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Contributors are requested to be clear and concise. The length of the articles should not exceed 15 printed pages. The manuscript should be in a final form for the press. The introduction and reviews of literature should be restricted and closely pertinent.

The manuscript should be typewritten on one side of the page only, with double spacing, and wide margins, including titles, foot-notes, literature citations and legends. Symbols, formulæ and equations must be written clearly and with great care. Too many tables, graphs, etc., should be avoided. Each table should be typed on a separate sheet with its proper position marked in the text in pencil. Two typewritten copies of the article should be sent.

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Practice Effect in the Estimation of Short Temporal Duration

BY

R. G. CHATTERJEA AND A. K. SIRKAR

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Introduction

The efforts of the investigators in the field of temporal perception have yielded very little success in establishing any conclusive answer to the various problems. With the initiation of the study by the early workers like Woodrow and others, the progress is rapid appreciably at present though the nature of the findings do not always confirm the previous results. A clear picture of these studies has been very nicely depicted in Woodrow's writing (12). Different aspects of the temporal field have been studied with varied techniques but the study of the indifference interval appears to be the epicentre of such investigations (3, 4, 6, 7, 10). Studies in this direction have been attempted to find if the individual's temporal perception is affected by different characteristics of the stimuli (8) ; as also if there is any significance in the variation of attitude in relation to temporal perception (1, 5, 9). In this context we find an investigator observing "Practice alone may cause a pronounced change in the magnitude of the time order errors or a reversal in their direction" (11). The present paper is concerned with the study of the effect of practice on individual's temporal estimation.

Procedure

The procedure applied is the same as followed by Chatterjea (2). The Leipzig Time Sense Apparatus was used for the presentation of the different stimulus durations, where the difference between the two arms of the Apparatus indicated the 'time' to be used as stimulus. A Hipp Chronoscope was introduced in the circuit for checking the accuracy of the stimulus time intended to present. The stimulus times as well as the estimations were recorded on a Universal Kymograph with the help of an electromagnetically operated writing lever.

The stimulus times ranged from 0.10 to 1.00 second divided in ten equal steps. A fair number of trials were had with each subject before actual experiment began.

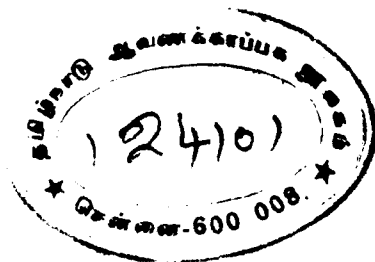


TABLE I

Means and SDs of the two halves : Visual Presentation

All values in seconds

STs	...	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
1st half											
Mean	...	.176	.257	.338	.433	.495	.606	.696	.787	.879	.969
SD	...	.031	.032	.030	.030	.015	.025	.045	.036	.039	.041
2nd half											
Mean	...	.186	.252	.321	.419	.505	.601	.682	.772	.875	.964
SD	...	.028	.028	.039	.024	.020	.026	.029	.036	.032	.037

TABLE II

Means and SDs of the two halves : Auditory Presentation

All values in seconds

1st half											
Mean	...	.234	.326	.502	.636	.746	.780	.929	1.04	1.16	1.21
SD	...	.058	.068	.054	.075	.060	.081	.078	.054	.069	.056
2nd half											
Mean	...	.236	.321	.487	.664	.767	.796	.948	1.07	1.14	1.28
SD	...	.086	.072	.078	.074	.073	.076	.092	.068	.067	.067

In actual experiment twenty estimations at a stretch of each subject at each duration were taken. The subjects got rest-pause automatically between two trials of different durations when necessary adjustments to fix up the required durations were made.

The data for each subject in any one sense modality were obtained mostly at a single sitting and the same sequence was maintained for each subject as far as practicable throughout the experiment. Preliminary instructions were given to the subjects to avoid all methods, physical or physiological, which might facilitate their estimations. Then the written instruction was read out to each subject before the experiment commenced and was repeated when required.

The stimulus times (ST) were presented in two sense modalities using continuous light and continuous sound. The sound was made free from initial and final clicks as well as from any after sensation. Both the light and the sound were of mild intensity. The subjects were all students of the post-graduate classes of Calcutta University, their number being 16. Acting subjects for two sense modalities were not necessarily the common individuals.

A 100 vibration tuning fork having electromagnetic arrangement was used as a time base.

Results and Discussion

According to procedure, each subject estimated every standard duration for twenty times at one sitting. In order to ascertain the practice effect total number of data from each subject was divided into two halves, each half consisting ten estimations. It was now considered that the estimations of the second half was the result of practice done by the subjects during estimating the ST for ten times in the beginning. In Table I the estimations of continuous light stimulus of various durations had been averaged and the standard deviations were calculated. It was found that the difference between the means of the two halves for all STs was not statistically significant. Among ten cases, only two estimations (0.3, 0.4) seemed to be better than the first half. On the other hand, three estimations of the first half (0.1, 0.7, 0.8) were nearer to the STs and for the remaining five other estimations almost no difference existed between the first half and the second half.

It is evident that, in general, the subjects overestimated the STs upto 0.4 sec. both in first half and second half and underestimated the given standard from 0.7 sec. to 1.00 sec. without any exception. The indifference interval period in both cases laid at the point between 0.5 and 0.6 sec., where the estimations tended to be more accurate.

In Table II, means, standard deviation of the estimations of continuous sound stimulus by ten subjects were given following the same way as in Table I. The most remarkable feature in Table II was the nature of data, which were completely of different trend in comparison with Table I. All the standard durations (STs) were significantly overestimated by the subjects in the first half as well as in the second half. Among these overestimations except one or two negligible differences there was no evidence of improvement in the estimations due to practice. From the beginning to end as all the STs were overestimated the transition point from one direction of error to the other was inapplicable. Hence there was no scope for determining the indifference interval point. The researchers in this line (5, 7) concluded that accuracy of discrimination of the duration of continuous light seemed to be approximately the same as for continuous tone. In another work (2) the result contradicted the former investigators' findings. However in the present experiment the data in connection with continuous sound stimulus were in favour of latter's conclusions.

Conclusions

The present results revealed the contradiction to the previous workers' contention (11) that practice can affect the individual's temporal perception. However it may be noted in this connection that the procedures followed here may be modified by increasing the number of estimations in the first half in order to get more genuine 'practice effect', though there was no reason to believe that the prescribed number of estimations taken here was in any way unsuitable for the purpose. The present findings did not also lend support to the view that due to practice the individual's indifference interval period shifted its position to other place.

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Construction of a table for estimation of item validity indices in terms of Davis Discrimination for Criterion groups based on Median Split

BY

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[Davis Discrimination index is obtained by using the product-moment coefficients from the percentages of frequencies in the upper and lower 27% of the cases. In case of small group, 27% split can not give a reliable estimate. So Davis Discrimination indices are obtained by splitting the group at the median and these values are put in the form of a table with the corresponding percentages of passing the item in the upper and lower 50%.]

There are many techniques of item analysis available for use for purposes of test construction. Davis in his publication entitled "Item Analysis Data" (1) has presented an adequate review of the various statistics frequently used.

According to Davis, the biserial correlation coefficient is most satisfactory measure of relationship for internal consistency among the different statistics frequently used for expressing the discriminating power of an item. As the computation necessary for calculating these coefficients are rather prohibitive, a short cut procedure was suggested by Kelly for estimating these coefficients from the upper and lower 27% of a sample. On the basis of this suggestion Flanagan (1936) constructed a chart for reading the item validity indices in terms of the product moment coefficient from the percentage frequencies in the upper and lower 27% of the cases. But there is some disadvantage, i.e., the difference between two correlations are not of similar significance at the different levels. For example a difference of .15 between .80 and .95 represents a greater degree of disparity in actual relationship than shown by a similar difference of .15 between .05 and .20.

So to meet the needs of the test constructors for an index of item discriminating power which is truly comparable from item to item Davis suggests a linear function of the hyperbolic arc tangent of the product moment r (estimated from Flanagan's Table) which has been termed as z by R. A. Fisher. Davis points out that z values based on these coefficients may be legitimately added, subtracted, and averaged, and the standard error of z value is independent of the true correlation which is

*The authors are thankful to Dr. A. Edwin Harper, Jr. who originally suggested the possibility of such an approach.

unknown. Davis further remarks that for the practical purpose a linear function of z that will do away with decimals, transforming the range from ± 1.66 to ± 100 , would be suitable. As Flanagan had already prepared a table for estimation of the product moment r , from the 27% upper and lower tails of the distribution, Davis simply converted these values into his Discrimination indices, and presented in a table the equivalent values of his Discrimination index, Fisher z , and the product-moment r estimated from Flanagan's table.

It should however be noted that estimating the discrimination values of the items on the basis of the 27% tails of the distribution is advisable only when the relevant group is sufficiently large; otherwise the number of cases in the high and the low scoring groups would tend to become too small for obtaining reliable results. This is of special importance when several regional samples are drawn and analysis on the basis of total group and the regional sub-groups is contemplated. Generally in the practical field it is found that in such sub-samples the number of cases are small, and there this difficulty regarding the use of 27% tails of the distribution assumes special importance. In such cases it would be rather advisable to use some splitting point other than the 27% limit. When the groups are quite small it would be best to split the sub-groups at the median for getting the 'high' and the 'low' groups, though with respect to the total group it would be advisable to use the 27% tails of the distribution, and the statistics to be used should ideally be the Davis Index. Hence for the sub-groups too the statistics to be used should be the same Davis Index. Here comes the problem. No abac or chart is available for estimating Davis Index when the group is split at the median. So if the sub-group, or small group item validity indices are to be obtained in terms of the Davis Index, then there could be only two alternatives. One of them being to calculate each and every item validity index: a procedure requiring tremendous amount of computational labour. The second alternative was to either construct or modify one of the charts or abac's (for groups split at the median) in such a way that the items validity indices could directly be read in terms of the Davis Discrimination Index.

It was noted in this connection that abac's are available for estimating both biserial and tetrachoric r when the group is split at the median of the score distribution, and both of the statistics require that the underlying trait being measured is normally distributed. When it comes to modifying any one of these two abac's so as to yield item validity indices in terms of Davis Index, it could be seen that both of them are suitable. Because, it is on the basis of the estimates of product-moment r from Flanagan's table (1, 2) that Davis constructed his chart, and when the distribution is normal both the biserial and the tetrachoric coefficients are analogous to product-moment coefficients. With respect to these coefficients McNemar (5) has pointed out that—

“... We can regard them as the values we would expect the product-moment coefficients to take if we had measuring scales for the dichotomous trait that actually did yield normal distribution of continuous variables ...

the tetrachoric r is particularly useful in estimating the degree of correlation between the variables for which we have only dichotomized information, but it can also be used instead of biserial r or the product-moment r , since situation for which these two methods apply can readily be converted into fourfolded tables by simply dichotomizing the graduated variables.” (Ch. 10)

Hence it appears that when the distribution is continuous and normal whether the biserial or the tetrachoric r is used, the obtained indices would be analogous to the product-moment indices estimated from Flanagan's table.

Hence it seems quite reasonable to assume that when the distribution is normal and underlying trait is a continuous variable no matter which of the coefficients is used for estimating the item validity index it could be readily converted into the discrimination index proposed by Davis, by simply substituting the obtained coefficients in place of the corresponding r values in the table of equivalent values referred to earlier (1) and therefrom reading the corresponding value on the Discrimination scale proposed by Davis.

Here a table has been constructed for estimating Davis Discrimination Index when the group is split at the median by converting the reading from the abac presented by Guilford (3) for estimating tetrachoric r (when the group is split at the median).

In order to construct the table the following steps were followed:

Firstly, the corresponding discrimination index in terms of the tetrachoric correlation coefficient was estimated for different combination of the high and low group percentages from aforesaid abac.

Secondly, looking up Davis's table of equivalent values (1) the corresponding discrimination values for his index was found.

Finally, the different values of Davis Discrimination Index are tabulated against the corresponding percentages in the upper and lower groups.

The following illustration will show how to use the table.

If for an item the percentages of passing the item in the upper and lower 50% groups are 50 and 20 respectively, then the corresponding Davis Discrimination Index will be 33, because, from the table it can be seen that the value corresponding to the row 50 and column 20 is 33.

A copy of this table is being attached herewith.

