1980

Persistence of Fear Reduction Resulting from Response Prevention

Stephen Abbot Neill
University of Rhode Island

PERSISTENCE OF FEAR REDUCTION
RESULTING FROM RESPONSE PREVENTION

BY

STEPHEN ABBOT NEILL

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS
IN
PSYCHOLOGY

UNIVERSITY OF RHODE ISLAND
1980

ABSTRACT

A review of the literature in response prevention revealed that the technique is generally considered to reduce fear but that proper assessment of the persistence of fear reduction was lacking. Previous studies attempting to measure the durability of fear reduction either failed to control for potential confounds in within subjects designs or used problematic fear assessment techniques. The purpose of this study was to assess the stability of fear reduction using improved fear assessment procedures and random groups design strategies.

One hundred and fifty albino rats were randomly assigned to receive or not receive response prevention or to act as control subjects with no avoidance training. Ten subjects from each treatment condition were randomly assigned to be tested for fear at either 0, 3, 27, 81 or 243 hours after the treatment phase. Fear was measured by the approach methodologies, approach latency and number of safety tests.

Results consistent with previous findings indicated that while fear was reduced it was not completely eliminated following treatment with response prevention. Most important, and contrary to the findings of previous research using within subjects designs and less sensitive fear assessment techniques, were results suggesting that the fear reduction resulting from response prevention was stable over a 10 day period. Implications for therapy analogues were discussed.

To Theresa and my parents

ACKNOWLEDGEMENTS

My appreciation to the following people for their guidance; advice and support in this endeavor cannot be overestimated: First, to the members of my thesis committee, Nelson Smith, Donald Corriveau, Wayne Velicer, James Prochaska and James Loy. Their collective expertise was the major factor contributing to the success of this study. Special thanks and appreciation are offered to Nelson and Don who continually provided invaluable suggestions from the project's conception to its completion. I have tried to emulate their high level of scholarship and professionalism in this thesis.

Thanks are also offered to two fellow graduate students, Joe Rossi and Bill Zwick, for their advice on data analysis and continued encouragement throughout this endeavor.

My deepest gratitude goes to my wife Theresa; without her this project would never have been completed. I thank her for the way she so patiently accepted my almost constant preoccupation with this work. Her support, encouragement and love can never be repaid.

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

Avoidance behavior is functionally defined as a response which prevents the occurrence of an aversive stimulus. In discriminated avoidance, an animal typically learns to terminate a warning stimulus which would otherwise result in the presence of an aversive stimulus. While the major interest in avoidance behavior is reflected in variety of theories generated to explain it (Bolles, 1970; Herrnstein, 1969; Miller, 1951; Mowrer, 1940, 1950; Rescorla & Solomon, 1967; Schoenfeld, 1950; Seligman & Johnston, 1973; Solomon, & Wynne, 1954), no one theory has been able to account for all the empirical data describing the phenomena.

Mowrer's (1940, 1947, 1950) two-process fear mediation theory is the most often cited framework for interpreting avoidance behavior (Corriveau, 1978; Mineka, 1979). Mowrer describes the acquisition and maintenance of avoidance as a dual process involving both the learning of fear and the learning of the observable avoidance response itself. The theory proposes that fear is learned through classical conditioning and that avoidance behavior is learned and maintained through instrumental conditioning. The process is established as follows: First, the warning stimulus becomes a conditional stimulus (CS) by repeated association with an aversive or unconditional stimulus(UCS). Fear, assumed to be a conditional response (CR), is thus elicited by the CS. Second, the avoidance response results in the termination of the CS, which in turn results in the reduction of fear. Thus, the avoidance response is thought to be instrumentally reinforced by fear reduction. Rescorla & Solomon's (1967) review of the evidence supported and slightly revised Mowrer's theory by concluding that some central state acted as a mediator between CRs and instrumental behavior. They also concluded that changes in this central state were subject to the laws of classical conditioning. Mineka (1979) cites that many experimental psychologists out of convenience have chosen the word "fear" to describe that state.

Other theorists have questioned whether or not fear has any role at all in the mediation of avoidance behavior. For example, Schoenfeld (1950) postulated that since a neutral stimulus is repeatedly paired with an aversive stimulus (a negative reinforcer), the neutral stimulus must become a conditioned aversive stimulus. What is learned in the discriminated avoidance paradigm is the escape from the conditioned aversive stimulus; thus, avoidance behavior is negatively reinforced. Herrnstein (1969) has extended this view by describing the warning stimulus simply as a discriminative cue which "sets the occasion" for responding. The avoidance response is maintained by the negatively reinforcing properties of the reduced frequency of UCS presentation rather than escape from a negative reinforcer or reduction in levels of fear. It should be noted that these theories do not deny that fear may be learned through classical conditioning in the avoidance paradigm. They contend simply that fear is not the motivator that maintains the instrumental avoidance response.

A third theory of avoidance behavior (Seligman & Johnston, 1973) involves the generation of two expectancies which account for the maintenance of the avoidance behavior. The first expectancy is that an avoidance response will lead to no shock; the second is that no avoidance response will lead to shock. It is further assumed that no shock is preferable to shock. Fear, again classically conditioned to the warning stimulus, serves only to motivate the avoidance response in the initial stages of training before the expectancies are formed. Once the expectancies exist, fear is no longer necessary to maintain avoidance behavior. In fact, fear could be extinguished through normal Pavlovian procedures and, because of the expectancies, avoidance behavior could persist.

Experimentally induced avoidance behaviors in animals have been shown to be considerably more resistant to extinction than other conditioned responses (Solomon & Wynne, 1954; Levis, 1966). For example, Solomon, Kamin & Wynne (1953) report that dogs who learned a hurdle-jumping response in a shuttle box after only a few intense shocks ran as many as

650 extinction trials without showing a decrement in avoidance behavior. In the laboratory, extinction has typically been operationalized by removing the UCS while continuing to present the CS. Since the organism continues to escape the CS, there is no opportunity for discrimination between the avoidance training and extinction conditions. That is, by escaping prolonged exposure to the CS, the organism removes itself from the very situation in which relearning might take place. Mowrer (1950) has drawn the analogy between this process and similar processes involved in human neurotic behavior which is often self perpetuating and self defeating.

