*Brit. J. Psychiat.* (1969), 115, 477–8 

# Differences Between Normals and Schizophrenics on Activation-induced Change in Two-flash Fusion Threshold

By D. J. HIEATT and J. E. TONG

Research relating brain stem stimulation and cortical selectivity by Lindsley (1957) led Venables (1963) to utilize a score from a perceptual discrimination task (two-flash fusion threshold, T.F.T.) to examine hypotheses relating arousal level to perceptual dysfunction and schizophrenic symptoms. Other work failed to confirm the results (Hume and Claridge, 1965), possibly due to the unsuitable method of determining T.F.T., a method of constant stimuli. The following experiments were based on the proposition that perceptual functioning is related to arousal level, and also attempted to resolve confusions arising from earlier studies by control of possible sources of error in the experimental situation.

Two hypotheses were posed: (i) normals, paranoid schizophrenics, and non-paranoid schizophrenics differ on resting T.F.T.; (ii) induced arousal will differentially affect T.F.T. for the three groups.

## Technique

Whilst seated at a table in the dark-room the subject was required to regard a screen and report whether he perceived one or two flashes of light. In all cases there were two flashes but of varying interflash interval (I.F.I.). The T.F.T. score was the longest I.F.I. in milliseconds at which the subject perceived the two flashes as one. Following two training periods all subjects were examined at four sessions, each being one combination of high or low arousal testing conditions and one of two methods of determining T.F.T.

The subjects, all male, were 16 non-paranoid and 16 paranoid schizophrenics, mean age 33·8 and 39·3 years, all hospitalized longer than 6 months, and 16 normals, mean age 36·4 years. The apparatus was a timing control device for producing flashes from a cathode ray tube behind the display screen at discrete 1 ms. intervals between 10 and 209 ms. Each flash was of 50 ft. L. illumination, fade time 5 microseconds and 5 ms. duration.

The two T.F.T. measures were (i) the modified method of constant stimuli used by Venables; and (ii) the modified method of limits used by Pearson and Tong (1968). The second method eliminates experimenter bias and also gives a measure of variability or subject consistency. It requires first an approximate threshold obtained by the Venables method, followed by ascending and descending presentations at 5-second intervals from a point 20 ms. below or above the approximate T.F.T., at one ms. steps of I.F.I. The Pearson-Tong score is the mean of the thresholds for the ascending and descending trials. The variability score is the number of inconsistent responses within 10 ms. either side of the fusion threshold.

The heart-rate was used as an indicator of physiological arousal and was continually monitored during all sessions. During the two high arousal sessions the subject performed a non-distracting pedalling activation task whilst seating at the viewing table, T.F.T. being measured by one of the two methods before and during activation. For the two low arousal sessions the appropriate T.F.T. measure was also obtained twice but with a four-minute rest interval and no activation during the session.

## Results

To test for differences under non-activation conditions $3 \times 2$ analyses of variance were used comparing groups and repeated non-activation measures for T.F.T., the heart rate obtained concurrently with the T.F.T., and the two methods of T.F.T. measurement. To test for activation effects $3 \times 2 \times 2$ analyses of variance with repeated measures on the last two factors were used for Pearson-Tong and Venables T.F.T.s, the T.F.T. variability score and concurrent heart rate taken at T.F.T. threshold. The interactions showed the effect of the activation task on the scores for the combined groups and the differential effects for the three groups of subjects.

1. Under non-activation conditions the mean heart rate differed significantly ($p = \cdot 05$) between the three groups (paranoids 82·46, sd. 13·26;



https://doi.org/10.1192/bjp.115.521.477 Published online by Cambridge University Press

non-paranoid 93·46, sd. 12·05; normals 76·59, sd. 7·29). If the heart rate is regarded as an indicator of arousal level then the groups differed in respect of resting arousal level.