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High ↓	Low →																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1																								
2	6																							
3	12	6																						
4	22	12	6																					
5	26	17	7	4																				
6	28	19	11	6	2																			
7	33	22	14	9	5	2																		
8	33	26	19	12	8	6	2																	
9	42	26	22	15	12	8	5	2																
10	42	29	24	18	12	11	6	5	1															
11	42	31	26	17	15	12	9	5	3	1														
12	42	33	28	24	17	15	12	9	5	3	1													
13	42	33	29	25	18	17	12	10	7	5	3	1												
14	52	34	32	26	22	18	15	12	9	7	4	3	1											
15	52	35	33	27	23	20	17	14	11	8	6	4	3	1										
16	52	36	34	29	26	23	18	15	12	11	8	6	4	3	1									
17	56	39	36	32	28	26	19	16	15	12	11	7	6	4	3	1								
18	56	40	39	33	28	26	21	18	15	14	12	10	7	6	4	3	1							
19	56	42	41	33	29	27	22	19	16	15	13	11	9	7	6	4	3	1						
20	58	43	42	35	31	28	23	20	18	15	14	12	11	8	7	6	4	3	1					
21	66	45	42	36	32	30	26	23	18	17	15	14	12	10	8	6	5	3	2	1				
22	66	47	43	38	33	32	28	26	22	18	17	15	14	11	9	8	6	5	3	2	1			
23	66	47	45	39	34	33	28	26	23	21	18	17	15	14	11	9	7	6	5	3	2	1		
24	66	51	47	41	36	34	31	27	25	23	20	18	16	14	12	11	9	7	6	5	3	2	1	
25	66	52	48	42	38	35	32	28	26	24	22	18	17	15	14	12	11	8	7	6	5	3	2	1

Low		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40													
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34		89	66	58	52	49	46	42	40	36	34	33	32	28	26	25	22	20	18	17	16	15	14	12	11	10	9	7	6	5	4	3	2	1																				
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37		90	69	63	56	51	50	45	42	40	37	35	33	32	28	28	27	25	23	21	20	18	17	16	14	12	12	11	9	8	7	6	5	4	3	2	1																	
38		90	71	64	57	52	50	47	43	41	39	37	33	32	30	28	27	26	23	22	21	20	18	17	15	14	12	11	11	9	8	7	6	5	4	3	2	1																
39		90	73	66	58	53	51	48	44	42	40	39	36	33	32	30	28	27	26	23	22	20	19	17	16	15	14	12	11	10	9	8	7	6	5	4	3	2	1															
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47		*	84	73	67	63	60	56	53	50	48	46	44	42	40	38	36	35	33	32	31	28	27	26	25	23	22	20	19	18	17	16	15	14	12	11	10	9	8	7	6	5	4	3	2	1								
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49		*	86	76	70	66	64	57	56	52	51	48	46	44	42	40	39	37	35	33	32	31	29	28	27	26	24	23	21	20	19	18	17	16	15	14	12	11	10	9	8	7	6	5	4	3	2	1						
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Low		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40																						
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56		*	91	84	80	71	69	65	61	60	57	56	53	51	49	47	46	44	43	41	38	37	36	35	33	32	30	29	28	27	26	25	23	22	21	20	20	18	17	16	15	13																					
57		*	92	85	81	73	70	66	64	60	58	57	54	52	50	48	47	46	44	42	39	38	37	35	34	33	31	30	29	28	27	26	25	23	22	21	20	20	18	17	16	15	13																				
58		*	94	86	82	75	71	67	64	63	60	58	55	53	51	49	48	46	45	42	40	39	38	36	35	34	32	31	30	29	28	27	26	25	23	22	21	20	20	18	17	16	15	13																			
59		*	*	87	83	77	73	69	66	63	60	60	56	54	52	50	49	48	46	44	42	42	39	37	36	35	34	32	31	30	29	28	27	26	25	23	22	20	20	18	17	16	15	13																			
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Low	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
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77	*	*	*	*	*	*	99	91	87	82	81	79	75	74	72	70	69	65	64	63	62	60	57	56	55	54	52	51	50	49	48	47	46	45	44	43	41	40	39		
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86	*	*	*	*	*	*	*	94	89	87	84	82	81	79	76	74	73	72	71	70	69	67	65	64	63	62	61	60	59	57	56	55	54	53	51	50	49	48	47	46	45
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91	*	*	*	*	*	*	*	97	91	90	87	85	84	82	81	80	79	77	75	74	73	72	71	70	69	68	66	65	64	63	62	61	60	59	57	56	55	54	53		
92	*	*	*	*	*	*	*	98	95	91	89	87	85	84	82	81	80	79	78	76	75	74	73	72	70	69	68	67	65	63	62	61	60	59	57	56	55	54	53		
93	*	*	*	*	*	*	*	98	97	91	89	87	85	84	82	81	80	79	77	76	75	74	73	72	71	70	69	68	66	65	64	63	62	61	60	59	57	56	55		
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96	*	*	*	*	*	*	*	98	97	94	93	90	87	85	84	83	82	81	80	79	78	76	75	74	73	72	71	70	69	68	66	65	64	63	62	61	60	59	57		
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99	*	*	*	*	*	*	*	98	97	96	95	94	93	90	89	88	87	85	84	82	81	80	79	78	76	75	74	73	72	71	70	69	68	66	65	64	63	62	61		

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42	1																								
43	2	1																							
44	3	2	1																						
45	4	3	2	1																					
46	5	4	3	2	1																				
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Low	→	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80			
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93		69	67	66	65	64	63	62	61	60	59	57	56	55	54	53	52	51	50	49	48	47	46	45	43	42	41	40	38	36	35	34	33	32	31	30	29	28	27	26	25			
94		72	71	70	68	67	66	65	64	63	62	62	60	58	57	55	54	53	51	51	50	49	48	47	46	45	43	42	41	40	38	36	35	34	33	32	31	30	28	27	26	25		
95		76	75	74	73	72	70	69	68	67	66	66	65	64	63	62	60	59	58	57	55	54	52	51	51	50	49	48	47	46	44	43	42	40	39	38	37	35	34	33	32	30	28	27
96		82	81	81	80	79	78	77	74	73	72	70	69	67	66	65	64	62	61	60	59	57	55	54	53	51	50	49	48	47	46	44	42	41	41	39	38	36	35	34	33	31		
97		86	85	84	83	82	81	80	79	78	78	76	75	72	70	69	68	67	66	65	64	63	62	60	59	57	55	54	53	52	51	50	48	47	46	44	42	41	40	38	36	35		
98		93	91	90	89	88	87	86	85	85	84	84	82	81	80	79	77	76	74	72	70	69	68	67	65	64	63	60	59	57	54	53	51	50	48	47	45	43	42	41	39	39		
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Phy. 2

	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
82	1																			
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92	20	18	17	16	14	12	9	7	6	4	1									
93	24	22	19	18	17	16	13	12	9	6	4	1								
94	26	24	23	20	19	18	16	13	12	9	7	6	3							
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96	33	33	31	29	27	26	24	20	18	16	13	12	9	6	3					
97	38	36	34	33	32	31	28	26	23	21	19	17	13	9	5	3				
98	42	42	41	41	37	35	33	32	29	27	26	22	17	13	9	5	3			
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The Structure of the Psyche and the Personalist View of Man: A Critical Study of the Depth-Psychology of C. G. Jung

BY

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1

The point of departure from which depth-psychology proceeds is the fact¹ that the psyche is not identical with consciousness but that beyond consciousness, unconscious spiritual "material" leads a life of its own. It lies below the threshold of consciousness, in the "depth of the soul" (hence the term "depth-psychology"). The unconscious confronts the conscious and raises the problem of the relationship between these two halves of the soul. Jung attacked the dualistic solutions of Freud and Klages which were adapted to the rationalism at the end of the nineteenth century. His researches showed that there are valuable positive elements in the unconscious² and as a result of this discovery he replaced the negative evaluation of the unconscious with a positive evaluation and transformed the relationship of opposition and conflict into one of mutual supplementing; his eyes were opened to the possibility of a synthesis between the conscious and the unconscious. His synthesis is no mere addition, no mere concession but a process called Individuation³ which is characterised by such forces and experiences as courage, suffering, endurance, self-control, contention and intellectual effort; a process, therefore, which arouses the innermost essence of a man. In this process of maturing, the powers of the conscious and the unconscious combine in the order of precedence which corresponds to their respective value. Consciousness is committed to the objective validity of truth, but the urges of the unconscious draw it into the process of individual realization. The synthesis is achieved in a third factor, the "Self", and this is the specifically new contribution which Jung has made bridging the gap between previous psychology and a personalist view of man. To describe the nature and

¹ "The concept of 'depth-psychology'" gives expression to the fact that our spiritual life is not confined to what we observe on the surface of consciousness, but that it has its backgrounds and undergrounds which reach down into the unconscious and that the unconscious is just as much a part of the reality of the spiritual life as the consciously experienced." Ph. Lersch., *Aufbau der Person*, p. 547. We may also recall a statement of Augustine's which expresses exactly what it meant by the unconscious: "Scis hoc, sed scire te nescis" (De. Trin., XIV 7 n. 9): "You know this but you do not know that you know it." It is in you but you do not know that it is there.

² C. G. Jung, *Two Essays in Analytical Psychology*, Collected Works, Volume 7, New York, 1954.

³ Cf. Josef Goldbrunner, *Individuation*, New York, 1956.

function of this third element in the human psyche it will be necessary, at any rate to begin with, to use the language of metaphor.

2

The self hovers like a bird over the land of the soul which lies partly in the light (consciousness), partly in the dark (the unconscious), with a twilight passage between the two (the changing threshold of consciousness). The self is able to take in the land of the soul at a single glance. It holds a quite distinct position as the third element in the soul but it is connected with the other two in a peculiar way: it is set over them, it embraces them, it unites them and guarantees their unity albeit "unobjectively".

The dimension of the "inner" reveals a different aspect of the self. The self is enthroned in the innermost room of the castle of the soul. Its art consists in attaching to itself and co-ordinating all the inhabitants of the other spheres of the soul, in its capacity as head of the spiritual "League of Nations", so that the energies of the soul are released for the full exertion of their influence. By means of its tactical, "diplomatic", "political", organizing activity the self is able to govern, to make decisions, to have the final word in the interplay of spiritual forces. The self is the innermost seat of justice in man; it represents the whole man, he is "contained" therein, he is really "himself" therein. The self is more than a purely psychological court; it is mysterious, unanalysable in its selfness, capable of making creative decisions. Its structure is beyond the understanding of psychology, since it is not open to analysis. It is the point which represents what I mean when I address another as "Thou", or the point where I am entirely, "I". Speaking figuratively, the self is the purest representation of the "material"⁴, from which the person is made; but in fact it is no longer possible to use the term "material" in this context since it is an objective concept, whereas the very essence of the person (I-ness, Thou-ness) is evinced by the self.

3

The person is also the "supreme" element above everything in man and must be seen in terms of the "inner" dimension. The psychological concept of the self may therefore be placed alongside the metaphysical concept of the person. Both are an expression of the same thing on different levels and to that extent the person and the self are identical. The self is the court which constitutes the core of the person; it contains within itself the mystery, the creative beginning and the "personal attitude". Self-discovery is therefore identical with the achievement of a personal attitude, with the actuating of the person and the process of becoming authentic. Individuation is the psychological process of "self-realization" which is called "taking hold of existence" on the philosophical plane.

⁴ Apex of the soul, spark of the soul (scintilla animae), ground of the soul.

4

We have used the Jung (ternary) (consciousness—unconscious self) as the basis of our description of the structure of the psyche, but Jung's own interpretation is different. On the other hand, the great importance of his theory, which may best be summed up in the above-mentioned ternary, lies in the fact that it implies a personalist view of man. Individuation as the synthesis of consciousness and unconsciousness in the self gives tangible expression to the process of maturation or the actuating of the person.

The application of depth-psychology to religious education may be formulated as follows: the psychological steps which lead to the discovery of the self also assist the actuating of the person. And since this is a precondition of the Christian relationship to God which is called faith, it is not surprising that individuation can be regarded as a criterion for the realization of the faith. This means that the life of faith is dependent on the general level of maturity which the person has reached. Any help that is given towards the maturing of the personality will also have a fruitful influence on the development of the faith. Religious education will have to turn its attention increasingly to these connections between the development of personal maturity and the development of faith.