Interestingly, the persistence of avoidance responding has caused several problems for Mowrer's theory of fear mediated avoidance. Over a series of consecutive avoidance responses, the fear CR should gradually extinguish due to what are in effect classical extinction trials in which the CS is not paired with the UCS. As fear extinguishes the motivation for the instrumental avoidance response should be removed resulting in extinction of this response. However, the response persists. As several studies have shown (Kamin, Brimmer & Black, 1963; Solomon & Wynne, 1954; Starr & Mineka, 1977), the fear CR may become attenuated during avoidance training without a concurrent or subsequent decrement in avoidance. It has also been demonstrated that under certain circumstances the avoidance response can be extinguished without a concurrent reduction in the fear CR (Coulter, Riccio & Page, 1969; Linton, Riccio, Rohrbaugh & Page, 1970; Mazzaro, Riccio & Riley, 1974; Page, 1955; Page & Hall, 1953). Despite these findings Mowrer's theory remains the most often cited as an explanation of how discriminated avoidance is learned.

Because of the similarities between experimentally induced avoidance behavior in animals and human neurotic behaviors (Bandura, 1969; Baum & Poser, 1971; Leitenberg, 1976; Stampfl & Levis, 1967) applied as well as basic researchers have been interested in investigating techniques for eliminating avoidance behavior. One such technique, call "forced reality testing" by Solomon & Wynne (1954) and "response prevention" by Baum (1966, 1970) has been used in laboratory settings with animals subjects. This method consists of training an animal to consistently avoid a CS and then preventing the avoidance response in the presence of the CS. The UCS is not presented during response prevention. According to Mowrer's theory, since the presentation of the CS is no longer paired with the UCS, the aversive properties of the CS (fear) extinguish, resulting in the cessation of the observable avoidance response. A number of studies have demonstrated the efficacy of response prevention (RP) in facilitating the extinction of discriminated behaviors (Baum, 1965, 1966, 1969a, 1969b; Benline & Simmel, 1967; Berman & Katzev, 1972; Corriveau, 1978; Lederhandler & Baum, 1970; Page & Hall, 1953; Reynierse & Wiff, 1973; Shipley, Mock & Levis, 1971; Siegeltuch & Baum, 1971; Solomon, et al., 1953). Typically, a reduction in active avoidance behavior is viewed as an index of fear reduction since it is presumably necessary for the fear CR to be extinguished before the instrumental avoidance responses cease.

Similarly, in applied treatment settings, implosion therapy and flooding, for which RP is the subhuman analogue, have been employed successfully in the treatment of anxiety motivated phobic behaviors in humans (Bandura, 1969; Leitenburg, 1976; Stampfl, 1966; Stampfl & Levis, 1967, 1968). In flooding the therapist exposes the client *in vivo* (or through imagery in implosion) to repeated prolonged contact with the anxiety producing stimuli, without the occurrence of physically injurious consequences. Phobic anxiety is then presumed to extinguish.

One alternative explanation of the process by which RP facilitates avoidance extinction, called the competing response theory, has been proposed by Page (Page, 1955; Page & Hall, 1953). Because the RP procedure prevents the occurrence of the originally learned avoidance response in the presence of the CS, new responses, such as crouching and freezing, are instrumentally reinforced through the absence of shock. Thus, when subjects are tested in an active extinction procedure they are likely to exhibit these newly learned instrumental responses in the presence of the CS rather than exhibit the conditioned avoidance response. Page contends that while RP reduces the persistence of avoidance behavior, this reduction does not necessarily demonstrate a concurrent reduction in fear. In one study, Page (1955) demonstrated that while the persistence of avoidance was reduced as a result of an RP procedure, the latencies to approach the CS were longer for the subjects exposed to RP than for those subjects extinguished in the normal fashion. Thus, Page concluded that subjects receiving RP were more fearful than the subjects exposed to normal extinction. While Page's study has some severe methodological problems, results from Coulter, et al. (1968), Linton, et al. (1970) and Rohrbaugh, Riccio & Arthur (1972) have supported his findings. Using latency to approach the CS as the measure of fear, these studies demonstrated that subjects receiving RP showed less fear than subjects receiving neither RP nor extinction trials but more fear than normally extinguished subjects. While these studies demonstrate support for Page's competing response theory of response prevention, they have been criticized by Corriveau & Smith (1978), Monti & Smith (1976) and Shipley, et al.

(1971) who argue that because the total amount of non-reinforced CS exposure for the groups receiving RP was considerably less than the same exposure for the groups extinguished in the normal fashion, the differential amounts of fear demonstrated between groups could be the result of differential amount of CS exposure. Shipley, et al. (1971) found that when the amount of exposure to the CS was held constant, the fear demonstrated was not significantly different across groups. These results then support Mowrer's two-process theory in that fear reduction as a result of RP was no different than the fear reduction resulting from normal extinction procedures.

It should be pointed out that Page's competing response theory does not preclude the possibility of a fear CR extinguishing as a result of non-reinforced CS presentations but simply dissociates fear extinction from avoidance extinction. As each extinction process involves a different response system, a reduction in avoidance could be due to either an interaction between the systems (fear mediated reduction) or the effect of learning new responses within the operant system alone. However, the competing response theory does raise doubt that the absence of avoidance responding in an active avoidance extinction procedure is an adequate index of the underlying fear state.

