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PREDICTION OF NOISE ANNOYANCE AND DISCOMFORT GLARE FROM PERSONAL CHARACTERISTICS

by

MUSA MOHAMED BABIKER

B.Sc. (Engineering), 1964

University of Khartoum/Khartoum, Sudan

Diploma, 1972

Research Institute for Management Science/Delft, The Netherlands

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Corwin A Bennett

Major Professor

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INTRODUCTION

With the advancement of technology in which man has been trying to develop the means to give himself control over the natural environment he finds that he has produced in the means themselves an artificial environment which he must consequently control.

The acoustic and luminous environments are environments to which people are exposed the whole of their lives. Also there is a high correlation between noisiness and luminousity of a community and its energy use. Noise and glare as pollutants and cause of stresses have been and still are topics of considerable concern.

Noise in the fields of electronics, neurophysiology and communication theory, means signals that bear no information and whose intensities usually vary randomly in time. This is acoustic noise. Usually the word noise is used to mean sound that is unwanted by the hearer as it is unpleasant or bothersome, interferes with perception of wanted sound, or it is physiologically harmful. On the other hand an unwanted sound to one hearer may be carrying important information to another. Therefore for a proper definition, the hearer as well as the sound must be taken into consideration. People are exposed to noise every day whether at work, home, or outdoors, some of these noises may well be described as excessive. Noise may not reach a level to produce functional effects, yet it can frequently produce a general psychological effect known as annoyance. Kryter (1970) defined the attribute of perceived noisiness (annoyance) as, "the subjective impression of the unwantedness of unexpected, nonpain or fear-provoking sound as part of one's environment." Noise annoyance and noise disability (functional effects) may arise at the

same time at whatever level noise is heard although with the highest levels of noise, such as might occur in warfare, or more exceptionally in industry, conditions can arise which would produce immediate and irreversible deafness in anyone exposed to them: 150 dB is the generally accepted level at or above which noise, even of very short duration as in an explosion, would cause immediate deafness (Canter and Stringer, 1975). Noise annoyance, however, may cause sleep disturbance, distraction from concentration when reading or studying, down to an undesirable general state of mind induced by the noise.

Light is distinguished from the rest of the electromagnetic spectrum by its effect on the retinal photoreceptors of man, through which, by photochemical and subsequent electrical changes, it produces the sensation of seeing. Sight is deeply dependent upon the lighting level. The ability of the eye to detect differences in luminance and sharpness of vision (visual acuity), both improve as the luminance is raised from low levels to high levels. On the other hand the eye does not function at its full efficiency when there is unwanted light in the visual field. If the luminance of part of the visual scene is too high for the state of adaptation of the eye then the source of the high luminance is called a glare source. There are two forms of glare effects, disability and discomfort glare. The two forms are not mutually exclusive since conditions producing disability glare also cause discomfort. Disability glare effects are performance effects. If the glare source produces discomfort or annoyance, irritation or distraction, the condition is called "discomfort glare." In practice both effects of glare may arise from the same glare cause, but in interior lighting at moderate levels of light the usual cause of complaint

is the discomfort rather than the disability which the presence of bright light sources introduce to the visual field.

In addition to physical variables in glare and noise which produce discomfort and annoyance there are factors characteristic of the viewer of light or the hearer of sound which are also relevant to discomfort and annoyance. Two people, exposed to the same glare or noise stimulus may well react differently. Different people's previous experience with glare or noise, general state of health including state of vision and hearing as well as personality differences will vary widely and might be expected to be related to noise or glare sensitivity.

Measuring these kinds of differences is a formidable task, the measurement of behavior is a different sort of problem than the measurement of the variables in the physical sciences. The personality evaluation is intuitive, subjective, and hence needs to be tested for its reliability and validity.

Literature Review

Noise. In early studies (Laird and Coye, 1929; Thomas, 1952) psychological attributes of sound or noise were described in terms of the relations between the physical characteristics of a noise stimulus presented to a person and his verbal response to questions. In most cases the questions asked had to do with the pitch (subjective "height") of a sound when its physical frequency content was changed, and the loudness (subjective intensity) of a sound as its physical intensity was varied. In brief, these studies (Kryrer, 1970) relied on the physical aspects of a sound and had used one or more of the following five significant features:

1 - spectrum content and level,

2 - spectrum complexity,

3 - duration of the total sound,

4 - duration of the increase in level prior to maximum level of nonimpulsive sounds,

5 - the increase in level, within an interval of 0.5 second of impulsive sounds.

Spieth (1956) used the method of individual adjustment, in a study which was conducted in the field under more or less real life. He found that annoyance as a function of frequency or intensity is an elusive phenomenon.

Mckennell and Hunt (1966) in a survey of noise in Central London, interviewed 1377 adults over an area of 35-40 square miles, the main source of noise being road traffic. Their survey was by questioning people at home; the questionnaire was designed to discover what the informant likes and dislikes about his neighbourhood, details of the sounds he hears and which bother him at home, outdoors and at work, the most annoying noise and how this affects him, and his attitude to noise in general. Background information such as the age, sex and occupation of the informant was also ascertained. They found that the large individual differences (in noise susceptibility or attitude) are almost totally unexplained, and that, from this study and an aircraft noise annoyance study (Mckennell, 1963), personal factors are far more potent in explaining individual differences in reaction to noise than are differences in the actual level of noise exposure.

A study by Bregman and Pearson (1972) demonstrated the ability to assess individual sensitivity to noise. A sample of 80 adults was chosen, 40 males and 40 females, between the ages of 21 and 74. They first had a hearing check

then a paper pencil test and finally a noise rating test. The paper pencil test was a questionnaire of 74 items of which 65 personality test items were selected by item analysis from the Cattell "16 P.F. Test" which includes 374 items in a pretest, plus nine attitude items which had previously been identified as high predictor items. The study was presented in a simulated living-room environment. Subjects were asked to rate the annoyance of six sounds which were equal in terms of peak sound pressure level. The analysis of noise rating data suggested no difference between noise ratings in a hard room with a hard chair compared to ratings in a soft room with soft chairs. By multiple regression analysis 20 predictive variables where chosen, giving a multiple R of 0.70.

Bryan and Tempest (1973), in a general review of the whole problem of individual differences in reaction to noise summarize:

> It is shown that not only is there a wide "spread" in the degree of annoyance due to noise, but also the population tends to show inhomogeneity in the nature of its responses. ... There is also evidence that, in some circumstances, factors relating to the individual can be more valuable in predicting the response to noise than is the nature of the noise itself.

Discomfort Glare. Most of the research done up to now was related to discomfort glare from one or a combination of the physical characteristics like size of source, position and background luminance etc (Putnam, 1951; de Boer, 1951; Hopkinson, 1957; Bennett, 1977). Bennett (1977) constructed a model for predicting BCD from source size, source angle and background luminance (physical parameters). He also found that individual differences

among observers were very large and of equal importance in predictiveness to the physical parameters. The main issues of interest have been the scaling of glare such as ratio estimation (Hopkinson and Bradley, 1959), category judgment (Haubner and Johanni, 1970), magnitude estimation (Atkinson and Ward, 1972), pupillary function as an index of discomfort glare (Fry and King, 1975). Correlation studies were also conducted between discomfort glare and some variables such as age and latitude of birth (Rex and Franklin, 1960). Bennett (1977) conducted a correlational study between discomfort glare judgments (BCDs) and age, eye color, occupation, sex, population of place of residence, hair color, and wearing of glasses, he found small correlations between BCD and age, eye color and occupation. Age was negatively correlated with BCD, brown-eyed observers tolerated higher luminances, and those with outdoor occupations tolerated higher luminances.

Individual sensitivity to discomfort glare as a function of personality factors and attributes, although realized by many researchers (Hopkinson and Collins, 1970, p. 86; Bennett, 1977), has not found much attention except in the work of Ostberg, Stone, and Benson (1975). The latter conducted an experiment to pursue three issues namely, the scaling of glare, influence of glare on the perception of task difficulty and the correlation of individual sensitivity to glare with personality factors. To study individual differences they employed the Petrie tests (dimensions of augmenting/reducing) together with personality assessments (extraversion/introversion and neuroticism) using the Eysenck Personality Inventory (Eysenck and Eysenck, 1964) and the category widith test of Pettigrew (1958). They found that only the test of neuroticism correlated significantly with glare variance, that the

subjective ratings were highly correlated to the corresponding objective Glare Indices, that increased task difficulty meant increased discomfort glare, and vice versa.

