

FLICKER FUSION FREQUENCY AS A FUNCTION OF ANXIETY REACTION; AN EXPLORATORY STUDY *

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The ability to perceive a certain number of visual stimuli per unit of time has been found to differ significantly between hypothyroid patients and normals (3), between older and younger persons (1, 2), between fatigued and rested truck drivers (5), etc. In all such cases, the number of light-dark cycles per second at which a physically intermittent light was just perceived as a steady light was found to be lower for the more fatigued cases or those with lower metabolic rates than for normals or rested persons.

If it is shown that this variable clearly differentiates between normals and any clinically diagnosed psychoneurotic group, then flicker fusion frequency may be useful for measuring, more or less roughly yet objectively, the degree of disturbance possessed by various individuals, not only at the time of the original diagnosis but also at various stages of therapy as a check on the progress of therapy.

This question was formulated in response to a military assignment involving the study of a neuroticlike syndrome exhibited by many of the Army Air Forces combat veterans after their return to the United States. This syndrome was officially designated as "operational fatigue" and is described elsewhere very ably by Grinker and Spiegel (4). Insofar as this syndrome was, on the surface, characterized chiefly by indications of severe hypertension, we shall refer to it simply as anxiety reaction. It should be noted that this reaction may be understood as normal in response to the combat situation. It is described as a neuroticlike syndrome only with reference to those for whom the reaction persisted, and in some cases became intensified, in postcombat life.

It was this group of aircrew returnees who served as the experimental group for our study of flicker fusion frequency. All testing was conducted at Army Air Forces Redistribution Station No. 2, Miami Beach, Florida.

PROCEDURE

Fifty normal aircrew returnees and 50 anxiety reaction cases were selected, from 1 June until 23 June 1945, to report for a flicker fusion test.

* This study was carried out as part of the Army Air Forces Aviation Psychology Program.

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1. From those returnees who were referred for psychiatric examination (approximately one-half the total processed at Station No. 2) during the course of routine medical processing, the psychiatrists selected 50 experimental cases showing fairly severe anxiety reactions.

2. From those returnees who were not referred for psychiatric examination, the medical officer at the final check station on the medical processing line selected 50 control cases.

3. Two testing conditions (A and B) were used, and the composition of the several groups of subjects was as follows:

	Condition A		Condition B	
	Officers	E. M.	Officers	E. M.
Control cases	16	9	19	6
Anxiety reaction cases	8	17	12	13

The apparatus used in this study was a General Radio Company "Strobotac," Model 631-B, which is capable of producing a variable oscillating light with a range of 600 to 14,500 cycles per minute. Because of certain extraneous light fluctuations which it was desirable to minimize, the apparatus was modified in the following manner:

1. The 5" diameter of the light source and reflector was cut down to 1 3/4" by placing an opaque cardboard shield in front of the apparatus. A circle of 1 3/4" diameter was cut out of the shield.

2. A single sheet of white bond paper was fixed to the back of the cardboard shield and acted as a translucent screen between it and the apparatus.

3. A fixation point on the shield was provided by drawing a cross with axes 3/8th of an inch long which intersected at a point 2" below the center of the stimulus light.

The physical characteristics of the test room situation were as follows:

1. The test room was 9' high by 9' wide and 11' long. Blackout curtains cut off all light from windows.

2. The apparatus was placed against a wall 9' wide, and equidistant from either side. A 7' wide portable movie projector screen was placed against the wall and behind the apparatus, in order that the background of reflected light would appear standard when the subject faced the apparatus.

3. Each subject was seated in such a manner that his eyes were level with the center of the

stimulus light, and 24 inches distant. This distance insured a 5 degree angle of vision when the subject fixated on the cross 2 inches below the center of the stimulus light. Vision was binocular.

4. The room was lighted by a 50-watt, 120-volt, G. E. Mazda lamp located in the center of the ceiling.

5. A General Electric fan effectively screened out sounds produced by the Strobotac motor and in this way completely eliminated possible auditory cues.

Upon entering the test room, the subject was seated, facing the apparatus. At this point a three-minute period, timed with a stopwatch, was given for the purpose of light-adapting the subject to the illumination level of the test room. During this three-minute period, the following data were recorded:

1. Time of day.
2. Age of subject.
3. Estimated visual acuity (by subject).

4. A short description of any strenuous exercise indulged in on the day of testing (*e.g.*, physical training).

5. Estimated hours of sleep on previous night.

6. A short description of any drinking (alcoholic) which might have taken place on the night prior to testing.

Standardized directions were read to the subject and ten measures of flicker fusion frequency were taken. These were separated by fifteen-second rest periods, during which time scores were recorded. The stimulus light was turned off as soon as the subject made a response, and turned on again five seconds before the start of the next trial.

