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COMMUNITY REACTION TO AIRCRAFT NOISE AROUND SMALLER CITY AIRPORTS

by William K. Connor and Harrold P. Patterson

Prepared by
TRACOR, Inc.
Austin, Texas 78721
for Langley Research Center

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16. Abstract

This report presents the results of a study of community reaction to jet aircraft noise in the vicinity of airports in Chattanooga, Tennessee, and Reno, Nevada. These cities were surveyed in order to obtain data for comparison with that obtained in larger cities during a previous study. (The cities studied earlier were Boston, Chicago, Dallas, Denver, Los Angeles, Miami, and New York.) The purpose of the present effort was to observe the relative reaction under conditions of lower noise exposure and in less highly urbanized areas, and to test the previously developed predictive equation for annoyance under such circumstances.

In Chattanooga and Reno a total of 1960 personal interviews based upon questionnaires were obtained. Aircraft noise measurements were made concurrently and aircraft operations logs were maintained for several weeks in each city to permit computation of noise exposures. The survey respondents were chosen randomly from various exposure zones.

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SUMMARY

This report presents the results of a study of community reaction to jet aircraft noise in the vicinity of airports in Chattanooga, Tennessee, and Reno, Nevada. These cities were surveyed in order to obtain data for comparison with those obtained in larger cities during a previous study. (The cities studied earlier were Boston, Chicago, Dallas, Denver, Los Angeles, Miami, and New York.) The purpose of the present effort was to observe the relative reaction under conditions of lower noise exposure and in less highly urbanized areas, and to test the previously developed predictive equation for annoyance under such circumstances.

In Chattanooga and Reno a total of 1960 personal interviews based upon questionnaires were obtained. Aircraft noise measurements were made concurrently and aircraft operations logs were maintained for several weeks in each city to permit computation of noise exposures. The survey respondents were chosen randomly from various exposure zones.

The following conclusions resulted from this study:

1. A significant difference exists between the smaller cities and the seven cities previously studied in regard to the relationship between annoyance and aircraft noise exposure at Composite Noise Rating values

below 125. The percentage of highly annoyed persons in the smaller cities was less than half that in the larger cities. This difference appears to be related to factors other than basic demographic characteristics.

2. The multivariant annoyance predictive equation developed in the previous study produced a somewhat less accurate prediction for the smaller cities than for the larger cities. A similar equation developed from the smaller city data employs a modified set of predictor variables and produced about the same accuracy as the earlier equation, when used for the smaller cities.

3. The relationship between aggregate community annoyance and complaint is well defined for the nine cities which have been studied. The percentage of complainants is considerably less than the percentage of highly annoyed and is proportional to the square of the latter.

4. Given the noise exposure and population density patterns for a community, the number of highly annoyed persons and the number of complainants can be estimated for the community as a whole.

This report presents the results, procedures, and data from a study of community reaction to jet noise around small city airports under Contract NAS1-10216. The specified period of performance is 17 August 1970 to 2 October 1971.

In 1970 TRACOR completed a three-year study of community reaction around seven major U.S. airports (Contract NASw-1549).[1] This study will be referred to as "the seven-city study," following a colloquial usage which has established itself. In this research considerable insight was gained into the interrelationships of noise exposure, annoyance, complaint, and individual attitudes and characteristics. Additional information was obtained concerning noise monitoring techniques, the relationships between different measures of community noise exposure, and the effect of house attenuation. A multivariant equation for predicting individual annoyance was derived in the first phase of work and tested in the second phase.

Following review of the seven-city study it was suggested that surveys be performed also in cities having smaller airports. Several reasons were advanced for this. First of all, additional data from relatively low noise exposure areas are needed to permit more accurate estimations of response following implementation of noise alleviation measures such as aircraft retrofitting, noise abatement flight patterns, and introduction of quieter aircraft. Second, because of increasing jet service to secondary traffic centers in relatively small cities, it is important to determine if such communities tend to have patterns of response significantly different from those observed in metropolitan areas. Finally, smaller airports offer an opportunity to test the weight of operations counts with respect to effective noise exposure, since they are served by typical aircraft but at a relatively low

traffic volume. This latter consideration is particularly significant since publication of the report on the second London airport survey, which raises some questions concerning the effect of the number of aircraft operations.[2]

The foregoing considerations led to the present work, which will be denoted "the two-city study" in contradistinction to the earlier effort. In the two-city study, acoustical and social surveys in Reno, Nevada, and Chattanooga, Tennessee, were performed employing essentially the same techniques used previously by TRACOR and by others.[3,4] The observed community response was significantly different from that in the seven-city study. Reasons for this are discussed in this report, which also presents noise exposure, demographic, and attitudinal data and explores the relationship of these to annoyance and complaint. In the course of this analysis, considerable use is made of data from the seven-city study as a baseline for comparison and some new results from these are included. In addition, a new computer tape containing salient data for all nine cities was prepared and used for comparisons; this tape is a resource for further research beyond the scope of the present effort.

In the sections entitled Social Survey and Noise Exposure, this report describes the procedures used in data collection and and analysis. The remaining sections present and discuss the results in various aspects. These results are also presented briefly in the SUMMARY. Appendices contain the survey questionnaire, definitions of all variables involved in the study, frequencies of these variables, and a comparison of annoyance scales.

SOCIAL SURVEY

Site Selection

During February 1970 a list of 22 candidate survey sites was compiled. Criteria for selection of these cities were a 1960 population of approximately 250,000 and annual scheduled aircraft departures from 10,000 to 25,000. Basic data (maps, census data, etc.) for each of these candidate sites were acquired for further study. Over one-half of the cities were dropped from the list for reasons which included 1) proximity to military air operations, 2) low population density in the vicinity of the airport, 3) increase in population substantially above 250,000, and 4) presence of other public or private airports in the near vicinity.

The remaining candidates were Little Rock, Arkansas; Chattanooga, Tennessee; Jacksonville, Florida; Madison, Wisconsin; Reno, Nevada; Salt Lake City, Utah; Sacramento, California; Spokane, Washington; and Colorado Springs, Colorado. Staff visits to these cities were made during July and August to obtain first hand information.

Most of the cities were eliminated for one or more of the reasons cited above. Madison and Spokane had extensive military air operations; Sacramento, Salt Lake City, Little Rock, and Jacksonville did not have an adequate sample population near the airport; and Colorado Springs was eliminated for both reasons.

After full consideration, Chattanooga and Reno (actually the cities of Reno and Sparks) were finally chosen for the sample cities. Reno did have some Air National Guard flights, but these originated from the commercial airport rather than from a military base and were readily distinguishable from commercial flights by residents.

Sampling Plan

Since low levels of noise exposure were expected in the survey cities, a sampling plan was developed which would assure continuity with seven-city data and at the same time achieve an adequate sample at all levels of exposure. The method employed was to map rough noise exposure zones off each end of the main runway, then to sample equally in each zone. The noise exposure zones were defined by PNdB contours for typical aircraft and operations in each city. As shown in Figures 1 and 2, the three sampling zones were 80-90, 90-100, and 100+ PNdB. These contours and zones were used for sampling purposes only; actual noise exposures were determined independently. However, this procedure did produce a reasonable distribution of respondent exposures, as shown in Figure 3. Initially, the plan called for equal interviewing off both ends of the runway. However, in Reno this was impossible for lack of population south of the airport. The procedure used in Reno was to list all possible blocks off both ends of the runway and, from these, to select a random sample in each noise exposure zone. In Chattanooga the sample was divided equally and a random sample of blocks within noise exposure zones was selected off both ends of the runway.

The mechanics of sample selection involved listing blocks by location from runway and by exposure zones, randomly selecting blocks and listing them, and finally producing assignment sheets complete with maps for each interviewer. With a planned sample size of 1,000 in each city and allowing six interviews per block, 167 blocks were selected in each city.

Field Operations

During and following the preparation of the sample plan, field operations were initiated. Interviewers were hired and trained and interviewing was begun in Reno during the period

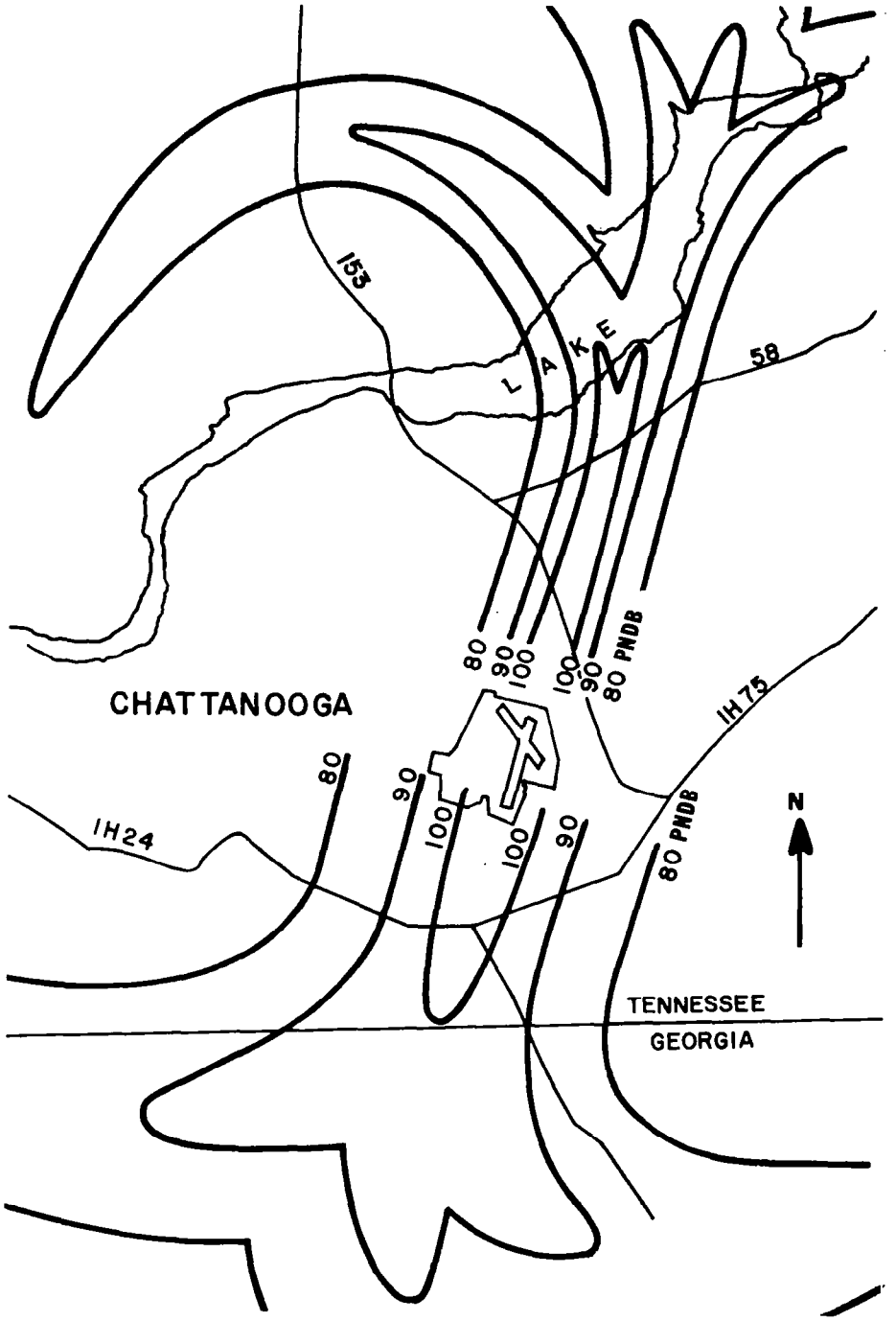


FIG. 1 - MAP OF CHATTANOOGA SHOWING SAMPLING ZONES DEFINED BY PNdB CONTOURS

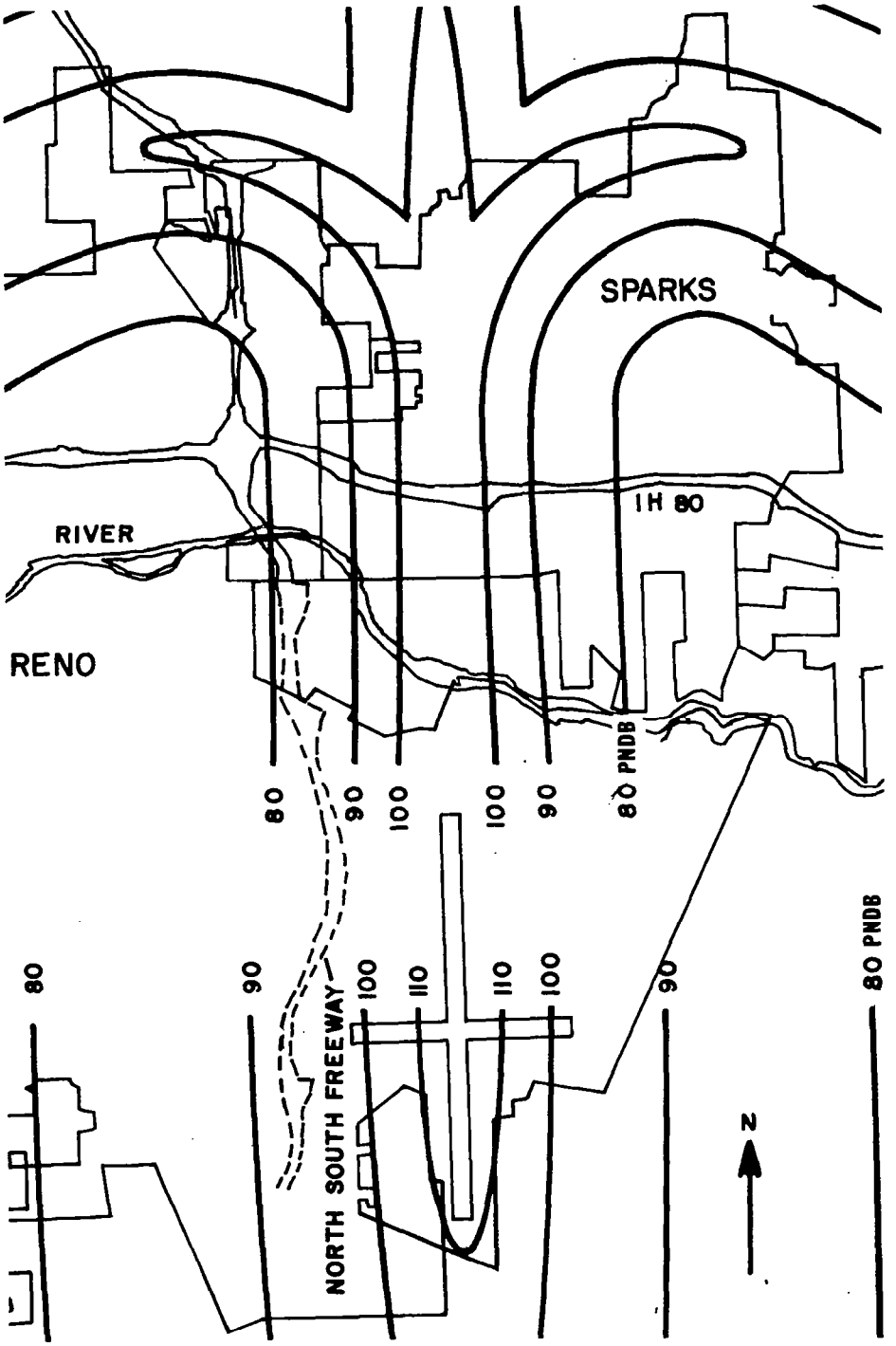


FIG. 2 - MAP OF RENO/SPARKS SHOWING SAMPLING ZONES DEFINED BY PNdB CONTOURS

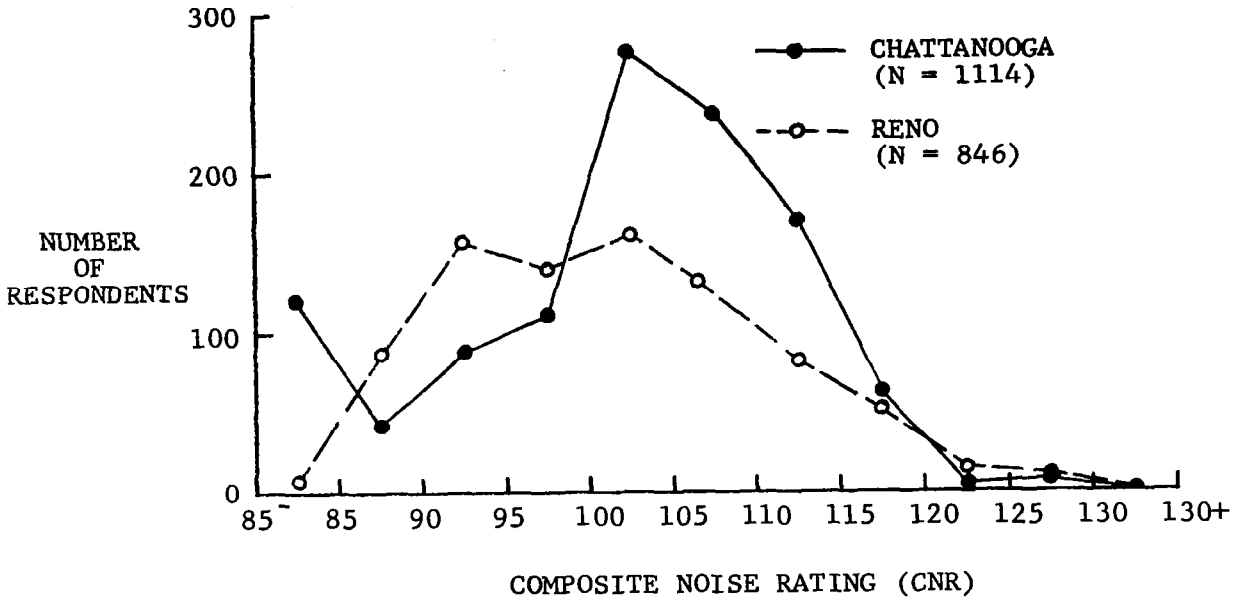


FIG. 3 - NUMBER OF RESPONDENTS BY CNR CATEGORY

from 13 October through 25 October. Hiring and training of interviewers was accomplished in Chattanooga during the period of 9 November through 16 November and interviewing there was begun immediately thereafter.