5

The process of individuation as understood by Jung is directed entirely to happenings within the soul, nevertheless its practical application brings it into touch with the outside world. Many spiritual problems can only be solved in the context of society, by meeting and dealing with the problems which come from outside. Theoretically, however, the Jungian position is restricted to the interior sphere of the soul. Jung says that he is a scientist, whose "only means of knowledge is the experience."⁵ which the soul affords the psychologist. All his utterances refer, therefore, merely to psychic facts and as a responsible scientist he cannot exceed this limit. According to Jung himself the philosophical pre-supposition of this position is Kant's epistemological statement on the unknowableness of metaphysical objects⁶, the "theory of the limitation and interiority of the spiritual."⁷

6

We are therefore on the threshold of a new "anthropological" era in which the gulf between the soul and the world is being closed psychologically. It is part of the very nature of the soul to stand in direct relationship to the world, to be affected by it and encounter it. The soul and the world are "two ontic spheres"

⁵ Merkur IV (1952), p. 469.

⁶ Cf. Goldbrunner, Individuation.

⁷ Philipp Lersch, Seele und Welt: zur Frage nach der Eigenart des Seelischen, Leipzig, 1943.

which represent a "bi-polar, co-existent unity"⁸. The soul can only be understood in relation to the world which it encounters. It belongs to the "reality of the soul" to be "in the world", in the sense in which Heidegger uses the phrase.

According to this development in psychology the soul is defined essentially as a being which is able to become aware of the world and therefore to encounter another being which does not belong to its own being but represents something quite different.

For the soul the encounter with the world is not only a "stimulus" but a "call". Its self-realization does not take place only in the interior sphere; on the contrary, it only achieves authenticity by entering into relationship with the world. In this way the two long separated endeavours of the human spirit are coming together again: philosophical-anthropological research on the one kind and ontic-experiential investigations on the other.

We owe a great debt to Ludwig Binswanger, Viktor Frankl, von Gebattel, Ernst Michel, Ernst Trub, Medard Boss, for having applied to depth-psychology the new anthropology based on Heidegger's philosophy.⁹

7

When the process of individuation is set within the framework of the ontology the process itself is affected in three ways. The soul is no longer "world-less", it is at home in the world and for its self-realization it looks not merely to the process in the interior sphere and the integration of consciousness and the unconscious, but also to the integration of itself and the world; i.e., action is required if it is to become itself. Decision within and action without both form part of the basic structure of existence. Together they require the complete devotion of the person.

Only when the truth heard within is "acted upon", can it exert its full influence. It is preceded by a "pale and unreal-seeming knowledge which only now appears in its full depth". Man grows together with the truth, he is stamped by it, he not only knows the truth, he is the truth. Man becomes "one with the deed of self realization."¹⁰ This leads to a new kind of truth, namely, "existential truth"¹¹.

⁸ "I come to my existence only by participation in the world.....Self-being is only real in so far as it appears in the objectivity of world-Being." Karl Jaspers, Philosophie, II, Existenzzerhellung, p. 48.

⁹ Ludwig Binswanger, "Die Daseinsanalytische Forschungsrichtung in der Psychiatrie" in Schweiz. Archiv für Neurologie und Psychiatrie, Vol. 57, pp. 210-223. Viktor Frankl, Artzliche Seelsorge, Vienna, 1946; Der unbewusste Gott, Vienna, 1948; Logos und Existenz, Vienna, 1951. Viktor Emil von Gebattel, Christentum und Humanismus, Stuttgart 1947. Ernst Michel, Rettung und Erneuerung des personalen Lebens, Frankfurt, 1951. Ernst Trub, Heilung aus der Begegnung, Stuttgart, 1951. Medard Boss, "Vom Weg und Ziel der Tiefenpsychologischen Therapie", in Psyche I, 1948.

¹⁰ Augustine speaks of the "doing of the truth" (Conf. X, 1) which binds man to the truth. Schmalz makes full use of Augustine's idea for the individuation of man.

¹¹ Needless to say, there is a danger of over-emphasising the "existential truth" and of its thereby becoming a mere individual truth.

Individuation leads to existential truth. This is of great significance in the sphere of religious education. Only the religious truth which is also "acted upon" can achieve its full power and be "realized". Whoever lives according to the words of Christ, will know their truth ("if any man will do his will he shall know of the doctrine")¹². The unity of faith and life, the striving after existential truth in the process of individuation, leads to the realization of faith.

8

The actuation of the person depends on the existence of other persons. The person needs to be in relationship with a Thou in order to come to itself; it can find its true nature only in dialogue. Personal relationship becomes scientifically "legitimate" when the barrier between the soul and the world has been removed.

The "dual mode of being" (Binswanger) of the person is part of the basic structure of human existence. "A man cannot become a personal man unless he responds to the call of the world around him (Michel).

Individuation must therefore, *pace* Jung, take a new theoretical turning. The Thou-relationship must not merely be set alongside the "self-entanglement" in which, according to Jung, it is imprisoned, but insofar as self-discovery is identical with the actuation of the person-personal encounter must become the most essential task on the way to the self; furthermore, the ultimate reality of the person is only awakened by the encounter with the absolute Thou, the person of God. The self which Jung regards as "neuter" reveals its personal content and recognizes its Thou-character when the divine person calls it by its full name. The self acquires a name. Personality is replaced by significance. The ground of man's being as a person is the dialogical relationship to transcendence; or to put it more precisely: the relationship to the Almighty who calls on the person by name.

9

Depth psychology constantly comes upon situations which are described as the "confluence" of the intellectual, spiritual, biological and physical strata. Spiritual and intellectual elements appear in the physical (in symptoms of disease too) and the physical draws the spiritual into dependence on itself. Contrary to his own philosophical presuppositions (psychology was for him a scientific discipline as it still is for Jung), Sigmund Freud and the whole psycho-therapeutic movement paved the way for the overcoming of the barrier between the body and the soul. It is impossible to understand or cure neurosis with physical symptoms if the theory of the pure interiority of the soul is maintained. The practical experience of depth-psychology coincides, therefore, with the new, yet age-old discovery of existential

¹² Cf. John 7, 17; 1 Cor. 4, 20: "it is power that builds up the kingdom of God, not words." Gal. 5, 6: "The faith that finds its expression in love." Imitation of Christ, I, 1: "Whoever wilfully understand and taste the words of Christ must endeavour to shape his whole life in the likeness of Christ."

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philosophy which sees the soul and the world in their togetherness and original unity. But the result is that the body again acquires a logical place in psychology. Man not only has a body, he is body. It is by way of the body that the soul enters into communication with the world in space and time. The symbolic language of the body and the symbolism of nature point to a line in the structure of human existence which crosses another line in the body, namely the line of man's individual history. The expression of the soul in the body (the incarnation of the spirit) and the historical, biographical mode of enquiry (long since used by psycho-therapy in treatment of anamnesis—and also necessary in pastoral work when judging guilt and sin) are legitimate aids in education and psychagogy; they give the process of individuation a home in the here and now and demonstrate the "incarnation of the spirit and the spiritualization of the flesh."¹³ In this context, the soul is man's personal soul, the duty of which, however, is to realize the faith and it can do this only when incarnate in a body.

¹³ Igor A. Caruso, *Psychoanalyse und Synthese der Existenz*, p. 229.

Value and Personality

BY

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1. Value research is an indispensable tool in the study of personality. Guilford (13) points out that two models are suggested in modern personality theory to account for personality structure. One model is by factor analysis and factor theory. It conceives of personality as an n -dimensional sphere of traits. Another model is proposed to represent the individual personality and this model is in the form of a hierarchial series of traits at different levels of generality, the *most general being* syndrome types, the *least general being* called 'hexes' and between the two being the primary traits. Now it can be asserted that whichever of these two models one selects for the study of personality a reference to values is very essential.

2. The term 'value' is here used in a three fold significance. A person's value (or values) includes the *value-systems*, the *value-attitudes* and the *value-responses* of that person. It is presumed here that a value-system as explicitly accepted by an individual is a term of highest generality; next in order and less in generality is the term '*value-attitudes or value-dispositions*' of a person. A person may have evaluating attitudes of a certain kind but his attitudes or dispositions may lack any consciously arrived at value-system. The term '*value-response*' is the last and the least general in the order of generality. It stands for habits of responding favourably or unfavourably to or choosing. This habit may be said to be present in animals as well as man. It is a product of learning and training.

3. As said before, the values of a person form an important problem in the factor analytic or hierarchial conceptions of personality structure. Taking for illustration, the many personality inventories of today which are based on factor analytic procedures, it may be said that the factors *S* and *T* (Social interaction and thinking or introversion) in STDCR test, or the factor *A* (Ascendency) in GAMIN inventory, or the factors *S* (Sociability) and *O* (Objectivity) in GZTS inventory are indicative of value-attitudes or value-dispositions of a person. In the hierarchial model also, a reference at least to the value-responses of an individual becomes apparent even at the lowest hierarchial level—i.e., at the 'hexis' level. The value-response cannot of course be long isolated from the value-attitude or value-system, especially in a highly organised personality structure. Reading books as an evaluating response cannot be bifurcated from the place of reading books in the value-system of an individual.

4. The distinction between value-responses, value-attitudes and value-systems in a person, after recognising their inter-connection and interdependence may be made clearer by certain illustrations. The three-fold distinction in values may be said to correspond to the three levels of personality structure implied in a hierarchial personality structure. Pecking responses in chicks (6), killing responses in cats (as studied by Kuo, vide Kuo Z.Y., *The Genesis of the Cats' Response to the Rat*. Journal of Comparative Psychology, 1930, Vol. II, pp. 1-30) and hoarding responses in monkeys (14) or children may be said to be value-responses acquired at the 'habit' or 'hexis' level of animal personality. These responses even when firmly established over a period of time in an animal or a child need not lead to the formation of any definite value-dispositions or value-attitudes. Considering the next higher level, i.e., at the trait level, an individual's attitude may be considerably influenced by some trait like 'need for achievement' (see 29). The need for high achievement is ingrained by influences from parents or from a group culture. Another value-attitudes may be 'good social relations'. Yet it is fully conceivable that 'achievement need' or 'good social relations' do not form part of a person's consciously accepted 'value-system'. What sort of an individual has a definite and clear-cut value-system? We may say that a value-system can be ascribed to an individual who accepts or believes in some concrete or abstract ends such as money, achievement, friendship etc., an individual who, when stimulated to do so, can analyse the components of each end accepted by him, who can discern the relationships of a number of such ends. Further, an individual with a value-system should be able to verbally analyse the values to which he is neutral, the values he rejects, as well as those that he accepts. An individual with a value-system should also be able to discern the difference between values for self and values for others, values that he holds strongly and those that he accepts only as a matter of course; or in other words, between the values that he has stuck fast to against odds and values that he has been, so to say, just playing with.

Recently, Tamara Dembo (8) has presented the results of quite an extensive programme of research carried out on the nature of value-systems of persons. The value-systems are to be understood in the sense just outlined above, and as contrasted with value-dispositions and value-responses. This investigator sought answers to the following problems in value-research:

- (a) Determination of a certain set of zero-level values. A zero-level value is a value elicited from the subject. (As distinguished from a zero-level value, a component of value is termed as value on the minus level. Systems of zero-level values are termed as values on the plus level. The term 'disvalue' is self-explanatory e.g., sickness, war, injury are disvalues.) This set of 'zero-level values' is determined by asking an individual to mention the values in life that he wishes for his child or a child close to that individual, values wished for the child so as to hold good for that child all his life,

- (b) Determination of the components of such zero-values. (minus-level)
- (c) Determination of systems among zero-level values. (plus-level)
- (d) Determination of zero-level values for oneself and examination of the differences between values for self and values for another person.
- (e) Determination of zero-level disvalues.
- (f) Determination of externally introduced values on the value-systems of an individual.
- (g) Determination of the relationship between person and values held by the person.
- (h) Determination of the value of disvalues.

Now the method of Dembo's investigations and some of the results obtained will be discussed. The experimenter sought to elicit the subject's values by the interview method. E asked the S to describe the seven wishes that he holds for some person like a child or for self. This may, therefore, be called the 'seven wishes value-study method.' The subjects of the experiment came from various backgrounds—such as socio-economic status, faith, sex, education, intelligence. When they were brought in the experimental room, the experimenter sought to put them at ease and to arouse their ego-involvement in the experiment by questioning them quickly but sympathetically about certain matters like marital status (single or married) number of children, other relatives etc. Immediately thereafter, the experimenter requested the subjects to respond to the main experimental question, viz., to mention the subject's seven wishes for a child for his whole life. A 'fairy-tale atmosphere' was introduced by the experimenter in initiating the subject to the main experimental question.

The findings of the study briefly are: There is a remarkable consistency of values among the subjects and the commonest values are 'health', 'economic security', 'knowledge', 'intelligence', and 'happy marriage'. Further, the part of the experiment that referred to the systems of values in a subject brought out that out of 15 subjects used, only one subject showed a-typicality in his values from the rest of the group. Results of that part of the study which referred to problem (d) above, show that there is some overlapping and some difference in the values accepted for oneself and for others.