PROBLEM

Research studies have shown large individual differences in sensitivity to noise annoyance or discomfort glare. These differences need to be explained whether for scientific purposes or practical application like personnel selection or assignment.

The hypothesis in this study is that individual sensitivity to noise annoyance or discomfort glare can be assessed and predicted by a combination of demographic variables, personality factors and attitudes.

METHOD

Preliminary Test Development

To measure one of the factors of individual differences an R-S (repression-sensitization) scale was chosen (Byrne, 1961). This scale was chosen as it was believed that it could measure the sensation of individuals to the environment as well as their level of anxiety. Byrne (1961) in a research study on the repression-sensitization scale and its rationale, reliability and validity, concludes that the R-S scale appears to be a reliable test. An R-S scale of 64 questionnaire items was used.

Four demographic variables, sex, age, eye color and occupation, were also included. Bennett (1977) found a small correlation between BCD, age, and eye color.

In the light of the successful study for the development of a noise annoyance sensitivity scale by Bregman and Pearson (1972) in which they used 74 questionnaire items, nine of them were noise attitude which had previously been identified as high noise predictor items, and 65 personality scale items which were selected by item analysis from the Cattell "16 P.F. Test" in a preliminary test, the final 20 predictive items of their study were also included.

In addition five glare attitude items were written to form a total of 93 test items for BCA and BCD.

A preliminary test of these 93 items was conducted on a class of 24 industrial engineering students at Kansas State University 1976-1977. The students were asked to answer all the questions and state the time it took

them to finish. The average time was found to be 14 minutes. As it was not possible to measure their BCAs and BCDs (the dependent variables), empirical BCA and BCD scores were obtained by adding up the six noise attitude items scoring to act as BCA and the five glare attitude items as BCD. A Pearson correlation and a stepwise multiple regression analysis with dummy variables were conducted. Two sets of variables were thus obtained for each dependant variable, the first set of variables were those which correlated significantly, at .10 level, with the dependent variable and the second set were those variables entered into the regression model by the stepwise procedure. From these four sets (two for BCA and two for BCD) a final questionnaire form of 64 items was developed, this will be referred to as "Personal Enlightenment Test", as shown in Appendix A. The 64 items were selected in such away as to include some items of each of the four categories of items, Appendix C, and also to shorten the test duration to conform with the nature of conducting the experiment on visitors of the annual Engineering Open House at Kansas State University.

Task, Informed Consent and Instructions

Subjects. Subjects for this experiment were visitors to the annual Engineering Open House at Kansas State University in the Spring of 1977. In this program, exhibits intended primarily for high school students are also visited by their parents and others. Signs were placed in the corridors inviting people to come to the experiment on noise and glare. A brief explanation of noise and glare and their effects were given to the visitors, they were then asked whether they would like to take part in the experiment which would take about 20 minutes. About 114 visitors participated in

the experiment although only 100 did all three tasks, while one visitor did not do the noise test. Thus the data for this experiment was from 101 subjects whose ages ranged from 13 to 64 years with a mean of 27 years and a median of 21 years, 71 males and 30 females.

When a visitor had agreed to take part in the experiment, he was asked to read a description of the experiment entitled "Informed Consent and Instructions", Figure 1, and indicate his willingness to participate. He was then assigned randomly to one of the three tasks.

Glare. For glare the subject sat with his face in a face rest looking horizontally at the pole of a two-foot radius hemisphere sitting on edge. Recorded instructions were read to him, Figure 2. This hemisphere was constructed of posterboard painted flat white. An aperture was placed at the pole (0^0) along the horizontal line-of-sight. The aperture was fixed to give a source size of 1.76×10^{-4} steradian. The background luminance was provided by room luminance producing a uniform luminance of about ten foot-lamberts over the hemisphere.

The glare source was a Sylvania CTT 1000 w, 120v, bulb. The observer adjusted the luminance of the glare source by means of a transformer and a selected neutral-density filter placed in front of the aperture. A stop on the transformer knob limited its lower value to 35 volts to eliminate operation of the source in the "red" region. The transmission factors of the filters were 100% (a hole) 9.1%, 0.68% and 0.07%. Subjects made two or three adjustments with the voltage reset to a low value each time. These voltage-readings, measured across the lamp, were averaged out and then transformed to foot-lamberts (fL).

This is an experiment on discomfort glare and noise annoyance, it involves three tasks only:

1. Answer a questionnaire
2. Make an adjustment to a glare source
3. Make an adjustment to a noise source.

In task number one you will be asked to answer some questions as to how you feel about various matters.

For task 2 you will be shown a small light source directly on your line-of-sight. You will be asked to adjust the source from a low brightness upwards to a level which is not quite uncomfortable. At no time do we want you to adjust the light to a level which is extremely uncomfortable.

For task 3 you will hear a low noise level from a loudspeaker at some distance in your back. You will be asked to adjust the source of noise from a low level upwards to a level which is not quite annoying. At no time do we want you to adjust to a level which is extremely annoying.

There would be no discomfort, annoyance nor risk from the experiment; however, you are free to stop your participation at any time. Naturally, we would prefer that you would continue to the end of the time period.

If you have any questions, now or later, feel free to ask.

"Having read the attached informed consent, I hereby freely agree to be a subject in the research entitled:

Discomfort Glare and Noise Annoyance"

Figure 1. Informed Consent and Instructions.

"There is a concept called borderline between comfort and discomfort" or "BCD". First, take the control and increase the intensity of the light to a high level. Look at the light! Most people would say that this level of light is uncomfortably glaring. Now take the control and turn the light down until it is at a low level. Look at the light! Most people would say that this level is comfortable, that is, not glaring. Now, somewhere in between these two extremes should be a point of change, a threshold, where the light is at the borderline between comfort and discomfort. This is what we call BCD. This point should be such that the light is not annoying or uncomfortable for you, but if it were any brighter it would be uncomfortable. Take your time to find the BCD point. It may take a little time at first to decide whether the light is comfortable or not. Adjust the brightness up and down until you find your BCD. Do not set the brightness at the border line between tolerable and intolerable ... that is a higher level. Similarly, do not use the pleasantness ... comfortable criterion ... this is a lower level. BCD is between these two criteria.

Now I want you to make your first adjustment to BCD. Take your time, run the control back and forth as much as you need. When you have completed your adjustment signal the experimenter to record the setting.

Now go ahead."

Figure 2. Recorded Instructions for Glare.

Noise. For noise adjustment, the subject was seated in a chair at a table on which the sound control knob was fixed while a loudspeaker was placed three feet behind his back at the level of his ears. Recorded instructions were then read to him, Figure 3.

A Lafayette 15011 and 12 white Noise Generator was used as the sound generator. An Alamo amplifier with 50-watts rated output drove the speaker. The attenuator of the white noise generator was kept fixed on 20 decibels. Background noise was provided by the apparatus at a level of about 55 dB, while the upper level was limited to 100 dB. As with glare each subject made two or three adjustments with the voltage reset to a low value each time. These voltage-readings, measured across the loudspeaker, were averaged and transformed to decibels.

For the written test subjects were handed the questionnaire and answer sheets, they were also told to write any comments on the questionnaire or the experiment at the back of the answer sheet. Appendix A shows the test and instructions. Appendix B shows the answer sheet.

"There is a concept called border line between comfort and annoyance or "BCA". First, take the control and increase the intensity of the sound to a high level. Wait for a few seconds! Most people would say that this level of sound is uncomfortable or annoying. Now take the control and turn the sound level slowly down until it is at a low level. Wait for a few seconds! Most people would say that this level is comfortable, that is, not annoying. Now, somewhere in between these two extremes should be a point of change, a threshold, where the sound is at the borderline between comfort and annoyance. This is what we call BCA. This point should be such that the sound is not annoying or uncomfortable for you, but if it were any louder it would be uncomfortable. Take your time to find the BCA point. It may take a little time at first to decide whether the sound level is comfortable or not. Slowly adjust the sound level up and down until you find your BCA. Do not set the sound at the borderline between tolerable and intolerable ... that is a higher level. Similarly, do not use the pleasantness ... comfortable criterion ... this is a lower level. BCA is between these two criteria.

Now I want you to make your first adjustment to BCA. Take your time, turn the control back and forth as much as you need. When you have completed your adjustment signal the experimenter to record the setting.

Now go ahead"

Figure 3. Recorded Instructions For Noise.

