The Mechanism of Therapy by Desensitization*

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SUMMARY

In order to assess whether an autonomic change accompanies desensitization by reciprocal inhibition we exposed two groups of anxious subjects to a stressful situation. One group was 'relaxed' pharmacologically using methoxyflurane. The 'relaxed' group was desensitized to the stress but showed no difference in autonomic responses. We have concluded that reciprocal inhibition acts at a cognitive and affective level, rather than as a purely autonomic change.

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The emotion of fear, or anxiety, may be diminished by a technique now commonly referred to as 'desensitization by reciprocal inhibition'[1,2] and this, in turn, is efficacious in bringing about an improvement in general adjustment and performance.[3,4] It has been shown that relaxation is an essential feature of the desensitization process.[5]

A conceptual problem remains concerning the level at which relaxation has its effect. Wolpe, in an early statement on the rationale of therapy by reciprocal inhibition, says: 'If a response antagonistic to anxiety can be made to occur in the presence of anxiety evoking stimuli so that it is accompanied by a complete or partial suppression of the anxiety responses, the bond between these stimuli and the anxiety responses will be weakened'.[6] The exact nature of the alleged 'antagonism' is, however, not clear. The orthodox Wolpe model seems to assume that the muscular relaxations oust the anxiety responses directly and on the physiological level. Thus, the beneficial effects of muscular relaxation may be due to 'the effort of relaxing skeletal muscles, which carries with it autonomic responses opposite in direction to those characteristic of anxiety'.[7] Yet clearly there is no logical or physiological necessity in this association.

If relaxation is to work on the autonomic nervous system then it follows that: (*i*) the induction of relaxation must manifest itself by a reduction in the autonomic indices of anxiety; and (*ii*) if any permanent lessening of anxiety occurs, i.e. has been learned, it should manifest itself by an equally permanent change in the physiological indices on the presentation of the same stimulus.

Work with a bearing on physiological changes during the therapy of anxiety has been relatively little reported.[8,9] Friedman and Silverstone[10] used intravenous methohexitone sodium (Brietal) to induce muscle relaxation directly, without the need for special training sessions, and found that desensitization was facilitated. Lader and Wing,[8] have found a supranormal response to auditory stimuli in anxious patients, as shown in certain physiological indices of anxiety, viz. heart rate and spontaneous fluctuations and habituation of galvanic skin response.

We decided to combine these approaches, namely to induce relaxation by pharmacological means and to examine the effects of this on the state of anxiety itself as experienced psychologically and manifested autonomically.

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METHOD

Induction of Relaxation

The drug chosen to induce a feeling of relaxation was methoxyflurane (Penthrane). The drug was used to induce a feeling of relaxation and not the physiological effects brought about by the greater dosage used for anaesthesia.[11] The drug was administered by the special apparatus supplied (Analgizer). Subjects were instructed to breathe from it until they felt relaxed. They then stopped inhaling, and repeated the process to maintain the relaxed state.

Subjects

Ten subjects were drawn from Tara Hospital, where they were undergoing treatment for disorders in which anxiety had been diagnosed as playing a major part. They were all females, aged 19 - 52 years.

Table I includes the medication received by each subject at Tara. Subjects, matched for age and similarity of clinical features, were assigned to the 2 groups. Subjects were selected by the medical staff who were unaware of the exact nature of the experiment.

Psychological Tests

1. On admission to Tara Hospital, diagnosis on a clinical basis showed a marked element of anxiety in each case (Table I).
2. Cattell's IPAT instrument was administered to each subject before the start of the first experimental session.
3. On entry into the test room, each subject was separately evaluated by each of us, on a 4-point scale, for outward manifestation of anxiety.
4. After each day's testing, subjects were asked to report on stress experienced under the various conditions of the experiment (see under 'Test Procedure', 7 and 10).

Physiological Measurements

The measurements were recorded on paper on an Elther polygraph. Heart rate was monitored by means of standard electrocardiogram lead 1; galvanic skin response was measured by recording the skin potential from the index finger of the left hand and the integrated electromyogram strapped from the left trapezius muscle of the neck. The electro-encephalogram was recorded from the C4 - O2