While the most commonly employed technique to assess fear in laboratory settings has been the measurement of persistence of the conditioned active avoidance response during extinction (see Corriveau, 1978 for a review), other differentially sensitive methodologies have been used. For example, Kamin, et al. (1963), Monti & Smith (1976) and Starr & Mineka (1977) employed the conditioned emotional response paradigm (CER), which gives an index of fear by measuring the amount of suppression of an ongoing operant during the presentation of a CS. However, Corriveau (1978) found fear assessment using CER to be less sensitive than the persistence of avoidance measure. Further, he demonstrated that the most sensitive measurement of fear was obtained when latency to approach a previously avoided CS was measured (Corriveau, 1977, 1978; Corriveau, Contildes & Smith, 1978; Corriveau & Smith, 1978). In one study, Corriveau & Smith (1978) noted that subjects tested for fear using the approach methodology would place a paw on the shock grid before completely approaching the grid area. It appeared as though the animals were testing for the presence or absence of shock. The number of these safety tests was significantly fewer for the subjects receiving RP compared with those not receiving RP and more frequent than non avoidance trained control subjects. In directly comparing the fear assessment techniques described above, Corriveau (1978) found approach latency and number of safety tests to be the most sensitive dependent variables, with persistence of avoidance and CER respectively providing increasingly less sensitive measurements. It is indeed unfortunate that the majority of studies reporting fear reduction resulting from RP procedures have employed fear assessment techniques other than the approach methodology.

Both applied and theoretical interest in methods of facilitating fear reduction has lead to a number of parametric studies investigating the effects of RP. Factors such as UCS intensity (Baum, 1969a; Corriveau, 1977), duration of RP (Baum, 1969b; Baum & Gordon, 1970) techniques facilitating RP (Corriveau et al., 1978; Lederhandler & Baum, 1970) and massed versus distributed RP (Berman & Kataev, 1970; Schiff, Smith & Prochaska, 1972) have been investigated.

While the above studies reflect efforts to discover ways to maximize fear reduction using RP techniques, one question not adequately addressed involves the duration of the effects of this treatment. One study which attempted to investigate the durability of fear reduction (measured by the problematic persistence of active avoidance technique), was conducted by Benline & Simmel (1967). Their results indicated that although the reduction of the conditioned avoidance response was facilitated by RP, the effect was only temporary. After avoidance training and RP in a shuttle box, subjects were given 100 extinction trials over five days. While the subjects who received RP avoided less on the first day of testing than control subjects, the degree to which the groups differed decreased as a function of the blocks of extinction trials. By day five, extinction performance was comparable for both groups with the RP groups avoiding consistently. However, by employing a within subjects design, Benline & Simmel may have confounded the effects of repeated testing for avoidance with the effects of RP. Crawford (1977) attempted to replicate these findings using a platform avoidance apparatus and a shorter duration of RP. Contrary to Benline & Simmel, she found no increased frequency of avoidance responding over the five day period in her RP groups. Thus, while RP has been shown to reduce avoidance behavior, the effect has not been conclusively demonstrated to be stable over time. Further, because fear assessment consisted of the measurement of persistent active avoidance rather than the more sensitive approach measurements, conclusions regarding the durability of fear reduction are equivocal.

The present study was designed to investigate the duration of the effects of RP. Avoidance trained animals either received or did not receive RP and were tested for fear at either 0, 3, 27, 81, or 243 hours. Control subjects who received no avoidance training were also tested for fear at these intervals. A 3 x 5 factorial design was employed. The retention intervals were chosen to provide information about the course of fear at both short (the 0 and 3 hour groups) and long (3 and 10 days respectively for the 81 and 243 hours groups) durations while conforming to the common practice within biological sciences of using a ratio scale. It should be noted that the assessment at 243 hours provides information about the duration of the effects of RP at twice the maximum retention interval employed by any previous study. This study is also the first to employ the approach assessment methodologies in the measurement of the durability of RP effects. Latency to approach the CS and the amount of safety test behavior were used to measure fear rather than the less sensitive avoidance or CER fear assessment techniques.

The following hypotheses were generated: First, RP would have an effect on the amount of fear the subjects exhibited. Specifically, subjects who received RP were expected to demonstrate less fear than subjects who did not receive response prevention (NRP) but more than control subjects. Second, because the between subject design eliminates the possible reactive effects of repeated testing within subjects, it was hypothesized that no significant change in the approach measures would occur over the 10 day retention interval. It was predicted that at each retention interval, the amount of fear exhibited by the subjects receiving RP would be less than that exhibited by the NRP subjects but more than that demonstrated by the control group. From this hypothesis, it was also predicted that the amount of fear demonstrated by the RP groups would remain consistent at each of the retention intervals.

METHOD

Subjects

The subjects were 165 experimentally naive Sprague-Dawley male rats obtained from the Charles River Breeding Laboratory. They were housed separately and maintained on _ad libitum_ food and water throughout the entire study. Weights at the start of training ranged from 250 to 366 g. Twelve subjects were discarded for failure to meet avoidance training criteria and three were replaced due to equipment failure.

Apparatus

All avoidance training and fear testing was conducted in a one-way platform avoidance apparatus, manufactured by the Lafayette Instrument Company (model 85200), housed in a sound attenuated chamber. The grid chamber was 23 cm. long, 20.3 cm. wide and 20.3 cm. high. The platform located 9 cm. above the grid floor through an 11 cm. by 20 cm. hole in an end wall of the grid chamber, was 20.3 cm. wide and 11.5 cm. deep when the door separating the platform from the chamber was fully open. A touch sensitive circuit between the grids and the platform allowed the recording of the number of times the subjects touched the grids without leaving the platform. A wooden chamber of dimensions equal to the grid chamber was used as a temporary retaining cage. Shocks were delivered from a Coulbourn Instruments solid state shocker (model E13-16) to the grid floor. All procedures, except placing or removing the subjects from the apparatus, were automated with standard electromechanical programming equipment.

Procedure

Avoidance Training

One hundred randomly selected subjects were trained to a criterion of 10 consecutive avoidance responses. Subjects not meeting this criterion within 60 trials were discarded and replaced. An avoidance response was defined as jumping completely onto the platform within 10 sec. of the door opening and remaining on the platform for 15 sec. No discriminative CS other than the door opening was used. The UCS was a scrambled shock registering 1.5 mA on the meter of the Coulbourn shocker. A variable 30 sec. intertrial interval was used.

Two measures reflecting the acquisition of avoidance were recorded. The first was the total number of trials to the criterion of 10 consecutive avoidance responses. The second was the total duration of the UCS received during avoidance training.