RESULTS

Three sets of data were obtained from this experiment. The first set were the physical adjustments of BCA in decibels (dB) and the second set were the physical adjustments of BCD in foot-lamberts (fL) as shown in Appendix D. The third set of data were the questionnaire responses. The first two sets of data were examined separately, then together, and finally each of them serving as the dependent variable or criterian was examined in relation to the questionnaire responses.

BCA

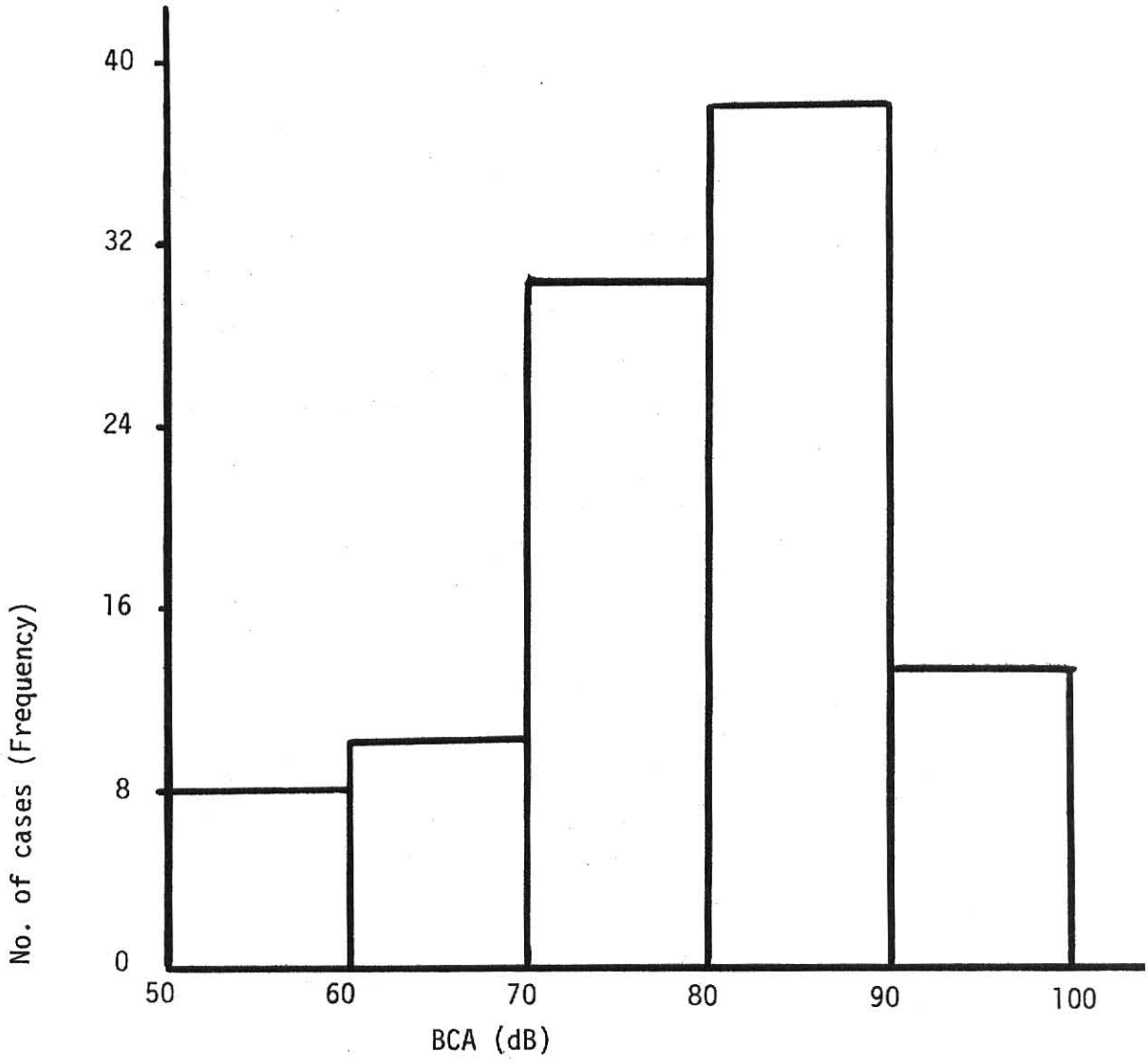
The distributional characteristics of 100 cases (one subject did not make BCA adjustment) are shown in Figure 4.

The distribution is almost a normal curve although the cases are clustered more to the right of the mean with most of the extreme values to the left. The distribution is also a little flatter than a normal distribution. A mean of 78.36 dB and a median of 80.00 dB were obtained.

BCD

The distributional characteristics of BCD for 101 cases are as shown in Figure 5.

The data is far from normality, the cases are clustered more to the left of the mean with some large values. The distribution tends to be more peaked than would be true for a normal distribution. The median of 4823.0 fL obtained for this study is not far from that obtained by Bennett (1977) with a value of 3551.75 fL.



Mean	78.36 db	STD ERR	1.007	Median	80.0 db
Mode	85.00 db	STD DEV	10.065	Variance	101.306
Kurtosis	-.368	Skewness	-.401	Range	43.10
Minimum	56.40 db	Maximum	99.50 db		

Figure 4. Distributional Characteristics of BCA

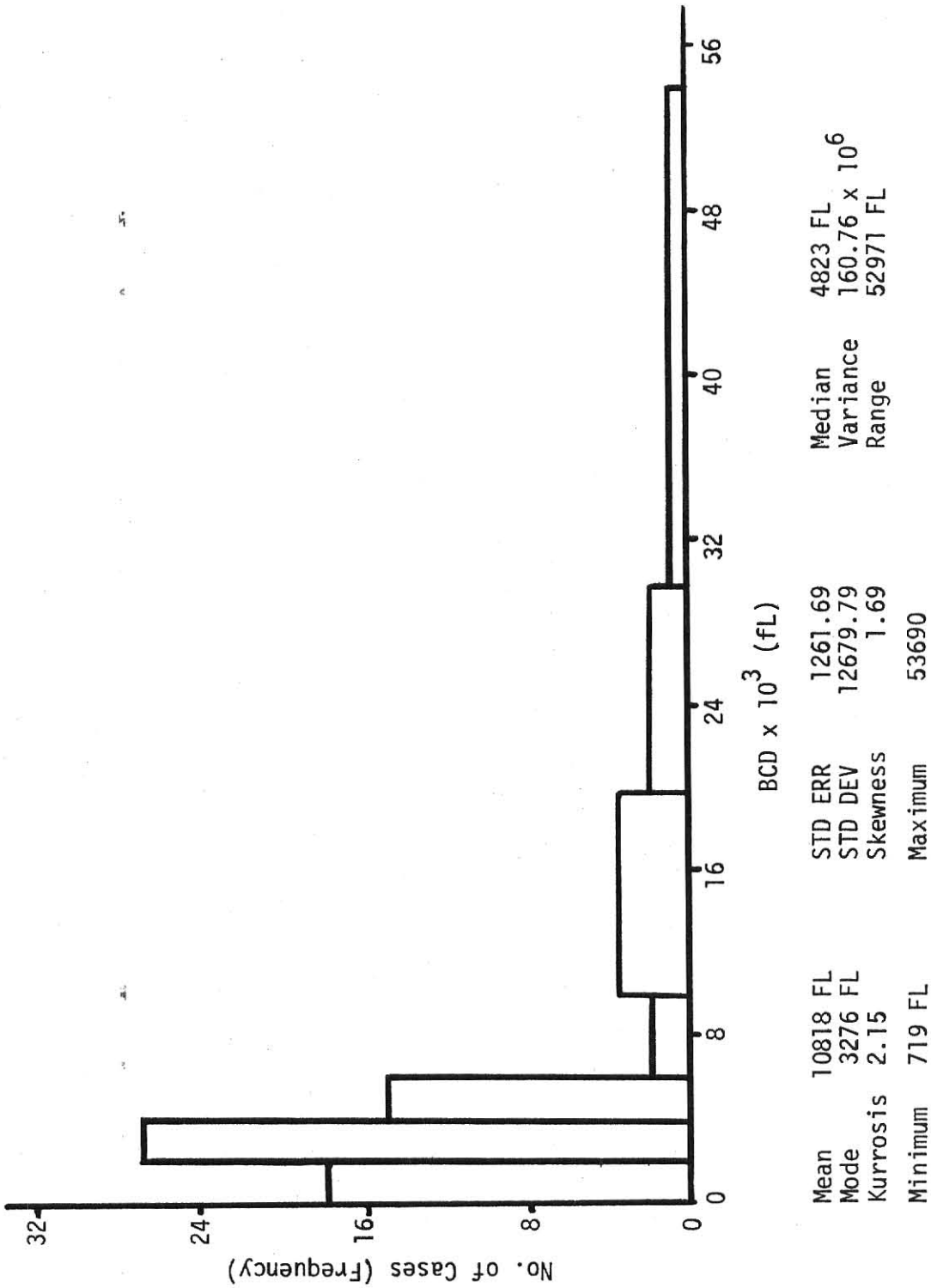


Figure 5. Distributional Characteristics of BCD

Correlation Between BCA and BCD

Using Pearson's zero-order or product-moment correlation a low correlation was found between BCA and log BCD, a correlation of 0.1869, significant at 6.3% level.

