12 Northern Irish subjects. In effect, the preexperimentally established social and emotional functions were incongruous with the experimental conditional discriminations and may have controlled subjects' performances on the equivalence test. Similar findings have also been reported in the context of sexual stereotyping (Moxon, Keenan, & Hine, 1993) and academic self-concept (Barnes, Lawlor, Smeets, & Roche, 1995).

Although Watt et al. (1991) offered an account of their data in terms of preexperimentally established incongruous stimulus functions, these functions were only inferred; that is, it was assumed that social functions of particular words had been established preexperimentally by the verbal community. In contrast, Pilgrim and Galizio (1990) established incongruous conditional discriminations in the laboratory. This was achieved by first training and testing subjects on a series of conditional discriminations and then exposing them to further training trials in which the original conditional discriminations were reversed. An interesting avenue of research, therefore, might be to extend the Watt et al. study by combining both of the foregoing research strategies. Rather than simply inferring that particular stimuli already have specific social and emotional functions, such functions could be established in the laboratory before examining their interaction with incongruous conditional discrimination training. For example, social or emotional functions might be established for two arbitrary stimuli, A1 and C2, by repeatedly pairing them with powerful eliciting stimuli. Emotionally neutral functions could also be established for two other stimuli, A2 and C1, by pairing them with visual material that typically elicits little or no response. Subsequently, subjects would be provided with incongruous conditional discrimination training, in which choosing B1 in the presence of A1 and C1 in the presence of B1 is reinforced, and choosing B2 in the presence of A2 and C2 in the presence of B2 is reinforced. Given this training history, would subjects match A1 with C2 and A2 with C1 consistent with the stimulus-pairing procedure, or would they match A1 with C1 and A2 with C2 based on the conditional discrimination training? The current series of experiments were designed to address this question.

GENERAL METHOD

Subjects

Fifty subjects participated in the current research. All subjects were recruited as volunteers through notice board advertisements and personal contacts. Nine male and 11 female subjects, aged between 18 and 23 years, completed Experiment 1. An additional 3 male and 7 female subjects participated in Experiment 2. Five males and 3 females participated in Experiment 3. Finally, 4 males and 8 females participated in Experiment 4. All subjects were undergraduate students. Twenty-five of the subjects were undergraduate psychology students who had not studied stimulus equivalence as a part of their undergraduate training. The remaining subjects were not psychology students or college graduates. Each of the 50 subjects completed the study in one session.

Apparatus

Conditional discrimination training and testing. Subjects were seated at a table in a small experimental room (2 m by 2 m) containing a microcomputer (Apple® Model LC) that displayed black characters on a white background. Stimulus presentations and the recording of responses were controlled by the computer, which was programmed in BBC BASIC.

Six nonsense syllables were employed in Experiments 1, 2, and 3 (JOM, CUG, ZID, PAF, VEK, and BEH). These were randomly assigned as sample and comparison stimuli for each subject and are labeled, in the interests of clarity, using the alphanumerics A1, B1, C1, A2, B2, and C2. An additional six nonsense syllables were employed in Experiment 4 (ROG, LER, YIM, NEP, MAU, and DAX). These were randomly assigned as sample and comparison stimuli for each subject and are labeled X1, Y1, Z1, X2, Y2, and Z2.

Stimulus pairing. Social or emotional functions were established using sexually arousing visual materials. Sexual stimuli were used in the current study for two reasons. First, the study formed part of an ongoing research program on human sexual functioning at the Cork laboratory (see Barnes & Roche, 1996; Grey & Barnes, 1996; Roche & Barnes, 1995, 1996a, 1996b, 1997). Second, insofar as Watt et al. (1991) employed stimuli that were assumed to possess relatively strong emotional functions (e.g., sectarian symbols in a Northern Irish context), we employed sexual stimuli that had proven to be emotionally powerful in an experimental setting in the Republic of Ireland (see Roche & Barnes, 1995). Nonsexual funtions were established using nonsexual visual materials (e.g., landscape scenes).

Sexual and nonsexual visual stimuli were paired with the nonsense syllables labeled A1, C1, A2, and C2 using 45- to 60-s film clips taken from a popular sex-instruction video and a geographic documentary. The four nonsense stimuli were quasirandomly paired with sexual or nonsexual material. In Experiment 4, sexual and nonsexual film clips also were paired with additional nonsense syllables (X1, Z1, X2, and Z2).

The film clips differed on every trial but were taken from the same sex-instruction video or nature documentary. Sexual film clips depicted heterosexual ''necking,'' heavy petting, coitus, cunnilingus, and fellatio, whereas nonsexual clips depicted scenic landscapes of mountainous or desert regions. (A detailed description of the film clips is available from the second author.) All film clips were played on a Panasonic® portable video player (Model NV 80) and relayed to a Panasonic® 14-in. television monitor located in an adjacent room. The subject's monitor was placed directly beside a microcomputer. None of the film clips contained a soundtrack.

Procedure

Stimulus pairing. Before being exposed to the stimulus-pairing procedure, subjects were required to read and sign a consent form (Appendix) acknowledging their awareness of the sexually explicit nature of some of the film clips that they were about to see. They were also informed that they were free to terminate their participation at any time, and were asked not to discuss the study with anyone. Subjects were seated comfortably, approximately 1 m from the television monitor, and were asked to relax and watch the television. Subjects were then left in privacy.

Sexual and nonsexual film clips were each paired with two of four nonsense syllables (A1, C1, A2, and C2). The A1, C1, A2, and C2 stimuli (7 cm by 3 cm) were presented, one per trial, in the center of the subject's

television screen. The stimulus remained on the screen for 3 s and was followed by a 5-s interval during which the screen went dark. At the end of the 5-s interval, a sexual or nonsexual film clip was presented. The stimulus that appeared before the onset of the film clip also flashed periodically during the film clip in the top right corner of the screen. That is, once every 15 s the nonsense syllable appeared on the screen five times, with the stimulus on for 1 s, off for 0.2 s, on for 1 s, and so on. Because film clips varied from 45 to 60 s in duration, the flashing stimulus presentation appeared three to four times during each film clip (i.e., every 15 s). Intertrial intervals also varied from 45 to 60 s. Subjects were exposed to 16 training trials (i.e., four exposures to each of A1, C1, A2, and C2), the order of which was randomized within and across subjects, with the restriction that no stimulus could appear more than twice in succession. The stimulus-pairing phase of the experiment lasted approximately 30 min.