It was originally intended that approximately 1,000 interviews would be gathered in each of the two cities. However, because of contract delay, a total of only 846 interviews were obtained in Reno by 19 December. As it was not economically feasible to suspend Reno operations during the Christmas holidays and to resume interviewing in January, it was decided to curtail the Reno survey and to over-sample in Chattanooga during the month of January. A total of 1,114 interviews were completed in Chattanooga when field operations were discontinued there on 31 January 1971. The total interview sample for both cities was thus 1,960.

The questionnaire used for interviewing was a revised version of the Form D questionnaire used in Phase II of the seven-city study; it is included as Appendix A. The revisions consisted largely of deletions approved by the Bureau of the Budget; these did not affect any of the variables dealt with in this report. Validity checks were made on 77% of the Reno interviews and 53% of the Chattanooga interviews.

Sample Characteristics

Table 1 gives some of the basic characteristics of the Chattanooga and Reno samples; for comparison, these are also shown for the Phase II samples of the seven-city study. (The latter, which include the cities of Boston, Miami, and New York, were selected in particular because they were most recently surveyed and because the interview procedures used were essentially the same as in the two-city study.) The variables presented in Table 1 are defined in Appendix B. The Chattanooga and Reno samples show a much higher degree of mobility than those of

Table 1

BASIC SAMPLE CHARACTERISTICS:
TWO-CITY STUDY VERSUS PHASE II SEVEN-CITY STUDY

City	Median Mobility	% High Occupational Rating	% High ($10,000+) Income	% Education more than High School	% Age 60+
Chattanooga	0.59	25	39	32	24
Reno	2.09	19	50	34	16
Boston	0.08	22	37	29	24
Miami	0.44	20	36	43	33
New York	0.13	37	56	38	13

	% Home-owners	% High Visitation	% Anglo	% Female	% High Discussion
Chattanooga	81	39	96	74	19
Reno	75	39	96	70	14
Boston	63	50	98	71	46
Miami	74	35	71	59	29
New York	82	54	94	68	54

Phase II, with Reno notably high in this respect. They also have lower indices of visitation and discussion than Boston and New York. Otherwise, the characteristics listed exhibit no prominent differences between the two-city and seven-city samples.

Tables 2, 3, and 4 deal with characteristics related to aircraft noise disturbance, again for both the two-city and seven-city Phase II samples. According to Table 2, more Reno respondents reported general disturbance by aircraft noise than did Chattanooga respondents, but in both cities the incidence of such response was much lower than in the Phase II cities, by a factor of 3 or more in comparison to Boston and New York. Table 3 has to do with potential or actual complaint concerning aircraft or other things most disliked in the neighborhood. The Chattanooga and Reno respondents tended to direct their animosity toward non-aircraft elements more so than did those of the Phase II sample; the level of actual complaint, irrespective of its object, is lower in Chattanooga and Reno. Table 4 gives a comparison of the cities with respect to annoyance and to the variables most closely related to it. (These variables are defined in Appendix B and discussed further in the section entitled Individual Annoyance.) The distinction between the two sets of cities is clear except in the case of "noise susceptibility" where little difference is seen. Chattanooga and Reno have a lower incidence of high annoyance, high fear, high misfeasance, and low importance, and a much higher index of adaptability.

From the foregoing evidence it is apparent that on a general community basis, aircraft noise is not a problem of dominant significance in Chattanooga and Reno. Both tend to rank somewhat below Miami (as surveyed in 1969) in all the indicators of aircraft noise impact and resulting reaction, and of course far below Boston and New York, where aircraft noise problems were unparalleled in the USA except for Los Angeles. These results are to be expected in view of the lower noise exposure conditions

Table 2

PERCENT RESPONDENTS MENTIONING (WITHOUT PROMPTING) AIRCRAFT NOISE AS FIRST NEIGHBORHOOD DISADVANTAGE, AND PERCENT REPORTING (WITH PROMPTING) AIRCRAFT NOISE AS MOST DISLIKED THING IN NEIGHBORHOOD

City	First Neighborhood Disadvantage	Most Disliked Thing
Chattanooga	5%	5%
Reno	8	13
Boston	24	37
Miami	12	19
New York	31	45

Table 3

PERCENT RESPONDENTS REPORTING POTENTIAL AND ACTUAL COMPLAINT CONCERNING MOST DISLIKED THING IN NEIGHBORHOOD

City	Complaint Potential*		Complaint Action**	
	Most Disliked Thing in the Neighborhood		Most Disliked Thing in the Neighborhood	
	Aircraft	Other	Aircraft	Other
Chattanooga	51%	72%	20%	43%
Reno	32	64	26	54
Boston	81	70	54	56
Miami	46	53	36	71
New York	81	53	74	70

*Felt like complaining

**Actually complained

Table 4

PERCENT RESPONSE ON ANNOYANCE AND ITS IMPORTANT CORRELATES

City	High Annoyance	High Fear	High Susceptibility	High Adaptability	High Misfeasance	Low Airport Importance
Chattanooga	9%	18%	5%	57%	5%	1%
Reno	14	13	9	61	8	1
Boston	43	44	10	29	16	4
Miami	21	16	4	50	9	2
New York	63	51	7	19	19	6

found around smaller airports. The question of response in the two sets of cities at the same levels of exposure is examined in the succeeding sections and it is found that the degree of reaction is lower in Chattanooga and Reno than in previously studied cities even at the same noise exposure levels.

NOISE EXPOSURE

Operations Logs

The fact that commercial traffic at both Chattanooga and Reno is relatively light permitted detailed records of operations as well as extensive noise measurements. With the cooperation of FAA tower officials, personnel were stationed in the respective airport control towers to maintain operations logs over a period of approximately two months prior to and during the social surveys. Although these persons worked on a 40-hour per week basis, their working shifts were staggered so as to cover about equally all periods of the day and all days of the week. In addition, information concerning the few night operations was obtainable at most times from the tower personnel. These records made possible an accurate reconstruction of events for correlation with field noise data and for determining average operations counts.

The distribution of commercial operations by time of day for the two survey cities is compared to that of three cities from the seven-city study in Figure 4. It is apparent that, although the total counts are much lower, the daily pattern is much the same.

Noise Monitoring

The noise produced in the survey areas was monitored and recorded in detail over a period of two to four weeks during the social survey. The purpose of these measurements was to obtain a good sampling of each type of flyover (by aircraft, runway, and operation type) at representative points in the community, from which, together with long-term average operation counts, noise exposure values could be computed.

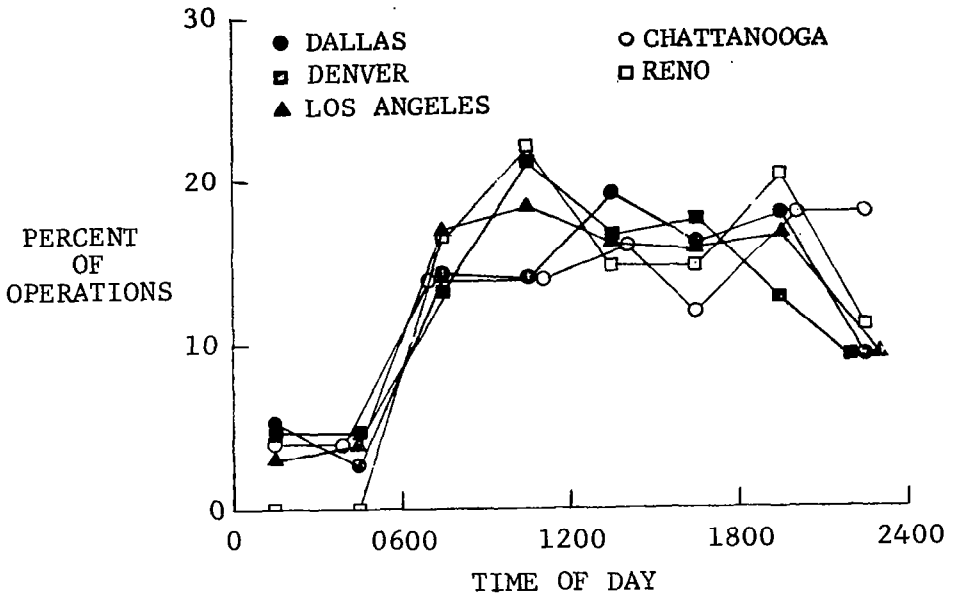


FIG. 4 - PERCENTAGE OF TOTAL DAILY OPERATIONS BY TIME OF DAY FOR CHATTANOOGA, RENO, AND THREE PHASE I CITIES FROM THE SEVEN-CITY STUDY

Five specially constructed monitor units were used to obtain noise data. Each unit consisted of a microphone with windscreen, an electronics section in a tamperproof housing, and a battery-inverter power supply. A block diagram of the system is shown in Figure 5. The N-weighted noise level was recorded continuously for periods of up to 4 days (at which point a change of battery and paper tape reloading was required) by a graphic recording device. The recording scale had a dynamic range of 50 dB which could be set according to the peak levels prevailing at the installation site.

In use, the five monitors were deployed as a group in one section of the community. By inspecting all five records simultaneously and referring to the operations logs, it was possible to associate the appropriate aircraft operation with each noise peak and to discriminate against peaks caused by local road vehicles. The monitors were moved according to wind conditions so as to sample both take-offs and landings at both ends of the primary runway at each airport.

Noise Exposure Computations

For comparison with data from the seven-city study, noise exposures were computed in terms of Composite Noise Rating (CNR) values. It was found in the previous study that CNR is at least as good a predictor of community and individual response as any other standard measure. For traffic levels such as those in Chicago, Dallas, and Los Angeles, the following approximations relating CNR to other well-known measures were found to be valid:

$$CNR \simeq NEF + 72$$
$$CNR \simeq NNI' + 56$$

where NEF is the Noise Exposure Forecast and NNI' the modified Noise and Number Index, both as computed from actual field data.

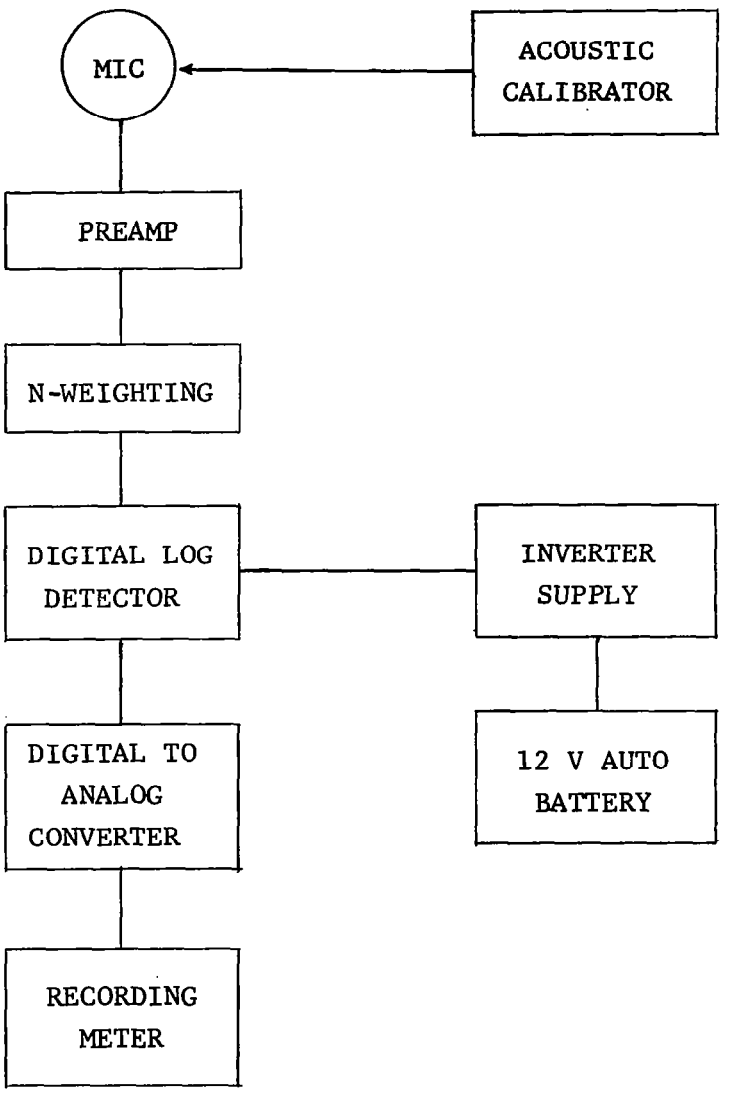


FIG. 5 - BLOCK DIAGRAM OF NOISE MONITOR SYSTEM

Exposure values were computed according to the formulae

$$CNR = 10 \log_{10} \sum_{j} \text{antilog } (CNR_j/10)$$

$$CNR_j = PNL_j + 10 \log_{10} (N_{Dj} + 20 N_{Nj}) - 12$$

where j is a single class of operation producing a particular noise characteristic at some particular reference point, N_{Dj} and N_{Nj} are the number of occurrences in that class during the periods (0600-2100) and (2100-0600) respectively, and PNL_j is the energy-mean maximum perceived noise level for that class. The PNL for each measured flyover was determined by adding 7 units to the maximum N-weighted level, this being the correction factor established from the seven-city data between the latter and the non-discrete-frequency-corrected PNL calculated from band analysis.

Noise exposure was determined at a number of points in each community and values were assigned to each block in the social survey, extrapolating where necessary. The distribution of exposure by survey respondents is shown in Figure 3. It can be seen that the sampling plan described previously resulted in a reasonable distribution up to CNR 120 including a good representation at the lower exposure levels which are of particular interest.

COMPARISON OF ANNOYANCE IN THE TWO-CITY AND SEVEN-CITY SAMPLES

Measures of Annoyance

Annoyance is by definition the state or condition of being disturbed or irritated, particularly by a specific set of repeated stimuli. For research purposes various scales of annoyance have been developed to quantify such states for individuals. The measure Annoyance G is used in this section. Other annoyance variables, such as Annoyance V used in Phase I of the seven-city study[1,5] and Annoyance F discussed in Appendix C are more sophisticated in construction than Annoyance G but in fact do not prove to have substantially greater meaning or utility. This is consistent with the observation of McKennell that annoyance measures are relatively insensitive to the procedures used in their construction.[6] Both the V and F measures incorporate Annoyance G or its elements and correlate very highly with it.

Annoyance G is a summated disturbance rating constructed for each survey respondent from his responses to Question 20 of the interview form. (The questionnaire is incorporated in this report as Appendix A.) A list of nine normal daily activities was presented to the respondent, who was asked to indicate the degree of bother by aircraft noise for each activity on a scale of 0 to 4. These ratings were scored according to the procedures described in Appendix C to form Annoyance G, which has a range of 0 to 45.

At a given level of aircraft noise exposure there is a wide range of individual annoyance scores. Therefore it is sometimes convenient to define categories of annoyance and to determine the proportion of the sample population in each category. Such a procedure was used in Phase I of the seven-city study. Low, moderate, and high annoyance categories were established so as to provide three respondent groups of approximately equal size. The category ranges, which are still used in order to maintain continuity, are as follows:

Range of Annoyance G	Annoyance Category
21 - 45	High
10 - 20	Moderate
0 - 9	Low

Although these categories were originally defined rather arbitrarily, the term "high annoyance" has literal meaning. In order to be a member of the highly annoyed group, a respondent must have median or higher scores on the disturbance of at least seven out of nine activities. To describe such a person as highly annoyed would seem reasonable. Thus the proportion of highly annoyed in a given population is a parameter on which meaningful community criteria may be based.

The percentage of respondents in each of the three annoyance categories for the two cities of the present study and those of the previous seven-city study are given in Table 5.

Table 5

PERCENTAGE OF RESPONDENTS WITH LOW, MODERATE, AND HIGH ANNOYANCE G

City		Low	Moderate	High
Chicago	(1967)	43%	23%	34%
Dallas	(1967)	52	23	25
Denver	(1967)	62	17	21
Los Angeles	(1967)	31	22	47
Boston	(1969)	29	28	43
Miami	(1969)	56	23	21
New York City	(1969)	14	23	63
Chattanooga	(1970)	74	18	9
Reno	(1970)	65	21	14

The term "annoyance" is sometimes used to denote the response of subjects in psychophysical experiments. In such cases it is associated directly with measures of noisiness such as PNL or EPNL. It should be emphasized that in this report no such meaning is ever implied; annoyance here means the elicited response of individuals to stimuli received during the course of normal home activity.