1. For the first 50 subjects (25 control and 25 experimental), scores were obtained by beginning with a frequency of 3,700 per minute and gradually diminishing the frequency until the presence of flicker was reported. For the second group of subjects, a frequency of 2,000 per minute was used at first, and gradually increased until the absence of flicker (flicker fusion) was reported. Although the second method is the traditional one, it was felt worthwhile to try both. These two methods are referred to as Conditions A and B.

2. The frequency of the stimulus light was controlled by a hand-operated dial. The rate at which this dial was turned was subject only to the very rough kind of standardization afforded by kinaesthetic control on the part of the examiner. The examiner looked away from the dial, the frequency scale and the subject during the progress of each

test trial in order that kinaesthetic control should not be influenced by what could be seen.

RESULTS

In Table I a statistical summary of the results is presented for each of the two testing conditions.

TABLE I

BASIC STATISTICS FOR TWO METHODS OF MEASURING FLICKER FUSION FREQUENCY

	Condition A Fusion to flicker		Condition B Flicker to fusion	
	Control (N = 25)	Experi- mental (N = 25)	Control (N = 25)	Experi- mental (N = 25)
	Cycles per minute		Cycles per minute	
Mean	3416	3248	2736	2613
S. D.	125	167	160	158
Fishers "t"	= 3.93 *		Fisher's "t" = 2.69 *	
r_{b1a}	= .62 **		r_{b1a} = .45 **	
S.E. r_{b1a}	= .13		S.E. r_{b1a} = .15	
r^2_{11}	= .98 ***		r^2_{11} = .96 ***	

* Difference between the means significant at the .1% level or better.

** Correlation between flicker fusion frequency and psychiatric diagnosis (presence or absence of operational fatigue).

*** Corrected for twice the length by use of the Spearman-Brown formula

TABLE II

VARIABLES FOR WHICH INTERCORRELATIONS WERE COMPUTED

1. Flicker fusion frequency
2. Psychiatric diagnosis
3. Hours of sleep
4. Time of day tested (hours since 0001)
5. Age
6. "Alcoholism" *

* For this variable the sample was split into those who drank more, and those who drank less, than one bottle of beer on the previous night.

It is apparent that the mean scores made by normals are significantly higher than those made by anxiety reaction cases, though there is considerable overlapping of the distributions. It is also evident that results for testing Condition A (fusion to flicker) seem to be somewhat more related to anxiety reaction diagnosis than the traditional testing condition, Condition B (flicker to fusion).

In order to evaluate the extent of the relationships between anxiety reaction and fusion frequency, it was considered desirable to determine the relationships between fusion frequency and some of the other variables in the test situation that might conceivably have affected the test scores. The intercorrelations of these variables and those of fusion frequency and psychiatric diagnosis are presented in Tables II and III. Visual acuity and physical exercise are omitted because no distribution was

obtainable (all subjects reported 20/20 vision and no exercise on the day of testing).

The intercorrelation tables suggest that flicker fusion frequency is not significantly related to any of the variables studied except that of psychiatric

CONCLUSIONS

Flicker fusion frequency is a rather easily measured, almost physiologic function, and its relationship with other types of abnormal-metabolic-rate states is fairly well known. Should the results of this admittedly preliminary study be confirmed by further studies, the measure of flicker fusion frequency may provide a means of assisting in the better evaluation of therapeutic results with patients exhibiting anxiety reaction.

Although overlap in the distributions of normal and anxiety reaction ("operational fatigue") cases prevents fusion frequency from being used for purposes of initial diagnosis or screening, the results obtained in this study suggest the possible usefulness of this index as an objective check on the progress of therapy. Because this study has demonstrated what appears to be a fairly close relationship between flicker score and psychiatric diagnosis of anxiety reaction, it may be expected that flicker fusion frequency would rise during the progress of successful treatment regardless of what an individual's flicker fusion frequency might have been when first referred.

The results of this preliminary study are sufficiently promising to indicate that a larger number of cases should be obtained. Experience in the preliminary study indicates that it might be well to take certain additional precautions in future studies. These are as follows:

1. Attempt to improve the flicker source. It was observed that the Strobotac light source, which is a neon tube, emitted certain slight irregular extraneous light fluctuations which confused some of those subjects who showed high thresholds for flicker fusion.
2. Standardize the rate at which the frequency of the source light oscillations are increased or decreased during fusion testing by substituting mechanical for human control of the frequency dial.
3. Attempt better to match the anxiety reaction cases and the control cases with respect to time of day tested.

SUMMARY

Flicker fusion frequency has previously been found to differentiate between normals and cases exhibiting various types of abnormal metabolic-rate states. This experiment attempted, in an exploratory way, to study the relationship between FFF and an anxiety reaction state found rather frequently among Army personnel shortly after their return from Air Forces combat assignments overseas.