Matching-to-sample training. To begin this phase of the experiment, the subject was oriented towards the microcomputer on which all conditional discrimination trials were presented. The following instructions were then presented to the subject via the computer monitor.

> During this stage of the Experiment you must look at the nonsense syllable at the top of the screen, and then choose one of the nonsense syllables at the bottom by pressing one of the marked keys on the keyboard. To choose the left syllable press the marked key on the left. To choose the right syllable press the marked key on the right. Press the space-bar twice to continue.

On all matching-to-sample tasks, the sample stimulus appeared in the middle of the screen, and after a 1-s delay two comparison stimuli appeared to the left and right below the sample at the bottom edge of the screen. The screen position of the comparison stimuli was counterbalanced across trials. The sample and comparison stimuli remained on the screen together until the subject pressed one of the marked keys (Z or M) on the computer keyboard (all other keys were deactivated). If the choice was defined as correct, the screen cleared and "CORRECT" appeared on the screen for 1.5 s, accompanied by a beep from the computer. If the choice was defined as incorrect, the screen cleared and the word "WRONG" appeared on the screen for 1.5 s, and no beep was presented. The feedback ("CORRECT" or "WRONG") followed all responses on all training trials. During the intertrial interval, the screen remained blank for 2.5 s.

There were four training-trial types: Choose B1 or B2 given A1 or A2, respectively, and choose C1 or C2 given B1 or B2, respectively. Subjects were exposed to the four trial types in a quasirandom order in blocks of four trials (i.e., each trial type was presented once every four trials) until they produced a minimum of eight consecutive correct responses.

Matching-to-sample testing. The instructions delivered to subjects before testing were identical to those delivered before training. The testing phase probed for (a) the transitive relations, A1-C1 and A2-C2, and (b) the combined symmetrical and transitive relations, C1-A1 and C2-A2. Testing occurred for 40 trials, with each of the four trial types presented 10 times in a quasirandom order. During test trials no feedback was provided (i.e., the subject's response was followed immediately by the intertrial interval). A stable test performance was defined as choosing the same comparison stimulus at least nine times out of every 10 exposures to each of the four trial types. The experimental protocol specified that subjects who failed to produce a stable performance be reexposed to the test phase, without training, up to a maximum of three times. In fact, no subject required more than two exposures to the test phase.

The matching-to-sample test phase served two purposes. First, it allowed the experimenters to probe for equivalence relations following conditional discrimination training. Second, following stimulus pairing, the matching-to-sample test allowed the experimenters to probe for control that was consistent with the stimulus pairing contingencies.

EXPERIMENT 1

Procedure

Nine male and 11 female subjects, aged between 18 and 23 years, completed Experiment 1. This experiment consisted of four conditions, with 5 subjects in each. Each of

the four conditions involved stimulus pairing, conditional discrimination training, and matching-to-sample testing, as described in the General Procedure. Conditions differed, however, in the order in which these phases were administered to subjects.

Condition 1. Subjects were first exposed to stimulus-pairing trials in which A1 and C2 were paired with sexual film clips and A2 and C1 were paired with nonsexual film clips. Immediately following training, the matching-to-sample test was administered. Subjects were then trained on the incongruous conditional discriminations A1-B1, A2-B2, B1-C1, and B2-C2. Immediately following training, the matching-to-sample test was again administered to determine whether subjects would repeat their initial matching-to-sample test performance.

Condition 2. Subjects were exposed to the same procedure as the subjects in Condition 1, except that stimulus-pairing trials were congruent with conditional discrimination training (i.e., A1 and C1 were paired with sexual stimuli, and A2 and C2 were paired with nonsexual stimuli).

Condition 3. Subjects were first trained on the following conditional discriminations: A1-B1, A2-B2, B1-C1, and B2-C2. Immediately after training, the matching-to-sample test was administered. Subjects were then oriented towards the television monitor on which incongruous stimulus-pairing trials were presented (i.e., A1 and C2 were paired with sexual stimuli, and A2 and C1 were paired with nonsexual stimuli). Finally, subjects were again exposed to the matching-to-sample test.

Condition 4. Subjects were exposed to the same procedure as in Condition 3, except that stimulus-pairing trials were congruent with conditional discrimination training trials (i.e., A1 and C1 were paired with sexual stimuli, and A2 and C2 were paired with nonsexual stimuli).

Results and Discussion

Subjects' response patterns from all conditions are presented in Table 1.

Condition 1. Following stimulus pairing, all 5 subjects responded in accordance with the stimulus-pairing contingencies on their first exposure to the matching-to-sample test (i.e., they matched A1 with C2 and A2 with C1). Following incongruous conditional discrimination training (A1-B1, A2-B2, B1-C1, B2-C2), all subjects repeated their initial test performance on the second matching-to-sample test.

Condition 2. Following stimulus pairing, all 5 subjects responded on their first exposure to the matching-to-sample test by matching A1 with C1 and A2 with C2. After congruent conditional discrimination training, all 5 subjects produced a matching-to-sample test performance that was consistent with both stimulus pairing and conditional discrimination training (i.e., they matched A1 with C1 and A2 with C2).

Condition 3. Subjects 11 and 13 responded in accordance with the predicted equivalence relations (i.e., they matched A1 with C1 and A2 with C2) on their first exposure to the matching-to-sample test phase. The remaining subjects (12, 14, and 15) required a second exposure to the test phase before they produced a stable performance in which they also matched A1 with C1 and A2 with C2. Following exposure to incongruous stimulus pairing, 4 of the 5 subjects repeated their initial performance on the matching-to-sample test (i.e., they matched A1 with C1 and A2 with C2). Subject 12, however, produced a test performance that was consistent with the incongruous stimulus-pairing contingencies (i.e., she matched A1 with C2 and A2 with C1).