Questionnaire Responses, BCA and BCD

The zero-order correlations between each of the dependent variables and the questionnaire items were generally small. A stepwise multiple regression analysis using dummy variables for all the questionnaire items except items 13, 35, and 62 (age) which were treated as continuous variables, was used to build the regression equations for prediction of BCA and BCD. The SPSS program (Nie, Hull, Jenkins, Steinbrenner, and Bent, 1975) was used. Cases with missing values, however, were not excluded instead a pairwise deletion was followed. Nearly all the variables were allowed to enter the equation by specifying an F value of .001 to enter. This naturally lead to an over-fitting as the number of parameters in the model got closer to the saturation point - that is, the number of cases. The multiple R for BCA in this case was 0.96 with 70 variables (some items have more than two dummy variables), and 0.96 for BCD with 60 variables. This step, however, was meant to determine the order of inclusion of variables into the equation. It should be mentioned here that although the subjects answered all the questions, variables which were related to glare attitude were excluded from the regression variable list for BCA and the same applied to BCD by excluding the noise attitude variables.

The cutoff point was then chosen at that step where the last entering variable had an F value significant at 0.1 level. This happened to be

step 22 for both BCA and BCD, with a multiple R of 0.78 ($P < .002$) for BCA and a multiple R of 0.81 ($P < .002$) for BCD.

The 22 variables were then grouped according to their four classifications, R-S variables, demographic, noise and glare attitudes, personality test variables (Bregman and Pearson, 1972), as shown in Table 1.

The first adjustment of the regression equation was done by completing the dummy variables for each item which had two or more dummy variables one being in the equation while the other was not. For example, an item having three responses will have two dummy variables, if it happened that one was in the equation and the other was not then the latter was forced into the equation. By this procedure the regression equations for BCA and BCD included 32 variables (21 items) and 29 variables (22 items) respectively, and the multiple R of BCA was 0.80 ($P < .005$) and for BCD 0.82 ($P < .005$).

Each set of variables were then correlated with its dependent variable. The multiple correlation coefficients (R) and probabilities obtained for BCA and BCD are as shown in Table 2.

The regression equations were also subjected to more investigation by using the four classification groups as sets of variables to detect the significance and contribution of each set to the regression models by a hierarchical inclusion in the order mentioned before. Table 3 shows the percentages of BCA and BCD variances accounted for by the R-S set and the increment due to the subsequent set over and above the preceding set. It also shows the percentage of each set related to the total explained variance, and the number of items in each set.

TABLE 1

Variables In the Regression Equation by Stepwise Analysis

1) R-S Variables

BCA	BCD
1	2
9	5
15	14
21	26
27	32
36	41
38	44
49	51
	54
	56
	58

2) Demographic Variables

BCA	BCD
61 - My eyes are (a) brown (b) light colored	sex
62 - My year of birth was _____	62 - My year of birth was _____

3) Noise Attitude Variables	Glare Attitude Variables
10c, 10E	24
16c	35
42	57c

4) Personality Test Variables (Bregnan and Pearson, 1972)

BCA	BCD
3c	3
28c	23c
34c	31
48	34c
53c	53
60	60

Numbers in the table refer to the 63 items of the Personal Enlightenment Test

TABLE 2

Multiple Correlation Coefficients (R) and Probabilities Between Each of BCA and BCD and the Four Sets of Variables

Set	BCA		BCD	
	R	Probability	R	Probability
1) R-S set	0.4910	P < .025	0.5574	P < .005
2) Demographic set	0.2526	P < .05	0.3605	P < .005
3) Noise Attitude set	0.2487	Not significant	0.3005	P < .10
4) Personality Test set	0.3867	P < 0.25	0.3998	P < .25

TABLE 3

Hierarchical Inclusion of Sets for BCA and BCD

Set	# of items	BCA Percentage Increment of the Set	% of Total Explained Variance	# of Items	BCD Percentage Increment of the Set	% of Total Explained Variance
1) R-S set	10	24.1%	38.0%	11	31.1%	46.3%
2) Demographic Set	2	6.6%	10.4%	2	4.2%	6.3%
3) Attitude set	3	8.5%	13.4%	3	11.5%	17.1%
4) Personality Test Set	6	24.2%	38.2%	6	20.3%	30.3%
Total	21	63.4%	100%	22	67.1%	100%

The final step was to test the statistical significance of the contribution of each set of variables to the explained variation by the preceding set(s), that is, testing the partial regression coefficients of the sets. This was performed by the hierarchical F-test method given in the SPSS (Wie, Hull, Jenkins, Steinbrenner, and Bent, 1975)

$$F = \frac{(R^2_{y\cdot i,1,2,\ldots,s} - R^2_{y\cdot i-1,1,2,\ldots,s})/M}{(1-R^2_{y\cdot 1,2,\ldots,K})/(N-K-1)}$$

where $R^2_{y\cdot i}$ = Multiple R squared up to and including set i.

$R^2_{y\cdot i-1}$ = Multiple R squared up to and including set i-1.

S = Number of sets.

M = Number of independent variables in the set

N = Number of cases.

K = Number of independent variables in the model.

The calculated values for F and probabilities are shown in Table 4.

Plotting of standardized residuals against standardized predicted values for each of the two dependent variables (BCA and BCD) indicated no pattern and that the regression equations had a good fit for the data.

In order to assess how well these multiple regression equations predict, a cross validation was performed. This test was accomplished by first obtaining the multiple regression equations for half the data and then using these to predict BCA's and BCD's on the other half. The correlation between the predicted values and the actual values was a measure of the adequacy of prediction. For this test the data was split into two halfs, odd-numbered

TABLE 4

F-test for Partial Regression Coefficients of Sets for BCA and BCD

Set	BCA Calculated F	BCA Probability	BCD Calculated F	BCD Probability
1) R-S Set	4.215	P < .005	5.661	P < .005
2) Demographic Set	5.755	P < .025	4.185	P < .025
3) Attitude Set	1.8725	P < .10	5.793	P < .005
4) Personal Test Set	3.527	P < .005	3.382	P < .005

and even-numbered cases. Stepwise multiple regression analysis was carried on the odd half which had 51 cases. For BCA the regression equation included 9 items with a multiple R of 0.79 ($P < .005$) compaired to an R of 0.8 ($P < .005$) for the final model (all data). For BCD the regression equation included 6 items with a multiple R of 0.73 ($P < .005$) compaired to an R of 0.82 ($P < .005$) for the final model (all data). The correlation coefficient between the actual BCA and predicted value was 0.24 with a probability of .046, and for the actual and predicted values of BCD the correlation coefficient was 0.21 with a probability of .077. Using the Spearman-Brown correction formula, a coefficient of 0.39 was found for BCA and a coefficient of 0.35 for BCD. This correction was used due to the fact that the two halves of the test were shorter than the actual test and since reliability is affected by test length, the correlation was multiplied by two and divided by one plus the correlation to obtain the corrected reliability coefficient.

The final forms of the predictive models for BCA and BCD are presented in Tables 5 and 6 respectively, with their partial regression coefficients. To obtain the predicted BCA in decibels (dB) or the predicted BCD in footlamberts (fL), one adds up to the constant value each partial regression coefficient corresponding to the response of an individual to an item, for all items except in the case of items 13, 34 and 62 the coefficients of which are to be multiplied by the scoring of an individual on those items and added up.

TABLE 5

Final Noise Annoyance (BCA) Prediction Equation with Partial Regression Coefficients.