Annoyance Categories and Noise Exposure

Figures 6 and 7 show, for the seven-city and two-city samples respectively, the percentage of respondents in each of the three categories of Annoyance G as a function of aircraft noise exposure. The latter is measured in terms of CNR computed in accordance with the section entitled Noise Exposure Computations. The contrast

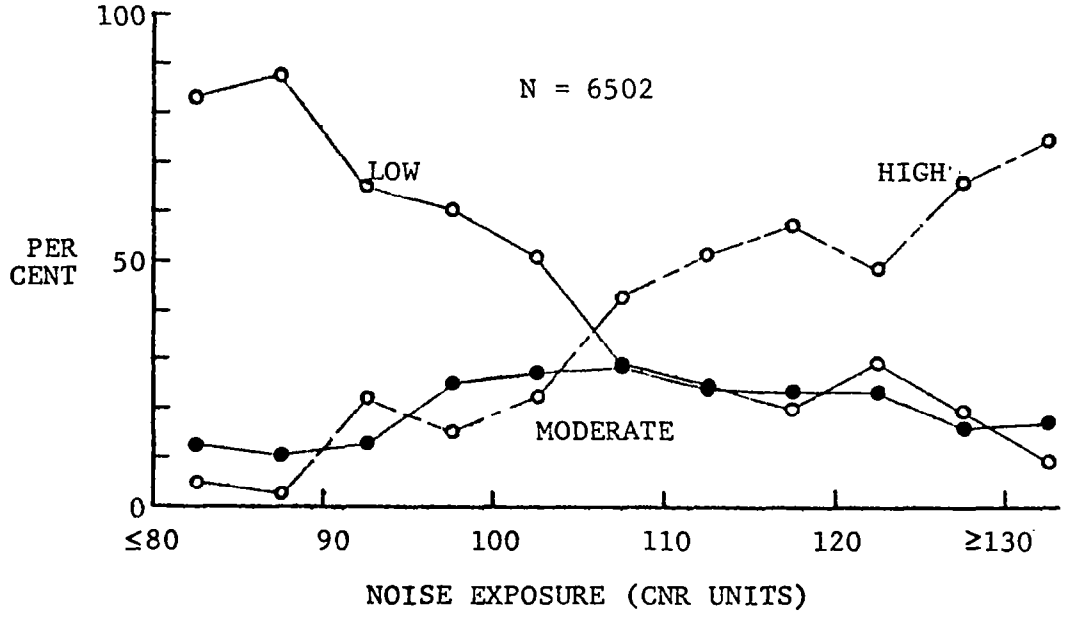


FIG. 6 - CATEGORIES OF ANNOYANCE AS A FUNCTION OF NOISE EXPOSURE, SEVEN-CITY SAMPLE

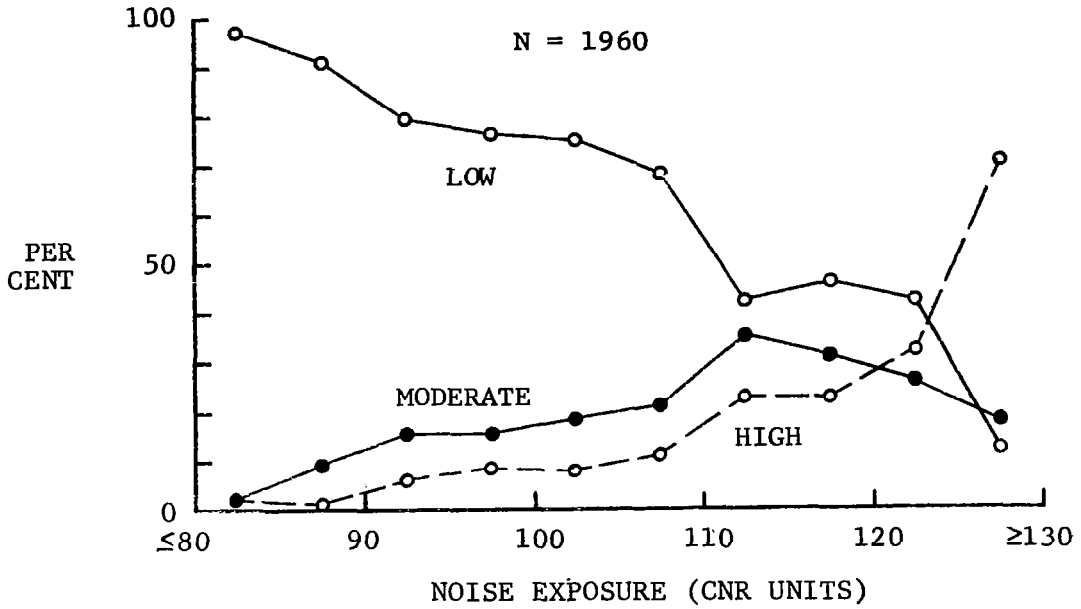


FIG. 7 - CATEGORIES OF ANNOYANCE AS A FUNCTION OF NOISE EXPOSURE, TWO-CITY SAMPLE

between these two sets of data is striking. The 10 percent highly annoyed level is reached at a CNR of about 90 in the seven-city case but at a CNR of 105 in the two-city sample, a shift of 15 units. Also, the proportions of the three categories are about equal for the seven cities at CNR 106, whereas for the two cities such a point would occur above CNR 120. Not only are the cities of the present study unusually low in aircraft noise disturbance generally, but also at specific levels of noise exposure.

It is instructive to compare the behavior of the high annoyance category alone in Figures 6 and 7. It is apparent that in both cases the percentage approaches zero at some point below CNR 90 but that the slopes are quite different. To emphasize this behavior, two regression lines as shown in Figure 8 were developed from the two sets of data respectively. These lines were constrained to pass through the same abscissa intercept, as

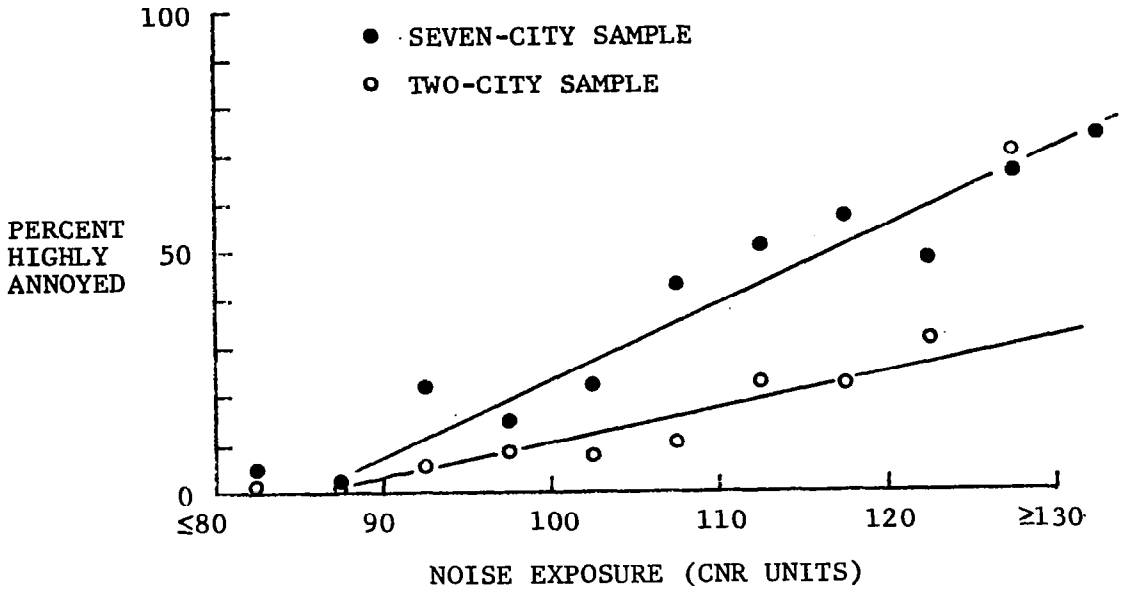


FIG. 8 - PERCENTAGE OF HIGHLY ANNOYED RESPONDENTS WITH LEAST-SQUARE LINES THROUGH COMMON INTERCEPT (CNR = 85.3)

determined from the combined data. This intercept value is CNR 85.3; for the seven-city data alone, the value is CNR 81.9 and for the two-city, CNR 85.9. The equations for the two lines are

$$\% \text{ Highly Annoyed (7-city)} = 1.585 \text{ (CNR - 85.3)}$$

$$\% \text{ Highly Annoyed (2-city)} = 0.729 \text{ (CNR - 85.3)}$$

The implication of this analysis is that below CNR 85 essentially no high annoyance exists but that its rate of growth in the seven-city sample is about 2.2 times that in the two-city. The point for CNR 125-130 in the latter sample was not used in determining the two-city regression line, in order to emphasize the relative slope of the two lines at lower levels; it should be remembered that the percentage of highly annoyed at this level of exposure is approximately the same for the two samples.

Discussion

The foregoing results show a substantial difference in response between the seven-city and two-city samples. Inasmuch as the field procedures for measurement of noise and acquisition of response data were essentially identical in the two studies, this difference must be attributable to some other factor or set of factors. Two areas in which these might lie are the noise exposure formulation and the characteristics of the sample. Each of these will be considered in turn.

Noise Exposure - The noise exposure parameter used in this report is the Composite Noise Rating (CNR). This measure reflects two relationships which were empirically determined in past studies.[7] These are the effective noise differential between daytime operations and nighttime operations (one night operation equivalent to 20 day operations) and the so-called number correction (10 log N). If these relationships are not generally correct, in the sense of being applicable to both the large-city and small-city situations, a shift in effective noise exposure could exist which might explain the observed difference in response.

In order for the time of day differential to produce a significant shift in effective exposure, the ratio of daytime to nighttime operations must be greatly different for the seven-city and two-city samples. In fact, this ratio (as determined from the data shown graphically in Figure 4) is 4.38 for the two-city operations and 4.77 for the representative seven-city operations. This difference between the two samples is so small that the day-night differential would have to be radically altered, controverting all previous evidence, in order to produce a significant exposure shift. It is concluded that this element

is a very unlikely source of the observed differences in response as a function of exposure.

The number correction is an element of particular interest, since the British NNI measure utilizes a 15 log N term[4] and the German Q index, as applied to aircraft noise, a 13 log N term.[8] The use of either of these stronger weightings in place of the 10 log N correction in the CNR formula would tend to emphasize the difference in operations counts between the two-city and seven-city studies in such a way as to reduce the apparent annoyance differences. Further evidence of the importance of operations counts, in addition to an independent confirmation of the effects observed in the present study, is given in a recent Swedish report.[9] In the Swedish study it was found that, in airport areas with less than 70 take-offs per day, the level of annoyance was much lower than elsewhere. This is consistent with the circumstances observed in Reno and Chattanooga.

The average daily number of commercial aircraft operations in the two-city study was 52 (range: 50 to 54). In the seven-city study, the average daily number (for the year 1967) was 834 (range: 353 to 1573). Using the ratio of the average operations counts, a number correction of 15 log N as opposed to the CNR number correction of 10 log N would produce an effective shift in exposure of 6 units; a number correction of 20 log N would produce a shift of 12 units. Alteration of the number correction in this way, however, does not produce a satisfactory resolution of the two-city/seven-city difference in observed annoyance, for the following reasons:

(1) The shift in response is not large enough over most of the exposure range.

(2) The effect is only a shift in exposure, which does not explain the difference in slopes shown in Figure 8.

(3) An increase in the number weighting produces a decrease in correlation of exposure and annoyance, as demonstrated in the chapter INDIVIDUAL ANNOYANCE, and is therefore undesirable.

Although the logarithmic number correction does not provide the desired explanation, it is possible that some other form might do so. The Swedish investigators suggest that the effect of operations counts may be different for different levels of air traffic, reaching a plateau of saturation for high operations counts; their data, however, are too limited to depict this behavior in detail.[9] Also, in the second Heathrow study it was found that annoyance correlated more highly with operations counts on a linear basis than on a logarithmic basis.[2] These results and those at hand suggest the need for investigation of a non-CNR-type exposure measure, using the presently available data bank and emphasizing the effect of operations counts upon both individual and aggregate annoyance scores, to determine if a number correction of linear or other type will produce both an explanation of the differences of Figure 8 and an acceptable correlation with individual annoyance.

Characteristics of the Sample - It was noted in the previous section entitled Sample Characteristics that the two-city sample differed from the seven-city Phase II sample in certain characteristics and, in particular, displayed lower ratings on variables associated with aircraft noise annoyance. The only basic social differences were more frequent moving or residence (mobility) in Reno and less discussion among family and friends of the most disliked

neighborhood problems in both Reno and Chattanooga. A significant association of mobility with annoyance has never appeared in analysis of data from either the two-city or the seven-city sample, nor is there any obvious rationale for such an effect. The same is not true of the discussion variable, however. In the two-city analysis, discussion ranked sixth among variables correlated with annoyance. (See Table 10.) It seems possible that lack of social reinforcement due to an unusually low level of discussion may to some extent be responsible for lower annoyance at a given exposure level in the two-city sample. However, this factor is too weak to account for more than a small part of the differences in observed annoyance.

The remaining variables reflecting two-city/seven-city differences, as listed under Sample Characteristics, tend to be associated with aircraft noise annoyance. These include "most disliked thing" in the neighborhood, adaptability to aircraft noise, and similar items. None of the differences in these variables can be regarded as factors determining, or conditioning toward, unusually low annoyance at a given level of noise exposure. Any causal relationships between negative attitudes about aircraft and noise exposure from aircraft are as likely to proceed from the latter to the former as in the opposite direction. There is thus no evidence that particular characteristics of the local samples contribute to decreased reaction, save for the minor effect of discussion mentioned above.

One remaining characteristic of the sample or, more accurately, of the survey itself, which may be responsible for the relatively low levels of annoyance in Chattanooga and Reno, is the season of the year. All of the seven-city surveys were performed in the summer, which is a season of heightened reaction, at least in northern communities, whereas the two-city field work was done in the late fall and early winter months October through January.

Some confirmation of the seasonal effect in quantitative terms is available from data on seasonal variation of community complaint concerning aircraft noise. Such data are available for New York City (Kennedy International Airport area) and are shown in Table 6. The mean monthly complaint rate for the seven-city survey months (May through September) is 16.6%; for the two-city survey months (October through January) it is 1.9%,

Table 6

PERCENTAGE OF ANNUAL COMPLAINTS RECEIVED BY MONTH, 1959-1967, KENNEDY INTERNATIONAL AIRPORT

Month	% Annual Complaints	Month	% Annual Complaints
JAN	2	JUL	24.5
FEB	1.5	AUG	23
MAR	2.5	SEP	10
APR	4	OCT	3.5
MAY	7.5	NOV	2
JUN	18	DEC	1.5

a ratio of 8.7. If it is assumed that this behavior is typical of all cities having a distinct winter season (including Chattanooga and Reno), then the expected summer complaint rate for the two-city sample would be 8.7 times the observed rate. The implication of this, according to the general relationship developed in the section entitled Annoyance and Complaint, is a substantially reduced level of annoyance during the winter survey months of the two-city study, as actually observed. To apply this hypothetical explanation directly to the data of Figure 8 in order

to resolve the difference shown would require knowledge of the distribution of "winter" and "non-winter" types in the sample according to noise exposure and annoyance category. For example, if it happened that the two-city subsample with an exposure of 125-130 CNR units was surveyed early during the warmer days, the relatively high percentage of highly annoyed which was actually obtained for that particular group would be expected. Since no simple assumptions can be made as to the seasonal distribution of the sample, however, confirmation of the seasonal effect will require additional data.

If the seasonal hypothesis is accepted, the question arises as to what mechanism produces the effect. The survey data do not provide any obvious indication of this. It is believed that seasonal changes in reaction are due to changes in individual orientation from outdoor circumstances to indoor, concomitant with normal seasonal changes in living habits. When a person goes out of doors only as a transient and conducts all his regular activities indoors, he is insulated from aircraft noise by building structures and is subjected to lower effective noise exposure, thereby probably experiencing reduced annoyance.

INDIVIDUAL ANNOYANCE

In the previous section, annoyance was dealt with in discrete categories. Such an approach is convenient for planning and estimating purposes involving large populations. It does not, however, lead to any understanding of the annoyance of specific individuals and to possible sources of alleviation based upon such knowledge. This section of the report discusses individual annoyance and its relationship to noise exposure and other variables.

Correlation of Annoyance and Noise Exposure

In the seven-city study it was shown that individual annoyance correlated as well or better with Composite Noise Rating (CNR) as with other standard measures of aircraft noise exposure. This correlation was re-examined in the present study using a master analytic data tape incorporating revised seven-city data as well as two-city data. The correlation of annoyance with exposure in terms of CNR was 0.25 for the two-city sample. The value for the seven-city Phase II sample was 0.41, lower than the 0.49 given in the seven-city report;[1] this difference resulted from revisions of the basic exposure data. The revised data are more accurate and thus also is the new correlation coefficient, even though it is lower. Improved correlation or prediction of individual annoyance requires consideration of additional variables as discussed in a later section.