Condition 4. All 5 subjects responded in accordance with equivalence relations on their first exposure to the matching-to-sample test. Following congruent stimulus pairing, all subjects produced a matching-to-sample test performance that was consistent with both conditional discrimination and stimulus-pairing contingencies (i.e., they matched A1 with C1 and A2 with C2).

In summary, Experiment 1 demonstrated that test performances based on stimulus pairing and conditional discrimination were resistant to alteration through the introduction of incongruous conditional discrimination and stimulus-pairing contingencies, respectively. Subjects in Condition 1 matched A1 with C2 and A2 with C1 following stimulus pairing, and continued to do so following incongruous conditional discrimination training. When exposed to conditional discrimination training first, 5 subjects in Condition 3 behaved in a manner consistent with the

Table 1

Number of trials on which responses were consistent with initial experimental training in Experiment 1.

Subject no. and gender	No. of MTS training trials	Test no.	Test trial types							
			C1A2	A2C1	C2A1	A1C2	C1A1	A1C1	C2A2	A2C2
Condition 1 (incongruous pairing/MTS)										
1/F		1	10	10	10	10				
	16	2	10	10	10	10				
2/F		1	10	10	9	10				
	16	2	10	10	10	10				
3/M		1	10	10	10	10				
	20	2	10	10	10	10				
4/M		1	10	10	10	10				
	108	2	10	10	10	9				
5/F		1	9	10	10	9				
	44	2	10	10	10	10				
Condition 2 (congruous pairing/MTS)										
6/F		1					9	10	10	10
	60	2					9	10	10	10
7/F		1					10	10	10	10
	36	2					10	10	10	10
8/M		1					9	10	10	10
	28	2					9	10	10	10
9/M		1					10	10	9	10
	36	2					9	10	10	10
10/F		1					10	10	10	10
	16	2					10	10	10	10
Condition 3 (incongruous MTS/pairing)										
11/F	28	1					9	10	10	10
		2					10	10	10	10
12/F[a]	20	1					8	9	8	8
		2					10	10	10	10
		3					0	0	0	1
13/M	20	1					10	10	10	10
		2					10	10	10	9
14/F[a]	16	1					6	6	6	4
		2					10	10	10	10
		3					10	10	10	10
15/F[a]	400	1					10	8	8	10
		2					10	9	10	10
		3					10	10	9	10
Condition 4 (congruous MTS/pairing)										
16/M	28	1					10	10	10	10
		2					10	10	10	9
17/M[a]	40	1					10	10	9	10
		2					10	10	8	10
		3					10	10	10	9
18/M	20	1					9	10	10	10
		2					9	10	10	10
19/F	40	1					10	10	10	10
		2					9	10	10	9
20/M	20	1					10	10	10	10
		2					10	10	10	10

[a] These subjects failed to produce stable performances (i.e., choose the same comparison at least nine times across 10 exposures to each task) on the matching-to-sample test. The additional rows of data represent performances on subsequent exposures to the test phase without additional training.

equivalence class (i.e., they matched A1 with C1 and A2 with C2), and 4 of these subjects subsequently reproduced this performance following exposure to incongruous stimulus-pairing contingencies (i.e., A1 and C2 paired with sexual stimuli and A2 and C1 paired with nonsexual stimuli).

EXPERIMENT 2

In Experiment 1, performances on the final matching-to-sample test were determined by the training and testing to which subjects were first exposed. One issue arises from this finding, however. Subjects were both trained *and* tested before incongruous training trials were administered. It is unclear, therefore, to what extent training, testing, or both controlled the observed performances on the final matching-to-sample test (see also Spradlin et al., 1992). For example, what performance might we expect on a matching-to-sample test following conditional discrimination training if a subject was first exposed to incongruous stimulus pairing *without* a matching-to-sample test? Experiment 2 was designed to address this issue.

Procedure

Three male and 7 female subjects participated in Experiment 2. This experiment consisted of two conditions, with 5 subjects in each. Both conditions involved stimulus pairing, conditional discrimination training, and matching-to-sample testing, as described in the General Procedure. The conditions differed, however, in the order in which these phases were administered to subjects.

Because all 10 subjects that were exposed to congruous conditional discrimination and stimulus pairing in Experiment 1 produced a performance that was consistent with both forms of training, Experiment 2 focused only on the effects of incongruity between these two training phases.

Condition 1. Subjects were first exposed to stimulus pairing trials in which A1 and C2 were paired with sexual stimuli and A2 and C1 were paired with nonsexual stimuli. Immediately following stimulus pairing, subjects were trained on the incongruous conditional discriminations A1-B1, A2-B2, B1-C1, and B2-C2. Following conditional discrimination training, subjects were exposed to the first matching-to-sample test to determine whether they would respond in accordance with the stimulus pairing (i.e., match A1 with C2 and A2 with C1) or with the emergent equivalence relations (i.e., match A1 with C1 and A2 with C2).

Condition 2. Subjects were first trained on the following conditional discriminations: A1-B1, A2-B2, B1-C1, and B2-C2. Immediately after conditional discrimination training, the subject was oriented towards the television monitor on which incongruous stimulus-pairing trials were presented (i.e., A1 and C2 were paired with sexual material, and A2 and C1 were paired with nonsexual material). Subjects were subsequently exposed to the first matching-to-sample test to determine whether they would respond in accordance with the stimulus pairing (i.e., match A1 with C2 and A2 with C1) or the emergent equivalence relations (i.e., match A1 with C1 and A2 with C2).

Results and Discussion

Subjects' response patterns from both experimental conditions are presented in Table 2.