5. Some questions present themselves about the general basis, assumptions and the methodology of the Dembo research.

The term 'value' is given a very limited signification than would be generally agreed upon. Dembo would include only 'concrete ends' among values. e.g., health, marriage, or security. But are persons motivated by concrete ends alone? It would seem not. This difficulty can be met with by avering that highly abstract values are not likely to be found

except in the minds of a few and that values like 'friendship' are sufficiently abstract in character.

More than the definition of value by Dembo, the writer would like to question the 'adequacy' if not utility of the seven wishes value-study method. Is it enough to ask for the seven most commonly wished—for things by a person and designate these as values? Is there any appreciable improvement in this method over the older methods such as AVL study of values or many different forms of vocational or interest and attitudes inventories available at present?

The data yielded by the method used by Dembo, as reported by the investigator is also more qualitative than quantitative. The two experiments which are particularly interesting were designed to find answers to the following questions :

(1) What is the relation between a system of values of a person and that person's acceptance or rejection of externally introduced values? (Expt. VI) and (2) What are the beliefs concerning the ways in which values come to be possessed? (Expt. VII) As regards the first problem, the results show that in spite of the knowledge that other people considered certain values important for the child, *i.e.*, despite social pressure, the subjects of the experiment were reluctant to add these externally given wishes to their own. In general, the subjects shield away from major changes in their value systems. Nor is this result inconsistent with the finding about a common system of values referred to above. In thinking about this result one feels, as Dembo would also agree, that the complicated processes concerning the structuring and functioning of concrete systems of values are yet to be satisfactorily spelled out. As regards the second and equally fascinating question, *viz.*, the source of value and causes of change in a system of values, the study is inconclusive—except for the verification of some common value-sources such as 'parents'. Here again Dembo has asked but not yet answered an important question : the attitude of the grantor of a value to the recipient of value and *vice versa*.

We can conclude that value-studies such as extensively reported and discussed above involve the risk of running in blind alleys at times, although they quite correctly focuss our attention on the importance of value-system of persons, its structuring and dynamics.

What are the possible ways of resolving these difficulties in value-research? It seems to the writer that following approaches to the value-problem may help in clarification of ideas and discovery of new ways of attacking the problem :

- (a) to orient value-research closely to the major theories of personality dynamics in present-day psychology?
- (b) to sift as many variables as possible involved in the personality-value relationship and to design studies to investigate the effects of these variables severally and jointly,

- (c) to change the methodological concept of value as value-system and make it more broad-based so as to include in it value-attitudes and value-responses as well ; also to use one of the three-fold aspects of value as a function of the other two aspects.

Let us examine the possibilities of each of these approaches.

6. Value-research and personality dynamics

Can we further the cause of value-research by orienting it to the recent developments in the studies of personality-structure and dynamics? To solve this problem, it is proposed to take the more widely accepted views of personality and examine their relevance and adequacy for the values of a person. In this effort we are concerned with the views of psychologists like Lewin, Spence, Tolman, McClelland and Atkinson, Rotter, etc.

Lewin's conceptual framework : As Sears shows (26) Lewin's programmatic writings have provided a conceptual work for personality dynamics. In his (Lewin's view) view, the behaviour of the individual is a function of the nature of the Person and the Environment. B (behaviour) is a function of P (Person) and E (Environment.) To quote from Lewin's *A Dynamic theory of Personality* "The effect of experience always consists in the fact that a person upon the repetition of a situation, reacts not in the same way but in another way from that in which he reacted the preceding time, the effect of experience is always a change of the person or of the psychological meaning of the environment." (p. 269)

Thus with every new interaction with the environment a person's tendencies or dispositions to react undergo a modification. These tendencies or dispositions are to be inferred and cannot be directly observed. However they are assumed to determine reportable cognitions and overt actions which constitute the observed manifestations of personality. These tendencies also influence the interaction of a personality structure and the value-judgments. But the difficulty in this theory centers round the problem of how to determine the contemporary strength of such inferred dispositions or tendencies. How to connect the functioning of dispositions with concrete ends or values as accepted by the individual?

Iowa or Spence Tradition : The present Iowa or Spence tradition originates from Hull's drive-reduction theory (27). In this theory, individuals respond with fear (an acquired drive) in achievement test situations as well as other situations which arouses noxious stimuli. If the task is simple arousing only one sHr, higher anxiety in the subject prevailing at the time should arouse higher performance. But when the test situation is complex, higher anxiety should produce some conflict between simultaneously activated response tendencies and consequently a decrement in response producing tendencies. On this basis J. A. Taylor (vide Drive Theory and Manifest Anxiety, Psychological Bulletin 1956, 53, 303-20) has attempted the construction of a Manifest Anxiety and Test Anxiety Scale. Now this theory has certain drawbacks. As has been found by Sarason, Mandler and Craighill (25)

performance of persons low in assessed anxiety disposition has been found enhanced by the so-called ego-involving threatful or situational cues. With reference to value problem, we may say that the S-R drive theory may be used to explain values that are called disvalues and not zero-level or plus-level values of Dembo.

Cognitive theory or Expectancy (Subjective Probability) theories: Another valuable orientation to the value-research problem is the Cognitive theory of Tolman—the conception of the Psychological Man (30). Recently some ex-S-R theorists have suggested a liberalisation of S-R concepts (21) so as to include the notion of expectancy or cognitive set of Tolman, as well as the concepts of Motive, Incentive and Reinforcement. This may be also in some sense related to the emphasis on achievement and affiliation motivation by Atkinson and McClelland (2, 19) although it may be said against this juxtaposition, that the latter owes its inspiration to Murray's work. Admitting some such criticism, one may still maintain that the welding of cognitive set, achievement motive, and expectation of accomplishment and incentive consequent on accomplishment, to derive another conceptual framework for personality—value relationship is possible. In this attempt, one can start with assuming that motives to achieve and to avoid failure are activated when a person sees his performance as likely to be evaluated against some standards of excellence or failure. The momentary strength of achievement (or avoidance) motivation and momentary strength of expectancy that success will or will not be attained as a consequence of performance and the incentive value of accomplishment are the tendencies acquired early in personality structure that determine the value of success recognised by a person towards the task. On this theory a person's values and changes in them are mediated by expected consequences such as success or failure. How far success itself can become a value? It is suggested that value of success is a linear function of the (felt) difficulty of task. A general comment on this type of theoretical orientation is that while it may be useful to explain a person's values in so far as they are related to the person's achievement motivation, it is not adequate to explain a set of values that are more related to *n-affiliation* (affiliation motive).

A reference to Rotter's (24) conception of Behaviour Potential is in place at this point. One may also like to utilise Cohen's (4) Subjective Probability theory which emphasises the rewarding and punishing consequences of action in personality functioning.

From the above cursory review of the chief trends of thoughts on personality dynamics it may be noted that although each conceptual framework has something worthwhile to suggest for value-research these frameworks have not become powerful enough to support a complete programme of value-research.

Value-research and individual and environmental variables

D. C. McClelland (19) proposes an analysis of the determinants of an individual's performance considered 'talented' in terms of its desired objects. A similar chart

can be presented, as given below, to show the several environmental and personality variables involved in value problems:

A chart to show the different individual and environmental variables in the study of value problems

(A) Antecedent conditions produce	(B) A person with certain characteristics	(C) WHO interacts with certain conditions	(D) and produces performance with desired outcomes
heredity cultural values family structure socio-economic status parental attitudes	abilities emotional stability motives characteristic modes of response (traits)	working condi- tions and per- sons in the work- ing conditions AND WHO forms valuing attitudes, gives value-res- ponses and builds value-systems	e.g. school grades occupational success, marital and family happiness salary grades, work efficiency, leadership, social work, religious work, scientific work, honours in academic world

The above chart should be looked upon as a convenient mode of tabulation of facts and not a completely logical way of expressing relationships between various factors. For instance, although the value-processes mentioned in column C are shown as effects of the variables mentioned in columns A and B and as probable causes of variables mentioned in column D it is quite possible that achievements or failures mentioned in column D may have a retroactive effect on the value-processes mentioned in column C. The above chart should therefore be understood only as an *ad hoc* scheme. Tentatively one may classify the factors mentioned in the four columns above as A-variables, B-variables, etc.

The influence of A-variables: Cultural values.—Danzigar (7) has shown differences in values between white and negro students. The white students lay emphasis on private satisfactions; negroes on group-satisfactions. Staines (28) has shown changes in values of peoples in desired directions when the teacher emphasised social desirability as a value. Rosen (2) has shown the differences in achievement value between different social classes. O'Reilly (22) has shown the relation between faiths in Catholic religion and values of college students.

Family structure.—Freeman and Grayson (11) have shown that child-rearing attitudes of mothers of schizophrenics have a relation to the thought-patterns of the latter. Jessor and Roberts (15) have shown, by using pictures akin to Rosenzweig's P.F. test, that high authoritarians are more extra-punitive, more personally punitive, and less punitive towards low status frustrations, than are low authoritarians. But the best evidence recently produced on the importance of a family's structure—especially the power-structure within family—as compared to the importance of membership of religious or particular immigrant groups is by Strodtbeck (29).

B-variables: All the B-variables, in the sense of the term 'B-variable' as clarified above, are more or less effective in value phenomena. It has been shown, for instance, that persons with very high and very low abilities are likely to change jobs (occupational values) more often than persons of medium intellectual abilities. The work of the McClelland-Atkinson group (18) has amply shown the relation between 'n-achievement' and 'n-affiliation' and 'social value.' A particular personality type which has come for intensive study during the last decade or so is the Authoritarian type. The meaning of authoritarian personality is well brought out in their famous work of the same title by Adorno, Frenkel-Brunswick, Levinson and Sanford (1), who have contributed important scales to measure the authoritarian trait like the F-scale. Since the development of the F-scale, a number of investigators have enriched our knowledge of the relationship of this trait and values of a person. French (10) shows the relation between the authoritarian trait and military ideology. Masling, Green and Gilmore (20) have shown the relations between authoritarianism and socio-economic status of a person, on the one hand, and the punitive attitudes of children. Roberts and Jessor (23) in another study, bring out the relation between authoritarianism and communication of aggression. Factor-analytic studies of authoritarianism and other types of personality traits to show their relation to values also need to be mentioned here. Cattell (3) by factor-analysing certain tests arrived at four motivational factors—Alpha (id) Beta (realised ego), Gamma (ideal or super-ego) and epsilon (suppressed complexes). Eyesenck (9) by similar approach arrives at three sets of orthogonal dimensions (psychotism-normality-neuroticism, hysteria-anxiety-neuroticism; dysrhythmia-extra-version-introversion). Guilford, Hertzka, Christenson, and Berger (13) in a similar vein draw the conclusion that evaluative attitudes associated with perceptual, verbal, logical and other modes of response involve a certain mode of approach to the world. Another interesting study is one by Leacy and Coffey (16). They prepared a scheme of describing personality in terms of sixteen ways in which a person may interact with others such as trustful-docile, executive-autocratic, etc. These variables according to these investigators form a circular continuum (something like a colour circle) in which adjacent variables are positively correlated. Also, as one goes from the centre of the circle to the outside one, one goes from moderate or adjustive behaviour to intensive or mal-adjustive behaviour, as the terms 'trustful-docile,' 'executive-autocrat' suggest. Subjects get scores on each of the sixteen sectors of the circle and all these may be condensed for certain purposes into a single point representing the subject's summary position in the personality sphere. Finally

these authors recognise that there are three levels at which the person may be measured—private, public and symbolic. It will be seen that this three-fold classification of personality measurement corresponds to the three-fold division of value responses made in this article—viz., value-responses (corresponding to private), value-attitudes (corresponding to semi-public or public) and value-systems (symbolic) that this writer had suggested at the beginning.

About the individual and environmental variables that have been discussed above one might point out a certain difficulty. There remains a certain temporal, spatial or functional distance between the variables in personality or other factors in the environment and the values studied. The same problem as in the case of the Dembo investigation crops up: can we, and if so how, relate immediately and directly the structuring and functioning of values and personality/environmental variables and if so how can these be demonstrated?