Question # on Personal Enlightenment Test		Question		Partial Regression Coefficients
Constant				102.50
R-S Variables				
1	1)	I am apt to pass up something I want to do because others feel that I am not going about it in the right way.		
			True	0.0
			False	-2.75
9	2)	There seems to be a lump in my throat much of the time.		
			True	0.0
			False	+15.45
15	3)	It makes me uncomfortable to put on a stunt at a party even when others are doing the same sort of thing.		
			True	0.0
			False	-2.71
21	4)	Most nights I go to sleep without thoughts or ideas bothering me.		
			True	0.0
			False	-6.08
27	5)	I can read a long while without tiring my eyes.		
			True	0.0
			False	+4.91
36	6)	I have a habit of counting things that are not important such as bulbs on electric signs, and so forth.		
			True	0.0
			False	-8.71
38	7)	I easily become impatient with people.		
			True	0.0
			False	+6.68

Question # on Personal Enlightenment Test		Question		Partial Regression Coefficients
46	8)	I have periods of such great restlessness that I cannot sit long in a chair.		
			True	0.0
			False	-5.95
47	9)	I commonly wonder what hidden reason another person may have for doing something nice for me.		
			True	0.0
			False	+4.63
49	10)	Life is a strain for me much of the time.		
			True	0.0
			False	-9.15
Demographic Variables				
61	1)	My eyes are	(a) brown	0.0
			(b) light colored	-4.90
62	2)	My year of birth was -	Age x	-0.229
Noise Attitude Variables				
10	1)	The taking of private property (including homes) for airport expansion and highway construction should be accepted by all citizens as a necessary step in the community growth		
			(a) strongly agree	0.0
			(b) agree	-2.94
			(c) indifferent	-4.45
			(d) disagree	-4.07
			(e) strongly disagree	+2.77
16	2)	If the world in which you live gets noticeably noisier in the future would this matter to you?		
			(a) hardly at all	0.0
			(b) it would matter a little	+1.54
			(c) it would matter very much	+4.62

Question # on Personla Enlightenment Test	Question	Partial Regression Coefficients
42	3) On the whole, would you say that you were more bothered by aircraft this year than in the past, or have you become used to aircraft?	
	(a) have become used to aircraft	0.0
	(b) about the same	-3.61
	(c) more bothered now	-3.25
	Personality Test Variables (Bregman and Pearson, 1972)	
3	1) I believe in:	
	(a) being properly serious in every day business	0.0
	(b) inbetween	-0.47
	(c) the motto "laugh & be merry" on most occasions	-10.25
28	2) I like to take an active part in social affairs, committee work etc.	
	(a) Yes	0.0
	(b) Inbetween	-2.40
	(c) No	-7.69
34	3) I think the spread of birth control is essential to solving the world's economic & peace problems.	
	(a) No	0.0
	(b) Uncertain	-2.17
	(c) Yes	-3.69
48	4) People sometimes call me careless even though they think me an attractive person.	
	(a) Yes	0.0
	(b) Inbetween	-5.98
	(c) No	-1.48
53	5) I think I am better described as:	
	(a) Forceful	0.0
	(b) Inbetween	- .51
	(c) Polite & quite	-4.22
60	6) In my newspaper, I like to see:	
	(a) good coverage of all local news	0.0
	(b) inbetween	-5.88
	(c) debate on social issues in the modern world	-2.83

TABLE 6

Final Discomfort Glare (BCD) Prediction Equation with Partial Regression Coefficients

Question # on Personal Enlightenment Test		Question		Partial Regression Coefficients
Constant				-3087.6
R-S Variables				
2	1)	I am almost never bothered by pains over the heart or in my chest.		
			True	0.0
			False	+8759.3
5	2)	My hardest battles are with myself.		
			True	0.0
			False	+8485.0
14	3)	I wish I could be as happy as others seem to be.		
			True	0.0
			False	-4053.3
26	4)	I am happy most of the time.		
			True	0.0
			False	+7288.7
32	5)	I enjoy many different kinds of play and recreation.		
			True	0.0
			False	-8019.8
41	6)	I am in just as good physical health as most of my friends.		
			True	0.0
			False	-9244.3
44	7)	I resent having anyone take me in so cleverly that I have to admit that it was on me.		
			True	0.0
			False	+5894.9
51	8)	I forget right away what people say to me.		
			True	0.0
			False	+6001.9
54	9)	Sometimes I become so excited I find it hard to get to sleep.		
			True	0.0
			False	-7186.4

Question # on Personal Enlightenment Test	Question	Partial Regression Coefficients
56	10) I often feel as if things were not real.	
	True	0.0
	False	-4540.3
58	11) I feel tired a good deal of the time.	
	True	0.0
	False	-6013.5
	Demographic Variables	
-	1) Sex	
	Female	0.0
	Male	+5167.2
62	2) My year of birth was _____ Age x	-13.1
	Glare Attitude Variables	
24	1) In your opinion can headlight glare be prevented:	
	(a) Yes	0.0
	(b) No	+5673.1
35	2) Here is a list of glaring lights which sometimes annoy people. Check all that ever bother you. (a) headlights (b) windows (c) floorlamps (d) desk lamps (e) ceilings light fixtures (f) candles on tables (g) sun reflections off of cars (h) street lights	
	Total number scored X	+980.9
	(i) Not bothered by any of these	0.0
57	3) Do you believe glare has any effect on your health?	
	(a) Yes ---- definitely	0.0
	(b) Probably --- perhaps indirectly	-1117.0
	(c) No --- I don't think so	+10027.6
	Personality Test Variables (Bregman and Pearson, 1972)	
3	1) I believe in:	
	(a) being properly serious in everday business	0.0
	(b) in between	+7247.3
	(c) the motto "laugh and be merry" on most occasions.	-449.4

Question # on Personal Enlightenment Test	Question	Partial Regression Coefficients
23	2) Going around selling things, or asking for funds to help a cause I believe in is for me:	
	(a) quite enjoyable	0.0
	(b) inbetween	+524.5
	(c) unpleasant job	+7563.4
31	3) When bossy people try to "push me around" I do just the opposite of what they wish.	
	(a) No	0.0
	(b) inbetween	+4690.3
	(c) Yes	-3065.7
34	4) I think the spread of birth control is essential to solving the world's economic and peace problems.	
	(a) No	0.0
	(b) Uncertain	+380.6
	(c) Yes	-5472.8
53	5) I think I am better described as:	
	(a) Forceful	0.0
	(b) Inbetween	+507.1
	(c) Polite & quiet	+3846.7
60	6) In my newspaper, I like to see:	
	(a) good coverage of all local news	0.0
	(b) inbetween	-4993.7
	(c) debate on social issues in the modern world	-874.8

DISCUSSION

Noise

The distributional characteristics of Figure 4 for BCA (dBA) suggest that the population is normally distributed with respect to its noise annoyance thresholds with a mean of around 80 dB and a standard deviation of about 10. The value of 80 dB for the median is somewhat less than what is designated as the limit of the risk of commencement of the hearing loss (85 - 90 dB(A)) for occupational noise. The standard in the USA by the Occupational Safety and Health Administration (OSHA) is 90 dBA for 8 hours exposure per day. Noise beyond 115 is not permitted, noise below 85 is considered to have no harmful effects. If discomfort or annoyance has a function of "protecting" the person against harmful environmental conditions, then this is an interesting relationship of BCA to the threshold limit value (TLV).

The multiple correlation between each of the sets of variables or items (in the final model) and BCA, over looking the number of items in each, showed that the R-S set had the highest value of about 0.5, significant below the .025 level (Table 2). The Personality - Test set (Bregman and Pearson, 1972) had a multiple correlation of about 0.4, significant below 0.25 level. The Personalty-Test set, however, has an equal contribution to the regression model (24.2%) as the R-S set although it contains only 6 items while the R-S set has 10 items, Table 3. The demographic set had a multiple correlation of 0.25, significant below the .05 level; its contribution to the regression model was only 6.6%. The noise attitude set had an insignificant multiple correlation with BCA. This last result can be considered in agreement with Mckennell and Hunt (1966) who found no correlation between attitude to noise and the physical measurements of the noise environment of the informant in their survey of noise in Central

London. In the final model, however, the attitude set contributed 8.5% to the regression model, Table 4 shows that the partial regression coefficients for the noise attitudes are significant below the .10 level.

The demographic set, age and eye color, indicated a negative correlation with BCA. The negative correlation of age with noise was expected, Mckennell, et al. (1966) stated "It is evident that the correlation with age is not very strong. There is a slight tendency for the under 30's and over 60's and (particularly) over 70's to be less susceptible, the latter perhaps because of increasing deafness." For the relation between eye color and noise annoyance, Kryter (1970, p. 532) says that noise has been thought to influence visual acuity and field, color vision, and the critical flicker frequency (CFF). In this study sex was found to be of little predictive value in agteement with Pearson and Hart (1968). The final regression equation has a multiple R of 0.8 ($p < .005$).