Condition 1. Immediately following exposure to stimulus pairing, subjects were exposed to incongruous conditional discrimination training (i.e., A1-B1, A2-B2, B1-C1, and B2-C2). Subsequently, 4 subjects demonstrated control by the conditional discrimination training on their first exposure to the matching-to-sample test (i.e., they matched A1 with C1 and A2 with C2). One subject, however, showed stable responding in accordance with the stimulus-pairing contingencies on her second exposure to the matching-to-sample test.

Condition 2. Following conditional discrimination training (A1-B1, A2-B2, B1-C1, and B2-C2), subjects were immediately exposed to stimulus pairing and the matching-to-sample test. During testing, 4 subjects responded in accordance with the stimulus-pairing contingencies (i.e., they matched A1 with C2 and A2 with C1), and 1 subject demonstrated control by the conditional discrimination contingencies (i.e., he matched A1 with C1 and A2 with C2).

These data indicate that test performances can be sensitive to modified contingencies when initial training phases have not been followed by matching-to-sample tests.

Table 2

Number of trials on which responses were consistent with initial experimental training in Experiment 2.

Subject no. and gender	No. of MTS training trials	Test no.	Test trial types							
			C1A2	A2C1	C2A1	A1C2	C1A1	A1C1	C2A2	A2C2
Condition 1 (incongruous pairing/MTS)										
21/F	16	1	0	0	0	0				
22/F[a]	68	1	10	10	7	8				
		2	9	10	10	10				
23/F	20	1	0	0	0	0				
24/F	44	1	1	0	0	0				
25/M	20	1	0	0	0	0				
Condition 2 (incongruous MTS/pairing)										
26/F	20	1					0	0	0	0
27/M	16	1					10	9	10	10
28/F	20	1					0	0	0	1
29/F	88	1					0	0	1	0
30/M	20	1					0	0	1	0

[a] This subject failed to produce a stable performance (i.e., choose the same comparison at least nine times across 10 exposures to each task) on the matching-to-sample test. The additional row of data represents performance on a subsequent exposure to the test phase without additional training.

EXPERIMENT 3

Experiments 1 and 2 established that exposure to the matching-to-sample test following initial training helped to determine the sensitivity of later test performances to incongruous contingencies. It is possible, however, that test performances can be made more sensitive to modified contingencies by means other than the exclusion of a matching-to-sample test after initial training phases. For instance, it may be possible to weaken persistent test performances by repeatedly exposing subjects to incongruous reinforcement or stimulus-pairing contingencies. This is of particular importance given one interpretive problem arising from Experiment 2. Specifically, given that a matching-to-sample test was not administered following the first training phase, we cannot be certain that test performances consistent with that training would have emerged. What is required, therefore, is an alternative experimental procedure that allows us to control test performances without removing either of the test phases. Experiment 3 addressed this issue.

Subjects in Conditions 1 and 2 of Experiment 3 were exposed to experimental procedures that were identical to those employed in Conditions 1 and 3 of Experiment 1, respectively. In addition, subjects in both conditions were exposed repeatedly to incongruous training and testing.

Experiment 3 also addressed an additional issue. Specifically, the matching-to-sample tests administered in Experiments 1 and 2 probed only for transitivity and combined symmetry and transitivity. Therefore, in cases in which transitive and combined symmetrical and transitive performances failed to emerge, it was unclear whether basic symmetry responding would have emerged if tested. Consider, for example, a subject who is exposed to stimulus-pairing trials followed by a matching-to-sample test. Given the data thus far, we would expect the initial test performance to be reproduced even after exposure to incongruous conditional discrimination training. However, what performance would be observed if the matching-to-sample test that followed incongruous conditional discrimination training included probes for symmetry? Previous research suggests that symmetry test performances are sensitive to novel (incongruous) reinforcement contingencies even when transitivity test performances are not (e.g., Pilgrim & Galizio, 1990, 1995). In Experiment 3, therefore, subjects were exposed to probes for symmetry on their final reexposure to the matching-to-sample test.

Procedure

Five males and 3 females participated in Experiment 3. Four subjects participated in each of two conditions. Both conditions involved stimulus pairing, conditional discrimination training, and matching-to-sample testing, including probes for symmetrical relations on the final matching-to-sample test.

During symmetry testing, both B1 and B2 were presented as sample stimuli with A1 and A2 as comparison stimuli, and both C1 and C2 were presented as sample stimuli with B1 and B2 as comparison stimuli. Symmetry probe types were presented 10 times each, randomly interspersed with the matching-to-sample test trials used in the previous two experiments. Thus, matching-to-sample testing, including symmetry probes, spanned 80 trials (i.e., 10 exposures to each of the two transitive, two combined symmetrical and transitive, and four symmetrical trial types).

Condition 1. Subjects were first exposed to stimulus-pairing trials in which A1 and C2 were paired with sexual stimuli and A2 and C1 were paired with nonsexual stimuli. Following training, the matching-to-sample test was administered. Subjects were then trained on the incongruous conditional discriminations A1-B1, A2-B2, B1-C1, and B2-C2. The matching-to-sample test was then readministered. Subjects were subsequently reexposed to cycles of incongruous conditional discrimination training and matching-to-sample testing, three times in succession (i.e., training and testing, followed by training and testing, followed by training and testing) to determine whether persistent test performances would be repeated. Furthermore, during the final reexposure to the test, probes for symmetrical relations were presented for the first time, as described previously (i.e., B1-A1, B2-A2, C1-B1, C2-B2).

Condition 2. Subjects were first trained on the following two conditional discriminations: A1-B1, A2-B2, B1-C1, and B2-C2. Immediately after training, the matching-to-sample test was administered. The subject was then oriented towards the television monitor on which incongruous stimulus-pairing trials were presented (i.e., A1 and C2 were paired with sexual stimuli, and A2 and C1 were paired with nonsexual stimuli). Subjects were then reexposed to the matching-to-sample test. Finally, subjects were reexposed to eight stimulus pairing trials followed by matching-to-sample testing, three times in succession (i.e., 24 additional stimulus-pairing trials in toto). The eight stimulus-pairing trials were chosen quasirandomly from the 16 original stimulus-pairing trials, and the trial types were balanced. Only eight of the 16 original trials were used in order to keep session length to a minimum. In addition, a pilot study had shown that eight trials were sufficient to reinstate the effects of the stimulus-pairing contingencies. During the final reexposure to the matching-to-sample test, probes for symmetry responding were presented for the first time (i.e., B1-A1, B2-A2, C1-B1, and C2-B2).