Figure 9 shows lines of regression of Annoyance G on CNR for the two samples. The two lines are given by

$$\text{Annoyance G (7-city Phase II)} = -35.3 + 0.497\ \text{CNR}$$

$$\text{Annoyance G (2-city)} = -9.24 + 0.190\ \text{CNR}$$

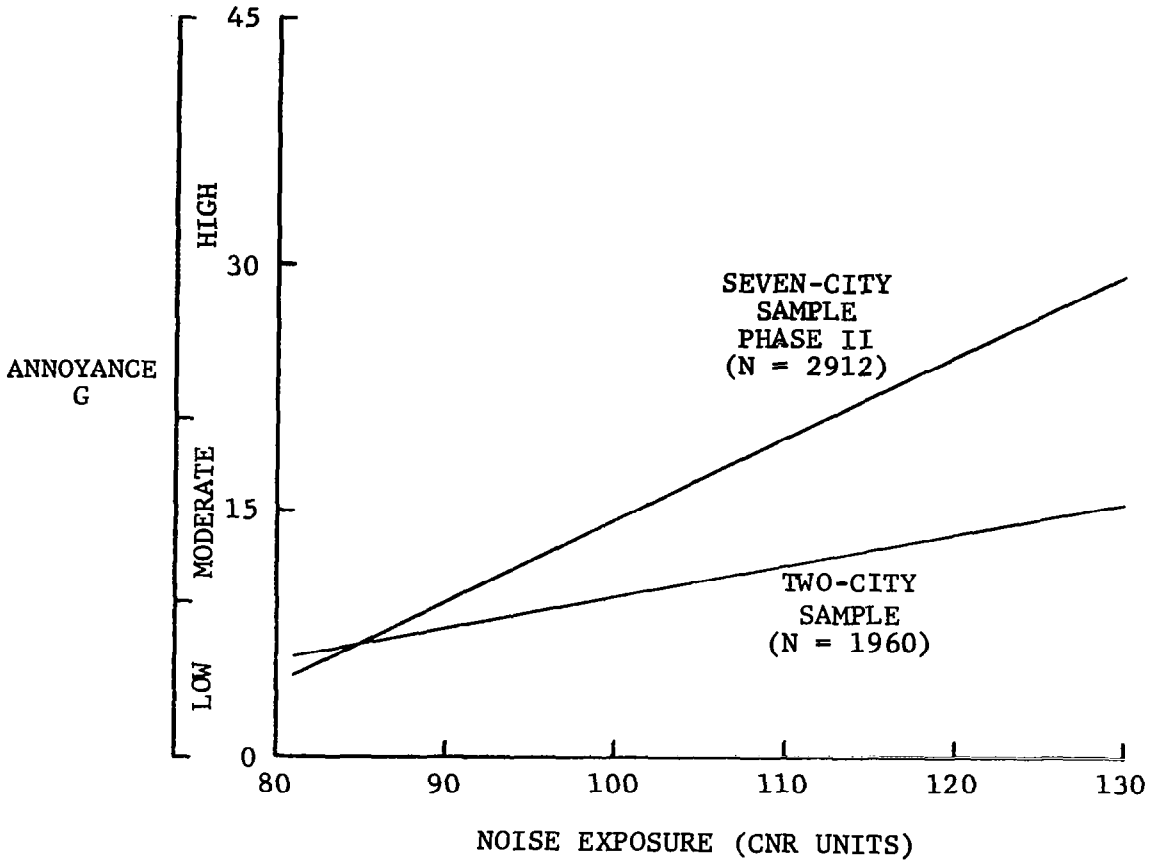


FIG. 9 - LINES OF REGRESSION OF ANNOYANCE G ON NOISE EXPOSURE (CNR) FOR SEVEN-CITY AND TWO-CITY SAMPLES

These regression lines behave similarly to those for percent highly annoyed (given in Annoyance Categories) in two respects. They intersect at CNR 85, which is the value at which the highly annoyed categories approached zero. Also the ratio of their slopes is 2.6, comparable to 2.2 for the categories with one of the two-city datum points omitted.

Effects of Number Correction and Operation Type

The new master analytic tape was also used to analyze the effects upon correlation of annoyance and exposure of the number correction and of operation type (landing or take-off). This was done by constructing CNR-type variables using different number weightings and by examining the partial CNR's for landings and take-offs separately as well as in combination. Such variables were defined as follows:

LCNR - Partial CNR for noise due to landings only
TCNR - Partial CNR for noise due to take-offs only
CCNR - Combined CNR for all operations
CNRK - CNR with (K log N) number correction

Thus in this notation the standard CNR measure would be denoted CCNR10. (Because exposure computations for Phase I of the seven-city study were performed without regard to operation types per se, the reconstruction of the basic data would be difficult and perhaps unreliable; therefore only Phase II is included in the present analysis.)

The correlations of Annoyance G, as computed for individual respondents, with the various constructed exposure variables is given in Table 7. The variation with number correction is small and clearly does not offer any justification for changing from the present standard 10 log N factor. It is apparent, however, that the 15 log N factor used in the Noise and Number Index (NNI) formulation would be somewhat inferior to a 5 log N weighting.

The variation of correlation with respect to type of operation is striking and also contrary in direction for the seven-city and two-city samples. In the former, take-off noise would appear to

Table 7

CORRELATION OF ANNOYANCE G WITH CNR-TYPE VARIABLES

	Seven-City Phase II				Two-City			
Exposure Variable	K = 5	K = 10	K = 15	K = 20	K = 5	K = 10	K = 15	K = 20
LCNRK	0.42	0.42	0.42	0.41	0.41	0.13	0.13	0.12
TCNRK	0.04	0.03	0.02	0.02	0.23	0.21	0.19	0.17
CCNRK	0.43	0.41	0.40	0.40	0.27	0.25	0.24	0.22

play essentially no role in determining reaction; in the latter, such noise tends to take precedence. The data of Table 8 offer some explanation. These show that noise exposure itself, as represented by the combined CNR, is dominated by landings in the first case and by take-offs in the second. This probably is a consequence of the geography of all three Phase II cities (Boston, Miami, and New York); their airports are situated by the ocean or adjacent to largely unpopulated land areas and offer options

Table 8

CORRELATION OF STANDARD CNR WITH OTHER CNR-TYPE VARIABLES

	Seven-City Phase II				Two-City			
Exposure Variable	K = 5	K = 10	K = 15	K = 20	K = 5	K = 10	K = 15	K = 20
LCNRK	0.62	0.61	0.60	0.59	0.38	0.36	0.36	0.35
TCNRK	0.31	0.29	0.28	0.27	0.95	0.93	0.91	0.88

for take-offs over the water and/or community-avoidance take-off flight procedures. Since take-offs are generally noisier than landings, such options are taken wherever possible. As a result, noise exposure for the Phase II survey respondents is predominantly from landings. In the case of the two-city sample, the dominance of take-offs is probably due to the fortuitous combination of wind and geographical population distribution, since the airports in these cities have only one major runway and thus offer no alternative flight options except under calm wind conditions. The stronger differential between landing and take-off coefficients in Table 7 as compared to Table 8 suggests a greater sensitivity to landing noise itself. This might partially explain the lower annoyance in the two-city sample, since take-offs are dominant there.

The preceding observations with respect to the number variable and types of operation are comparable to findings of the second London airport study.[2] In particular, it was found that the factor K in the number correction had little effect upon annoyance prediction by a measure of the NNI type and thus that the 15 log N term used in the NNI formula is of no special distinction among other possibilities. It was also found that the proportion of landings to total operations was not a factor sufficiently important to be included in a simple noise exposure measure.

Seven-City Predictive Equation

During Phase I of the seven-city study a dummy-variable multiple regression equation was developed for explaining and predicting annoyance due to aircraft noise exposure. This equation used the following eight predictor variables, for each of which the detailed construction is described in Appendix B:

Fear - apprehension or worry that aircraft might crash in the neighborhood

Noise Susceptibility - degree of bother by typical neighborhood sounds

Distance - distance from center of airport to residence

Adaptability - willingness to accept increased aircraft noise

City - city of residence

Misfeasance - belief that responsible persons are not doing anything about aircraft noise

Importance - feelings regarding the value and importance of the airport and air transportation in general

Noise Exposure - Composite Noise Rating

Using these variables, a multiple correlation coefficient of 0.75 was obtained for the Phase I data on the basis of which the predictive equation was derived. When subjected to validation using Phase II data, the same equation produced a correlation of predicted and observed annoyance of 0.71. There has been speculation as to how well the equation would work under low noise exposure conditions such as those found in Reno and Chattanooga. Thus one goal of the present research was to determine the applicability of the seven-city predictive equation to such situations.

The following procedure was followed in evaluating the equation with data from the two-city study. All eight variables (except for City) were constructed from the two-city data. The same

categories were used as in the original equation. (The lowest possible coefficient was used for the City variable since both Chattanooga and Reno had considerably lower levels of air traffic.) Then, using the coefficients from the seven-city study, a predicted Annoyance G value was obtained for each two-city respondent. These were then compared to actual values calculated from the survey data.

Table 9 shows a comparison between mean values of predicted and actual Annoyance G for the two-city study and also for the Phase II cities of the seven-city study. In Reno the equation predicts low; in Chattanooga it predicts high. In general, the equation predicts less well for the two-city study than for the larger cities, although the correlation is much better than that obtained in a preceding section using CNR as the sole predictor variable. The lower correlation for the two-city sample is consistent with Swedish findings at smaller airports in Scandinavian countries; essentially no correlation between annoyance and noise-related variables was obtained where there were less than 70 take-offs per day.[9]

Two-City Predictive Equation

Data from the two-city sample were used to establish a predictive equation for annoyance similar to the seven-city equation. The purpose of this effort was to determine whether an equation derived exclusively from smaller city data would have greater predictive power than the seven-city equation and to ascertain whether the important variables would be the same or not.

Table 10 shows the variables which correlate to a significant extent with Annoyance G in the two-city data. (Distance from the airport was included simply to show that it does <u>not</u> correlate with annoyance in the smaller cities.)

Table 9

COMPARISON OF PREDICTED AND ACTUAL ANNOYANCE G FOR TWO-CITY AND SEVEN-CITY PHASE II SAMPLES (PREDICTIONS BASED ON PHASE I EQUATION)

	Mean Predicted Annoyance G	Standard Deviation	Mean Actual Annoyance G	Standard Deviation	Correlation Coefficient
Boston	21.0	8.8	18.8	12.8	0.61
Miami	10.0	8.0	9.3	10.7	0.69
New York	23.1	9.4	24.3	12.2	0.61
Chattanooga	10.4	8.1	9.1	7.1	0.49
Reno	10.5	7.4	10.9	9.2	0.54
Two-city sample	10.4	7.8	9.9	7.7	0.51

Table 10

CORRELATIONS OF VARIOUS VARIABLES WITH ANNOYANCE G

(Two-City Sample)

Variable	Correlations with Annoyance G
Fear	0.3789
Adaptability	-0.2657
CNR	0.2502
Pollution Annoyance	0.2306
Noise Susceptibility	0.2236
Discussion	0.1961
Misfeasance	0.1682
Importance	0.1576
Age	-0.1389
Health Damage	0.1350
Noise Irritability	0.1238
Distance	0.0055

In addition to variables embodied in the seven-city equation, Table 10 lists five other variables which are defined in detail in Appendix B. These are as follows:

Pollution Annoyance - bother by aircraft smoke, fumes, oil dropout, landing lights

Discussion - frequency of discussion of aircraft noise with friends, neighbors, or relatives

Age - age of respondent

Health Damage - belief that aircraft noise can damage a person's health

Noise Irritability - degree of bother by sounds of high irritation potential

The procedure used in developing a two-city equation was to construct a series of models (equations) for evaluation, each utilizing a certain number of variables from Table 10. The single variable Fear was used in the first model. Both Fear and Noise Susceptibility were used in the next model. Each succeeding model incorporated another variable and at each step the significance of adding that variable was tested. The Multiple Classification Analysis (MCA) scheme was used throughout to construct the models.

Table 11 lists the models by number, the variables in each model, the relation of each variable to Annoyance G without considering the influence of the other variables in the model (Eta), the relation of each variable to Annoyance G taking into consideration the other variables in the set (Beta), the multiple correlation coefficient (R), the amount of variance explained in the dependent variable by the model (R^2), and an F value which represents the significance of the increment over the previous model.

This procedure tests the significance of adding variables to a multiple regression equation. Model 1 is very significant. Each variable added to the previous model produces a significant increment in the amount of variance explained until Model 7 is reached. From that point on, no significant increments are obtained. The optimal model is thus Model 6 involving the variables Fear, CNR, Noise Susceptibility, Adaptability, Pollution Annoyance, and Discussion, in order of importance.

Table 11

MULTIPLE CLASSIFICATION ANALYSIS MODELS FOR PREDICTION OF ANNOYANCE G (TWO-CITY SAMPLE)

Model	Variables	Eta	Beta	R	R^2	F-Value
1	Fear	0.40	0.40	0.395	0.156*	120.25
2	Fear	0.40	0.38			
	Noise Susceptibility	0.25	0.16	0.424	0.179	18.75
3	Fear	0.40	0.33			
	Noise Susceptibility	0.25	0.14			
	Pollution Annoyance	0.23	0.14	0.443	0.196	13.28
4	Fear	0.40	0.30			
	Noise Susceptibility	0.25	0.13			
	Pollution Annoyance	0.23	0.13			
	Adaptability	0.27	0.16	0.468	0.219	28.89
5	Fear	0.40	0.26			
	Noise Susceptibility	0.25	0.15			
	Pollution Annoyance	0.23	0.11			
	Adaptability	0.27	0.13			
	CNR	0.31	0.21	0.508	0.258	10.28
6	Fear	0.40	0.25			
	Noise Susceptibility	0.25	0.14			
	Pollution Annoyance	0.23	0.11			
	Adaptability	0.27	0.13			
	CNR	0.31	0.21			
	Discussion	0.21	0.10	0.517	0.267	4.53
7	Fear	0.40	0.24			
	Noise Susceptibility	0.25	0.13			
	Pollution Annoyance	0.23	0.10			
	Adaptability	0.27	0.12			
	CNR	0.31	0.21			
	Discussion	0.21	0.10			
	Misfeasance	0.17	0.07	0.520	0.271	1.89
8	Fear	0.40	0.24			
	Noise Susceptibility	0.25	0.13			
	Pollution Annoyance	0.23	0.10			
	Adaptability	0.27	0.12			
	CNR	0.31	0.21			
	Discussion	0.21	0.10			
	Misfeasance	0.17	0.07			
	Noise Irritability	0.12	0.03	0.520	0.271	0.

*Significant at the 0.001 level

Table 11 - cont.

MULTIPLE CLASSIFICATION ANALYSIS MODELS FOR PREDICTION OF ANNOYANCE G (TWO-CITY SAMPLE)

Model	Variables	Eta	Beta	R	R^2	F-Value
9	Fear	0.40	0.23			
	Noise Susceptibility	0.25	0.12			
	Pollution Annoyance	0.23	0.09			
	Adaptability	0.27	0.12			
	CNR	0.31	0.21			
	Discussion	0.21	0.10			
	Misfeasance	0.17	0.07			
	Noise Irritability	0.12	0.03			
	Importance	0.20	0.08	0.525	0.275	0.93
10	Fear	0.40	0.23			
	Noise Susceptibility	0.25	0.12			
	Pollution Annoyance	0.23	0.09			
	Adaptability	0.27	0.12			
	CNR	0.31	0.21			
	Discussion	0.21	0.10			
	Misfeasance	0.17	0.06			
	Noise Irritability	0.12	0.03			
	Importance	0.20	0.08			
	Health Damage	0.14	0.05	0.527	0.278	0.39
11	Fear	0.40	0.23			
	Noise Susceptibility	0.25	0.11			
	Pollution Annoyance	0.23	0.09			
	Adaptability	0.27	0.12			
	CNR	0.31	0.21			
	Discussion	0.21	0.09			
	Misfeasance	0.17	0.05			
	Noise Irritability	0.12	0.03			
	Importance	0.20	0.08			
	Health Damage	0.14	0.06			
	Age	0.14	0.09	0.532	0.297	0.43

It is apparent that the two-city MCA equation represented by Model 6 does not in fact offer any significant increase in predictive power over the seven-city equation, although it does utilize a modified set of predictors as discussed in the next section. The two-city equation and associated coefficients are given in Tables 12 and 13 respectively. It may be noted that the number of categories for most predictors is smaller than in the seven-city equation; this was necessary because of the limited distribution of these predictors in the two-city sample.

Comparison of the Seven-City and Two-City Equations

There are both contrasts and similarities between the constituents of the seven-city and two-city equations as shown in Table 14. An important difference is the inclusion of Discussion in the latter equation. This is the first instance in which a sociological variable has entered into the prediction of annoyance. It is also important that the two-city equation does not contain the items Misfeasance, Importance, and Distance. The only new variable included besides Discussion is Pollution Annoyance, which is an indication of dissatisfaction with the polluting aspects of aircraft operations and which was important in the seven-city study in the explanation of complaint. A consideration of the Beta values in Model 6 shows that Fear and CNR are more important than the other variables. The rank of CNR has risen considerably from fifth out of eight variables in the seven-city equation. The central element in both equations in the explanation of annoyance is Fear. In the larger cities feelings of mistrust of officials and non-affective ties to the airport are important in explaining annoyance. In the smaller cities this is not the case.