TABLE I. CLINICAL DETAILS

	Subject	Age	Clinical diagnosis	Drug therapy
Without methoxyflurane	1	21	Neurotic depression with anxiety	**Trasicor 20 mg** t.d.s. **Amitryptyline 10 mg** t.d.s.
	2	36	Obsessional state with anxiety	—
	3	27	Personality disorder with anxiety	**Melleril 100 mg** nocte **Mandrax 1 tablet** nocte **Nardil 15 mg** b.d.
	4	52	Neurotic depression with anxiety	**Parnate 10 mg** td. **Librium 5 mg** t.d.s.
	5	42	Anxiety state with depression	**Pertofran 25 mg** q.i.d. **Melleril 200 mg** nocte
With methoxyflurane	6	19	Endoreactive depression with anxiety	**Tofranil 50 mg** t.d.s. **Valium 2 mg** t.d.s.
	7	22	Personality disorder with anxiety	**Oxazepam 15 mg** t.d.s. **Trasicor 10 mg** t.d.s.
	8	40	Neurotic depression with anxiety	**Parnate 10 mg** b.d. **Valium 5 mg** t.d.s. **Mandrax 1 tablet** nocte
	9	29	Manic-depressive psychosis with anxiety	**Parnate 10 mg** b.d. **Valium 10 mg** t.d.s.
	10	29	Anxiety state with reactive depression	—

locations (international 10 - 20 system). This last parameter was also recorded on magnetic tape.

Stimulation Procedure

This was by means of a buzzer, sounded for 1 second at random intervals but within a range of 4 - 14 seconds of each other. There were a total of 30 presentations in each sequence. The buzzer sound was a 100 Hz square wave from a loudspeaker mounted on a wall 2 m from the subject's head and which had an intensity of 87 db (ref. 0.00002 dynes per sq cm) at the subject's ear.

Test Procedure

The subjects were told that they were to be exposed to auditory stimuli, and that they would be asked to inhale a completely safe relaxing substance. The voluntary nature of the experiment was emphasized. The IPAT test was then administered. The subjects were then connected to the polygraph in the test room. The following procedure was then carried out:

1. All parameters were recorded for a total of 2 minutes, to provide basal readings, no stimulation being given (R1).

2. With no warning, the buzzer stimulation programme began, and all parameters were measured throughout the period (N1).

3. Immediately on completion of this sequence the same one of us entered the test room and repeated the instructions concerning the use of the Analgizer, which was then handed to the subject. The experimenter then left the room. According to a pre-arranged random schedule half the subjects were given the Analgizer charged with a measured amount of methoxyflurane and half were handed the instrument empty.

4. A period of 2 minutes now ensued when the subject breathed from the 'Analgizer' (R2).

5. The buzzer programme was then repeated (N2).

6. The Analgizer was then removed and weighed.

7. The subject was released from the test room, asked how the stress experienced under N2 compared with that under N1, and thanked.

8. On the following day at the same time the subjects returned and recordings at rest were taken for 2 minutes (R3).

9. The buzzer stimulation programme was repeated (N3).

10. The subjects were released and questioned concerning stress experienced in comparison with the previous day.

RESULTS

The Effectiveness of the Stimulation

All subjects reported that the stimulation procedure was highly arousing with unpleasant affect. One patient was unable to proceed once the buzzer had sounded a few times, and was released from the experiment and replaced.

The Effectiveness of the Methoxyflurane

All subjects who had the drug reported feeling increasingly relaxed during its use, whereas the others reported no change while using the Analgizer. The weight difference in the Analgizer before and after N2 ranged from 0·6 to 1·0 g.

TABLE II. PSYCHOLOGICAL MEASUREMENTS

	Subject	IPAT	Overt anxiety totalled	Report by subject of stress experienced* N2 vs. N1	Report by subject of stress experienced* N3 vs. prior
Without methoxyflurane	1	10	4	O	O
	2	9	6	O	O
	3	10	7	O	+
	4	9	3	O	O
	5	10	4	O	O
With methoxyflurane	6	9	3	+	+
	7	10	6	+	+
	8	10	2	+	+
	9	9	4	+	+
	10	10	5	+	+

* O indicates that the subject reported feeling no better.
+ indicates that the subject reported feeling better.

Psychological Measurements

Clinical diagnosis on admission to Tara Hospital showed marked elements of anxiety in all cases (Table I).

The IPAT scores, on a scale from 0 - 10 standard sten score, and our own assessments of overt anxiety, are set out in Table II. There is no significant difference in anxiety levels in terms of these two scores between the two groups. The range of values in our observations of overt anxiety manifested by the subjects is greater than that shown by the IPAT results in which both overt and covert anxiety is assessed.

Table II also shows that subjects in the 'with methoxyflurane' group, in their subjective assessment, without exception, found the N2 situation to be less stressful than N1, and N3 again less so than the previous day. On the other hand, no subjects in the 'without methoxyflurane' group found N2 less stressful than N1, and only one found N3 preferable to the previous day. These differences were significant at a level of $P < 0{\cdot}01$ for N2 *vs.* N1 and $P < 0{\cdot}05$ for N3 *vs.* the previous day.

Physiological Measurements (Table III)

1. Heart rate. The average and the peak heart rates[12] were calculated for each stage in the experimental procedure. The two groups did not differ significantly during R1.