8. Possibilities of introducing methodological changes in value-concepts

In this last section we propose to show that in order to strike a golden mean between the somewhat abstract value-system research of the type suggested by Dembo and the other extreme method of reduction of higher values of persons to overt valuing responses or behaviour we can use the functional interdependence of the three aspects of value and break some new ground in value research. We may use the following relation as a primary function of the simplest type in value problems:

$$V = (\text{or is a function of}) V_s, V_a \text{ where} \quad \dots(1)$$

V_s is a system of values of the person as obtained at the time of measurement;

V_r is the actual value response of a subject; and

V_a is the value-attitudes or value-dispositions of a subject which are the result of various antecedent personality and environmental conditions as previously pointed out in a chart.

It may be noted that while V_s and V_a mediate V_r , they may mediate each other as well. If V_s and V_a change they may lead to a change in V_r ; but a change in V_r may bring about a change in V_s and *vice versa*. Either if V_s and V_a change an individual change in V or V_a may also lead to a change in V_r . Lastly, it is proposed to show how experimental studies may be designed to demonstrate the functional interdependence of the factors V_s , V_a and V_r . Suppose the problem is cleanliness of habits (V_r) a child shows in taking care of his school materials such as books, note-books, writing materials, clothes, etc. V_r may be measured by selecting a particular characteristic like the frequency of pencil or ink marks on the child's school material during a particular period like one month. The V_a measure in this case may be obtained by the score a child makes on a Cleanliness Habits Test (which may be a sort of a personality self-questionnaire) or the parents' or teachers' ratings for that child on the child's acquired sense of values of cleanliness. Here, therefore, we have the possibility of demonstrating the functional

relationships between V_s and V_r . Let us take another example—the relationship between variations in V_s and V_a . Let V_s stand for a value such as “importance of self-sacrifice”, in a person's life. Let V_a stand for the score of a subject makes on the Ascendence Submission reaction toward a person who is believed to be the ‘grantor’ of the value in question to our subject. Then it can be shown that changes in the own attitudes of the grantor towards the subject or changes in the attitudes of the recipient to the grantor or changes in the personality development of the grantor are elements involved in the general class of variables designated as V related to changes in the V_s value-systems of our subject.

Assuming a more closer inter-relationship between the three aspects of value it is possible to open a more fruitful area of value research.

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A Study of Insecurity Feeling and Anxiety in Step-children and Non-step children

BY

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The mother is an important figure in the child's life. She plays a role of considerable importance in the emotional development of the child. Her death leaves an imperishable impression on him and colors his emotional adjustment to his world. Firstly, because he has lost his mother; he is deprived of maternal love, care, affection and attention. Secondly, if his father marries and brings a second wife, he has a step-mother. He is likely to get step-motherly treatment. Consequently he might develop a constant feeling of being rejected, refused, unloved, uncared and treated coldly and unreasonably whereas the non-step child (child from the second wife) has a constant feeling of being loved, cared, attended and treated warmly and favourably. The step-child is not secure and satisfied with the home environment. He does not have a sense of "belongingness", a feeling of being emotionally attached with family members particularly with parents. He does not have a sense of "togetherness" which helps adjustment to the changing world together with parents. In some cases, it is also seen that the father does not take due interest in his elder son and favourably treats his younger son (son from the second wife) in order to please his second wife. As a result of these unhealthy factors working beneath the adjustment process, he is insecure and experiences a good amount of constant feeling of insecurity which significantly differs from those of a non-step child. He also experiences a good amount of anxiety because insecurity feeling gives rise to many manifest symptoms of anxiety, such as tenseness, restlessness, aimlessness, tiredness, nervousness, uncertainty and emotional instability.

Thus it leads to the hypothesis that step-children experience more insecurity feeling and anxiety than non-step children (their step-brothers).

Method

Maslow's Security-Insecurity inventory and Taylor's Manifest Anxiety Scale were applied to a group of 21 step-children (group I) and to a group of 21 non-step children (group II). The children were 11 to 16 years of age.

Result :

TABLE I

		M	SD	SE	t	
Group I Insecurity	...	43.61	4.35	.97	8.8	Significant at .01 level
Group II Insecurity	...	29.61	5.75	1.28		
Group I Anxiety	...	30.14	3.63	.81	10.5	Significant at .01 level
Group II Anxiety	...	16.38	4.54	1.02		

TABLE II

		r	df	
Group I Insecurity—Anxiety	...	.67	19	Significant at .01 level
Group II Insecurity—Anxiety	...	.11	19	Insignificant.

Summary and conclusion

The present attempt makes a comparative study of insecurity feeling and anxiety of step-children and non-step children. The data suggest that step-children (group I) experience a greater amount of insecurity feeling and anxiety than their step-brothers (group II). This significant difference may be attributed to this that step-children are generally treated coldly and unreasonably by their step-mother and in some cases by their father also. Their perception of self and of others is changed and distorted. They feel themselves rejected, dejected, and depressed, consequently they are more insecure and anxious than their step-brothers who are loved, attended and perceived favourably.

The study supports the hypothesis.

Computation of Tetrachoric^r: A Comparison of Three Methods*

BY

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Introduction

The author, in connection with his research project, had to think about an easy and accurate method of computing tetrachoric r for the item analysis of a personality inventory. Tables prepared by Chesire, Saffir, and Thurstone (1) could be utilised. But as it is time consuming and since exact values in some cases could not be read from the diagrams, the simple method of Davidoff and Goheen (2) could be of much help. But as Jenkins (9) points out, it would not be possible to use the method in all cases, particularly for extreme splits. It was not clear, however, from Jenkins' paper what could be regarded as an extreme split. This motivated the author to compare the tetrachoric r found by using three different methods, using the same basic figures to see what departure from median-split could be tolerated.

A short review of the available literature, in this connection, may not be out of place. Pearson (10) first introduced the tetrachoric correlation coefficient and since then it has become a very useful technique for analysis of certain kinds of data. As the original formula requires much computational labour, many persons were motivated to devise simple processes of computation. Chesire, Saffir, and Thurstone (1) developed tables for computing tetrachoric correlation coefficient. Guilford and Lyons (5) presented tables to determine the reliability and significance of tetrachoric r . Hayes (7) prepared diagrams to find out tetrachoric correlation coefficient from percentage differences. Goheen and Kavruck (4) worked on Hayes diagrams and tables and they presented work-sheet for tetrachoric r and standard error of tetrachoric r . Hamilton (6) prepared a monogram for the tetrachoric correlation coefficient. Jenkins (8) first prepared charts for rapid determination of tetrachoric r . He (9) then presented an improved method for determining tetrachoric r following Davidoff and Goheen's (2) table. Fishman (3) pointed out how negative correlation can also be determined from Jenkins' improved method of tetrachoric r .

*The author is highly indebted to Dr. S.K. Mitra, the then head of the Psychometric Research and Service Unit, Indian Statistical Institute, Calcutta, for his valuable suggestions and advice.

Methods used

Three methods of determining tetrachoric correlation coefficients have been used in this study. The methods and the notations used are:

Method I.—Due to Davidoff and Goheen. Tetrachoric r will be noted as r_{DG} .

Method II.—Due to Jenkins. Tetrachoric r will be noted as r_J .

Method III.—Due to Chesire, Saffir, and Thrustone. Tetrachoric r will be noted as r_{CST} .

The second one, of course, is not altogether different from that of Davidoff and Goheen; it is an improvement for extreme splits.

Procedures

Considering two separate variables three series of five examples each were set in. Fourfold tables were prepared and the cells were labelled as follows:

b	a
d	c

The data were hypothetical to some extent. In all the examples the values of $(a + c)/2$ were kept constant at .50 (to make it similar with the obtained data) but the values of $(a + b)/2$ differed in almost all the cases. Series I consisted of examples having nearly .50 (median split) values for $(a + b)/2$. The values for the same in case of examples of Series II were nearly .30. For Series III these values were about .10 (extreme split). Three series were considered in order to compare the results of various tetrachoric r that could be determined from various splits.

Results and Discussion

The tetrachoric correlation coefficients and also some other relevant figures are presented in Table I below.

TABLE I

Example No.	$\frac{a + c}{2}$	$\frac{(a + b)}{2}$	Base correction	Multiplier	r_{DG}	r_J	r_{CST}
Series I							
1	.50	.46	.000	.00	.01	.01	.00
2	.50	.47	.000	.90	.65	.65	.65
3	.50	.48	.000	.42	.41	.41	.43
4	.50	.49	.000	.41	.40	.40	.41
5	.50	.50	.000	.38	.38	.38	.38

Example No.	$\frac{a+c}{2}$	$\frac{a+b}{2}$	Base correction	Multiplier	r_{DG}	r_J	r_{CST}
<i>Series II</i>							
6	.50	.26	.042	.71	.54	.51	.52
7	.50	.27	.046	.27	.25	.24	.24
8	.50	.28	.030	.05	.06	.06	.07
9	.50	.29	.029	.53	.42	.44	.43
10	.50	.30	.029	.00	.01	.01	.00
<i>Series III</i>							
11	.50	.10	.129	.06	.05	.04	.06
12	.50	.11	.121	.28	.21	.18	.20
13	.50	.10	.129	.41	.31	.26	.29
14	.50	.13	.106	1.00	.70	.59	.66
15	.50	.12	.114	.71	.52	.44	.47

Comparison of r_{CST} and r_{DG} shows that they are generally in close agreement, when they differ in r_{DG} most of the cases seems to be greater than r_{CST} ; similar trends have also been observed by Davidoff and Goheen (2). Similarly from the comparison of r_{DG} and r_J it can be said that there is close agreement between the two values and in case of difference r_{DG} is greater in almost all the cases than r_J . Disagreement to some extent between r_{CST} and r_J probably indicates that some correction factor is needed to accurately determine r_{CST} for extreme splits.

The overall results clearly indicate that tetrachoric correlation coefficients determined by three methods do not differ much in case of examples of Series I and Series II. But in case of examples of Series III, the variability in results is more marked. This is due to the fact that in this series only extreme splits were considered. So, obviously, for splits having values .30 to .50 and with low values of uncorrected r one can safely use Davidoff and Goheen's method, which is very easy from computational point of view. Jenkins' method is, of course, profitable in cases of extreme splits and where values of uncorrected r and multiplier are both high.

A few words might also be helpful regarding the limitations of Jenkins' method. The primary condition to use Jenkins' method is to "letter the fourfold table so that a is smaller than d and ad greater than bc ." But in some cases it might not be possible to letter the fourfold table so that a is smaller than d and again there might

be cases where though a is smaller than d , ad is not greater than bc . Jenkins has not mentioned anything regarding the method applicable for these cases.

Summary

Tetrachoric correlation coefficients were determined by the methods devised by (1) Davidoff and Goheen, (2) Jenkins, and (3) Chesire, Saffir, and Thurstone. On the basis of comparison of the results of fifteen examples general recommendations to use Davidoff and Goheen's and Jenkins' methods were made. Limitations of Jenkins' method had also been discussed.

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On Optimal Points of Section on a Linear Scale

BY

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Summary

A new criterion for grouping a population into a given number of homogeneous classes, using Gini's Mean-difference instead of the 'within variance' is proposed. A computational technique for applying this criterion in case of a frequency table is illustrated with a simple example. A plausible conjecture which, if true, would considerably reduce the number of trial evaluations, is stated and its usefulness is brought out by means of an example.

Introduction

Let a frequency distribution of some characteristic in a population be given. Sometimes it will be of interest to section out the population into a given number of groups so that the differences between the individuals within the same group are at a minimum in some sense.

To give an illustration. The frequency distribution of marks of students in an examination is known. It is required to fix up the limits which divide the students into three classes so that the students within each class are more or less homogeneous.

The Average Within Distance

Measuring the degree of likeness or homogeneity by the smallness of variance, we may think of this as a problem of finding the cut-off points which minimise the within-variance of the groups so formed.

An alternative approach is suggested here as being a more meaningful one. The essence of this approach is to define an average distance among the members of a given population* and to form the classes such that the average distance within classes becomes a minimum. The method given in this paper enables one to apply this criterion for sectioning a population given in the form of a frequency table.