The multiple R value of 0.53 to 0.55 for the two-city equation does not compare favorably with the value of 0.75 obtained with

Table 12

TWO-CITY PREDICTIVE EQUATION FOR ANNOYANCE G

$$G = K + \sum_{m} \sum_{n} \alpha_{mn} X_{mn}$$

$$= 9.96 + \sum_{n=1}^{3} \alpha_{1n} X_{1n} \quad \text{(Fear)}$$

$$+ \sum_{n=1}^{3} \alpha_{2n} X_{2n} \quad \text{(Noise Susceptibility)}$$

$$+ \sum_{n=1}^{3} \alpha_{3n} X_{3n} \quad \text{(Pollution Annoyance)}$$

$$+ \sum_{n=1}^{3} \alpha_{4n} X_{4n} \quad \text{(Adaptability)}$$

$$+ \sum_{n=1}^{10} \alpha_{5n} X_{5n} \quad \text{(CNR)}$$

$$+ \sum_{n=1}^{5} \alpha_{6n} X_{6n} \quad \text{(Discussion)}$$

Table 13

VARIABLES, CLASSES, AND MCA COEFFICIENTS FOR TWO-CITY PREDICTIVE EQUATION

m	Variable	n	Class		α_{mn}
1	Fear	1	0-3	(low)	-1.24
		2	4-6	(med)	-0.01
		3	7-10	(high)	4.14
2	Noise Susceptibility	1	0-9	(low)	-1.07
		2	10-29	(med)	-0.12
		3	30+	(high)	3.62
3	Pollution Annoyance	1	0-5	(low)	-0.21
		2	6-11	(med)	3.15
		3	12+	(high)	4.09
4	Adaptability	1	None		1.22
		2	Any		-0.85
5	CNR	1	0-84		-0.25
		2	85-90		-1.72
		3	90-95		-0.68
		4	95-99		-0.97
		5	100-104		-0.69
		6	105-109		-0.11
		7	110-114		2.71
		8	115-119		1.42
		9	120-124		4.64
		10	125+		10.77
6	Discussion	1	0		-0.73
		2	1		0.68
		3	2		0.48
		4	3		0.53
		5	4		1.52

Table 14

COMPARISON OF VARIABLES USED IN
SEVEN-CITY AND TWO-CITY PREDICTIVE EQUATIONS FOR ANNOYANCE

Seven-City Equation	Rank	Two-City Equation	Rank
Fear	1	Fear	1
Noise Susceptibility	2	CNR	2
Adaptability	3	Noise Susceptibility	3
Distance	4	Adaptability	4
CNR	5	Pollution Annoyance	5
City	6	Discussion	6
Misfeasance	7		
Importance	8		

the original Phase I equation for Annoyance G or with the correlation coefficient of 0.71 obtained in the Phase II validation of that equation. This lack of predictive power may be due partially to the limited distribution of the dependent and predictor variables; it also reflects the operation of factors not included among the predictor variables.

Amalgamation of the seven-city and two-city samples for the derivation of a new predictive equation would appear to be a desirable goal. Unfortunately, the differences in behavior of the fundamental variables are such that the data cannot be readily combined for this purpose. It was shown in previous sections that the growth of annoyance with noise exposure is different for the two samples and that the difference is not attributable to a simple shift in either variable. If the data are simply combined, the resulting predictive equation could have inferior predictive power and would be less applicable to the larger

airport communities. If the data are combined and an additional binary large-city/small-city variable added in the MCA scheme, this variable would serve only as an additive constant rather than as a true predictor, although it might produce an inflated correlation and might cause the mean annoyance values for the two samples to coincide more nearly. To combine the data meaningfully, a procedure is needed for adjusting the effective noise exposure so as to resolve the two-city/seven-city differences in the previous chapter.

ANNOYANCE AND COMPLAINT

Annoyance and complaint as dealt with in this section denote, respectively, the "highly annoyed" category of Annoyance G as defined under Annoyance Categories and the fact of having at some time registered an overt complaint concerning aircraft noise. In the analysis of the seven-city data, it was found that high annoyance tends to be a necessary but not a sufficient condition for complaint. Also it was shown that a relationship exists between the percentage of respondents in a city who are highly annoyed and of those who are complainants. This was expressed as a linear relation, but it was recognized that this was an approximation to a curvilinear function.

Addition of the two-city data requires a more accurate definition of the annoyance-complaint relationship. The fundamental information for all nine cities surveyed to date are given in Table 15. The percentage of highly annoyed ranges from 9% to 65%; that of complainants, from 0.3% to 22.4%. These

Table 15

ANNOYANCE AND COMPLAINT STATISTICS FOR SEVEN-CITY AND TWO-CITY SAMPLES

City	N	Number Complainants	Percentage Complainants	Number Highly Annoyed	Percentage Highly Annoyed
Boston	1,166	156	13.4	517	44.3
Chattanooga	1,114	3	0.27	102	9.15
Chicago	872	43	4.93	299	34.3
Dallas	923	22	2.38	236	25.6
Denver	1,009	33	3.27	215	21.3
Los Angeles	786	93	11.8	382	48.6
Miami	676	12	1.78	148	21.9
New York	1,070	240	22.4	696	65.0
Reno	846	4	0.48	124	14.6

data are plotted in Figure 10 together with a least-squares parabola, given by (percent highly annoyed) = 14.3√(percent complainants), which fits the data well. The coefficient of linear correlation between observed and predicted values is 0.98, whether the fundamental predictor is percent highly annoyed or percent complainants. The implication of the relationship postulated above is that the rate of increase of complaint with respect to annoyance is proportional to annoyance. Since this applies to a large population, the further implication is that a social interaction process is at work. If individuals such as the survey respondents were totally isolated from one another, it is unlikely that the probability of one individual's being a complainant would be dependent upon the state of annoyance in others. It is reasonable to assume that a person's complaint potential depends upon both his own degree of annoyance and the amount of general community disturbance, the latter as perceived through the news media and discussions with others, individually or within a group.

On the basis of the hypothetical curve of Figure 10, high annoyance on the part of an entire population would not impel all its members to become complainants. The 100% highly annoyed point corresponds to 49% complainants, in fact. Although this is an extrapolation, it does agree with the finding that certain predisposing factors other than annoyance are involved in complaint behavior.[1,4] It also has been suggested that some households may have only one "representative" when such reaction is manifested; this would tend to reduce the observed complaint incidence.

It should be possible to predict the number of highly annoyed persons or the number of complainants in a community of reasonable size, given the other variable, with good accuracy. This is a useful capability when dealing with the problem of community reaction. If adequate records are kept of complaint

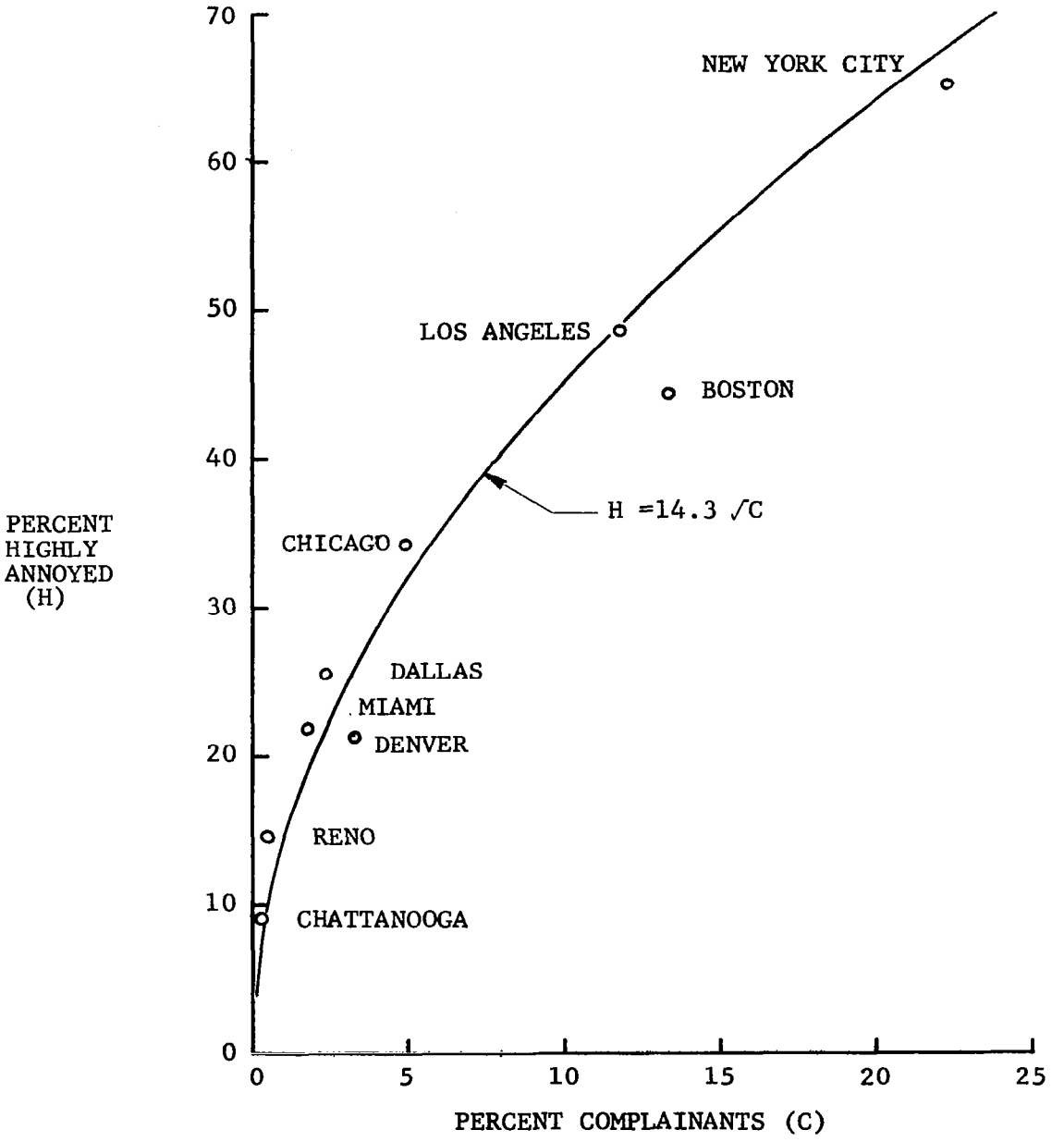


FIG. 10 - RELATIONSHIP BETWEEN PERCENTAGE OF HIGHLY ANNOYED AND PERCENTAGE OF COMPLAINANTS IN SEVEN-CITY AND TWO-CITY SAMPLES

activity at an existing site--this requires distinguishing complainants from complaints--an assessment of the state of community annoyance is available. On the other hand, if the number of highly annoyed is known from a survey of an adequate sample, or if it can be predicted from noise exposure data, the number of complainants expected can be computed. A simple procedure for doing the latter is set forth in the next chapter.

ESTIMATING COMMUNITY REACTION

Relationships established earlier in this report can be used to estimate or predict reaction to aircraft noise in airport communities in terms of the number of people highly annoyed and the number who are expected to be complainants. The basic relationships (given previously) are the following:

$$\% \text{ Highly Annoyed (7-city)} = 1.585 \text{ (CNR - 85.3)}$$

$$\% \text{ Highly Annoyed (2-city)} = 0.729 \text{ (CNR - 85.3)}$$

$$\% \text{ Complainants} = (\% \text{ Highly Annoyed}/14.3)^2$$

For convenience, the first two equations may be modified to use the Noise Exposure Forecast (NEF) as the exposure variable on the basis of the relation NEF $\simeq$ CNR - 72 developed from the seven-city noise data.[1] With this modification and reasonable rounding off, one obtains

$$\% \text{ Highly Annoyed (7-city)} = 1.6 \text{ (NEF - 15)}$$

$$\% \text{ Highly Annoyed (2-city)} = 0.73 \text{ (NEF - 15)}$$

It is also convenient in many cases to deal in terms of standard NEF zones. For these situations the values in Table 16 may be used. For larger cities in the summer months the seven-city values are applicable; for smaller cities in the fall and winter, the two city values should be used. For other circumstances--such as a large city in wintertime--the choice will depend upon whether one accepts the seasonal hypothesis or not. This choice must be left to the user, pending further knowledge.

The required steps in estimating community reaction are as follows:

Table 16

PERCENTAGE HIGHLY ANNOYED BY NEF ZONE

NEF Zone	Percentage Highly Annoyed	
	Seven-City	Two-City
15-20	6	3
20-25	14	7
25-30	22	10
30-35	30	14
35-40	38	18
40-45	46	21
45-50	54	25
50-55	62	29

(1) Establish geographical aircraft noise exposure zones using published NEF contours or measured exposure data.

(2) Determine the resident population in each zone starting at NEF 15, using census tract data, land area times estimated population density, etc.

(3) Calculate the number of highly annoyed in each zone from the population data and the percentage in Table 16.

(4) Sum the number of highly annoyed and the populations over all zones.

(5) Calculate the percentage of highly annoyed for the entire community area within the NEF 15 contour.

(6) Calculate the percentage of complainants for the area.

The foregoing procedure is carried out as an example in Table 17. Thus far it has not been applied to a real community or otherwise independently validated.

Table 17

ESTIMATION OF COMMUNITY REACTION
FOR A HYPOTHETICAL AIRPORT COMMUNITY

NEF Zone	Population	Percentage Highly Annoyed	Number Highly Annoyed
15-20	6,000	6	360
20-25	4,000	14	560
25-30	3,000	22	660
30-35	2,000	30	600
35-40	700	38	266
40-45	200	46	92
45-50	100	54	54
50-55	0	62	0
TOTALS	16,000	-	2,592

$$\text{Community Percentage Highly Annoyed} = \frac{2,592}{16,000} \times 100$$

$$= 16.2\%$$

$$\text{Community Percentage Complainants} = (16.2/14.3)^2$$

$$= 1.3\%$$

It is not presently possible to estimate the percentage of complainants in particular exposure zones, although it is recognized that complaints do arise from areas of relatively low noise exposure. The relationship between the percentage of complainants and the actual monthly complaint rate has not been established. It is likely that this relationship is highly dependent upon the complaint channels available as well as other factors and therefore may have to be assessed for each individual community. On the basis of subjective observations made in the nine cities thus far surveyed, it appears that airport community noise problems of a very serious nature, such as numerous legal suits, may arise when the proportion of highly annoyed exceeds 25% or when the proportion of complainants exceeds 3%.

CONCLUSIONS

A study of community reaction to jet aircraft noise in the vicinity of airports in Chattanooga, Tennessee, and Reno, Nevada, together with data from previous studies in seven larger cities of the USA, led to the following conclusions:

1. The percentage of highly annoyed persons in the Chattanooga-Reno sample was slightly less than half that for the large-city sample at Composite Noise Rating (CNR) values below 125. For both samples, essentially no high annoyance existed at a CNR of 85 or less.

2. The difference in annoyance between the two samples is not attributable to basic demographic characteristics; the factors most likely responsible are season of the year and number of aircraft operations.

3. Prediction of individual annoyance in Chattanooga and Reno, either by CNR alone or by the predictive equation developed in the study of larger cities, was less accurate than in the previous study. This result may be partly attributed to limited annoyance in the two-city sample. A new predictive equation derived solely from the two-city data emphasizes a somewhat different set of variables and affords about the same predictive power as the earlier equation.

4. The relationship between annoyance and complaint in a community as a whole is well defined for the nine cities studied. The percentage of complainants is considerably less than the percentage of highly annoyed and is proportional to the square of the

latter. This relationship is indicative of social reinforcement underlying complaint.

5. From known noise exposure and population density patterns in a community, the number of highly annoyed persons and the number of complainants can be estimated for the community as a whole.

APPENDIX A

FORM D(R) QUESTIONNAIRE

The original questionnaire page number is given in parentheses at the bottom of each page for reference as required for Appendices B and C.

OFFICE USE ONLY

No. _____

Rcd. _____ /

Log _____

Validity P/R /

Grade _____

PROGRAM
IN
COMMUNITY STUDIES
1970
FORM D (R)

FORM APPROVED

BUDGET BUREAU NO. 104-S70002

QUESTIONNAIRE (FORM D--REVISED)

Interviewer Name _____ Number _____

City _____

Date of Interview _____ / _____ / _____
Month Day Year

Time Interview Began _____ Ended _____ Total Minutes _____

Census Tract _____ _____ Census Block _____

(NOTE TO INTERVIEWER: YOUR INSTRUCTIONS ARE IN CAPITAL LETTERS AND ENCLOSED IN PARENTHESES. DO NOT READ THESE INSTRUCTIONS TO RESPONDENT.)

(1). (INTRODUCE SELF)

(2). (INDICATE SUBJECT AND PURPOSE OF STUDY, FOR EXAMPLE:)

I am a research interviewer working on a study of community issues here in (NAME OF CITY). My job is to help conduct a survey of the attitudes and opinions of the residents of this city and this neighborhood regarding common issues. Any answers you give me will be confidential, and they will be used to help plan future community improvements.