Treatment

Response Prevention. Fifty avoidance trained subjects were randomly assigned to receive RP. Each of these subjects remained in the avoidance apparatus with the door closed (the platform unavailable) for 45 min. immediately after avoidance training. Following RP each subject was placed in the retaining cage for one min, after which it was returned to its home cage for the assigned retention interval.

No Response Prevention. Each of the 50 randomly assigned subjects in the NRP group was placed in the retaining chamber after its tenth consecutive avoidance response. The subject remained there for 46 min. after which it was returned to its home cage for the assigned retention interval.

Control. Fifty randomly selected subjects which did not receive avoidance training were placed inside the avoidance apparatus with the platform door open for 15 min., approximately the amount of time it took for avoidance training. This allowed control subjects equal familiarity with the apparatus. In order to be able to compare the subjects receiving RP to the control subjects, each of the latter remained in the avoidance apparatus with the door closed for 45 min. immediately following this "mock" avoidance training. Each subject was then placed in the retaining chamber for one min. and then returned to its home cage for the assigned retention interval.

Fear Assessment

Fear was assessed at either 0, 3, 27, 81 or 243 hours after the end of the treatment phase. Ten subjects from each of the three treatment conditions were randomly assigned to be tested for fear at one of the five retention intervals in the 3 x 5 factorial design shown in Table 1.

The fear assessment procedure began by placing the subject on the platform of the avoidance apparatus with only 6.2 cm. of the platform available. Two dependent measures were recorded during a 60 min. assessment period. The first, approach latency, was defined as the duration in seconds before the subject completely departed from the platform and remained on the shock grids for at least three consecutive seconds. If the subject did not meet this criterion within one hour, a score of 3600 sec. was recorded. The second dependent measure was the number of safety test responses emitted before the subject completely departed from the platform. A safety test was defined as the subject touching the grid with his paws prior to a complete approach response (Corriveau & Smith, 1978). These response were detected and automatically recorded using the touch sensitive relay and counter.

Table 1

3 x 5 Factorial Design for Testing the Durability of Response Prevention

Treatment Group	Retention Interval in Hours				
	0	3	27	81	243
No Response Prevention					
Response Prevention					
Control					

Note: n per cell = 10

N = 150

RESULTS

Avoidance Training

Both avoidance acquisition variables were examined to determine whether the RP and NRP groups received equivalent avoidance training. Table 2 shows the means and standard deviations for total trials to avoidance criterion and total duration of UCS exposure. An F_{max} test failed to reveal heterogeneity of variance for either of the training variables. Since the analysis of variance is relatively insensitive to the assumption of homogeneity of variance, an alpha level of .01 was selected for all F_{max} tests. One-way analyses of variance failed to reveal differences between the two groups for either total trials or the duration of UCS ($Fs < 1.0$). (The summary tables for these and all other analyses of variance are shown in the appendix.)

Fear Assessment

Approach Latency. Table 3 shows the means and standard deviations for approach latency in seconds for the treatment groups at each retention interval. The time taken to depart from the platform appears greatest for the group of avoidance trained subjects receiving no treatment and the least for the control subjects who approached the shock grids almost immediately. An examination of the approach latencies for each retention interval (collapsed across treatments)

Table 2

Means and Standard Deviations of the

Two Avoidance Training Variables

Treatment Group	Trials to Avoidance Acqusition M	Trials to Avoidance Acqusition SD	Total UCS Duration M	Total UCS Duration SD
No Response Prevention	31.30	16.48	25.20	9.04
Response Prevention	28.82	17.61	25.26	11.08

Note: n per cell = 30

Table 3

Means and Standard Deviations for Approach Latency (sec.)

Treatment Group		Retention Interval in Hours					
		0	3	27	81	243	overall
No Response Prevention	M	2570.90[1]	1009.80	1208.90	1373.90	1268.60	1486.42
	SD	1343.30	1381.52	1332.06	1478.65	1007.73	1382.16
Response Prevention	M	168.80	622.80	296.20	396.10	659.20	428.62
	SD	118.90	1093.71	234.94	259.02	1065.23	699.76
Control	M	15.40	25.40	43.40	29.00	55.60	33.76
	SD	8.63	20.61	31.26	35.18	71.16	40.40
Overall	M	918.37	552.67	516.17	599.67	661.13	649.60
	SD	1407.84	1064.37	9909.58	1016.38	960.51	1080.84

[1] Note: n per cell = 10

suggests that the greatest time to depart the platform was taken by subjects who were tested immediately after treatment, with little difference shown among the other four intervals.

Table 3 also suggests that the cell variances appear to be severely heterogeneous. Results of an F_{max} test found significant heterogeneity of variance ($F_{max(15,9)}$ = 29,350.19, $p < .01$). While the analysis of variance is relatively robust to violations of homogeneity of variance, the severity of the violation in this case warranted a transformation of these data. A common log transformation (base 10) was successful in removing the heterogeneity of variance ($F_{max(15,9)}$ = 19.08, n.s.). The means and standard deviations of the transformed data are shown in Table 4.

A 3 x 5 analysis of variance performed on these transformed data showed a significant treatment effect, $F_{(2,135)}$ = 116.39, $p < .001$, but no significant retention or interaction effect. An Omega squared showed that the significant treatment effect accounted for 60% of the total variance (ω^2 = .596). To further investigate the significant treatment effect, a Newman-Keuls analysis was performed. The results of the test indicated that all three groups were significantly different from each other ($p < .01$).