Let $x_1, x_2, \dots, x_n$ be n individual values on a linear scale. We then define the distance between x_i and x_j as the mutual deviation $|x_i - x_j|$ of x_i

* The Mean Difference of Gini, cf: An introduction to the Theory of Statistics—Yule and Kendal; 14th edition (1950) p. 146.

and x_j . The 'average-distance' in the population is defined as the average of the distances between all possible pairs including $i = j$. If the data are given as a frequency table with f_i as the frequency at x_i , $i = 1, 2, \dots, n$, the average distance $\rho(n)$ of the group is

$$\rho(n) = \frac{\sum_{i=1}^n \sum_{j=1}^n f_i f_j |x_i - x_j|}{\sum_{i=1}^n \sum_{j=1}^n f_i f_j} = \frac{\sum_{i=1}^n \sum_{j=1}^n f_i f_j |x_i - x_j|}{\left(\sum_{i=1}^n f_i\right)^2}$$

Then for a dichotomy at n_1 , that is, taking the first n_1 cells as forming one class and the remaining $n - n_1$ cells as the second class, the average within distance is given by

$$\rho(n_1, n) = \frac{\sum_{i=1}^{n_1} \sum_{j=1}^{n_1} f_i f_j |x_i - x_j| + \sum_{i=n_1+1}^n \sum_{j=n_1+1}^n f_i f_j |x_i - x_j|}{\left(\sum_{i=1}^{n_1} f_i\right)^2 + \left(\sum_{i=n_1+1}^n f_i\right)^2}$$

Similarly for trichotomy and other numbers of section.

One is to choose that n_1 (or $n_1, n_2, \dots, n_k = n$) which makes the average within distance as small as possible.

The efficiency of a section ($n_1, n_2, \dots, n_k$) can be judged by comparing $\rho(n_1, n_2, \dots, n_k)$ with $\rho(n)$, the average within distance of the population; the nearer the ratio is to zero, the more efficient it is.

Computational Technique

The chain of computations for finding the optimal section points has been cast into the form of a routine. Once the 'Cumulative Distance Matrix' (see infra) is computed, it requires two additions and two subtractions only to find the sum of distances within any given class. The corresponding denominators can be easily found out as the sums of squares of the appropriate partitions of the total frequency.

We start with forming a 'distance matrix.' This is an $n \times n$ matrix with entries a_{ij} equal to the distance between the i -th and j -th cells. Evidently, for our present purpose, a_{ij} is taken equal to a_{ji} and a_{ii} equal to zero. When the cells are of equal width, by a proper choice of scale we can take $a_{ij} = |i - j|$. In what follows this assumption will be made, though the technique is applicable in the general case too.

The total distance in the population can be represented as a quadratic form in the cell frequencies : Total distance $D(n) =$

$$= (f_1, f_2, \dots, f_n) \begin{Bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{Bmatrix} \begin{Bmatrix} f_1 \\ f_2 \\ \vdots \\ f_n \end{Bmatrix} = F' A F$$

With a dichotomy at n_1 , the 'total within distance' becomes

$$D(n_1, n) = (f_1, f_2, \dots, f_{n_1}) \begin{Bmatrix} a_{11} & a_{12} & \dots & a_{1n_1} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n_1 1} & a_{n_1 2} & \dots & a_{n_1 n_1} \end{Bmatrix} \begin{Bmatrix} f_1 \\ f_2 \\ \vdots \\ f_{n_1} \end{Bmatrix} \\ + (f_{n_1+1}, \dots, f_n) \begin{Bmatrix} a_{n_1+1, 1} & a_{n_1+1, 2} & \dots & a_{n_1+1, n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n, n_1+1} & a_{n, n_1+2} & \dots & a_{n, n} \end{Bmatrix} \begin{Bmatrix} f_{n_1+1} \\ \vdots \\ f_n \end{Bmatrix} ;$$

or if $A = \begin{Bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{Bmatrix}$ it is $F' \begin{Bmatrix} A_{11} & O \\ O & A_{22} \end{Bmatrix} F$

In general, with partitions at $(n_1, n_2, \dots, n_k)$, the 'Total Distance Within' is

$$D(n_1, n_2, \dots, n_k) = F' \begin{Bmatrix} A_{11} & & & \\ & A_{22} & & O \\ & & \ddots & \\ O & & & A_{kk} \end{Bmatrix} F$$

The corresponding denominator is got by replacing the elements in the diagonal block by unities, which then equals

$$\left(\sum_{i=1}^{n_1} f_i \right)^2 + \left(\sum_{i=n_1+1}^{n_2} f_i \right)^2 + \dots + \left(\sum_{i=n_{k-1}+1}^{n_k} f_i \right)^2, \text{ where } n_k = n$$

The 'cumulative distance matrix' is constructed in two steps : The first step consists in computing what may be called 'cumulative linear forms.'

$c(i, k) = \sum_{j=1}^k a_{ij} f_j$ is defined as the c.l.f. for i -th row and k -th column. The matrix $[c(i, k)]$ is the matrix of c. l. f.

We then construct the 'cumulative bilinear forms' (c. b. f.) defined by $d(r, s) = \sum_{i=1}^r f_i c(i, s)$, the c. b. f. for r -th row and s -th column. The matrix $[d(r, s)]$ is the 'cumulative distance matrix.'

It is easy to see that $d(r, s) = \sum_{i=1}^r \sum_{j=1}^s a_{ij} f_i f_j$. To compute the total within distance in the class including only the contiguous cells $i+1, i+2, \dots, i+k=j$, note that

$$\sum_{i_1=1}^k \sum_{i_2=1}^k f_{i_1+j_1} f_{i_2+j_2} a_{i_1+i_2, i_1+i_2} = d(j, j) - 2d(i, j) + d(i, i)$$

Hence the 'Total Within Distance' for the grouping $(n_1, n_2, \dots, n_{k-1}, n)$ is equal to $D(n_1, n_2, \dots, n_{k-1}, n) = 2d(n_1, n_1) - 2d(n_2, n_1) + 2d(n_2, n_2) - 2d(n_3, n_2) + \dots - 2d(n, n_{k-1}) + d(n, n)$.

An Illustration—

Let the given frequency distribution be :

Class mark :	x	0	1	2	3	4	Total
Frequency :	f	3	8	15	9	5	40

The Cumulative Linear Form matrix is

$$\begin{Bmatrix} 0 & 1 & 2 & 3 & 4 \\ 1 & 0 & 1 & 2 & 3 \\ 2 & 1 & 0 & 1 & 2 \\ 3 & 2 & 1 & 0 & 1 \\ 4 & 3 & 2 & 1 & 0 \end{Bmatrix} \begin{Bmatrix} 3 \\ 8 \\ 15 \\ 9 \\ 5 \end{Bmatrix} \rightarrow \begin{Bmatrix} 0 \times 3 = 0 & 0 + 1 \times 8 = 8 & 8 + 2 \times 15 = 38 & 65 & 85 \\ 1 \times 3 = 3 & 3 + 0 \times 8 = 3 & 3 + 1 \times 15 = 18 & 36 & 51 \\ 2 \times 3 = 6 & 6 + 1 \times 8 = 14 & 14 + 0 \times 15 = 14 & 23 & 33 \\ 3 \times 3 = 9 & 9 + 2 \times 8 = 25 & 25 + 1 \times 15 = 40 & 40 & 45 \\ 4 \times 3 = 12 & 12 + 3 \times 8 = 36 & 36 + 2 \times 15 = 66 & 75 & 75 \end{Bmatrix}$$

In the case of equal class intervals, as in the case above we can change the scale of the variable to get $a_{ij} = |i-j|$. Then the terms below the leading diagonal in any column are got by successive addition of the cumulative frequency up to and including the corresponding class. Denoting the elements of the c. l. f. matrix by c_{ij} , we get for example $c_{33} = c_{23} + (3+8)1 = 14$,

$C_{43} = C_{22} + (3 + 8) 2 = 25$ and $C_{53} = C_{22} + (3 + 8) 3 = 36$. The matrix of the Cumulative Bilinear Forms (the Total Distance Matrix) is

$$\begin{matrix} (3,8, \\ 15,9,5) \end{matrix} \left\{ \begin{matrix} 0 & 8 & 38 & 65 & 85 \\ 3 & 3 & 18 & 36 & 51 \\ 6 & 14 & 14 & 23 & 33 \\ 9 & 25 & 40 & 40 & 45 \\ 12 & 36 & 66 & 75 & 75 \end{matrix} \right\} \rightarrow \left\{ \begin{matrix} 3 \times 0 = 0 & 3 \times 8 = 24 & 114 & 195 & 255 \\ 0 + 8 \times 3 = 24 & 24 + 8 \times 3 = 48 & 258 & 483 & 663 \\ 24 + 15 \times 6 = 114 & 48 + 15 \times 14 = 258 & 468 & 828 & 1158 \\ 114 + 9 \times 9 = 195 & 258 + 9 \times 25 = 483 & 828 & 1188 & 1563 \\ 195 + 5 \times 12 = 255 & 483 + 5 \times 36 = 663 & 1158 & 1563 & 1938 \end{matrix} \right\}$$

Note that the c. b. f. matrix is symmetric and hence, say, up-diagonal terms may not be calculated. $\rho(5)$, that is, the average distance for the population of our example, is equal to $1938/40^2 = 1.21$.

The 'average within distance' for the various dichotomies follows:

x	*D (x, 5)	*N (x, 5)	$\rho(x, 5) = \frac{D}{N}$	Efficiency $1 - \rho(x, 5)\rho(5)$
1	1428	1378	1.036	0.144
2	708	962	0.736	0.392
3	558	872	0.640	0.479
4	1188	1250	0.950	0.215

$$*D(x, 5) = 2d(x, x) - 2d(5, x) + d(5, 5); N(x, 5) = \left(\sum_{i=1}^x f_i \right)^2 + \left(\sum_{i=x+1}^5 f_i \right)^2$$

We find that optimal dichotomy is at 3. The average within distance for the grouping (3, 5) is 0.640 with an efficiency of 48%.

Appendix : A conjecture

It is conjectured that on varying only one section point keeping the others fixed, the value of ρ increases as the section point moves away from the conditional optimum. If this is true the number of trial sectionings to be evaluated will be considerably reduced.

Though no formal proof is available, the conjecture seems quite plausible in the light of experience gained while analysing a number of frequency tables by using this method.

We give below an illustration of the usefulness of this conjecture.

Optimal trichotomy is to be found for the following distribution:

Cell No.	...	1	2	3	4	5	6	7	8
Frequency	...	13	49	102	155	260	451	635	807

Cell No.	9	10	11	12	13	14	15	16	17
Frequency	546	1998	1022	687	348	166	58	25	12

The matrices of c.l.f. and c.b.f. for this table are not given here.

The average distance for the population, $\rho(17) = 2.897$.

(i) We start with the trial trichotomies (6, 12, 17) and (6, 13, 17).
 $\rho(6, 12, 17) = 1.663 < \rho(6, 13, 17) = 1.818$.

Hence if y_0 is the conditional optimal section point for the first section at 6, $y_0 \leq 12$. Therefore we try

$$\rho(6, 11, 17) = 1.457 < \rho(6, 12, 17) \quad \therefore y_0 \leq 11$$

$$\rho(6, 10, 17) = 1.228 < \rho(6, 11, 17) \quad \therefore y_0 \leq 10$$

$$\rho(6, 9, 17) = 1.255 > \rho(6, 10, 17) \quad \therefore y_0 = 10$$

Thus (6, 10, 17) is the optimal trisectioning when the first section point is fixed at 6.

(ii) We proceed to examine the sections with first point at 7 and find that $\rho(7, 10, 17) = 1.040$ is the minimum.

(iii) $\rho(6, 10, 17) > \rho(7, 10, 17)$. Hence we try sections with the first point at 8 and find that $\rho(8, 11, 17) = 1.004$ is the minimum.

(iv) $\rho(8, 11, 17) < \rho(7, 10, 17)$. Hence we try sections with the first point at 9.

(v) $\rho(9, 11, 17) = 1.158$ is found to be the minimum for the set of sections with the first point fixed at 9 and $\rho(9, 11, 17) > \rho(8, 11, 17)$.

(vi) Thus we find $\rho(7, \text{opt.}, 17) > \rho(8, \text{opt.}, 17) < \rho(9, \text{opt.}, 17)$. Hence (8, opt., 17), i.e., (8, 11, 17) is the optimal trisection and has the average distance $\rho(8, 11, 17) = 1.004$. The efficiency of this section is $(1 - .346) = 65.4\%$.

The total number of trichotomies here is 120. By using the above conjecture only 17 trial trichotomies were to be evaluated to arrive at the optimal trichotomy.

defecation response, and only the central stimulant, pipradrol, increased the ambulation scores of the rats.

Conditioned emotional response in the rat : Effects of stimulant and depressant drugs

BY

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I. Introduction

In a previous experiment (Singh, 1958) some of the constitutional and situational determinants of a conditioned emotional response (CER) of the "anxiety" type were examined. The response was quantified in terms of its depressant effect on a regularly recurring lever pressing response under thirst drive in a Skinner box. The experiment reported in this paper is an attempt to analyse the nature of this response by using drugs to vary the subjects' physiological state, and hence their susceptibility to the formation of the CER.