(3) (HAND RESPONDENT OPINION THERMOMETER.)

The two sides of this card have "opinion thermometers" which we will use in several questions to estimate how you feel about certain things. For example, turn to Side I. On the left is a Frequency Scale to estimate How Often. For practice, let's estimate how often you go to the movies. Think of how often you go. If you rarely go to the movies, you

would say "zero". On the other hand, if you went very often, you would say "four" or perhaps "three". If you sometimes go to the movies, you would say "one" or "two". If you go to the movies about as often as your friends or acquaintances you would have a score of "two" - the average in most cases.

Now, how often would you say you go to the movies? (CIRCLE NUMBER) 0 1 2 3 4

The other scales (How Much and How Good) are used in the same way. Remember that "three" or "four" mean Very Much or Very Good, "zero" means Very Poor or Not at All, and "two" means About Average.

Now we will start.

1. How long have you lived in (NEIGHBORHOOD)? _____ (RECORD IN YEARS)
   DK _____ NR _____

2. How long have you lived in (CITY)? _____ (RECORD IN YEARS)
   DK _____ NR _____

Now, at the present time, what are some of the things you like or don't like about living in this neighborhood - things that you feel are advantages and make this a good place to live, or disadvantages - things that you feel are unpleasant?

3. What are the advantages, if any?

(RECORD ANSWER VERBATIM IN SPACE BELOW)

APPENDIX A

Now, most neighborhoods have some things about them people dislike.

4a. What are the disadvantages of living in this neighborhood, if any?

(RECORD ANSWER VERBATIM, RETAINING ORDER OF MENTION)

(NUMBER ORDER OF MENTION IN COLUMN 4A)

(IF VERBATIM ANSWERS DO NOT "FIT" CATEGORIES, RECORD ANSWERS IN SPACES BELOW "AIRCRAFT NOISE")

DISADVANTAGES

1. _____

2. _____

3. _____

4. _____

DK_____ NR_____

Here is a list of things some people dislike the most about where they live.

(INTRODUCE CARD 1, HAND TO RESPONDENT)

4b. Which one thing on this list (ADD ANY MENTIONED IN 4a) do you dislike the most about where you live?

(MARK ONE THING DISLIKED THE MOST IN COLUMN 4B)

4A		4B	4C	DK	NR
	NOTHING DISLIKED				
	INCONVENIENT LOCATION		0 1 2 3 4		
	EXPENSIVE PLACE TO LIVE		0 1 2 3 4		
	UNSAFE PLACE TO LIVE		0 1 2 3 4		
	RUN-DOWN NEIGHBORHOOD		0 1 2 3 4		
	POOR FACILITIES		0 1 2 3 4		
	UNFRIENDLY NEIGHBORS		0 1 2 3 4		
	DISLIKE FOR A CERTAIN HOUSE		0 1 2 3 4		
	NO PRIVACY		0 1 2 3 4		
	OTHER NOISE		0 1 2 3 4		
	AIRCRAFT NOISE		0 1 2 3 4		
			0 1 2 3 4		
			0 1 2 3 4		
			0 1 2 3 4		
			0 1 2 3 4		

(TAKE BACK CARD 1)

4c. Using the Opinion Thermometer, how much do you dislike this one thing? (CIRCLE NUMBER IN COLUMN 4C)

(GO TO 4D)

→(SKIP TO 5A)

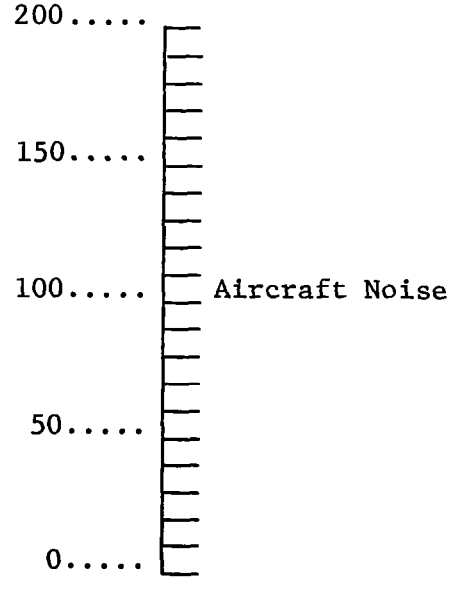
4d. In order to find out how important (Most Disliked Thing) is in comparison to other things in the neighborhood, we want you to locate several items on a scale. (HAND R. CARD 2.) The idea is to pick a number on the scale which shows the relative importance of (Most Disliked Thing) to you.

(IF AIRCRAFT NOISE IS MOST DISLIKED THING):
Notice that Aircraft Noise is located at the number "100." What number below it do you feel best fits the next most disliked thing in your neighborhood?
(WRITE IN LOCATION OF NEXT MOST DISLIKED THING) (TAKE BACK CARD 2)
(GO TO 5C)

- -

(IF AIRCRAFT NOISE IS NOT MOST DISLIKED THING):
For example, Aircraft Noise is located at the number "100." What number above it do you feel best fits (Most Disliked Thing) in comparison to Aircraft Noise?
(WRITE IN LOCATION OF MOST DISLIKED THING) (TAKE BACK CARD 2)
(GO TO 5C)

- -



(IF NOTHING DISLIKED, ASK:)

5a. In the past was there ever anything you disliked about living here?

YES _____; NO _____ (IF NO, DK OR NR GO TO QUESTION 8)
DK _____; NR _____

5b. (IF YES): What was that? _____

_____

5c. How many times in an average week do/did you discuss (MOST DISLIKED THING OR ONE THING DISLIKED IN THE PAST) with friends, neighbors, or relatives?

(CIRCLE NUMBER) 0 1 2 3 4 More than 4 DK___NR___

5d. Do/did you yourself ever feel like doing something to improve this situation? For example, do/did you feel like: (READ LIST, MARK "YES" OR "NO")

	5D				5E			
	YES	NO	DK	NR	YES	NO	DK	NR
DISCUSSING IT WITH SOMEONE								
TELEPHONING OR WRITING TO AN OFFICIAL								
SIGNING A PETITION								
VISITING AN OFFICIAL								
ATTENDING A MEETING ABOUT IT								
HELPING TO SET UP A COMMITTEE TO DO SOMETHING ABOUT IT								
WRITING A LETTER TO THE EDITOR								
FILING A SUIT								
OTHER								

APPENDIX A

(IF RESPONDENT ANSWERS "NO" TO ALL ITEMS IN 5D, GO TO 5F)

5e. Did you (or your family) actually do any of these things?

YES _____; NO _____ DK _____ NR _____

(IF YES): Which one(s)? (MARK IN COLUMN 5E)

What happened? _____

_____

_____

(IF NO): Why is that? That is, why did you decide not to do anything?

_____

_____

5f. Has any local organization ever asked you to do any of these things?

YES _____; NO _____; DK _____; NR _____

5g. What do you think are/were the chances of an organization improving or reducing this situation?

VERY GOOD ___; GOOD ___; FAIR ___; NOT VERY GOOD ___;

POOR ___; DK ___; NR ___

6. Do/did you happen to know who or where to call if you wanted to complain?

YES ____; NO _____; DK _____; NR _____

7. In your own opinion, how much are/were your neighbors bothered by this situation? Use the Opinion Thermometer.

(CIRCLE NUMBER) 0 1 2 3 4 DK____ NR____.

(ASK EVERYONE):

8. Here is a list of sounds which sometimes bother people. Most people hear these sounds somewhere, not necessarily in their own homes. Use the Opinion Thermometer to rate how much each sound bothers you when you do hear it.

(READ LIST AND CIRCLE NUMBER FOR EACH SOUND)

SOUNDS	RATING	DK	NR
WALKING ON GRITTY FLOORS	0 1 2 3 4		
MUSICAL INSTRUMENTS IN PRACTICE	0 1 2 3 4		
BANGING DOORS	0 1 2 3 4		
AIR HAMMERS	0 1 2 3 4		
DRIPPING WATER	0 1 2 3 4		
WHISTLING	0 1 2 3 4		
CHALK SCRAPING ON A BLACKBOARD	0 1 2 3 4		
NEIGHBOR'S RINGING TELEPHONE	0 1 2 3 4		
PEOPLE WALKING ON THE FLOOR ABOVE	0 1 2 3 4		
CHAIRS SCRAPING ON THE FLOOR	0 1 2 3 4		
NEIGHBORS LAUGHING OR QUARRELING	0 1 2 3 4		
TYPEWRITERS	0 1 2 3 4		

9a. I will now read a number of noises heard in different neighborhoods. Which ones do you hear in this neighborhood ?

(READ LIST TO RESPONDENT, CHECKING WHETHER NOISE IS HEARD OR NOT)

(FINISH 9a BEFORE ASKING 9b)

9b. Of those that you hear, how much are you bothered or annoyed? Use the Opinion Thermometer.

(CIRCLE NUMBER IN COLUMN 9b ONLY FOR THOSE NOISES HEARD)

(FINISH 9b BEFORE ASKING 9c)

9c. Some people are more aware of noise than others. How much is each noise that you hear noticeable to you; that is, how much attention do you pay to each one? Please use the Opinion Thermometer.

(CIRCLE NUMBER IN COLUMN 9c)

(PROBE TO SEE IF RESPONDENT WOULD NOW LIKE TO INCLUDE MORE NOISES AS HEARD)

	9a HEARD				9b ANNOYS			9c NOTICES		
			DK	NR		DK	NR		DK	NR
AUTOS	YES	NO			0 1 2 3 4			0 1 2 3 4		
NEBH. CHILDREN	YES	NO			0 1 2 3 4			0 1 2 3 4		
AIRCRAFT	YES	NO			0 1 2 3 4			0 1 2 3 4		
DOGS/PETS	YES	NO			0 1 2 3 4			0 1 2 3 4		
PEOPLE	YES	NO			0 1 2 3 4			0 1 2 3 4		
CYCLES/HOT RODS	YES	NO			0 1 2 3 4			0 1 2 3 4		
TRAINS	YES	NO			0 1 2 3 4			0 1 2 3 4		
SIRENS	YES	NO			0 1 2 3 4			0 1 2 3 4		
CONSTRUCTION	YES	NO			0 1 2 3 4			0 1 2 3 4		
LAWN MOWERS	YES	NO			0 1 2 3 4			0 1 2 3 4		
GARBAGE COLLECTION	YES	NO			0 1 2 3 4			0 1 2 3 4		
SONIC BOOMS	YES	NO			0 1 2 3 4			0 1 2 3 4		
TRUCKS	YES	NO			0 1 2 3 4			0 1 2 3 4		
OTHER (SPECIFY)	YES	NO			0 1 2 3 4			0 1 2 3 4		
NO NOISES HEARD	YES									

→(SKIP TO QUESTION 20a)

10. When you see or hear airplanes overhead, how often do you feel they are flying too low for the safety of residents in the area? Use Opinion Thermometer.

(CIRCLE NUMBER) 0 1 2 3 4 DK_____; NR_____

11. When you see or hear airplanes overhead how often do you feel there is some danger that they might crash nearby? Use Opinion Thermometer.

(CIRCLE NUMBER) 0 1 2 3 4 DK_____; NR_____

12. What times of the day do you particularly notice aircraft noise? (CHECK WHETHER WEEKDAYS OR WEEKENDS)

	Morning		Afternoon		Evening		Night	
	6-9	9-12	12-3	3-6	6-9	9-12	12-3	3-6
WEEK-DAYS								
WEEK-ENDS								
DK								
NR								

All the time _____

No particular time _____

13. What days of the week do you particularly notice aircraft noise?

	Sun.	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.
YES							
NO							
DK							
NR							

Every day _____

No particular day _____

14. How often do you notice smoke, fumes, oil dropout, or landing lights from overflying airplanes? Use the Opinion Thermometer. (MARK IN COLUMN 14 BELOW)

	14	15
SMOKE	0 1 2 3 4 DK NR	0 1 2 3 4 DK NR
FUMES	0 1 2 3 4 DK NR	0 1 2 3 4 DK NR
OIL DROPOUT	0 1 2 3 4 DK NR	0 1 2 3 4 DK NR
LANDING LIGHTS	0 1 2 3 4 DK NR	0 1 2 3 4 DK NR

IF "NONE," (ZERO ON ALL ITEMS) FOR QUESTION 14

15. How much does (EACH ITEM IN QUESTION 14 THAT IS NOTICED) annoy you? Use the Opinion Thermometer. (MARK IN COLUMN 15 ABOVE)

16. Were you fully aware of the noise from aircraft operations in this neighborhood before coming here?

YES _____; NO _____; DK _____; NR_____

17. How much would you say aircraft operations have increased in this area in the past five years? Use the Opinion Thermometer.

(CIRCLE NUMBER) 0 1 2 3 4 DK_____; NR_____

18. Would you say that you have learned to live with aircraft noise the way it is now?

YES_____; NO_____; UNDECIDED_____; NR_____

19a. If this area were to receive more noise from aircraft, how much of this noise do you think you could learn to live with?

TWICE AS MUCH_____; THREE TIMES AS MUCH_____;

FOUR TIMES AS MUCH_____; NO MORE AT ALL_____; UNDECIDED_____

NR_____

19b. Which could you learn to live with, aircraft noise which occurs frequently but not very loud, or aircraft noise which occurs infrequently but loud?

FREQUENTLY BUT NOT VERY LOUD_____

INFREQUENTLY BUT LOUD_____

UNDECIDED_____

NR_____

20a. I will now read a number of daily activities. Which of these are disturbed by aircraft noise in your own situation here? (READ LIST BELOW AND CHECK "YES," "NO," "DK," OR "NR")

	20a DISTURBED				20b BOTHERED		
			DK	NR		DK	NR
RELAXING/RESTING INSIDE	Yes	No			0 1 2 3 4		
RELAXING OUTSIDE	Yes	No			0 1 2 3 4		
CHILDREN SLEEPING/NAPPING	Yes	No			0 1 2 3 4		
CONVERSATION	Yes	No			0 1 2 3 4		
TELEPHONE CONVERSATION	Yes	No			0 1 2 3 4		
GOING TO SLEEP	Yes	No			0 1 2 3 4		
LISTENING TO RECORDS/TAPES	Yes	No			0 1 2 3 4		
LISTENING TO RADIO/TV	Yes	No			0 1 2 3 4		
WATCHING TV	Yes	No			0 1 2 3 4		
LATE SLEEP	Yes	No			0 1 2 3 4		
READING OR CONCENTRATION	Yes	No			0 1 2 3 4		
EATING	Yes	No			0 1 2 3 4		
OTHER	Yes	No			0 1 2 3 4		
NONE	Yes						

20b. (OF THOSE THAT ARE DISTURBED): How much are you bothered? Use the Opinion Thermometer. (CIRCLE NUMBER IN COLUMN 20b)

21. How often do airplanes make the house (building) vibrate or make the windows rattle? Use the Opinion Thermometer.

(CIRCLE NUMBER) 0 1 2 3 4 DK_____ NR_____

22. Who would you say controls the flight operations of aircraft around here?

_____

DK_____NR_____

23a. Would you say the value of land in this area has gone up, gone down, or not changed in the past five years?

NOT CHANGED _____ DK _____
GONE DOWN _____ NR _____
GONE UP _____

23b. (IF CHANGED): Has the airport or aircraft operations been responsible for this change in any way?

YES_____; NO_____

24a. (IF LAND VALUE HAS GONE DOWN IN QUESTION 23a): If a person felt that aircraft operations were reducing the value of his property, do you think he would be able to recover damages through an appeal to the proper authorities?