Results and Discussion

Subjects' performances from both experimental conditions are presented in Tables 3 and 4.

Condition 1. Following stimulus pairing, all subjects matched A1 with C2 and A2 with C1 on their first exposure to the matching-to-sample test. Subjects then completed incongruous conditional discrimination training, after which all 4 again responded in accordance with the stimulus pairings on the matching-to-sample test. All 4 subjects subsequently maintained their original matching-to-sample performances across all three reexposures to the matching-to-sample test.

Condition 2. Following conditional discrimination training, all 4 subjects responded in accordance with the emergent equivalence relations (i.e., they matched A1 with C1 and A2 with C2). This performance was maintained by all subjects following their first exposure to incongruous stimulus pairing. All subjects then reproduced their initial matching-to-sample test performance after each of the additional incongruous stimulus-pairing phases.

Symmetry probes. Under typical equivalence training and testing conditions, emergence of the following symmetrical relations would be predicted from the conditional discrimination training: B1-A1, B2-A2, C1-B1, and C2-B2. During their final reexposure to the matching-to-sample test phase, 3 subjects in Condition 1 responded in accordance with these predicted symmetrical relations (see Ta-

Table 3

Number of trials on which responses were consistent with initial experimental training in Experiment 3.

Subject no. and gender	No. of MTS training trials	Test no.	Test trial types							
			C1A2	A2C1	C2A1	A1C2	C1A1	A1C1	C2A2	A2C2
Condition 1 (incongruous pairing/MTS × 4)										
31/M		1	10	10	10	10				
	16	2	10	10	10	10				
	20	3	10	10	10	10				
	16	4	10	10	10	10				
	20	5	10	10	10	10				
32/M		1	9	10	10	10				
	36	2	10	9	10	10				
	16	3	10	10	10	10				
	20	4	10	10	10	10				
	16	5	10	10	9	10				
33/M		1	10	10	10	10				
	20	2	10	10	10	10				
	16	3	10	10	10	10				
	52	4	10	10	10	10				
	36	5	10	10	10	10				
34/F		1	10	10	10	10				
	44	2	10	10	10	10				
	20	3	9	9	10	9				
	16	4	10	10	10	10				
	16	5	10	10	10	10				
Condition 2 (incongruous MTS/pairing × 4)										
35/F[a]	44	1					10	8	10	10
		2					10	10	10	10
		3					10	10	10	10
		4					10	10	10	10
		5					10	10	10	10
		6					10	10	10	10
36/F	28	1					10	10	10	10
		2					10	10	10	10
		3					10	10	10	10
		4					10	10	10	10
		5					9	10	9	10
37/M	36	1					10	10	10	9
		2					10	10	10	10
		3					10	10	10	10
		4					10	10	10	10
		5					10	10	10	10
38/M	28	1					10	9	9	10
		2					10	10	10	10
		3					10	10	10	10
		4					10	10	10	10
		5					10	10	10	10

[a] This subject failed to produce a stable performance (i.e., choose the same comparison at least nine times across 10 exposures to each task) on her first exposure to the matching-to-sample test. The subsequent row of data represents performance on a subsequent exposure to the test phase without additional training.

ble 4), although transitive responding was consistent with stimulus pairing. Subject 33, however, responded in accordance with only two of these symmetrical relations (i.e., B1-A2, B2-A1, C1-B1, and C2-B2). All 4 subjects in Condition 2, who repeatedly produced a conditional-discrimination-based test performance, responded in accordance with the emergent symmetrical relations during the final test phase.

In summary, Experiment 3 demonstrated that once a matching-to-sample test perfor-

Table 4

Number of trials on which responses to the symmetry probes were consistent with matching-to-sample training in Experiment 3.

Subject no. and gender	Test trial types			
	B1A1	B2A2	C1B1	C2B2
Condition 1				
31/M	10	10	10	10
32/M	10	10	9	10
33/M	1	1	10	10
34/F	9	9	9	10
Condition 2				
35/F	10	10	9	10
36/F	10	10	10	10
37/M	10	10	10	10
38/M	10	10	10	10

mance had been established, it was highly resistant to change, even after repeated exposures to incongruous training and testing. Furthermore, in Condition 1, subjects consistently and repeatedly failed to respond in accordance with conditional discrimination training on combined symmetrical and transitive probes, even though responses on symmetry probes were sensitive to the conditional discrimination contingencies. This finding supports previous research in which symmetry test performances were manipulated independently of transitivity test performances (Pilgrim & Galizio, 1990, 1995).

EXPERIMENT 4

Experiment 3 demonstrated that repeated exposure to incongruous contingencies does not enhance those contingencies as sources of control over test performances. One way in which we might enhance the behavioral control that is exerted by a particular set of incongruous contingencies, however, is to provide subjects with an early history of interaction with similar contingencies. In Experiment 4, therefore, some subjects were exposed to preliminary stimulus pairing and matching-to-sample testing *before* being exposed to conditional discrimination training and testing with novel stimuli followed by incongruous stimulus pairing and testing. Other subjects were exposed to preliminary conditional discrimination training and testing before being exposed to stimulus pairing and testing with novel stimuli followed by incongruous conditional discrimination training and testing.