Number of Safety Tests. Table 5 shows the means and standard deviations for the number of safety tests for each

Table 4

Means and Standard Deviations of Log Transformed Scale for Approach Latency

Treatment Group		Retention Interval in Hours: 0	3	27	81	243	Overall
No Response Prevention	M	3.33 [1]	2.65	2.72	2.88	2.99	2.91
	SD	0.31	0.61	0.75	0.51	0.35	0.56
Response Prevention	M	2.11	2.27	2.24	2.47	2.32	2.28
	SD	0.38	0.77	0.59	0.44	0.79	0.60
Control	M	1.18	1.31	1.54	1.29	1.56	1.37
	SD	0.18	0.31	0.34	0.38	0.40	0.35
Overall	M	2.20	2.08	2.17	2.21	2.29	2.19
	SD	0.58	0.70	0.62	0.88	0.38	0.82

[1] Note: n per cell = 10

Table 5

Means and Standard Deviations for Number of Safety Tests

Treatment Group		Retention Interval in Hours					
		0	3	27	81	243	Overall
No Response Prevention	M	3.90 [1]	2.90	3.10	2.50	3.80	3.24
	SD	4.23	6.77	3.87	2.55	4.87	4.51
Response Prevention	M	0.50	3.10	0.40	0.40	1.00	1.08
	SD	0.97	7.23	0.97	0.97	2.49	3.52
Control	M	0.00	0.00	0.00	0.00	0.00	0.00
	SD	0.00	0.00	0.00	0.00	0.00	0.00
Overall	M	1.47	2.00	1.17	0.97	1.60	1.44
	SD	2.99	5.71	2.63	1.88	3.46	3.55

[1] Note: n per cell = 10

treatment group at each retention interval. These data suggest that the NRP subjects emitted more safety test responses than RP subjects. No safety testing behavior was performed by any subject in the Control group. Further, the amount of safety testing at each retention interval produced no apparent pattern.

These data also appear to exhibit heterogeneity of variance. Since the five cells in the control group each had zero variance, this group was excluded from the F_{max} test. This test revealed severe heterogeneity with $F_{max(10,9)} = 56.02$, $p < .01$. A log transformation produced relatively homogeneous data ($F_{max(10,9)} = 5.42$, $p > .01$). The means and standard deviations for the transformed data can be seen in Table 6.

Since zero variance remained after the transformation in the five cells for the control subjects, the exclusion of this group from the analysis of variance was warranted. Thus, a 2 x 5 analysis of variance was performed on the number of safety tests emitted by the RP and NRP subjects at the five retention intervals. The analysis revealed significant treatment effect, $F_{(1,90)} = 22.94$, $p < .001$, but showed no interval effect or interaction effect. An Omega squared showed 19% of the total variance was accounted for by the treatment ($\omega^2 = .190$).

To compare controls with both RP and NRP subjects,

Table 6

Means and Standard Deviations of Log Transformed Scale

for Number of Safety Tests

Treatment Group		Retention Interval in Hours					
		0	3	27	81	243	Overall
No Response Prevention	M	0.58 [1]	0.32	0.43	0.44	0.56	0.47
	SD	0.31	0.42	0.43	0.32	0.30	0.36
Response Prevention	M	0.12	0.28	0.09	0.09	0.16	0.15
	SD	0.21	0.47	0.20	0.20	0.31	0.29
Control	M	0.00	0.00	0.00	0.00	0.00	0.00
	SD	0.00	0.00	0.00	0.00	0.00	0.00
Overall	M	0.23	0.20	0.17	0.18	0.24	0.20
	SD	0.33	0.38	0.32	0.29	0.34	0.33

[1] Note: n per cell = 10

two chi square tests were performed. For each treatment group, the number of subjects who safety tested as well as the number of subjects who did not emit this behavior was determined. These frequencies are shown in Table 7. The χ^2 analysis showed a significant difference between the groups, $\chi^2 = 16.28$, $p < .001$. A similar analysis also demonstrated that significantly more subjects in the NRP group emitted safety tests than subjects in the Control group ($\chi^2 = 66.67$, $p < .001$).

The Relationship Between Approach Latency and Number of Safety Tests. A Pearson correlation analysis was performed between the two fear assessment variables in order to determine the extent to which approach latency and safety testing measured the same fear construct. The result showed a significant correlation ($r = .64$, $p < .001$).

Table 7

Frequencies of Safety Test Behavior

Treatment Group	Number of Subjects Safety Testing	Number of Subjects Not Safety Testing
No Response Prevention	40	10
Response prevention	14	36
Control	0	50

DISCUSSION

The hypothesis that RP facilitates the reduction of fear to a CS was supported. The subjects receiving RP approached the shock chamber sooner and safety tested less frequently before approaching the grids than the subjects not receiving RP. This result is consistent with the majority of studies employing response prevention and assessing fear with either the persistence of avoidance (Baum, 1966; Benline & Simmel, 1967; Coulter, et al., 1969; Schieff, et al., 1972; Solomon, et al., 1953), or the CER assessment techniques (Monti & Smith, 1976; Starr & Mineka, 1977). It is also consistent with other work using the more sensitive approach assessment technology (Bersh & Paynter, 1972; Corriveau, 1977, 1978; Corriveau & Smith, 1978; Corriveau, et al., 1978; Spring, et al., 1973).

However, the subjects receiving RP had significantly longer latencies to approach the shock chamber and performed more safety tests than control subjects. Thus, fear reduction was not complete in this study. While subjects receiving RP were significantly less fearful than those not receiving RP, the differences between the RP group and the Control group suggest that subjects receiving the treatment were still somewhat fearful of the shock chamber. These results do not support the claim of some researchers that RP leads to complete elimination of fear (Baum, 1969a., 1970; Shipley, et al., 1971). It should be noted that research demonstrating complete fear reduction typically measures fear by persistence of the avoidance response. Corriveau's (1978) finding that the avoidance measures are less sensitive fear assessment techniques than approach measurements may explain why these studies failed to show residual fear. The findings from this study are congruent with other research which found only partial fear reduction when fear was assessed with the more sensitive approach measures (Corriveau & Smith, 1978; Coulter, Riccio & Page, 1969; Linton, Riccio, Rohrbaugh & Page, 1970; Spring, Prochaska & Smith, 1974). It should also be pointed out that the duration of RP in the present experiment was 45 min. compared with less than 10 min. in the Shipley et al. (1971) study and 30 min. in the Baum (1969a) study. In comparison to these studies, the duration of RP in the present study was quite long. Thus it is unlikely that the lack of total fear reduction was due to a short RP treatment in this experiment.