YES_____; NO_____; DK_____; NR_____

24b. (IF NO): Why not?_____

_____

_____

25. Do you know of anyone who has moved out of this area because of aircraft noise?

YES_____; NO_____; DK_____; NR_____

(IF YES): How many?_____

		YES	NO	DK	NR
26.	Do you think that jet engines could safely be made quieter with mufflers or other devices like that?	___	___	___	___
27.	Is it necessary for jet planes to sit on the ends of runways and roar their engines?	___	___	___	___
28.	Do jet planes have to takeoff and land on certain runways because of weather conditions?	___	___	___	___
29.	Do all airplanes have to circle the airport before landing?	___	___	___	___
30.	Do jet planes have to fly at lower altitudes depending on weather conditions?	___	___	___	___

Now we have a series of True-False questions :

		TRUE	FALSE	DK	NR
31.	Politics in this country are controlled by only a handful of persons or families.	___	___	___	___
32.	Most local government officials are honest.	___	___	___	___
33.	Most people don't care what happens to the next fellow.	___	___	___	___
34.	Nowadays a person has to live pretty much for today and let tomorrow take care of itself.	___	___	___	___
35.	Any devices designed to reduce aircraft noise will prove too costly to be practical.	___	___	___	___
36.	Aircraft designers are doing all they can to produce quieter engines.	___	___	___	___

		TRUE	FALSE	DK	NR
37.	The airport is operated in such a way as to serve the best interests of the entire city.	___	___	___	___
38.	A person should not have to put up with aircraft noise.	___	___	___	___
39.	Community leaders are doing all they can possibly do to reduce aircraft noise in this city.	___	___	___	___
40.	Airport authorities are doing all they can possibly do to reduce aircraft noise.	___	___	___	___
41.	Aircraft noise is rather pleasant and soothing.	___	___	___	___
42.	This city can be proud of the services its airport provides to both the community and to its clients.	___	___	___	___
43.	The advantages to the community from having a large airport far outweigh any disadvantages.	___	___	___	___
44.	Airport authorities probably are not very much concerned with what the average citizen thinks about them.	___	___	___	___
45.	Airport authorities try to avoid sending many flights over heavily populated areas.	___	___	___	___
46.	Most business firms and leaders in this city are simply pawns of different governmental officials and agencies.	___	___	___	___
47.	It is not likely for an airplane to crash in this area.	___	___	___	___
48.	The defense of our country is not possible without military aircraft.	___	___	___	___
49.	Most individuals and groups that protest about airplane noise do so because they are genuinely interested in eliminating the annoyance to themselves and others.	___	___	___	___

		TRUE	FALSE	DK	NR
50.	People who complain about airplane noise are only trying to gain personal fame and advancement.	____	____	__	__
51.	Most people are sometimes frightened by aircraft noise.	____	____	__	__
52.	Most people are often frightened by aircraft noise.	____	____	__	__
53.	Airplane noise can damage a person's health.	____	____	__	__
54.	Airline companies will do nothing about airplane noise unless they are forced to.	____	____	__	__
55.	Air transportation is the only practical way of long-distance travel.	____	____	__	__

56. Do you think that a jet plane could safely land at less than full power?

YES_____; NO_____ DK_____; NR_____

57. Have you flown as a passenger on a jet plane once, twice or more, or never?

ONCE_____; TWICE OR MORE_____; NEVER_____

58a. Do you think air travel is as safe as cars?

YES_____; NO_____; DK_____; NR_____

58b. (IF YES): Is it safer?

YES____; NO____; DK_____; NR_____

59. Do you think pilots consider the people below them when they take off and land?

YES_____; NO_____; DK_____; NR_____

60. Do you think pilots try to hold down the noise made by their planes?

YES_____; NO_____; DK_____; NR_____

61. Do you think that noise made by planes at the terminal and while on the ground could be reduced?

YES_____; NO_____; DK_____; NR_____

62. Who is responsible for reducing the noise from airplanes? The pilot, the airport authorities, the manufacturers, or who? (CHECK MORE THAN ONE, IF NECESSARY)

PILOT_____; AIRPORT AUTHORITIES_____; MANUFACTURER_____;

OTHERS_____

DK_____

63a. What kinds of clubs or organizations do you work with or participate in? For example: educational, recreational, political, social, business, church, fraternal, or any other such groups.

63b	63c	63d	63e	63f		
ORGANIZATION	PURPOSE	MEETS	ATTENDS	OFFICER	COMMITTEE	MEMBER ONLY

(IF INVOLVED IN ONE OR MORE ORGANIZATIONS):

63b. What are these organizations?
(RECORD IN COLUMN 63b)

63c. What is the purpose of these organizations? For example, discussions of current events, service to the community, brotherhood, socializing, etc.?
(RECORD IN COLUMN 63c)

63d. How many times did the organization(s) meet in the last year?
(RECORD IN COLUMN 63d)

63e. How many times did you attend meetings in the last year?
(RECORD IN COLUMN 63e)

(22)

63f. Were you or are you now an officer or committee member in any of these organizations?
(RECORD IN COLUMN 63f)

APPENDIX A

(IF ANY ORGANIZATION INTERESTED IN AIRCRAFT NOISE, ASK QUESTION 64.)

64. Do you think they could succeed if they tried to do something to improve or reduce aircraft noise?

YES_____; NO_____; DK_____; NR_____

65. How many people including yourself, any children, and relatives live here?_____ DK_____ NR_____

66a. Who is the head of the household in this house?

_____ _____ DK_____ NR_____

66b. Is he (she) employed now, at the present time?

YES_____; NO_____; DK_____; NR_____

66c. What sort of work does (HEAD OF HOUSEHOLD) do, that is, what does he (she) do on the job?

OCCUPATION_____

DK_____ NR_____

(IF RESPONDENT IS NOT THE HEAD OF THE HOUSEHOLD, ASK QUESTION 67, OTHERWISE GO TO QUESTION 68a)

67a. Do you have a job away from home?

YES_____; NO_____; DK_____; NR_____

67b. (IF YES): What sort of work do you do?
OCCUPATION_____

67c. (IF NO, INDICATE STATUS; i.e., HOUSEWIFE, STUDENT, RETIRED, ETC.)

HOUSEWIFE_____; STUDENT_____; RETIRED_____; DISABLED_____;
OTHER, SPECIFY_____

68a. Are you or anyone in your family employed at this time at an airport or by an airline company?

YES_____; NO_____; DK_____; NR_____

68b. (IF YES): What type work does he (she) do? (MECHANIC, CLERK, MANAGER, ETC.)

_____

_____

68c. Have you or anyone in your family ever worked or been employed at an airport or by an airline company?

YES_____; NO_____; DK_____; NR_____

69. Here is a card with typical family incomes. (HAND RESPONDENT CARD 3) Which category most nearly represents your total family income -- from all sources and before taxes?

(CIRCLE NUMBER) 1 2 3 4 5 6 7 8

REFUSED TO ANSWER_____ DK_____

(TAKE BACK CARD 3)

70a. What is the highest grade of school head of household/you has/have completed?

GRADE SCHOOL (1-8)	_____
HIGH SCHOOL (9-12)	_____
1-3 YEARS COLLEGE	_____
COLLEGE GRADUATE	_____
MORE THAN 4 YEARS COLLEGE	_____
DK	_____
NR	_____

70b. In which age category does/do head of household/you belong?

20-29 ___

30-39 ___

40-49 ___

50-59 ___

60-69 ___

70+ ___

71a. Do you own your home or are you renting?

OWN_____; RENT_____; DK_____; NR_____

→ 71b. (IF OWN): How much would a home like this rent for in this neighborhood, not including furniture and utilities?

UNDER $75____; $75-$124_____; $125-$174_____; $175-$224_____;

$225-$274_____; $275-$324_____; $325-$374_____; $375-$424_____;

$425 OR MORE_____

→ 71c. (IF RENT): Approximately how much do you pay for rent?

UNDER $75_____; $75-$124_____; $125-$174_____; $175-$224____;

$225-$274_____; $275-$324____; $325-$374_____; $375-$424____:

$425 OR MORE_____

72. How many times have you moved within the past ten years?

(CIRCLE NUMBER) 0 1 2 3 4 5 6 7 8 9 or more DK__NR__

73. How often do you visit or drop in on relatives or friends? Use the Opinion Thermometer.

(CIRCLE NUMBER) 0 1 2 3 4 DK_____ NR _____

74. Do you have a fireplace?

YES_____; NO_____; DK_____; NR_____

75. Do you have central air-conditioning, window air-conditioning, evaporative coolers, or fans?

YES_____; NO_____; DK_____; NR_____

76. Does the building have insulation in the walls or between the ceiling and the roof?

NO _____
WALLS _____
ROOF _____
BOTH _____
DK _____
NR _____

77. Are your windows made of single or multiple thicknesses of glass?

SINGLE _____
MULTIPLE _____
BOTH _____
OTHER _____
DK _____
NR _____

78. Does the building have storm windows?

YES_____; NO_____; DK_____; NR_____

79. Does the building have an attic or a space between the ceiling and the roof?

YES_____; NO_____; DK_____; NR_____

80. What is the outside of this building made of?

WOOD OR STUCCO	____
MASONRY (BRICK, STONE, CEMENT, ETC.)	____
WOOD AND STUCCO/MASONRY	____
ASBESTOS/SHINGLE	____
OTHER	____
DK	____
NR	____

81. About how thick are the exterior walls?

LESS THAN SIX INCHES	_____
SIX TO TWELVE INCHES	_____
MORE THAN TWELVE INCHES	_____
DK	_____
NR	_____

82. How many windows and glass doors are there?

_____ DK_____ NR_____

83. How many outside doors (excluding large glass doors) do you have?

_____ (RECORD NUMBER) DK_____ NR _____

(IF DWELLING UNIT IS OTHER THAN A SINGLE-UNIT HOUSE I.E., AN APARTMENT, DUPLEX, ETC., ASK QUESTION 85):

84. How many walls are exposed to the outside?

_____ DK_____ NR_____

85. (DOES THE RESPONDENT LIVE ON THE TOP FLOOR OF A MULTI-UNIT STRUCTURE?)

(YES_____; NO_____)

86. In case I've forgotten anything and we need to call, what number should we call, and what would be the best time of day?

NUMBER:_____ BEST TIME:_____

87. May I please have your name?

_____

88. What is your address here?

_____

(RECORD NAME AND ADDRESS ON COVER)

89. (INTERVIEWER: SEX OF R)
Male ___ Female ___

90. (INTERVIEWER: ETHNIC GROUP OF R)
A___ N ___ S ___ O ___

APPENDIX A

CARD 1

INCONVENIENT LOCATION (far from schools, work, shopping, etc.)

EXPENSIVE PLACE TO LIVE (expensive housing, high rent, high taxes).

NOISINESS OF AREA

UNSAFE PLACE TO LIVE

RUN-DOWN NEIGHBORHOOD

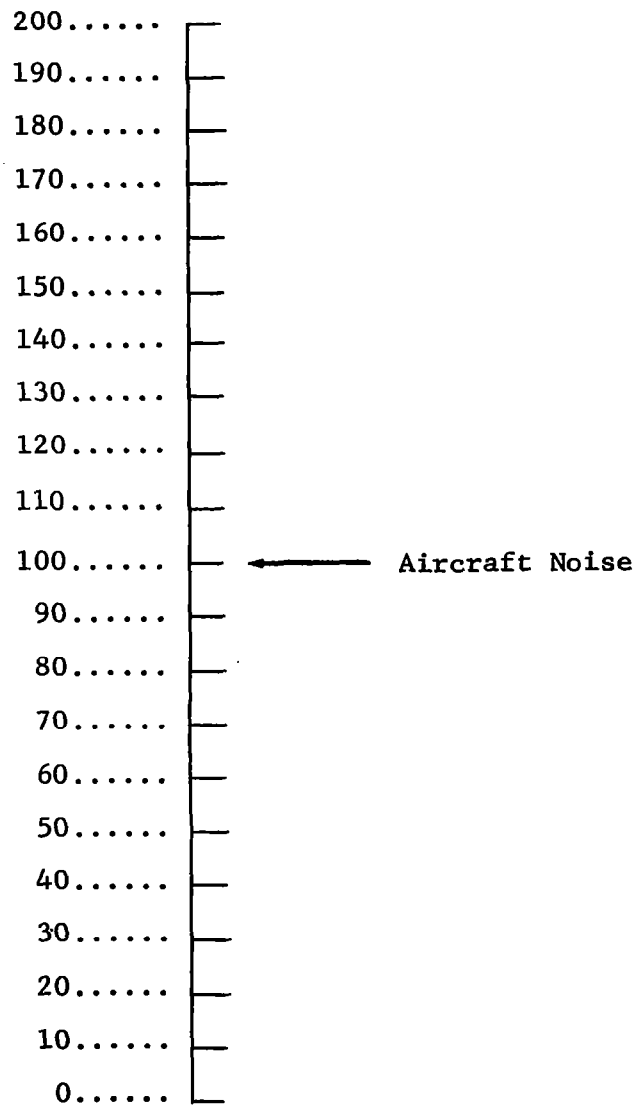
POOR FACILITIES (poor stores, schools, etc.)

UNFRIENDLINESS OF NEIGHBORS

DISLIKE FOR A CERTAIN HOUSE

NO PRIVACY

CARD 2

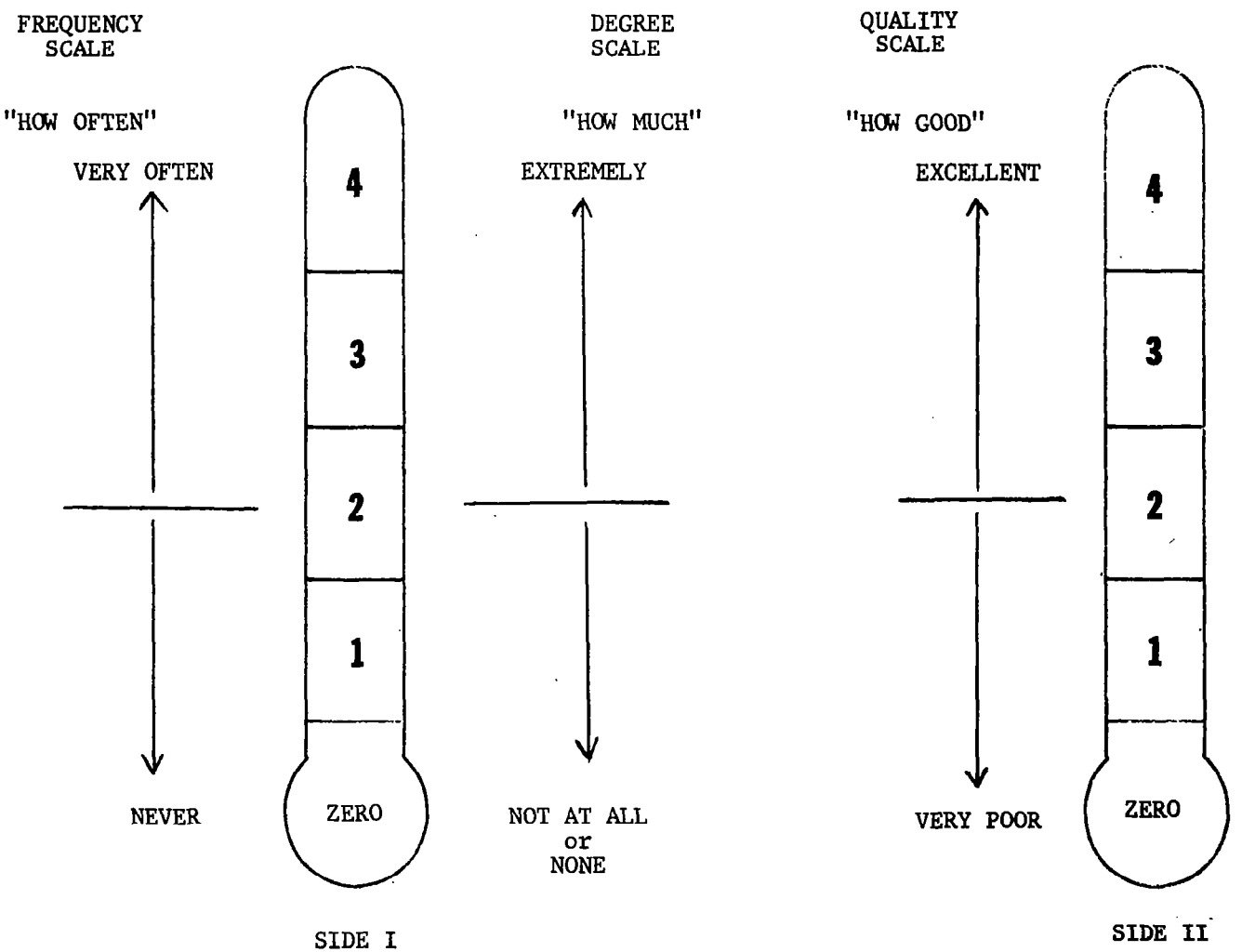

200.....
190.....
180.....
170.....
160.....
150.....
140.....
130.....
120.....
110.....
100.....
Aircraft Noise
90.....
80.....
70.....
60.....
50.....
40.....
30.....
20.....
10.....
0.....

APPENDIX A

CARD 3

INCOME	NUMBER
UNDER $1,999	1
$2,000-$3,999	2
$4,000-$5,999	3
$6,000-$7,999	4
$8,000-$9,999	5
$10,000-$14,999	6
$15,000-$24,999	7
$25,000-OVER	8

OPINION THERMOMETER



APPENDIX B
CONSTRUCTION OF VARIABLES

The variables in this appendix were used at different points in this report. In order that the reader may more easily understand what each variable means, complete documentation is presented. The title of the variable (e.g. Fear) is listed first. The range of possible values follows. If the range of values has been grouped into categories (e.g., high, medium, and low) the latter are also given. The source of each variable is found in the questionnaire item number and page number. Finally, if a special process was involved in constructing the variable, this is specified. The variables are ordered alphabetically.

1. Variable: Adaptability
2. Range: 0-1
3. Categories: none
4. Questionnaire items:

   19A. (p. 14) If this area were to receive more noise from aircraft, how much of this noise do you thing you could learn to live with?
   TWICE AS MUCH___, THREE TIMES AS MUCH___,
   FOUR TIMES AS MUCH___, NO MORE AT ALL___,
   UNDECIDED___, NR___.

5. Construction:

   If the respondent indicated NO MORE AT ALL, UNDECIDED, or NR, he was given the score of zero (0). If the respondent indicated TWICE AS MUCH, or more, the score of one (1) was given.

APPENDIX B

1. Variable: Age
2. Range: Under 30-70+
3. Categories: under 30, 30-39, 40-49, 50-59, 60-69, 70+
. Questionnaire item:
   70B. (p. 25) In which age category does/do the head of household/you belong?
4. Construction:
   Age is as indicated by the chosen category.