As a test of Bregman and Pearson's (1972) predictor items and the other items, 17 out of the 20 predictive items were used alone as independent variables in a multiple regression equation using dummy variables. The 17 items were composed of 6 noise attitude items and 11 personal-test items. A multiple R of 0.7 ($p < .10$) was found. This value of R was the same as that obtained by Bregman, et al. (1972) using the 20 variables. This result was considered as an indication of the validity of their test items and a reliability of the present instrument.

From the preceding discussion it is evident that what might be called the personality factors, the R-S and the personality - test sets of predictors, account for most (75%) of the explained variation by the regression model. However, a question can be raised: How do the personal characteristics

differ from each other after the differences in age are adjusted for? In this study the effect of age is considered as additive i.e. the predicted value of BCA is:

= Constant + Partial Coeff of Item 1 + Partial Coeff. of item 2
+ ------ + Partial Coeff. X Age.

In other words the regression model could contain in addition to these main effects all possible interaction terms of age with each dummy variable. This, however, was not done in this study and is left for future studies as the number of cases in this study were less than the required number for fitting such a model.

This study has been successful first in reflecting the power of each set of variables, second in demonstrating the possibility of predicting noise annoyance thresholds of individuals by a written questionnaire, and third it has the interesting finding that BCA is slightly lower than the threshold limit value (TLV):

Glare

The distributional characteristics of Figure 5 for BCD are far from normality, the clustering is more to the left of the mean (low BCDs) and the extreme thresholds (high BCDs) to the right of the mean. The mean BCD is about 11000 fL with a standard deviation of about 13000 fL and a median of about 5000 fL. To compare these values with the standard in practice in Britain, Table 7 was constructed using the empirical formula developed by the Building Research Station (Interior Lighting Design, 1969, p. 30):

$$\text{Glare Constant} = \frac{B_s^{1.6}\, w^{.8}}{B_b\, p^{1.6}}$$

TABLE 7

Equivalent Glare Indices for BCD

Present Study Values BCD fL	Glare Constant	Glare Index
Min. BCD = 719	1.356	1.323
Mode BCD = 3276	15.350	11.860
Median BCD = 4823	28.500	14.550
Mean BCD = 10818	103.800	20.160
Max BCD = 53690	1347.080	31.234

where

B_s = the brightness of the source measured in fL.

B_b = the brightness of the background measured in fL

w = the apparent size of the source (in steradians)

luminance factor to account for its location),

the value of the Glare Index was then determined from the IES (London) empirical formula:

$$\text{Glare Index} = 10 \log_{10} (\text{glare constant})$$

The Glare Index limit for the IES code is 10 to 28 increasing in Steps of 3. The lower limit (Glare Index = 10) is used for environments where no glare at all is permissible e.g. an art gallery or inspection shops for minute work (e.g. very small instruments). The upper limit (Glare Index = 28) is for environments where glare of a higher degree can be permitted due to the nature of the work e.g. relatively rough industrial work. The present calculated values for the mode, median, and mean are the Glare Indices 11.9, 14.6, 20.2 respectively. This means that all are within the limits. If the IES limits were transfered into foot-Lamberts a Glare Index of 10 yields a BCD of 2506 fL and a Glare Index of 28 yields a BCD of 33422 fL. The values obtained in this study, Table 7, are therefore justifiable. Hopkinson and Collins (1970, pp. 84-86) relate the glare constant to the Criterion of Glare Discomfort. In this study the mean BCD is equivalent to a Glare, Constant of 104 which lies between Hopkinson's Criteria "B" and "C", i.e., between "just uncomfortable" and "just acceptable". From the graph of Hopkinson and Collins (1970, p. 86) this equivalent value could be estimated to satisfy 85% of the general population.

The relation found between BCA and TLV could also be extended for BCD assuming that discomfort glare is, like noise annoyance, a point or a stage prior to the commencement of harmful effects. Thus the lower threshold limit value (TLV) could be set a little over a Glare Index of 20 or 11000 fL BCD.

In the U.S.A., however, the Illuminating Engineering Society (IES Lighting Handbook, 1972) standard lighting guide adopts a rating system based on the degree of freedom from discomfort glare called visual comfort probability (VCP). The rating of the lighting system is expressed as a percent of people who, if seated in the most undesirable location, will be expected to find it acceptable. Computations similar to those of the British standard practice were not, however, possible for this study due to the lack of some references.

The classification of the predictor items or variables (in the final model) into sets and the multiple correlations between each set and BCD, Table 2, shows that the R-S set has the highest correlation and is also significant ($p < .005$). The correlation with the demographic set (.36) was also significant ($p < .005$). The multiple correlation between BCD and the attitude and personality-test sets was nearly the same as that found for BCA. The final regression equation had a multiple R of 0.82 which was significant ($p < .005$). Table 3 shows that the R-S set of variables contributed the highest percentage (31.1%) of the variance accounted for by the regression model, while the personality test set accounted for only 20.3%. The glare attitude set accounted for more than the noise attitude set for BCA. The total explained variation accounted for by regression model is 67.1%. Table 4 shows that all the partial regression coefficients are significant.

In the demographic set of variables, males were found to have a higher BCD than females with a non-significant correlation of .10 with BCD, Bennett (1977) found a mon-significant correlation of 0.09. Age was found to have a negative correlation of 0.38 ($p = .001$) with log BCD or 0.31 with BCD, Bennett (1977) also found negative correlations of 0.31 and 0.36 - based upon log transformation of both variables. A small correlation of 0.06 was found between BCD and eye color in this study, which in agreement with Bennett (1977) who found a correlation of 0.16.

From the above discussion it could be stated that the study has succeeded in explaining some of the individual differences with respect to glare sensitivity. It was found that what might be called the personality factors, the R-S and personality-test sets of predictors, together constitute about 75% of the explained variation by the regression model, although what has been mentioned for BCA with respect to the interaction of age and personal characteristics is also applicable here. The final regression model demonstrated the possibility of predicting discomfort glare by a written questionnaire. The study has also managed to suggest something to the question of how the threshold limit values (TLV) for glare might be in analogy to noise. However, a more substantive further research basis is needed here.

Noise and Glare

Some common relationships have also been investigated in this study. The correlation between BCA and log BCD was small (.19) and was significant, this might suggest that some common factor underlies BCA and BCD.

The corrected correlation coefficients of 0.39 and 0.35 for the predicted and actual values of BCA and BCD respectively in the cross-validation seem to be reasonable for this study as the number of cases is not big enough for so many predictors. Fifty cases, half the data, for more than 70 dummy variables will not give a good regression model. For better results, however, about 3 cases per variable are usually necessary.

Noise or glare control, in general, should take into consideration the noise or glare sources as well as the listener or viewer. The efforts by engineers and designers to reduce noise and glare levels at the source and/or through the conduction media, could be complemented by raising the levels of tolerance of the individuals to noise and glare . As this study indicates the sensitivity of individuals to noise or glare is a complex of factors governed by their previous experience, customs, attitudes, education etc as well as personality and/or personal factors. Raising the average levels of tolerance (without damage to the health) does not seem easy to achieve. Something could be done however, by classifying the population into categories according to noise or glare sensitivity and similarly classifying the human environments according to their noiseness or luminousity and then the matching of each category of individuals to its most suitable environmental category. This, however, could be put into practical use in some cases like in urban planning by making noise level zones or contours. Thus we can say that in a city zone "A" for individuals with high BCA, zone "B" for people with a lower BCA, etc. This could help in setting laws and regulations aimed at controlling excessive noise to cover the majority of individuals in a specific category. Industries or sections within an

industry can also be classified according to their noiseness or luminousity, and hence people could be selected for work or jobs in an industry or a section according to their noise or glare sensitivity. To attain such a classification of individuals or their selection for jobs an appropirate procedure is by written tests such as developed in this study.

Although the above discussion referred to both noise and glare problems, usually noise is a more disturbing pollutant in the environment than glare.

Further research in the problem of individual differences with respect to noise annoyance or discomfort glare is necessary. Inclusion of as many sets or categories of test items related to individual differences like demographic, attitudinal, biographical, personality factors, etc, might give more predictiveness especially when interaction terms are considered. The number of subjects for such a study should at least be three times the number of variables. Also experiments with recruited subjects might give better results than those with volunteers as the recruited subjects can be familiarized with BCA or BCD adjustments before taking final readings. Observers or hearers who have acquired some experience will tend to give more stable settings, i.e., an experienced subject may have only a small variance about his own mean value of adjustments.