Both Corriveau & Smith (1978) and Monti & Smith (1976) found that RP in the presence of the environmental stimuli of the avoidance apparatus alone resulted in fear reduction equivalent to that when the CS was presented. The results from the present study are consistent with this finding. It could be argued that the opening of the door to the platform was in fact the CS in the present procedure as it was consistently paired with shock onset in avoidance training. This interpretation is open to question on both conjectural and empirical grounds. First, from the observation of subjects during avoidance training, it seems that the opening of the door acted simply as a cue for the initiation of the avoidance response. During the trials on which the initial avoidance response was made most animals attempted to escape from the grid chamber by clawing and jumping at the door prior to its opening. As these responses were frequently not reinforced, the animals would cease making them before the door opened and "wait" at the foot of the platform. When the door subsequently opened the avoidance response was made. Thus, the subjects appeared to be afraid of the grid chamber but learned to emit the avoidance response only in the presence of the open door. Of course, this interpretaion is speculative as no empirical demonstration of the cuing properties of the opening of the door were attempted in this study. While this speculation is consistent with Herrnstein's (1969) and Schoenfeld's (1950) interpretation of discriminated avoidance, it does not deny the possibility that the opening of the door could also act as a CS capable of producing a fear CR. The present results do demonstrate, however, that even if the opening of the door was a CS, it was not the only one. Since the door remained closed throughout the entire RP procedure and the treatment was effective in reducing fear, the CS to which the animal's fear extinguished was probably the compound made up of the environmental stimuli of the avoidance apparatus. Whether the opening of the door was in fact a CS, and if so, to what extent it contributes to the compound CS of environmental stimuli remains an empirical question.

Perhaps the most interesting results of this study come from the investigation of the durability and stability of fear reduction. The second hypothesis stated that fear reduction from response prevention would persist over time. This led to the prediction that at each retention interval the amount of fear exhibited by the subjects receiving RP would be less than that demonstrated by the non-treated subjects and more than that exhibited by the non-avoidance trained subjects. The lack of a significant statistical interaction between treatment and retention intervals for both dependent variables supported this prediction. Specifically, the results showed that not only was RP an effective treatment for reducing fear but that when subjects receiving RP were compared with subjects not exposed to the procedure, the former demonstrated significantly less fear than the latter up to 10 days after treatment. Further, the RP subjects consistently demonstrated more fear than the control subjects. While the studies of Corriveau & Smith, (1978), Coulter, Riccio & Page (1969) and Monti & Smith (1976) demonstrated incomplete fear reduction as a result of response prevention when tested immediately after treatment, the present results show that this effect is maintained for at least 10 days.

The prediction that the effects of RP would be stable over time was also supported. The results showed no significant main effect for retention intervals, for either approach latency or number of safety tests. This indicates that the level to which fear was reduced remain stable over at least 10 days.

The finding that the effect of RP in reducing fear is both consistent and stable over a 10 day period conflicts directly with the results reported by Benline & Simmel (1967). These authors found that subjects who were exposed to RP after they were trained to avoid in a shuttle box demonstrated significantly less fear 24 hours after training than comparable subjects that did not receive the treatment. However, further testing of each animal at 48, 72, 96 and 120 hours after the training revealed a steady increase in fear. By the fifth day of testing, no differences were found between the treated and untreated groups indicating a substantial recovery of fear for the subjects treated with RP. Results of the present study, however, indicate that for a period twice as long as that employed by Benline & Simmel, fear reduction was stable.

Two important differences between the present procedure and that employed by Benline and Simmel may explain these discrepant results. First, the methods of fear assessment were not the same. Benline and Simmel employed the active avoidance measure while the approach assessment techniques were used in this study. By giving 20 extinction trials per day, Benline and Simmel introduced the possibility of the spontaneous recovery of the conditioned avoidance response. This phenomenon alone would not explain the complete recovery of the response, however, as spontaneous recovery seldom brings response strength back to pre-extinction levels. Benline and Simmel noted a gradual increase in the levels of responding over the five days. This gradual increase can be explained by the reinforcement received from the CS termination (Bolles, Stokes & Younger, 1966; Kamin, 1956) whenever an avoidance response was made in extinction. If fear of the CS is not completely eliminated by RP, as much of the previously presented research indicates, the CS termination may provide sufficient reinforcement for a partial relearning of the avoidance response within each set of 20 extinction trials. Thus, within the first set of extinction trials spontaneous recovery may account for the first avoidance response and reinforcement by fear reduction resulting from CS termination may account for the subsequent increase in responding. The use of the approach assessment methodology in this study reduced the possible effects these confounds would have on the measurement of fear within a test session. This technique provided the subject with only one exposure to the CS complex in each test session as opposed to 20 exposures (extinction trials) in Benline and Simmel's procedure. Thus, the opportunity for relearning either the avoidance response or the fear CR was minimized by making the training and the testing sessions more discriminable.

The second difference between the present study and that of Benline and Simmel was the experimental design employed. By using a within subjects design, Benline and Simmel may have confounded the effects of repeated testing for fear with the effects of response prevention. Specifically, one cannot be sure that the level of fear measured in the group exposed to RP (on every test day except the first) was not influenced by the previous day's fear test procedure, thus precluding an accurate measurement of fear retention at that interval. The possibility that testing did have a subsequent effect on fear assessment is made more plausible by finding that their NRP group showed no signs of extinction over five days and 100 extinction trials. Coupled with the possibility of the relearning of the original avoidance contingency as discussed earlier, the possible confounding of repeated testing with the effects of treatment renders the use of a within subjects design inappropriate for the assessment of the durability of the effects of RP. By employing a between subjects design, this study eliminated the possibility of such confounding as each subject was tested for fear only once at a specified retention interval. That the NRP groups showed no decrease in approach latency or number of safety tests over the 10 day period for the group receiving no treatment demonstrates that the avoidance training was a potent fear producing procedure. Of greater interest is the fact that the subjects receiving RP and tested at different intervals over 10 days exhibited equivalent approach latencies and number of safety tests, indicating durability of fear reduction. Since the subjects were exposed to no events that could interfere with the effects of RP over 10 days, such as repeated testing, the reduction in fear remained stable. It is interesting to note that other authors have reported much more impressive retention intervals. For example, Marquis & Hilgard (1936) showed evidence for a 16-month retention of conditioned eyelid reactions in dogs and Skinner (1960) reported immediate and correct responding in pigeons trained on an operant pecking task after six years of inactivity.