In order to compare each subject's heart rate during N2

TABLE III. PHYSIOLOGICAL MEASUREMENTS

		R1				N1				N2				R3				N3			
	Subject	HR		SF	EMG	HR		GSR	EMG	HR		GSR	EMG	HR		SF	EMG	HR		GSR	EMG
		P	A			P	A			P	A			P	A			P	A		
Without methoxyflurane	1	72	70	0	1	86	73	12	4	82	73	3	3	75	71	0	3	75	71	0	10
	2	120	102	1	55	113	95	2	31	113	93	0	27	120	105	4	65	120	93	3	45
	3	90	86	0	16	95	85	15	26	90	86	22	35	82	86	0	60	90	86	1	43
	4	82	75	0	10	79	76	0	3	82	78	0	0	82	79	0	16	82	74	0	20
	5	82	76	1	28	82	77	0	52	86	77	1	40	90	82	0	36	90	77	0	29
With methoxyflurane	6	100	88	0	3	100	86	2	5	100	90	0	1	100	91	0	8	106	94	3	16
	7	79	75	0	26	82	79	14	25	90	75	4	26	69	69	0	22	75	71	3	19
	8	79	72	0	18	74	69	1	10	86	82	1	9	79	70	2	12	82	73	0	25
	9	90	74	13	1	90	74	18	3	90	75	12	4	90	74	2	9	100	74	8	8
	10	121	110	7	3	121	110	9	2	113	105	0	1	121	121	10	2	121	114	10	2

HR=heart rate.
P=peak heart rate.
A=average heart rate.
GSR=total number of galvanic skin responses.
EMG=value of integrated electromyogram (see text).
SF=spontaneous fluctuations of galvanic skin responses.

with that during N1, $\frac{HR\ (N1) - HR\ (N2)}{HR\ (N1)}$ was calculated, and $\frac{HR\ (N1) - HR\ (N3)}{HR\ (N1)}$ for comparison of N3 and N1 conditions. Neither of these measurements showed a significant difference between the 'drug' and 'no-drug' groups.

2. Galvanic skin response. This was measured as skin potential changes; only changes of $10\,\mu V$, or over, were counted.

Spontaneous fluctuations during R1, and individual changes in the total number of responses during N1, N2 and N3 were compared as above for heart rate. None of these measures significantly separated the two groups.

3. Electromyogram. The integrated electromyogram trace was scored by measuring the height of the record above the base line at 85 identical intervals during the stimulation procedure.

There was no significant difference between the groups during R1, nor during N1, N2 and N3.

A progressive reduction in heart rate, galvanic skin response and electromyogram trace was noted in some members of both groups across the experiment. This may be ascribed to the effect of repetition/habituation.

4. Electro-encephalogram. The α-index and evoked responses will be reported upon separately.

DISCUSSION

The precise amount of drug inhaled by each subject has not been taken into account. Subjects were instructed to inhale until a sense of pleasant relaxation was achieved. This they were able to attain within a narrow dose range, and the exact amount consumed to achieve this state is of little further significance.

We are aware that among the medication being received by some of the subjects, certain of the agents have a direct action on the adrenergic nervous system, e.g. Melleril and Trasicor. However, we consider that the basic psychological difference which became manifest between the two groups is not thereby vitiated, since subjects in both groups were involved, and also since subjects acted as their own controls.

Although the original emphasis in desensitization therapy was on relaxation by reduction of muscular tension, recent work has begun to question the precise psychophysiological axis involved.[9,13] Gelder[9] has measured forearm EMG during 6 desensitization sessions, and concludes: 'There was thus no evidence that "relaxation" induced any change in muscle tension . . . relaxation procedures are probably important in lowering general arousal levels . . . muscle relaxation *per se* does not appear essential'. It was precisely such a lowering of 'general arousal levels' that was produced by methoxyflurane.

Our results show that:

1. During R1 and N1 there was no correlation between any physiological and psychological measure.

2. During none of the stimulation sequences was there any significant separation of physiological measures between the 'drug' and 'no-drug' groups.

3. We did observe a diminution in heart rate, galvanic skin response and EMG response among some members of both groups, which may be ascribed to the effect of habituation; but, neither the rate nor the degree of habituation varied significantly between the two groups.

4. Since this occurred without significant distinction in both the 'relaxed' and 'control' groups, it cannot be held to account for the significant separation which was noted in our psychological findings.

CONCLUSIONS

The subjects in the 'relaxed' group found the situation less stressful both during the use of methoxyflurane and on the following day. Learning by desensitization had therefore occurred. This was not reflected in any concomitant autonomic change.

We therefore suggest that a cognitive and affective influence is at work; that, in other words, the stressful situation has been given a different psychological significance and emotional value to the patient. For emotion to be experienced there must be both a physical and a psychological correlate present,[14] yet behavourists have tended to overlook the importance of cognitive and affective elements in this duality.

Therefore the technique and theory of therapy by reciprocal inhibition may be subsumed under the general classification of 'insight' psychotherapy.

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