In the literature there are a number of studies designed to survey drug effects on conditioned response of the escape—avoidance type. But in a recent review of comparative behavioural pharmacology, Brady (1957) points out that the information about drug effects on conditioned fear from such studies is tenuous : a majority of these experiments were not adequately controlled for "generalised motor effects, sensory decrements, and general malaise", and any of these could have distorted the effects of drugs on conditioned fear. However, there are some reports which clearly indicate that conditioned fear is decreased by reserpine and chlorpromazine, while increased by amphetamine (Hunt, 1956).

Pharmacologically, there are drugs which are classified into two categories : drugs mainly affecting the higher central nervous system, and known as central stimulants and depressants, and drugs mainly affecting the autonomic nervous system, and known as autonomic stimulants and depressants. For the study of the underlying mechanism of the CER, it seems important to know which of the two types of drugs, central or autonomic, has greater effect. There is little available evidence bearing on this problem. It seems, therefore, that the use of both stimulant and depressant drugs which, broadly speaking, are known for their action at either the central or autonomic level might be helpful for this purpose. This implies a fourfold classification of drugs of the type shown in Table 1. It must be stressed that this classification of drug action is arbitrary, because the site of action of a drug is frequently not well established. It is only adopted here to provide an approximation to a rational basis for selection of the drugs actually used. Broadhurst, Sinha and Singh (1958) have used this classification for surveying the effects of drugs on emotional responses as measured by a standardised open-field test (Broadhurst, 1957). However, none of the drugs used showed a significant effect on the

TABLE 1

Fourfold classification of drugs used

Site of action in Nervous System.	Stimulant		Depressant	
	Central	...	Pipradrol	Amylobarbitone
	Autonomic	...	Ephedrine	Chlorpromazine

Because of the recently developing interest in combined drug therapy for the treatment of mental patients (Barsa and Kline, 1956), it may be relevant to know whether fear conditioning is affected more by combinations of central and autonomic depressants or stimulants than by their respective components. Furthermore, in the previous study (Singh, 1958) it was observed that rats from the Maudsley Reactive and Non-reactive Strains (Broadhurst, 1958) differed significantly in CER formation, the emotionally reactive rats conditioned better than the non-reactive ones. Whether these two selectively-bred strains also differ in their reactions to drugs may have important pharmacotherapeutic implications for understanding individual differences in human drug susceptibility.

The present experiment was, therefore, designed to make a comparative evaluation of the effects of four drugs which roughly represent the above classification, and of certain combinations of them. They were : pipradrol hydrochloride ("Meratran"), a central stimulant (Brown and Werner, 1954) ; sodium amylobarbitone ("Sodium Amytal"), a central depressant; ephedrine hydrochloride, which acts as an autonomic stimulant ; and chlorpromazine hydrochloride ("Largactil"), which acts as an autonomic depressant (Margolis, 1957).

II. Method

(i) *Subjects* : Twenty-four male rats served as subjects ; twelve of them were drawn from the 7th generation of the selectively-bred emotionally reactive strain, and the other twelve from the non-reactive strain. Like the previous generations of these strains, all the animals of this one were brought up under strictly uniform conditions in respect of diet, size of cages, and other laboratory conditions, such as air temperature, and light/dark cycles. Between 100 and 110 days of age they were given the standardised open-field test (Broadhurst, 1957). Only subjects scoring a total of more than 12 fecal boluses were assigned to the reactive group (mean : 16.7, $\pm$.79), and only subjects scoring less than 3 to the non-reactive group (mean : 2.08, $\pm$.35). The difference between the means is significant beyond the 1% level by two-tail *t*-test. All the subjects were between 205 and 215 days of age when they were gradually initiated to a 23-hour water deprivation schedule

for the present experiment. They were not experimentally naive as they had already been used in a similar drug study (Singh, 1958). It might be objected that this previous use of these subjects might have altered their susceptibility to the drug treatments to be given. However, because all of them had been treated alike in respect of medication, and because these treatments had no significant effects, the use of these animals in the present experiment would appear to be justified.

The subjects were randomly assigned to one of the following six drug groups, each comprising 2 reactive and 2 non-reactive rats; a pipradrol group, an amylobarbitone group, an ephedrine group, a chlorpromazine group, a pipradrol plus ephedrine group, and an amylobarbitone plus chlorpromazine group; there were thus two replications of the 6×2 factorial design. Because of our main interest in the comparative evaluation of different drug effects, no control (placebo) groups were included.

(ii) *Apparatus*: The detailed description of the apparatus used is given elsewhere (Singh, 1958); In brief, it consisted of two different boxes: a Skinner box and a conditioning box. Illumination in both boxes was provided by .5 W. bulbs, and a timer was used to produce flashing of this light which served as the conditioned stimulus (CS). In the conditioning box the animal was given a .25-ma (A.C.) shock to the feet of 2-sec. duration through the bottom of the box, with a resistor of 2 megohms between the box and the transformer. This served as the unconditioned stimulus.

(iii) *Procedure*: All the subjects were first trained in lever pressing to obtain water in the Skinner box. The procedure was as follows. Each was placed in the box for 4 min. each day and the number of times it pressed the lever was recorded for 3 min. beginning 30-sec. after the animal was put in and ending 30 sec. before it was taken out. This procedure continued until the animal showed a stable lever response, defined as two or more equal scores on three successive daily trials. On the day after the last of these criterion trials, the lever pressing performance of the animals was observed under the flashing light (CS). It was observed that the CS in its neutral capacity did not affect the performance of the animals.

On this and the next three days each subject received one fear conditioning trial, while under the influence of the appropriate drug. For this, it was placed in the conditioning box, and after 2 min. the flashing light was introduced which, after 3 min. was contiguously terminated with the electric shock. After a further 1 min. the rat was taken out. This procedure was the same for all subjects except for the differences in medication given by intraperitoneal injection before the trial, at a suitable time to allow it to have maximum effect. The rats of the pipradrol group received 10 mg./kg. of body weight 30 min. before the conditioning trials; those of the amylobarbitone group 15 mg./kg. 30 min. before, those of the ephedrine group, 5 mg./kg. 15 min. before; those of the chlorpromazine group, 100 mg./kg. 150 min. before. The subjects in the pipradrol-ephedrine group had two injections, one of 10 mg./kg. of pipradrol followed 15 min. later by another of 5 mg./kg. of ephedrine, the second being 15 min. before the conditioning trials; while those in

the amylobarbitone-chlorpromazine group also had two injections, one of 100 mg./kg. of chlorpromazine followed after 120 min. by another of 15 mg./kg. of amylobarbitone, the second being 30 min. before the conditioning trials. All drugs were dissolved in distilled water and the volume of each injection was 5 c.c./kg. in each case.

To let the drug effects wear off completely in order to avoid their interaction with the lever response, one day was allowed between the last conditioning and the first of the six test trials which followed. For testing the intensity of the CER developed (by the association of the CS and the shock) under different drugs, the animal was placed in the Skinner box, at the exact time of the day when it had the criterion trials. Its lever responses were recorded as usual, but in the presence of the flashing light (CS), which was, however, no longer reinforced by the shock, as it had been in the conditioning box.

III. Results

The scores obtained were converted to inflection ratios. The inflection ratio represents the difference between a subject's test score and its initial scores as a proportion of its initial score. This conversion was done by using the formula: $\text{inflection ratio} = \frac{B-A}{A}$, where A = mean of the criterion scores, representing the initial score, and B = test score. Negative ratios express a decrease in the number of lever responses, that is, an increase in conditioned fear (CER), while positive ratios express the opposite.

The results of an analysis of variance (Lindquist, 1953) of the data are presented in Table 2. Because one of the non-reactive rats died during the experiment,

TABLE 2
Results of analysis of variance

Source	df.	Mean square	F-ratio
Drugs	5	.6336	11.437**
Strains	1	1.7521	31.6263**
Trials	5	.6984	12.606**
Drugs $\times$ strains	5	.4263	8.491*
Drugs $\times$ trials	25	.0740	1.4741
Strains $\times$ trials	5	.0600	1.1952
Residual variance	91	.0502	
+ Residual variance	121	.0554	
Total	137		

*Significant at the 1% level.

**Significant at the .1% level.

+ Combining non-significant interactions.

calculations were done on the scores of 23 subjects only, and analysis was not therefore extended beyond the first order interactions, the rest of the total variance being used as an error term with 91 degrees of freedom for obtaining the *F*-ratios for these interactions. The non-significant interactions were then pooled with this residual variance, and the new combined residual variance (now with 121 degrees of freedom) was used to test the significance of the main effects. The *F*-ratios for drugs, strains, trials, and the drugs $\times$ strains interaction are significant beyond the 1% level. The significant *F* for trials is due merely to the expected extinction of conditioned fear on successive test trials. The overall difference between the strains is in the expected direction, as may be seen in Table 3, reactive rats having a significantly higher ratio than non-reactive ones, and confirms our previous finding (Singh, 1958).

For the further analysis of the between drugs variance, *t*-ratios were calculated. The results, as may be seen in Fig. 1, show that the central stimulant and depressant drugs are respectively more effective in increasing and in blocking the development of the CER than the corresponding autonomic drugs, though the difference only reaches a significant level ($P < .01$) between the depressant drugs (amylobarbitone group mean: $-.05$, chlorpromazine group mean: $-.30$). Only the combination of the stimulant drugs, pipradrol plus ephedrine, appears to have greater effect ($P < .01$)—in accelerating the CER—than do its components. No such additive effect is observed in the case of the combination of the depressants. That depressants decrease and stimulants increase fear conditioning appears to be true only for the central drugs and not for the autonomic drugs. The weekly significant difference between the ephedrine and chlorpromazine groups ($P < .05$) is in the non-expected direction.

To what extent the drug effects are influenced by the strain differences is shown in Table 3 and Figure 2. Table 3 represents the various group means for the reactive and non-reactive subjects, and the levels of significance of the differences between

TABLE 3

Interaction between the strains and drugs

	C	C + A	A	P	P + E	E	Total
Reactive ...	-.36	-.37	-.01	-.25	-.83	-.42	-.38
Strains ...	n.s.	n.s.	n.s.	n.s.	<i>P</i> .001	<i>P</i> .001	<i>P</i> .001
Non-reactive.	-.23	-.25	-.09	-.18	-.21	+.10	-.14

C = chlorpromazine A = amylobarbitone P = pipradrol
E = ephedrine + = combined treatments,

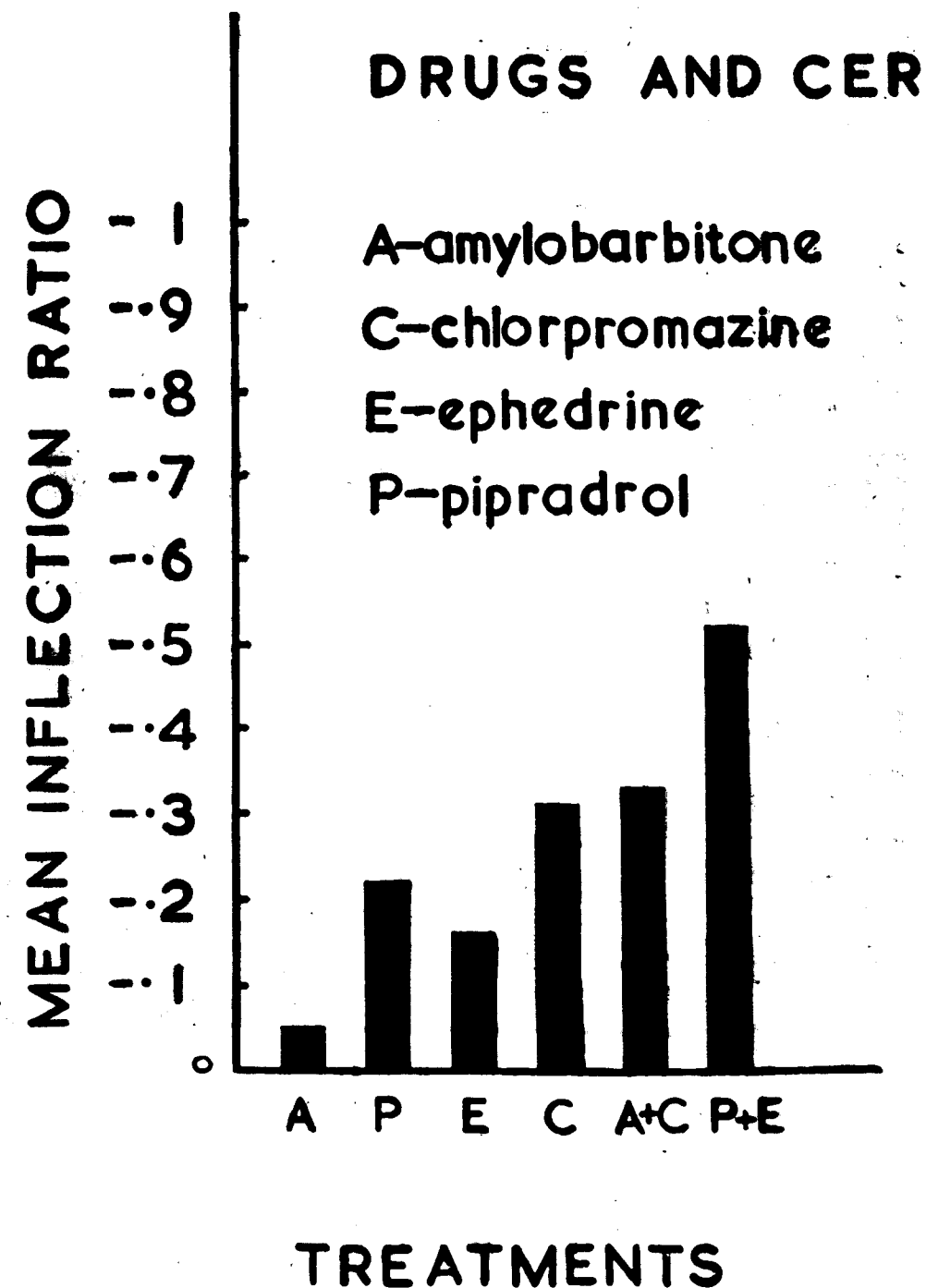


Fig. 1. The bars in the diagram represent the mean CERs (inflection ratios) for the various treatment groups. There were four rats in each group, except for the C group, which contained only three.