Procedure

Conditions 1 and 2 of Experiment 4 corresponded precisely with Conditions 1 and 3 of Experiment 1 with the following difference. Subjects in Condition 1 were first exposed to preliminary conditional discrimination training and matching-to-sample testing. Six nonsense syllables, unique to this preliminary condition, were used as stimuli (X1, Y1, Z1, X2, Y2, and Z2). Subjects in Condition 2 were first exposed to preliminary stimulus pairing and matching-to-sample testing, using four stimuli (X1, Z1, X2, and Z2) unique to this preliminary phase. Preliminary stimulus pairing and conditional discrimination training were administered in precisely the same manner as subsequent training phases. Four males and 8 females participated in Experiment 4. The 12 subjects were distributed among three conditions (Condition 1, Condition 2, and a control condition), with 4 subjects in each condition.

Condition 1. Before being exposed to experimental training and testing, subjects were first trained on the conditional discriminations X1-Y1, X2-Y2, Y1-Z1, and Y2-Z2, and were subsequently exposed to matching-to-sample tests. Subjects were then exposed to experimental stimulus pairing trials in which A1 and C2 were paired with sexual stimuli and A2 and C1 were paired with nonsexual stimuli. Following training, the matching-to-sample test was administered. Subjects were then trained on the incongruous conditional discriminations A1-B1, A2-B2, B1-C1, and B2-C2, after which the matching-to-sample test was readministered.

Condition 2. Before being exposed to experimental training and testing, subjects were first exposed to 16 preliminary stimulus-pairing trials in which the nonsense syllables X1 and Z1 were paired with sexual stimuli and the nonsense syllables X2 and Z2 were paired with nonsexual stimuli. A matching-to-sample test was then administered.

Subjects were then trained on the following two conditional discriminations: A1-B1, A2-B2, B1-C1, and B2-C2. Following training, the matching-to-sample test was administered. Each subject was then oriented towards

Table 5

Number of trials on which responses were consistent with preliminary training and then initial experimental training in Experiment 4.

Subject no. and gender	No. of MTS training trials	Test no.	Test trial types											
			X1Z1	Z1X1	X2Z2	Z2X2	C1A2	A2C1	C2A1	A1C2	C1A1	A1C1	C2A2	A2C2
Condition 1 (preliminary MTS → incongruous pairing/MTS)														
39/F	20	1	10	10	10	9								
		2					10	10	10	10				
	36	3					0	1	0	0				
40/F[a]	44	1	8	7	7	8								
		2	9	9	10	9								
		3					10	10	10	10				
	16	4					0	0	0	0				
41/M	56	1	10	10	10	10								
		2					10	10	10	10				
	20	3					1	0	0	0				
42/M	40	1	10	10	10	9								
		2					9	10	10	10				
	16	3					0	0	0	0				
Condition 2 (preliminary pairing → incongruous MTS/pairing)														
43/F		1	10	10	10	9								
	24	2									10	10	9	10
		3									0	0	0	0
44/F		1	10	10	10	10								
	20	2									10	10	10	10
		3									0	0	0	0
45/F		1	10	10	10	10								
	48	2									9	10	10	10
		3									0	0	0	0
46/M		1	10	10	9	10								
	32	2									10	10	10	10
		3									1	0	0	0

[a] This subject failed to produce a stable performance (i.e., choose the same comparison at least nine times across 10 exposures to each task) on the matching-to-sample test. The additional row of data represents performance on a subsequent exposure to the test phase without additional training.

the television monitor on which incongruous stimulus-pairing trials were presented (i.e., A1 and C2 were paired with sexual stimuli, and A2 and C1 were paired with nonsexual stimuli). Finally, subjects were reexposed to the matching-to-sample test.

Control subjects. As a control measure, the preliminary training phases from Conditions 1 and 2 were reversed for 4 additional subjects. Two subjects received preliminary matching-to-sample training and testing before being exposed to experimental matching-to-sample training and testing followed by incongruous stimulus pairing and testing. Similarly, an additional 2 subjects were first exposed to preliminary stimulus pairing and testing before being exposed to experimental stimulus pairing and testing followed by incongruous conditional discrimination training and testing.

Results and Discussion

Subjects' training and testing performances for both experimental conditions are presented in Table 5. Control subjects' performances are presented in Table 6.

Condition 1 and controls. All 4 subjects completed preliminary matching-to-sample training within 56 trials. Subsequent matching-to-sample test performances were consistent with equivalence relations (i.e., subjects matched Z1 with X1 and Z2 with X2). Following stimulus pairing, matching-to-sample test performances demonstrated control by the stimulus-pairing contingencies (i.e., subjects matched A1 with C2 and A2 with C1). Follow-

Table 6

Number of trials on which responses were consistent with preliminary training and then initial experimental training for the control subjects in Experiment 4.

Subject no. and gender	No. of MTS training trials	Test no.	Test trial types											
			X1Z1	Z1X1	X2Z2	Z2X2	C1A2	A2C1	C2A1	A1C2	C1A1	A1C1	C2A2	A2C2
Control Condition 1 (preliminary pairing → incongruous pairing/MTS)														
47/M		1	10	9	10	10								
		2					10	10	10	10				
	20	3					10	10	9	10				
48/F		1	10	10	10	10								
		2					9	10	10	10				
	52	3					10	10	10	10				
Control Condition 2 (preliminary MTS → incongruous MTS/pairing)														
49/F	28	1	10	10	9	9								
	60	2									10	10	10	10
		3									10	10	9	10
50/F	44	1	10	9	9	9								
	32	2									10	10	10	10
		3									10	9	9	10

ing incongruous conditional discrimination training, the previous stimulus-pairing-based test performances were altered; subjects matched A1 with C1 and A2 with C2, thus demonstrating control in accordance with equivalence relations. Control Subjects 47 and 48 (see Table 6), who had been exposed to stimulus pairing as opposed to conditional discrimination pretraining, showed no impact from the final conditional discrimination training. Both control subjects repeated their previous test performances based on experimental stimulus pairing.