Although Benline and Simmel's results showed that fear recovered over a 5 day period, an attempt to replicate this finding by Crawford (1977) failed. Crawford's study differed from Benline and Simmel's in that she used a platform avoidance apparatus rather than a shuttle box and only five min. of RP were provided as opposed to a minimum of 15 min. She found that there was no difference between the group receiving RP and the untreated group on the fifth day of testing. However, she also reported no difference in the amount of fear exhibited by the subjects in each group on <u>any</u> previous test day including the first day. Crawford has interpreted these results to show that RP in presence of stimuli other than the CS was just as effective as the standard treatment procedure. However, a more plausible interpretation is that the short duration of RP employed in her study had no effect on fear reduction. A number of studies have shown that prolonged durations of RP are more effective in reducing fear than short durations (Baum, 1969 a & b; Reynierse & Wiff, 1973) and that very short treatments may actually enhance fear (Coulter, et al., 1968; Linton, et al., 1970). Thus, since no differences were found between Crawford's treated and untreated groups suggests the duration of treatment may have been too short to effectively eliminate fear.

While extreme caution and care must be exercised in discussing the implications for clinical settings from any subhuman analogue research, the present study may be useful retention of conditioned responses shown by Marquis & Hilgard (1936) and Skinner (1960) is needed at both the subhuman and human level before the utility of the model can be fully assessed.

REFERENCES

Bandura, A. Principles of Behavior Modification, New York: Holt, Rinehart and Winston, Inc., 1969.

Baum, M. Rapid extinction of an avoidance response following a period of response prevention in the avoidance apparatus. Psychological Reports, 1966, 18, 59-64.

Baum, M. Extinction of an avoidance response following response prevention: Some parametric investigations. Canadian Journal of Psychology, 1969 (a), 23, 1-10.

Baum, M. Extinction of an avoidance response motivated by intense fear: Social facilitation of the action of response prevention (flooding) in rats. Behaviour Research and Therapy, 1969(b), 7, 57-62.

Baum, M. Extinction of avoidance responding through response prevention (flooding). Psychological Bulletin, 1970, 74, 276-282.

Baum, M. & Poser, E. Comparison of flooding procedures in animals and man. Behaviour Research and Therapy, 1971, 9, 249-251.

Benline, T. & Simmel, E. Effects of blocking of avoidance response on the elimination of the conditioned fear response. Psychonomic Science, 1967, 8, 357-358.

Berman, J. & Katzev, R. Factors in the rapid elimination of avoidance behaviour. Behaviour Research and Therapy, 1972, 10, 247-256.

Bersh, P. & Paynter, W. Pavlovian extinction of avoidance responses under curare. Journal of Comparative and Physiological Psychology, 1972, 51, 519-524.

Bolles, R. Species-specific defense reaction and avoidance learning. Psychological Review, 1970, 77, 32-48.

Corriveau, D. UCS intensity and safety testing behavior following response prevention. Paper presented to the Eastern Psychological Association, April, 1977.

Corriveau, D. A direct comparison of three fear assessment techniques. Unpublished doctoral dissertation, University of Rhode Island, 1978.

Corriveau, D. Contildes, K. & Smith, N. Social facilitation following response prevention in the rat. Psychological Reports, 1978, 43, 127-133.

Corriveau, D. & Smith, N. Fear reduction and safety testing behavior following response prevention: A multivariate analysis. Journal of Experimental Psychology; General, 1978, 107, 145-158.

Coulter, S., Riccio, D. & Page, H. Effects of blocking an instrumental avoidance response. Journal of Comparative and physiological Psychology, 1969, 68, 377-381.

Crawford, M. Brief 'response prevention' in a novel place can facilitate avoidance extinction. Learning and Motivation, 1977, 8, 39-53.

Herrnstein, R. Method and theory in the study of avoidance. Psychological Review, 1969, 76, 49-69.

Hogan, R. & Kirchner, J. Preliminary report of the extinction of learned fears via short-term implosion therapy.

Journal of Abnormal Psychology, 1967, _72_, 106-109.

Hogan, R. & Kirchner, J. Implosive, eclectic verbal and bibliotherapy in the treatment of fears of snakes. _Behaviour Research and Therapy_, 1968, _6_, 167-171.

Kamin, L. The effects of termination of the CS and avoidance of the US on avoidance learning. _Journal of Comparative and Physiological Psychology_, 1956, _49_, 420-424.

Kamin, L., Brimmer, C. & Black, A. Conditioned suppression as a monitor of fear of the CS in the course of avoidance training. _Journal of Comparative and Physiological Psychology_, 1963, _56_, 497-501.

Lederhandler, I. & Baum, M. Mechanical facilitation of the action of response prevention (flooding) in rats. _Behaviour Research and Therapy_, 1970, _8_, 43-48.

Leitenberg, H. Behavioral approaches to treatment of neurosis. In H. Leitenberg (Ed.), _Handbook of behavior modification and behavior therapy_. Englewood Cliffs, N. J., Prentice Hall.

Levis, D. _Implosion therapy: The subhuman analogue, the strategy, and the technique_. V. A. Publication, Battle Creek, Michigan, 1966.

Levis, D. Implosion therapy: A critical analysis of Morganstern's review. _Psychological Bulletin_, 1974, _81_, 155-158.

Linton, J., Riccio, D., Rohrbaugh, M. & Page, H. The effects of blocking an instrumental avoidance response: Fear reduction or enhancement? _Behaviour Research and Therapy_, 1970, _8_, 267-272.

Marquis, D. & Hilgard, E. Conditioned lid responses to light in dogs after removal of the visual cortex. Journal of Comparative Psychology, 1936, 22, 157-158.

Mazzaro, M., Riccio, D. & Riley, J. Effects of Pavlovian conditioned stimulus - unconditioned stimulus pairings during avoidance response prevention trials in rats. Journal of Comparative and Physiological Psychology, 1974, 86, 96-100.