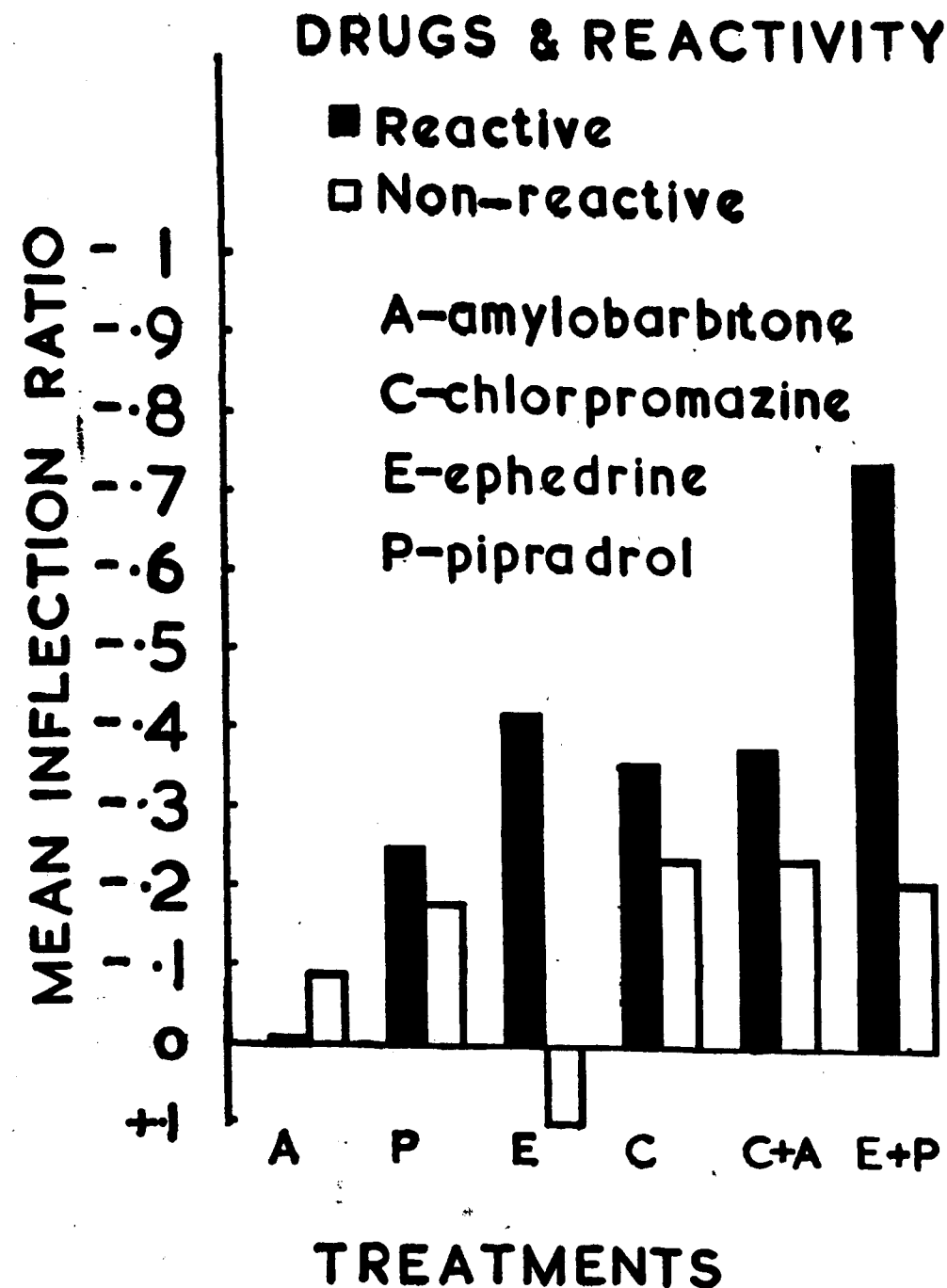


Fig. 2. The bars in the diagram represent mean CERs (inflection ratios) of the emotionally reactive and non-reactive rats in the various treatment groups. There were two rats in each group, except for the non-reactive C group, which contained only one.

the related means, obtained by *t*-tests. An inspection of this Table will show that the significant interaction between the strains and drugs, shown in Table 1, is mainly due to the greater sensitivity of the reactive subjects to the action of ephedrine and its combination with pipradrol. The difference between the reactive and non-reactive subjects in both cases is significant beyond 1% level. Another aspect of the strain difference in reaction to drugs became clear when the differences between drug effects *within* each strain were analysed. This analysis revealed that, within the reactive strain, the effects of the stimulant and depressant drugs were in the expected direction, and statistically significant at the 1% level in the case of the central drugs and their combinations with the autonomic drugs. On the other hand, within the non-reactive strain, no such differences were obtained, and on the contrary, the autonomic drugs had significantly reverse effects, that is, ephedrine decreased, and chlorpromazine increased, the CER.

IV. Discussion

It is quite clear from this experiment that the formation of a conditioned emotional response of the "anxiety" type can be modified by drugs. The stimulant drugs produce stronger conditioned emotional response than the depressant drugs. It was, however, the central acting drugs, pipradrol and amylobarbitone, and not the autonomic drugs, ephedrine and chlorpromazine, which showed this effect. The central acting drugs seem to affect the conditioning of the response more or less in the same way as they do eyelid conditioning (Franks and Trouton, 1958).

The finding that the central drugs effect the conditioning of fear more than the autonomic drugs do, seems to be parsimoniously accounted for by the cortical excitation-inhibition theory (Eysenck, 1957), rather than by a drive theory (Taylor, 1956). This conclusion is derived as follows: Franks (1954) suggested that if conditioning is mainly a function of drive then the drugs which affect sympathetic activity should affect drive (D), and thus, according to Hull's (1943) formulation, $R = f(D \times sHr)$, affect conditioning. But if conditioning is a function of the cortical excitation-inhibition balance and not of D, then drugs which affect cortical excitation-inhibition should affect conditioning.

The results confirm that the reactive subjects acquire greater CER than the non-reactive ones do. This was also found in other experimental situations which may also be thought to involve fear stimulating underwater swimming to escape air deprivation, (Broadhurst, 1957, 1958). On the other hand, they do not differ in this way in other learning experiments using a food or a water reward, (Sinha, Franks and Broadhurst 1958; Kendrick, 1958; Das and Broadhurst, 1958). It therefore seems reasonable to conclude that the strain difference in emotional reactivity are only operative in fear-eliciting situations, and this in turn supports the view that the defecation response in the open-field test, for differences in which these strains were selectively bred, provides a measure of fearfulness in the rat.

The significant interaction between drugs and strains suggests that emotionally reactive rats and non-reactive rats react differently to drugs. The reactive rats

seem to be more affected by the stimulant drugs, and the non-reactive ones by the depressant drugs, the reaction to amylobarbitone being the only exception. Since no control groups were run, such an evaluation must remain tenuous. However, the results strongly suggest that the emotional reactivity is an important determinant of an individual's reaction to drugs. Furthermore, the greater differential reaction of the two strains to the autonomic drugs, as compared with the central drugs seems attributable to innate differences of their autonomic make-up. Moreover, subsequent work has also confirmed the differential reaction of the two strains to drugs (Singh and Eysenck, 1958).

The results obtained with the combinations of drugs must be accepted with reserve. Firstly, it should be remembered that the rats in the combination groups had two injections, while those in the single drug groups had only one. It might be possible that the results obtained may have been influenced by the artefact of an emotional reaction of subjects to the injection procedures itself, which may be supposed to potentiate the effect of the stimulants and antagonise that of the depressants. This consideration renders suspect comparisons between single and combined drug treatments, but may nevertheless account for the failure of the combination of depressants to depress the CER more than chlorpromazine alone did, and for the large effect of the stimulants. On the other hand, the central effect on conditioning of the stimulants is perhaps partly attributable to a summation of central effects, since the autonomic stimulant, ephedrine, in addition to its main effect, has a minor stimulant side effect upon the central nervous system (Goodman and Gilman, 1955).

Summary

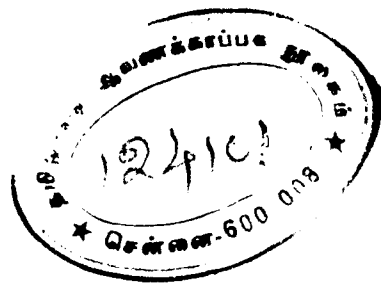
The present experiment investigated the effects of four drugs, having stimulant or depressant action at the central or autonomic level, and certain combinations of them, on the acquisition of a conditioned emotional response (CER), defined in terms of a decrease in a stable lever pressing response in Skinner box in the presence of a signal previously associated with electric shock. Twelve emotionally reactive and twelve non-reactive rats selected on the basis of their defecation scores in a standardised open-field test served as subjects. The results showed that the response was more affected by the "central" rather than the "autonomic" drugs, a finding supporting the cortical excitation-inhibition theory of conditioning. A differential reaction of the two strains to the drugs was also observed, and was attributed to the differences in their autonomic make-up. Only the combination of the stimulant drugs showed an additive effect.

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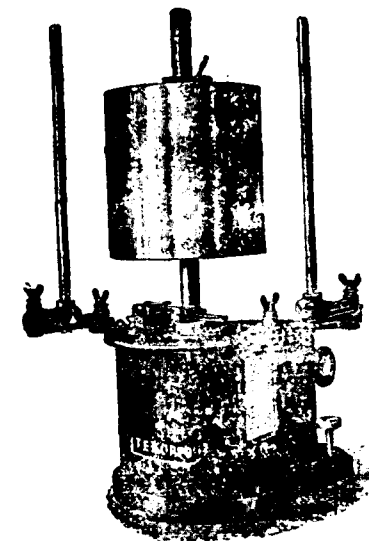
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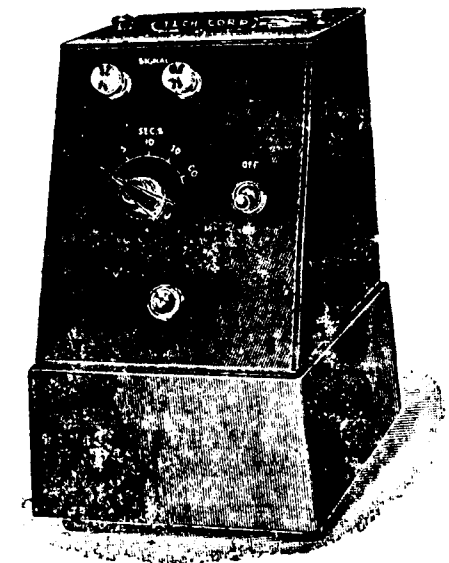


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