Condition 2 and controls. Following exposure to preliminary stimulus pairing, all subjects matched X1 with Z1 and X2 with Z2 on the matching-to-sample test, thus demonstrating control by the stimulus-pairing contingencies. Following conditional discrimination training, subjects responded in accordance with equivalence relations on the matching-to-sample test (i.e., they matched A1 with C1 and A2 with C2). Finally, following exposure to incongruous stimulus pairing, all 4 subjects altered their previous matching-to-sample test performances by matching A1 with C2 and A2 with C1, thus demonstrating control by the stimulus-pairing contingencies. Matching-to-sample performances of Control Subjects 49 and 50 (Table 6), who had received preliminary conditional discrimination training as opposed to stimulus pairing, were not influenced by the incongruous stimulus pairing. Both control subjects repeated their previous test performances based on experimental conditional discrimination training.

In summary, Experiment 4 demonstrated that preliminary training and testing appeared to sensitize novel matching-to-sample test performances to conflicting contingencies when the contingencies are similar in kind to those of pretraining.

GENERAL DISCUSSION

Experiment 1 demonstrated that matching-to-sample test performances were determined by the training and testing to which subjects were first exposed. Experiment 2 demonstrated that a critical factor involved in producing persistent control by the initial training phase was the administration of a matching-to-sample test following exposure to the initial training phase. Experiment 3 attempted to gain control over persistent test performances without removing either of the test phases. It was found that once a matching-to-sample test performance had been demonstrated, it was highly resistant to change, even following repeated exposures to incongruous contingencies. Furthermore,

Experiment 3, Condition 1, demonstrated that even though symmetry relations based on subsequent conditional discrimination training sometimes emerged, combined symmetrical and transitive relations based on the same conditional discriminations did not. Finally, Experiment 4 indicated that preexposure to conditional discrimination or stimulus-pairing contingencies increased the sensitivity of novel matching-to-sample test performances to incongruous contingencies.

One possible criticism of the current study is that the number of stimulus-pairing trials (i.e., 16) was relatively small and predetermined, whereas the number of conditional discrimination training trials was sometimes large and was determined by the training performance of each subject. It could therefore be argued, for example, that subjects from Experiment 1, Condition 3, demonstrated a conditional-discrimination-based test performance following incongruous stimulus pairing simply because of the small number of stimulus-pairing trials employed. It is important to note, however, that some of these subjects received as few as 16 conditional discrimination training trials. In actuality, the difference between the number of training trials across training phases (i.e., conditional discrimination and stimulus pairing) was often small. Furthermore, subjects from Experiment 1, Condition 1, maintained stimulus-pairing-based test performances after as many as 108 incongruous conditional discrimination training trials. This persistence suggests that the relative number of stimulus-pairing trials versus conditional discrimination training trials employed in the current study was not directly responsible for the observed performances.

It may also be tempting to account for the current data in terms of the contextual control exerted by the different experimental settings that were associated with conditional discrimination and stimulus pairing. For example, subjects from Experiment 1, Condition 3, were first exposed to conditional discrimination training and matching-to-sample testing on a computer monitor. The subsequent stimulus-pairing trials, however, were delivered via a television monitor, and no overt response was required on the part of the subject. Thus, when the matching-to-sample test was readministered on the computer monitor following stimulus pairing, it is possible that subjects may have repeated their initial test performance simply because the experimental setting controlling it (i.e., the computer) had been reinstated.

Although the foregoing argument may appear plausible at first, it cannot account for the persistent stimulus-pairing-based test performances produced by subjects in Experiment 1, Condition 1. These subjects were first exposed to stimulus pairing via a television monitor, followed by matching-to-sample testing on a computer. Subjects were then exposed to incongruous conditional discrimination training, again on a computer. Subsequent matching-to-sample test performances, however, were insensitive to these novel reinforcement contingencies. In effect, test performances on the computer were controlled by stimulus pairing that took place in a different context (i.e., the television monitor). Furthermore, similar results were also obtained in Experiment 3, Condition 1, across repeated exposures to incongruous conditional discrimination training. It appears, therefore, that the television and computer monitors as contexts cannot, on their own, account for the observed performances.

We should not, however, completely dismiss the possibility of contextual control by specific features of the experimental setting or procedure. Another source of contextual control, for example, might be the matching-to-sample test arrangement itself. There are three possibly important differences between the matching-to-sample test and the other phases of the experiment. First, during the matching-to-sample test, three stimuli were presented in a trigram configuration on each trial, whereas during the stimulus-pairing procedure film clips were shown with a single nonsense syllable. Second, the matching-to-sample test required subjects to respond on the computer keyboard, but during the stimulus-pairing procedure no keyboard response was required. Third, feedback was never provided during the matching-to-sample test (or during stimulus pairing), but matching-to-sample training always involved feedback. Perhaps one or a combination of these procedural differences (i.e., the visual properties, the response requirements, and the presence or absence of feedback) functioned as

a contextual cue or cues that controlled final test performances in each experiment.

In Condition 1 of Experiment 1, for example, all 5 subjects responded in accordance with the initial stimulus-pairing procedure across both matching-to-sample tests. In this condition, the absence of feedback during the final exposure to the matching-to-sample test may have functioned as a contextual cue to repeat the performance that had been produced during the previous exposure to this test during which feedback was also absent. Note that the visual properties or response requirements could not have functioned as contextual cues in this condition because the visual and response properties of the matching-to-sample training were identical to those of the final test.

Consider now Condition 3. In this condition, persistent responding in accordance with the initial conditional discrimination training could not have been controlled simply by the presence or absence of feedback. Feedback was absent not only in the initial test following conditional discrimination training but also in the stimulus pairing and subsequent matching-to-sample test. In Condition 3, therefore, contextual control would have to have been provided by the visual properties or response requirements that were common to both the matching-to-sample training and testing procedures.

In summary, in Condition 1 the presence or absence of feedback may have functioned as a contextual cue over final test performances, whereas in Condition 3 the visual properties or response requirements may have fulfilled this role. At the present time, therefore, appealing to the context of the experimental procedures as the basis for persistent performances raises an important question. Exactly what aspects of the different experimental conditions established specific features of the procedure as contextual cues? In fact, this question is also raised by the results of Experiment 4. Consider the following.