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APPENDICES

Appendix A. Personal Enlightenment Test

This is a research test. There are no right nor wrong answers. We are simply interested in how different people react to their environment.

Answer quickly. Some of the questions may seem quite personal. All results of individuals will be kept confidential. You may not answer any question if you prefer.

Do not mark on this questionnaire-instead circle the proper answer on the answer blanks provided.

1. I am apt to pass up something I want to do because others feel that I am *not going about it in the right way.* true false
2. I am almost never bothered by pains over the heart or in my chest. true false
3. I believe in: (a) being properly serious in everyday business (b) in between (c) the motto "laugh and be merry" on most occasions.
4. It takes a lot of argument to convince most people of the truth. true false
5. My hardest battles are with myself. true false
6. My sleep is fitful and disturbed. true false
7. I do not tire quickly. true false
8. If the world in which you live gets noticeably more glaring in the future, would this matter to you? (a) hardly at all (b) it would matter a little (c) it would matter very much.
9. There seems to be a lump in my throat much of the time. true false
10. The taking of private property (including homes) for airport expansion and highway construction should be accepted by all citizens as a necessary step in the community growth. (a) strongly agree (b) agree (c) indifferent (d) disagree (e) strongly disagree.
11. Much of the time my head seems to hurt all over. true false
12. My hands and feet are usually warm enough. true false
13. Here is a list of noises which sometimes annoy people. List any that ever bother you.
    (a) lawn mowers
    (b) dripping water faucet
    (c) dogs barking
    (d) banging doors
    (e) someone turning on the radio when you want quiet
    (f) jack hammers and pneumatic drills, air compressors
    (g) air conditioning units
    (h) sound of a knife grating on a plate
    (i) automobile horns
    (j) church bells
    (k) motor bikes, motor cycles, and scooters
    (l) someone whistling *out of turn*
    (m) not bothered by any of these

14. I wish I could be as happy as others seem to be. true false
15. It makes me uncomfortable to put on a stunt at a party even when others are doing the same sort of thing. true false
16. If the world in which you live gets noticeably noisier in the future would this matter to you? (a) hardly at all (b) it would matter a little (c) it would matter very much.
17. I tend to keep quiet in the presence of senior persons (people of greater experience age, or rank) (a) yes (b) in between (c) no
18. At times I feel like picking a fist fight with someone. true false
19. I frequently have to fight against showing that I am bashful. true false
20. Much of the time I feel as if I have done something wrong or evil. true false
21. Most nights I go to sleep without thoughts or ideas bothering me. true false
22. Criticism or scolding hurts me terribly. true false
23. Going around selling things, or asking for funds to help a cause I believe in is for me: (a) quite enjoyable (b) in between (c) an unpleasant job.
24. In your opinion can headlight glare be prevented? (a) yes (b) no
25. Often I can't understand why I have been so cross and grouchy. true false
26. I am happy most of the time. true false
27. I can read a long while without tiring my eyes. true false
28. I like to take an active part in social affairs, committee work etc. (a) yes (b) in between (c) no.
29. When I am called in by my boss (or teacher) I: (a) see a chance to put in a good word for things I am concerned about (b) in between (c) fear something is wrong
30. I think most people would lie to get ahead. true false
31. When bossy people try to "push me around" I do just the opposite of what they wish. (a) no, (b) in between (c) yes.
32. I enjoy many different kinds of play and recreation. true false
33. I worry over money and business. true false
34. I think the spread of birth control is essential to solving the world's economic and peace problems. (a) no (b) uncertain (c) yes.
35. Here is a list of glaring lights which sometimes annoy people. Check all that every bother you.
    (a) headlights
    (b) windows
    (c) floorlamps
    (d) desk lamps
    (e) ceiling light fixtures
    (f) candles on tables
    (g) sun reflections off of cars
    (h) street lights
    (i) not bothered by any of these
36. I have a habit of counting things that are not important such as bulbs on electric signs, and so forth. true false
37. Upsetting the dignity of teachers, judges, and "cultured" people always amuses me. (a) yes (b) in between (c) no.

38. I easily become impatient with people. true false
39. In your opinion can aircraft noise be prevented? (a) no (b) yes
40. Bad words, often terrible words, come into mind and I cannot get rid of them. true false
41. I am in just as good physical health as most of my friends. true false
42. On the whole, would you say that you were more bothered by aircraft this year than in the past, or have you become used to aircraft? (a) have become used to aircraft (b) about the same (c) more bothered now
43. At periods my mind seems to work more slowly than usual. true false
44. I resent having anyone take me in so cleverly that I have to admit that it was on me. true false
45. I have few or no pains. true false
46. I have periods of such great restlessness that I cannot sit long in a chair. true false
47. I commonly wonder what hidden reason another person may have for doing something nice for me. true false
48. People sometimes call me careless even though they think me an attractive person. (a) yes, (b) inbetween (c) no
49. Life is a strain for me much of the time. true false
50. On the whole, would you say that you were more bothered by glaring lights this year than in the past or have you become use to them? (a) have become use to them (b) about the same (c) more bothered now
51. I forget right away what people say to me. true false
52. I frequently notice my hand shakes when I try to do something. true false
53. I think I am better described as: (a) forceful (b) in between (c) polite & quiet
54. Sometimes I become so excited I find it hard to get to sleep. true false
55. Do you believe noise has any effect on <u>your</u> health? (a) yes--definitely (b) probably--perhaps indirectly (c) no--I don't think so
56. I often feel as if things were not real. true false
57. Do you believe glare has any effect on your health? (a) yes--definitely (b) probably--perhaps indirectly (c) No--I don't think so
58. I feel tired a good deal of the time. true false
59. I seldom or never have dizzy spells. true false
60. In my newspaper, I like to see: (a) good coverage of all local news (b) in between (c) debate on social issues in the modern world.
61. My eyes are (a) brown (b) light colored
62. My year of birth was _____

Appendix B. Answer Sheet

I have read the informed consent statement _____.
signed

Answer Sheet

1. T F
2. T F
3. a b c
4. T F
5. T F
6. T F
7. T F
8. a b c
9. T f
10. a b c d e
11. T F
12. T F
13. a b c d e
    f g h i j
    k l m
14. T F
15. T F
16. a b c
17. a b c
18. T F
19. T F
20. T F
21. T F
22. T F
23. a b c
24. a b
25. T F
26. T F
27. T F
28. a b c
29. a b c
30. T F
31. a b c
32. T F
33. T F
34. a b c
35. a b c d e
    f g h i
36. T F
37. a b c
38. T F
39. a b
40. T F
41. T F
42. a b c
43. T F
44. T F
45. T F
46. T F
47. T F
48. a b c
49. T F
50. a b c
51. T F
52. T F
53. a b c
54. T F
55. a b c
56. T F
57. a b c
58. T F
59. T F
60. a b c
61. a b
62. _____

For Research Use Only Subj. _____ F M

BCD/V

BCD/F-L

BCA/V

BCA/DB

Appendix C. Classification of Test Items

Question # on Personal Enlightenment Test	Question
R-S set of Test Items	
1	1) I am apt to pass up something I want to do because others feel that I am not going about it in the right way. True False
2	2) I am almost never bothered by pains over the heart or in my chest. True False
4	3) It takes a lot of argument to convince most people of the truth. True False
5	4) My hardest battles are with myself. True False
6	5) My sleep is fitful and disturbed. True False
7	6) I do not tire quickly. True False
9	7) There seems to be a lump in my throat much of the time. True False
11	8) Much of the time my head seems to hurt all over. True False
12	9) My hands and feet are usually warm enough True False
14	10) I wish I could be as happy as others seem to be. True False
15	11) It makes me uncomfortable to put on a stunt at a party even when others are doing the same sort of thing. True False
18	12) At times I feel like picking a first fight with someone. True False
19	13) I frequently have to fight against showing that I am bashful. True False
20	14) Much of the time I feel as if I have done something wrong or evil. True False