2. The activation task significantly increased the heart rate for all groups ($p = \cdot001$) but there were no significant differences between the groups as indicated by the interaction. (Mean change scores, i.e. difference between resting and activation heart rates, paranoid 12·07, sd. 6·42; non-paranoid 10·54, sd. 6·49; normals 14·44, sd. 4·91.)

3. Under non-activation conditions the mean Pearson-Tong T.F.T. differed significantly ($p = \cdot01$) between the groups, (paranoid mean 81·06 ms., sd. 18·37; non-paranoid 66·65, sd. 11·55; normals 65·03, sd. 15·43).

4. The activation task did not significantly affect the Pearson-Tong T.F.T. for the combined groups, but did have a significant differential effect ($p = \cdot001$) bringing about a *decrease* for normals and an *increase* for schizophrenics, the paranoids showing the greater increase. (Mean change scores, i.e. difference between resting and activation T.F.T.s, paranoid 11·03, sd. 12·09; non-paranoid 5·40, sd. 8·51; normals 9·00, sd. 9·96.) There was no significant difference between the psychiatric groups.

5. The variability scores indicated that the paranoid group made more inconsistent responses ($p = \cdot01$) but the activation task had no effect on variability for the combined groups and no differential effect. (Paranoid mean 4·65, sd. 1·74; non-paranoid 3·53, sd. 1·93; normals 2·62, sd. 1·26.)

6. The T.F.T. scores for the Venables testing sessions brought out no significant results although the trends were similar to the above and the heart rate change under arousal was significantly increased. T.F.T. reliability coefficients were about ·92 for both methods over 4 minutes. Over two weeks coefficients for patients were ·75 for Pearson-Tong, ·65 for Venables and ·9 for both methods for normals.

## Discussion

The failure of the Venables method to bring out significant results may not be entirely technical. The two methods use different procedures which could affect T.F.T. The Pearson-Tong technique takes 8 minutes plus 4 minutes of rests, compared with 2 minutes for the Venables. Hence the former involves greater dark adaptation, about 100 retinal stimulations compared with 20, and a longer period of activation during testing.

The results indicate that the paranoids and non-paranoids showed perceptual discrimination differences under low arousal conditions and that induced high arousal had a differential effect on patients and normals. The normals *decreased* their T.F.T.s and the schizophrenics *increased*, the paranoids more so. A lowering T.F.T. score implies greater efficiency in perceptual discrimination. In terms of a Yerkes-Dodson explanation the subjects with low T.F.T.s under low arousal conditions (e.g. normals) may not be sufficiently aroused to perform with their maximum perceptual efficiency. On further arousal they would further decrease their T.F.T.s, i.e. improve discrimination. However, subjects whose resting level of arousal was beyond that required for optimal discrimination would, following an increase in arousal, show an increase in T.F.T. This inverted U explanation fits the present results, suggesting that both groups of schizophrenics function under chronically high arousal, the paranoids being the more highly aroused. Scrutiny of medication records gave no indication of a drug artefact.

## Acknowledgment

Experimental work was performed at Kingseat Hospital, Auckland, New Zealand, and permission for publication is due to the Director of Mental Hygiene, N.Z.

## References

Hume, W. I., and Claridge, G. S. (1965). "A comparison of two measures of 'arousal' in normal subjects." *Life Sci.*, **4**, 545–553.

Lindsley, D. B. (1957). "The reticular system and perceptual discrimination." In: *Reticular Formation of the Brain* (eds. H. H. Jasper *et al.*), London.

Pearson, L. A., and Tong, J. E. (1968). "Two flash fusion: the effects of age, method, etc." *Brit. J. Psychol.*, **59**, 407–414.

Venables, P. H. (1963). "The relationship between level of skin potential and fusion of paired light flashes in schizophrenic subjects." *J. psychiat. Res.*, **1**, 279–287.

D. J. Hieatt, M.A., *Lecturer*
J. E. Tong, Ph.D., *Professor*
*Psychology Department, University of Guelph, Ontario, Canada*

(*Received 25 March, 1968*)

https://doi.org/10.1192/bjp.115.521.477 Published online by Cambridge University Press