In contrast to Experiments 1 and 3, Experiment 4 showed that test performances could be reversed when subjects had been provided with an early history of exposure to stimulus pairing or conditional discrimination contingencies using different stimuli. One possible explanation for this outcome is that once a particular training procedure (e.g., conditional discrimination training) had established control over test performances, as in Experiments 1 and 3, those test performances were unlikely to be altered by incongruous contingencies established by a formally different training procedure (e.g., stimulus pairing). In Experiment 4, however, preliminary stimulus pairing, for example, may have established the stimulus-pairing procedure itself as a source of contextual control for test performances. Consequently, the stimulus-pairing procedure was then able to control later test performances, even when the contingencies established by that procedure were incongruous with other previously introduced contingencies. In a similar manner, preliminary conditional discrimination training may have established the conditional discrimination procedure itself as a source of contextual control for test performances. Again, however, it remains unclear exactly what features of the two training procedures may have been functioning as contextual cues (i.e., the visual properties, the response requirements, the presence or absence of feedback, or some other features of the procedures). Clearly, therefore, future research will need to examine this issue in some detail.

Another issue arising from the present study that deserves further attention relates to the possibility that the stimulus-pairing procedure actually functioned as a form of equivalence training (see Barnes, Smeets, & Leader, 1996; Leader, Barnes, & Smeets, 1996). During stimulus-pairing trials, nonsense syllables were presented before and during the presentation of film clips; thus, the sexual film clips, for example, may have acted as a node through which two nonsense syllables became related to one another.

Of course, one might dismiss the idea that the stimulus-pairing procedure produced equivalence relations as traditionally defined, because the nonsense syllables were flashed repeatedly on the screen during the film clips. In effect, the symmetrical relations between the syllables and film clips might be seen as directly trained (see Stromer, McIlvane, & Serna, 1993). At the present time, therefore, it remains unclear

exactly what implications the current study might have for previous research that has either found or failed to find sensitivity to reversed baseline conditional discriminations using only matching-to-sample procedures (Dube, McIlvane, Maguire, Mackay, & Stoddard, 1989; Pilgrim & Galizio, 1990, 1995; Pilgrim et al., 1995; Saunders et al., 1988; Spradlin, Cotter, & Baxley, 1973; Spradlin et al., 1992; Wilson & Hayes, 1996). Parenthetically, however, future researchers might bear in mind that the common practice of presenting sample and comparison stimuli simultaneously during conditional discrimination training may allow subjects to scan back and forth between sample and comparison stimuli, thus giving rise to directly trained symmetrical relations (for a more detailed analysis of this and related issues, the reader is referred to Markham & Dougher, 1993; Smeets, Schenk, & Barnes, 1994, 1995; Stromer et al., 1993).

Important theoretical issues are raised by the results of the current study. Consider, for example, the fact that the symmetry test performances of subjects in Experiment 3, Condition 1, were sensitive to the incongruous reinforcement contingencies, even though combined symmetry and transitivity test performances were not. Consider also that the presence of symmetry probes in the final matching-to-sample test effected no observable change in response patterns on probes for combined symmetry and transitivity. These data support the view that equivalence classes are not integrated units, but consist of more flexible relations (see discussions by Hayes, Gifford, & Wilson, 1996; Pilgrim & Galizio, 1995; Spradlin et al., 1992; Wilson & Hayes, 1996). In a similar vein, we and others have argued that equivalence, and derived relational responding in general, may be approached usefully as a form of operant behavior (Barnes, 1994, 1996; Barnes & Roche, 1996, in press; Hayes et al., 1996; Wilson & Hayes, 1996). In the words of Wilson and Hayes, ''As with other operant behavior, responding relationally has properties of both flexibility and stability—properties that would be expected if deriving stimulus relations is itself operant behavior'' (p. 279). The results of the present study provide further support for an operant account, insofar as it was shown that derived relational responding may persist, or remain stable, under certain conditions (Experiments 1 and 3), but can be modified, or made flexible, given other conditions (Experiment 4). Of course, this complex theoretical issue is far from resolved, but a growing body of empirical findings appear to support an operant analysis of derived relational responding.

As a final point, the current data may have important implications for our understanding of attitude formation and change. A number of researchers (e.g., Barnes & Holmes, 1991; Barnes, Lawlor, Smeets, & Roche, 1995; Barnes & Roche, in press; Grey & Barnes, 1996; Moxon et al., 1993; Roche & Barnes, 1996a; Watt et al., 1991) have argued that social attitudes may be conceptualized usefully in terms of derived and explicitly reinforced stimulus relations (e.g., a negative attitude towards condom use could be seen as responding in accordance with an equivalence relation between actual condoms and descriptive terms such as ''unromantic'' and ''disgusting''). Insofar as this interpretation is correct, the data from Experiments 1 and 3 suggest that once an attitude has been formed (e.g., an equivalence relation between ''condoms'' and ''unromantic'') this relation may persist, despite the introduction of incongruous reinforcement or stimulus-pairing contingencies (e.g., seeing an advertisement for an AIDS awareness campaign; see also Kelly et al., 1991, 1992; Wulfert & Biglan, 1994). The findings from Experiment 4, however, indicate that it is possible to increase the sensitivity of equivalence responding to incongruous contingencies in a laboratory setting. Perhaps further research in this area will provide a solid empirical base for developing effective interventions for changing dangerous or unhealthy attitudes in the wider community (see Barnes & Roche, in press, for a detailed discussion).

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APPENDIX

I consent that I am willing to participate in this study. I am aware that as a requirement of this study, I will be exposed to film clips containing sexually explicit scenes. The films from which these clips are taken are widely available in leading department stores and record shops in the Irish Republic. I have not been coerced in any way to participate in this study and I understand that I may terminate my participation in this study at any stage if I so wish. I understand that my participation in this study has no bearing upon grades for academic work in the department of Applied Psychology or in University College Cork, in general.