Question # on Personal Enlightenment Test	Question
R-S set of Test Items	
21	15) Most nights I go to sleep without thoughts or ideas bothering me. True False
22	16) Criticism or scolding hurts me terribly. True False
25	17) Often I can't understand why I have been so cross and grouchy. True False
26	18) I am happy most of the time. True False
27	19) I can read a long while without tiring my eyes. True False
30	20) I think most people would lie to get ahead. True False
32	21) I enjoy many different kinds of play and recreation. True False
33	22) I worry over money and business. True False
36	23) I have a habit of counting things that are not important such as bulbs on electric signs, and so forth. True False
38	24) I easily become impatient with people. True False
40	25) Bad words, often terrible words, come into my mind and I cannot get rid of them. True False
41	26) I am in just as good physical health as most of my friends. True False
43	27) At periods my mind seems to work more slowly than usual. True False
44	28) I resent having anyone take me in so cleverly that I have to admit that it was on me. True False
45	29) I have few or no pains. True False
46	30) I have periods of such great restlessness that I cannot sit long in a chair. True False

Question # on Personal Enlightenment Test		Question
R-S set of Test Items		
47	31)	I commonly wonder what hidden reason another person may have for doing something nice for me. True False
49	32)	Life is a strain for me much of the time. True False
51	33)	I forget right away what people say to me. True False
52	34)	I frequently notice my hand shakes when I try to do something. True False
54	35)	Sometime I become so excited I find it hard to get to sleep. True False
56	36)	I often feel as if things were not real. True False
58	37)	I feel tired a good deal of the time. True False
59	38)	I seldom or never have dizzy spells. True False
Demographic set of Variables		
-	1)	Sex F (Female) M (Male)
61	2)	My eyes are (a) brown (b) light colored
62	3)	My year of birth was _____
Noise-Attitude Set of Items (Bregnan and Pearson, 1972)		
10	1)	The taking of private property (including homes) for airport expansion and highway construction should be accepted by all citizens as a necessary step in the community growth. (a) strongly agree (b) agree (c) disagree

Question # on Personal Enlightenment Test		Question
13	2)	Here is a list of noises which sometimes annoy people. List any that ever bother you. (a) Lawn mowers (b) dripping water faucet (c) dogs barking (d) banging doors (e) someone turning on the radio when you want quiet (f) jack hammers & pneumatic drills, air compressors (g) air conditioning units (h) sound of a knife grating on a plate (i) automobile horns (j) church bells (k) motor bikes, motor cycles, and scooters (p) someone whistling out of tune (m) not bothered by any of these.
16	3)	If the world in which you live gets noticeably noisier in the future would this matter to you? (a) hardly at all (b) it would matter a little (c) it would matter very much
39	4)	In your opinion can aircraft noise be prevented? (a) no (b) yes
42	5)	On the whole, would you say that you were more bothered by aircraft this year than in the past, or have you become used to aircraft? (a) have become used to aircraft (b) about the same (c) more bothered now
55	6)	Do you believe noise has any effect on your health? (a) yes ... definitely (b) probably ... perhaps indirectly (c) no ... I don't think so

Glare-Attitude Set of Items

8	1)	If the world in which you live gets noticeably more glaring in the future, would this matter to you? (a) hardly at all (b) it would matter a little (c) it would matter very much.
24	2)	In your opinion can headlight glare be prevented? (a) yes (b) no
35	3)	Here is a list of glaring lights which sometimes annoy people. Check all that ever bother you. (a) headlights (b) windows (c) floor-lamps (d) desk lamps (e) ceiling light fixtures (f) candles on tables (g) sun reflections off of cars (h) street lights (i) not bothered by any of these

Question # on Personal Enlightenment Test		Question
Glare-Attitude Set of Items		
50	4)	On the whole, would you say that you were more bothered by glaring lights this year than in the past or have you become use to them? (a) have become use to them (b) about the same (c) more bothered now
57	5)	Do you believe glare has any effect on your health? (a) yes ... definitely (b) probably ... perhaps indirectly (c) no ... I don't think so
Personality-Test Set of Items (Bregman and Pearson, 1972)		
3	1)	I believe in: (a) being properly serious in everday business (b) in between (c) the motto "laugh and be merry" on most occasions.
17	2)	I tend to keep quiet in the presence of senior persons (people of greater experience, age, or rank) (a) yes (b) in between (c) no
23	3)	Going around selling things, or asking for funds to help a cause I believe in is for me: (a) quite enjoyable (b) in between (c) an unpleasant job
28	4)	I like to make an active part in social affairs, committee work etc (a) yes (b) in between (c) no
29	5)	When I am called in by my boss (or teacher) I: (a) see a chance to put in a good word for things I am concerned about (b) in between (c) fear something is wrong
31	6)	When bossy people try to "push me around" I do just the opposite of what they wish, (a) no, (b) in between (c) yes.
34	7)	I think the spread of birth control is essential to solving the world's economic and peace problems. (a) no (b) uncertain (c) yes
37	8)	Upsetting the dignity of teachers, judges, and "cultured" people always amuses me. (a) yes (b) in between (c) no.

Question # on Personal Enlightenment Test	Question
Personality Test for Set of Items (Bregman and Pearson, 1972)	
48	9) People sometimes call me careless even though they think me an attractive person. (a) yes, (b) in between (c) no
53	10) I think I am better discribed as: (a) forceful (b) in between (c) polite and quiet
60	11) In my newspaper, I like to see: (a) good coverage of all local news (b) in between (c) debate on social issues in the modern world.

Appendix D. BCA's (dB) and BCD's (fL) Data for 101 Subjects

BCA	BCD	BCA	BCD	BCA	BCD	BCA	BCD
59.4	1365	82.6	1001	91.0	11830	57.4	1347
74.6	1483	67.3	7007	80.6	1356	81.2	5096
				81.3	2184	69.0	3276
56.4	2366	59.4	1365	89.2	15743	81.0	3276
						75.1	4004
56.9	2821	93.0	6370	81.0	1347	87.2	1347
67.3	19110	79.0	3276	83.9	3822	87.7	4823
				74.7	11830	73.1	719
76.6	1137	85.0	719			57.0	2730
				79.0	2202		
87.0	5096	73.2	1411	74.0	22750	90.5	1347
81.4	1993	93.0	2275	80.0	719	57.0	3276
85.0	5096	93.0	18928	94.0	53690	71.7	28210
80.6	3094	76.5	6552	74.0	2202	71.3	11830
				84.0	2202		
70.1	3276	81.2	3822			82.6	18928
				99.5	53690		
75.5	10101	96.5	28210	88.7	3276	82.9	10192
				67.2	3003		
69.8	5460	92.6	2992			60.2	18928
				86.5	18928		
65.5	40040	67.2	15015	76.0	4914	79.6	22750
74.8	11830	82.6	45500	85.0	4823	85.0	10465
				85.0	22750		
81.0	4823	65.4	21203			70.7	4823
				93.5	15015		
71.3	18928	81.7	4823	75.0	22750	89.8	10192
				75.5	36400		
74.8	5096	85.7	3549			82.0	2912
				78.2	22750		
68.8	33670	84.2	28210	74.0	719	74.8	1984
				90.5	11830		
84.6	2821	80.3	1356	57.0	2202	*	3276
80.0	3276	74.0	40040				
87.2	9100	86.3	4186				
629	4823	89.4	40040				
73.2	3276	88.7	4823				
78.0	45955	92.5	21112				

* Value Missing

BCA median 80.00

BCD median 4823.00

PREDICTION OF NOISE ANNOYANCE AND DISCOMFORT GLARE FROM PERSONAL CHARACTERISTICS

by

MUSA MOHAMED BABIKER

B.Sc. (Engineering), 1964

University of Khartoum/Khartoum, Sudan

Diploma, 1972

Research Institute for Management Science/Delft, The Netherlands

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AN ABSTRACT OF A MASTER'S THESIS

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KANSAS STATE UNIVERSITY

Manhattan, Kansas

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ABSTRACT

A test of human sensitivity to noise and glare was developed against the criterion of noise annoyance and discomfort glare using the concepts of borderline between comfort and annoyance (BCA) and borderline between comfort and discomfort (BCD) respectively. The test development stemmed from the current findings that individual differences rather than the physical characteristics of noise and glare might be responsible for much of the variation in sensitivity to this stimulation. The experiment was conducted on 101 visitors to the annual Engineering Open House at K.S.U. in the Spring of 1977. Subjects made two or three adjustments for their BCA and BCD and answered a questionnaire of 63 items related to personal factors, demographic items, and attitudinal items. Using a multiple regression analysis by dummy variables, it was found that sensitivity to noise annoyance and discomfort glare could be predicted from these sets of variables. It was found that 75% of the explained variation by the regression model was due to the sets of personal factors. For noise a relation between BCA and the Threshold Limit Values (TLV) had been found, while for glare the study recommended a TLV similar to noise to be adopted.