Fifty such cases (termed "operational fatigue"

TABLE III

INTERCORRELATIONS: CONDITION A (N = 50)

	1	2	3	4	5	6
1	—	.62 *	-.06	-.41 **	.01	.22
2	bis	—	.33 *	-.44 **	-.05	.60 *
3	pm	bis	—	.10	-.14	-.09
4	pm	bis	pm	—	-.11	-.08
5	pm	bis	pm	pm	—	-.06
6	bis	tet	bis	bis	bis	—

* The variables are so defined that these positive correlations indicate that normals slept more, drank more and got higher scores than the operational fatigue cases.

** Fatigue cases tended to report later in the day.

INTERCORRELATIONS: CONDITION B (N = 50)

	1	2	3	4	5	6
1	—	.45 *	-.04	-.09	-.05	-.14
2	bis	—	-.19	-.09	.50 *	-.20
3	pm	bis	—	.11	-.19	-.24
4	pm	bis	pm	—	-.24	.13
5	pm	bis	pm	pm	—	.07
6	bis	tet	bis	bis	bis	—

* The variables are so defined that these positive correlations indicate that normals were older and got higher scores.

TABLE IV

CORRELATION BETWEEN FLICKER FUSION FREQUENCY AND PSYCHIATRIC DIAGNOSIS WITH COMBINATIONS OF CERTAIN VARIABLES HELD CONSTANT *

Coefficients	Condition A	Condition B
r ₁₂₋₃	.68	.45
r ₁₂₋₄	.54	.45
r ₁₄₋₅	.62	.55
r ₁₄₋₆	.62	.43
r ₁₂₋₃₄	.60	.45
r ₁₂₋₃₅	.68	.55
r ₁₂₋₃₆	.73	.43
r ₁₂₋₄₅	.54	.56
r ₁₂₋₄₆	.54	.44
r ₁₂₋₅₆	.62	.54
r ₁₂₋₃₄₅	.60	.56
r ₁₂₋₃₄₆	.68	.43
r ₁₂₋₃₅₆	.73	.53
r ₁₂₋₄₅₆	.54	.55
r ₁₂₋₃₄₅₆	.68	.55

* Let 1 = flicker score.
 Let 2 = psychiatric diagnosis.
 Let 3 = hours of sleep.
 Let 4 = time of day tested.
 Let 5 = age.
 Let 6 = "alcoholism."

diagnosis. A clearer picture of this situation may be afforded in the table (Table IV) of partial coefficients of correlation where whatever slight degree of relationship between these other variables and fusion frequency is shown to have slightly obscured rather than exaggerated the degree of correlation between fusion frequency and psychiatric diagnosis.

in the AAF) and 50 normal aircrew returnees were selected for testing under standardized conditions. Statistically significant differences were found between the mean FFF scores of the two groups although the distribution of scores overlapped considerably.

Because of the relationship between FFF and anxiety reaction ("operational fatigue") demonstrated in this study, it would be expected that the FFF scores of such patients would rise during the progress of successful therapy. Further research would seem to be indicated.

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CALIFORNIA DEPARTMENT OF MENTAL HYGIENE ANNOUNCES NEW PROGRAM AND POSITIONS

The State of California has embarked upon a new and progressive program for the prevention and treatment of mental disease and deficiency; preparation is already under way for the construction of several new mental institutions and for the modernization of existing facilities.

The Director of the Department of Mental Hygiene has appointed Dr. Lawrence Kolb, former Chief of the Mental Hygiene Division of the United States Public Health Service, to the position of Deputy Director, Medical, to develop and administer a program of raising treatment standards to the highest possible level and generally to promote mental health in the community.

A new position of Director of Clinical Services has also been established at each one of the mental institutions in the State of California. These positions carry responsibility for the supervision of medical activities in the institution and the development of a teaching and research program. The Clinical Directors holding these positions will be relieved of administrative responsibilities as far as possible so that they may devote their full attention to the medical aspects of their work.

The Langley Porter Clinic, in San Francisco, under Dr. Karl M. Bowman, which operates in conjunction with the University of California, is also included in the Department of Mental Hygiene. This institution offers an intensive twelve-week refresher course in psychiatry, and physicians employed by the Department are eligible for assignment to the Clinic to participate in this course.

At present there are available in the Department positions for physicians and surgeons, psychiatrists and clinical directors. Salaries range from \$345 to \$715 per month, depending upon experience and training. Veterans applying will receive special consideration for appointment and extra credit in civil service examinations. Physicians who are licensed in any other state may practice in a California mental institution for one year before securing their California license.

Inquiries should be addressed to: F. E. Kline, State Personnel Board, 401 State Building, Los Angeles, California.