Miller, N. Learnable drives and rewards. In S. S. Stevens (Ed.), Handbook of experimental psychology. New York: Wiley.

Mineka, S. The role of fear in theories of avoidance learning, flooding and extinction. Psychological Bulletin, 1979, 86, 985-1010.

Monti, P. & Smith, N. Residual fear of the conditioned stimulus as a function of response prevention after avoidance or classical defensive conditioning in the rat. Journal of Experimental Psychology, 1976, 105, 148-162.

Morganstern, K. Implosion therapy and flooding procedures: A critical review. Psychological Bulletin, 1973, 79, 318-334.

Morganstern, K. Issues in implosive therapy: Reply to Levis. Psychological Bulletin, 1974, 81, 380-382.

Mowrer, O. H. On the dual nature of learning -- A re-interpretation of "conditioning" and "problem-solving", *Harvard Educational Review*, 1947, *17*, 102-148.

Mowrer, O. H. Anxiety reduction and learning. *Journal of Experimental Psychology*, 1940, *27*, 497-516.

Mowrer, O. H. *Learning theories and personality dynamics*. New York: The Ronald Press, 1950.

Page, H. The facilitation of experimental extinction by response prevention as a function of the acquisition of a new response. *Journal of Comparative and Physiological Psychology*, 1955, *48*, 14-16.

Page H. & Hall, J. Experimental extinction as a function of prevention of a response. *Journal of Comparative and Physiological Psychology*, 1953, *46*, 33-34.

Rachman, S. Studies in desensitization: II. Flooding. *Behaviour Research and Therapy*, 1966, *4*, 1-6.

Rachman, S., Marks, I. & Hodgson, R. The treatment of obsessive-compulsive neurotics by modelling and flooding *in vivo*. *Behaviour Research and Therapy*, 1973, *11*, 463-471.

Rescorla, R. & Solomon, R. Two-process learning theory: Relationships between Pavlovian conditioning and instrumental learning. *Psychological Review*, 1967, *74*, 151-182.

Reynierse, J. & Wiff, L. Effects of temporal placement of response prevention on extinction of avoidance in rats. *Behaviour Research and Therapy*, 1974, *12*, 175-180.

Riccio, D. & Silvestri, R. Extinction of avoidance behavior and the problem of fear. *Behaviour Research and Therapy*, 1973, *11*, 1-9.

Rohrbaugh, M., Riccio, D. & Arthur, A. Paradoxical enhancement of conditioned suppression. *Behaviour Research and Therapy*, 1972, *10*, 125-130.

Schiff, R., Smith, N. & Prochaska, J. Facilitation of extinction of an avoidance response by response blocking. *Journal of Comparative and Physiological Psychology*, 1972, *81*, 356-359.

Schoenfeld, W. An experimental approach to anxiety, escape and avoidance behavior. In P. H. Hoch and J. Zubin (Eds.) *Anxiety*,, New York: Greene and Stratton, 1950.

Seligman, M. & Johnston, J. A cognitive theory of avoidance learning. In F. J. McGuigan and D. B. Lumsden (Eds.), *Contemporary Approaches to Conditioning and Learning*, Washington, D. C.: V. H. Winston, 1973.

Shipley, R., Mock, L. & Levis, D. Effects of several response prevention procedures on activity, avoidance responding, and conditioned fear in rats. *Journal of Comparative and Physiological Psychology*, 1971, *77*, 256-270.

Siegeltuch, M. & Baum, M. Extinction of well established avoidance responses through response prevention (flooding). *Behaviour Research and Therapy*, 1971, *9*, 103-108.

Skinner, B. F. Pigeons in a pelican. *American Psychologist*, 1960, *15*, 28-37.

Solomon, R., Kamin, L. & Wynne, L. Traumatic avoidance learning: The outcomes of several extinction procedures with dogs. Journal of Abnormal and Social Psychology, 1953, 48, 291-302.

Solomon, R. & Wynne, L. Traumatic avoidance learning: The principles of anxiety conservation and partial irreversibility. The Psychological Review, 1954, 61, 353-384.

Spring, D., Prochaska, J. & Smith, N. Fear reduction in rats through avoidance blocking. Behaviour Research and Therapy, 1974, 12, 29-34.

Stampfl, T. Implosive therapy: The theory. V. A. Publication, Battle Creek, Michigan, 1966.

Stampfl, T. & Levis, D. The essentials of implosive therapy: A learning theory based psychodynamic behavioral therapy. Journal of Abnormal Psychology, 1967, 72, 496-503.

Stampfl, T. & Levis, D. Implosive therapy - A behavioral therapy? Behaviour Research and Therapy, 1968, 6, 31-36.

Starr, M. & Mineka, S. Determinants of fear over the course of avoidance learning. Learning and Motivation, 1977, 8, 332-350.

Appendix A

Analysis of Variance Summary Tables for the Two Avoidance Training Variables

Trials to Avoidance Acqusition

Source	Sum of Squares	df	Mean Square	F	p
Treatment	0.09	1	0.09	.0009	n.s.
Error	10015.59	98	102.20		
Total	10015.68	99			

Total UCS Duration

Source	Sum of Squares	df	Mean Square	F	p
Treatment	154.01	1	154.01	0.53	n.s.
Error	28491.91	98	290.73		
Total	28645.92	99			

Appendix B

Analysis of Variance Summary Table for a Log Transformation on Avoidance Latency

Source	Sum of Squares	df	Mean Square	F	p
Retention Interval	0.71	4	0.18	0.69	n.s.
Treatment	59.77	2	29.89	116.39	$<.001$
Interaction	3.97	8	0.50	1.93	n.s.
Error	34.66	135	0.26		
Total	99.11	149	0.67		

Appendix C

Analysis of Variance Summary Table for

a Log Transformation on Number of Safety Tests

Source	Sum of Squares	df	Mean Square	F	p
Retention Interval	0.17	4	0.04	0.40	n.s.
Treatment	2.50	1	2.50	22.94	$< .001$
Interaction	0.55	4	0.14	1.25	n.s.
Error	9.82	90	0.11		
Total	13.04	99	0.13		