1. Variable: Annoyance-G
2. Range: 0-45
3. Categories: 0-9 (low), 10-21 (medium), 22-45 (high)
4. Questionnaire items:

   20A. (p. 15) I will now read a number of daily activities Which of these are disturbed by aircraft noise in your own situation here? (READ LIST BELOW AND CHECK "YES," "NO," "DK," OR "NR.")

   20B. (p. 15) (OF THOSE THAT ARE DISTURBED): How much are you bothered? Use Opinion Thermometer.

5. Construction:

   Annoyance-G is a summated-ratings index composed of nine everyday activities: relaxing/resting inside, relaxing/resting outside, sleep, conversation, telephone conversation, listening to records/tapes, radio/TV interference, reading or concentration, and eating. From the list of items on page 15, an average of the items "children sleeping/napping," "going to sleep," and "late sleep" was used for the item "sleep." An average of "listening to radio/TV" and "watching TV" was used for the item "radio/TV interference." In order to form the total index, each 0-to-4 scale was converted to 1-to-5, "DK" and "NR" were coded zero (0), and all scores summed.

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1. Variable: CNR (Composite Noise Rating)
2. Range: 0-130+
3. Categories: 0-84, 85-89, 90-94, 95-99, 100-104, 105-109, 110-114, 115-119, 120-124, 125-129, 130+
4. Questionnaire item:
   (Calculated by direct field measurement)
5. Construction:
   See the section on Noise Exposure Computation in the text.

1. Variable: Complaint Action
2. Range: 0-1
3. Categories: none
4. Questionnaire items:

   5E. (p. 8) Did you (or your family) actually do any of these things?
   Discussed it with someone?
   Telephoned or wrote to an official?
   Signed a petition?
   Visited an official?
   Attended a meeting about it?
   Helped to set up a committee to do something about it?
   Wrote a letter to the editor?
   Filed a suit?
   Other?

5. Construction:
   Since the incidence of anyone actually doing anything was low, a response of "yes" to any of the above items was considered action and the respondent was given a code of one (1), "any," for complaint action, otherwise he was given the code zero (0), "none."

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1. Variable: Complaint Potential
2. Range: 0-1
3. Categories: none
4. Questionnaire items:

   5D. (p. 7) Do/did you yourself ever feel like doing something to improve this situation?
   For example, do/did you feel like:
   Discussing it with someone?
   Telephoning or writing to an official?
   Signing a petition?
   Visiting an official?
   Attending a meeting about it?
   Helping to set up a committee to do something about it?
   Writing a letter to the editor?
   Filing a suit?
   Other?

5. Construction:
   Since the incidence of anyone feeling like doing anything was slight, a response of "yes" to any one of the above items was considered potential action and the respondent was given a code of one (1), "any;" otherwise he was given the code zero (0), "none."

1. Variable: Discussion
2. Range: 0-4
3. Categories: none
4. Questionnaire items:

   5C. (p. 7) How many times in an average week do/did you discuss (MOST DISLIKED THING OR ONE THING DISLIKED IN THE PAST) with friends, neighbors, or relatives? (CIRCLE NUMBER.)

   0 1 2 3 4 More than 4__ DK__ NR__

5. Construction:

   The category "more than 4" was combined with "4." All "DK" and "NR" are given the code of blank and are dropped from the analysis.

APPENDIX B

1. Variable: Distance
2. Range: 0-10
3. Categories: 1.0-1.9, 2.0-2.9, 3.0-3.9, 4.0-4.9, 5.0-5.9, 6.0-6.9, 7.0-7.9, 8.0-8.9, 9.0-9.9, 10.0+
4. Questionnaire item:
   (Calculated from maps)
5. Construction:
   Distance was calculated from the end of the runway to the block address of the respondent. Measurement was to the nearest tenth-mile.

1. Variable: Education (head of Household)
2. Range: Grade school - more than 4 years college
3. Categories: Grade school (1-8), high school (9-12)
   1-3 years college, college graduate,
   more than 4 years college.
4. Questionnaire item:
   70A. (p. 24) What is the highest grade of school head of household/you has/have completed?
5. Construction:
   Education was considered one of the five categories listed above.

APPENDIX B

1. Variable: Ethnicity (Respondent)
2. Range: N/A
3. Categories: Anglo, Spanish-American, Negro, Other
4. Questionnaire item:
   (Interviewer observation)
5. Construction:
   none

1. Variable: Fear
2. Range: 0-10
3. Categories: 0-3 (low), 4-6 (medium), 7-10 (high)
4. Questionnaire items:

   10. (p. 12) When you see or hear airplanes overhead, how often do you feel they are flying too low for the safety of residents in the area? Use Opinion Thermometer. 0 1 2 3 4 DK_ NR_

   11. (p. 12) When you see or hear airplanes overhead how often do you feel there is some danger that they might crash nearby? Use Opinion Thermometer. 0 1 2 3 4 DK_ NR_

5. Construction:
   "Fear" is formed by converting 0-to-4 scale to 1-to-5, coding "DK" and "NR" zero, and summing for both items.

APPENDIX B

1. Variable: Health Damage
2. Range: 0-1
3. Categories: none
4. Questionnaire item:
   53 (p. 19) Airplane noise can damage a person's health.
   TRUE___ FALSE___
5. Construction:
   TRUE is coded one (1) and FALSE is coded zero (0).

1. Variable: Home ownership
2. Range: N/A
3. Categories: Owner, Renter
4. Questionnaire item:
   71A. (p. 25) Do you own your home or are you renting?
5. Construction:
   none

APPENDIX B

1. Variable: Importance
2. Range: 0-5
3. Categories: none
4. Questionnaire items:
   - 42. (p. 18) This city can be proud of the services its airport provides to both the community and to its clients.
     TRUE___ FALSE___
   - 43. (p. 18) The advantages to the community from having a large airport far outweigh any disadvantages.
     TRUE___ FALSE___
   - 45. (p. 18) Airport authorities try to avoid sending many flights over heavily populated areas.
     TRUE___ FALSE___
   - 48. (p. 18) The defense of our country is not possible without military aircraft.
     TRUE___ FALSE___
   - 55. (p. 19) Air transportation is the only practical way of long-distance travel.
     TRUE___ FALSE___
5. Construction:
   For each item TRUE is coded zero (0) and FALSE is coded one (1). The sum of the five items constitutes the Importance index. This index measures the affective attractiveness of the airport or the airline industry to the respondent. A high score indicates a lack of importance to the respondent.

1. Variable: Income (Total Family Annual Income)
2. Range: 0-$25,000+
3. Categories: 0-$1,999, $2,000-$3,999, $4,000-$5,999, $6,000-$7,999, $8,000-$9,999, $10,000-$14,999, $15,000-$24,999, $25,000+
4. Questionnaire item:

   69. (p. 24) Here is a card with typical family incomes. (HAND RESPONDENT CARD 3.) Which category most nearly represents your total family income--from all sources and before taxes?

5. Construction:

   Total income was considered one of the eight categories listed above.

1. Variable: Misfeasance
2. Range: 0-4
3. Categories: none
4. Questionnaire items:

   36. (p. 17) Aircraft designers are doing all they can to produce quieter engines.
   TRUE___ FALSE___ DK___ NR___

   37. (p. 18) The airport is operated in such a way as to serve the best interests of the entire city.
   TRUE___ FALSE___ DK___ NR___

   39. (p. 18) Community leaders are doing all they can possibly do to reduce aircraft noise in this city.
   TRUE___ FALSE___ DK___ NR___

   40. (p. 18) Airport authorities are doing all they can possibly do to reduce aircraft noise.
   TRUE___ FALSE___ DK___ NR___

5. Construction:
   For each item TRUE is coded zero (0) and FALSE is coded one (1). The sum of the four items constitutes the Misfeasance index. This index measures the respondent's belief that those officials and authorities who are in a position to do something about the noise problem simply are not doing their job. Misfeasance is used rather than malfeasance since there is no intent to break the law or to do something illegal.

1. Variable: Noise Irritability
2. Range: 0-60
3. Categories: 0-12 (low), 13-36 (medium), 37-60 (high)
4. Questionnaire items:
   8. (p. 9) Here is a list of sounds which sometimes bother people. Most people hear these sounds somewhere, not necessarily in their own homes. Use the Opinion Thermometer to rate how much each sound bothers you when you do hear it.
5. Construction:
   Item list is as follows: Walking on gritty floors, musical instruments in practice, banging doors, air hammers, dripping water, whistling, chalk scraping on a blackboard, neighbor's ringing telephone, people walking on the floor above, chairs scraping on the floor, neighbors laughing or quarreling, and typewriters. The 0-to-4 scale is converted to 1-to-5 and all scores are summed.

APPENDIX B

1. Variable: Noise Susceptibility
2. Range: 0-65
3. Categories: 0-9 (low), 10-29 (medium), 30-65 (high)
4. Questionnaire items:
   9A. (p. 10) I will now read a number of noises heard in different neighborhoods. Which ones do you hear in this neighborhood? (READ LIST TO RESPONDENT, CHECKING WHETHER NOISE IS HEARD OR NOT.)
   9B. (p. 10) Of those that you hear, how much are you bothered or annoyed? Use Opinion Thermometer.
5. Construction:
   The thirteen noise sources are autos, neighborhood children, aircraft, dogs/pets, people, motorcycles/hot rods, trains, sirens, construction, lawn mowers, garbage collection, sonic booms, and trucks. Each 0-to-4 scale was converted to 1-to-5, "DK" and "NR" were coded zero (0), and all items summed.

1. Variable: Occupational Rating (Head of Household)
2. Range: 0-99
3. Categories: retired, 1-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99
4. Questionnaire item:
   66C. (p. 23) What sort of work does (Head of Household) do, that is, what does he (she) do on the job?
5. Construction:
   Occupational ratings were derived only for heads of household according to Methodology and Scores of Socio-economic Status, U.S. Department of Commerce, Bureau of the Census, Working Paper No. 15, 1963.

APPENDIX B

1. Variable: Pollution Annoyance
2. Range: 0-20
3. Categories: 0-5 (low), 6-11 (medium), 12-20 (high)
4. Questionnaire items:
   14. (p. 13) How often do you notice smoke, fumes, oil dropout, or landing lights from overflying airplanes? Use Opinion Thermometer.
   15. (p. 13) How much does (EACH ITEM IN QUESTION 14 THAT IS NOTICED) annoy you? Use Opinion Thermometer.
5. Construction:
   For each of the four items the 0-to-4 scale was converted to 1-to-5, "DK" and "NR" were coded zero (0), and all items were summed.

1. Variable: Residential Mobility
2. Range: 0-9
3. Categories: Not moved, 1, 2, 3, 4, 5+
4. Questionnaire item:
   72. (p. 25) How many times have you moved within the past ten years?
   0 1 2 3 4 5 6 7 8 9 or more__
5. Construction:
   Number of times moved represents residential mobility directly.

APPENDIX B

1. Variable: Sex (Respondent)
2. Range: N/A
3. Categories: Male, Female
4. Questionnaire item:
   89. (p. 28) (Interviewer observation)
5. Construction:
   none

1. Variable: Visitation
2. Range: 0-5
3. Categories: none
4. Questionnaire item:
   73. (p. 26) How often do you visit or drop in on relatives or friends? Use Opinion Thermometer.
   0 1 2 3 4 DK__ NR__
5. Construction:
   The 0-to-4 scale was changed to 1-to-5; "DK" and "NR" were changed to zero (0).

APPENDIX C
SCALES OF ANNOYANCE

Since a variety of methods have been used to measure annoyance both in the seven-city study and elsewhere, it is appropriate to consider what is the most appropriate way to develop a scale of annoyance. This section is concerned with this question and specifically examines the choice between summated-rating and factor score techniques.

Scales of annoyance from aircraft noise typically are constructed by the summated-rating method. This procedure involves asking respondents a series of questions related to some item of interest; in each case having them rate their feelings or attitudes toward this item on a numerical scale (either explicit or implicit); and then simply adding all the ratings to obtain a summary score.

In the TRACOR studies, respondents were asked whether aircraft noise disturbed each of nine everyday activities. (These were relaxing inside, relaxing outside, sleep, conversation, telephone conversation, listening to records or tapes, radio or television reception, reading or concentration, and eating.) When the respondent indicated disturbance of a particular activity, he was asked how much he was bothered. The response, obtained with a graphic aid called an "opinion thermometer," had a range of 0 to 4 for each activity. This range was scored on a scale of 1 to 5 and the value 0 was assigned when no disturbance of the activity was reported. The scores for all nine activities were added to produce a summated rating which thus had a value of 0 representing no disturbance of any activity and a range of 1 to 45 for those respondents who were disturbed. This scale is Annoyance G as used in this and previous reports.

After Phase I of the seven-city study it was suggested that the list of activities be expanded. The "sleep" category was

divided into the more specific categories "children sleeping or napping," "going to sleep," and "late sleep" (being awakened after being fully asleep), the intent being to better define the time of day or night involved. The category "radio or television reception" was also split into "listening to radio or television" and "watching television," the envisioned distinction being between acoustical and visual interference. The list of activities potentially disturbed thus included twelve items. This list was used in Phase II of the seven-city study and in the two-city study. The nine-item Annoyance G scale was produced from twelve-item data by averaging responses in the subdivided categories.

A more sophisticated method of developing a scale is to perform a factor analysis and to use factor weights to construct a score for each respondent. A factor score has several advantages over a summated-ratings score. Since the factor score is based on the intercorrelation of each question with the overall factor, arbitrariness of item weighting is eliminated. Of course, it is necessary to show that an annoyance factor does exist and that other factors explain very little of the common variance. This method relieves the researcher of the responsibility of assigning weights to each item or, as is more often the case, deciding to weight each item equally.

Three different scales of annoyance will be examined: (1) a summated-rating scale based on nine items (Annoyance G), (2) a factor score based on nine items (Annoyance F), and (3) a factor score based on twelve items (Annoyance T). These will be considered in terms of their correlations with each other and with other annoyance-related variables.

Before a factor analysis could be performed on the combined data from both the seven-city and two-city studies, considerable manipulation was necessary since three different questionnaires,

interview schedules, and coding forms were used. Standardization of questionnaire items and homogenization of the data were required in order to produce meaningful results. A specific problem was that in Phase I of the seven-city study respondents were asked about disturbance of activities by aircraft noise only if they reported hearing aircraft, whereas all respondents in later surveys were asked about such disturbance. Although the original procedure would seem rational, a possible effect on the data of the procedures employed existed. To evaluate such an effect, factor analyses were performed on limited sample data for those who reported hearing aircraft (N = 2857) and those who did not (N = 55). The factors for both Annoyance F and Annoyance T were evaluated and the results are given in Tables 14 and 15. The factor loadings are sufficiently similar, it is felt, that the

Table 14

FACTOR LOADINGS FROM PRINCIPLE-COMPONENT FACTOR ANALYSIS OF NINE ANNOYANCE F COMPONENTS ACCORDING TO PERCEPTION OF AIRCRAFT NOISE

Activity Disturbed	Factor Loadings	
	Reports Hearing Aircraft	
	Yes	No
Relaxing inside	0.7490	0.8203
Relaxing outside	0.7162	0.6812
Sleep	0.6585	0.6864
Conversation	0.7436	0.7792
Telephone conversation	0.7102	0.7669
Listening to records or tapes	0.6670	0.6385
Radio or television reception	0.6871	0.5720
Reading or concentration	0.6622	0.6440
Eating	0.5017	0.6902
Number of Respondents	2857	55

APPENDIX C

Table 15

FACTOR LOADINGS FROM PRINCIPLE-COMPONENT FACTOR ANALYSIS OF TWELVE ANNOYANCE T COMPONENTS ACCORDING TO PERCEPTION OF AIRCRAFT NOISE

Activity Disturbed	Factor Loadings		
	Reports Hearing Aircraft Yes		No*
Relaxing inside	0.7543	0.3517	-0.8610
Relaxing outside	0.7019	0.5528	-0.3659
Children sleeping or napping	0.4198	0.4722	0.0006
Conversation	0.7402	0.7329	-0.3320
Telephone conversation	0.7100	0.7500	-0.2936
Going to sleep	0.6650	0.2181	-0.7089
Listening to records or tapes	0.6766	0.7988	-0.0533
Listening to radio or television	0.7348	0.6024	-0.3293
Watching television	0.6886	0.5826	-0.1938
Late sleep	0.5616	0.1605	-0.8909
Reading or concentration	0.6576	0.1334	-0.8389
Eating	0.4965	0.5393	-0.3838
Number of Respondents	2857		55

*Varimax rotation used, producing two factors

annoyance scores obtained for the small number of respondents in the later surveys who did not report hearing aircraft can be included in the general analysis.

The combined data (N = 8462) were subsequently subjected to a principle-component factor analysis. The loadings and weights for elements of the nine-item scale Annoyance F are shown in Table 16. These represent a single strong factor. In the case

Table 16

FACTOR LOADINGS AND FACTOR WEIGHTS
FROM PRINCIPLE-COMPONENT FACTOR ANALYSIS OF
NINE ITEMS DISTURBED BY AIRCRAFT NOISE (N = 8462)

Activity Disturbed	Factor Loadings	Factor Weights
Relaxing inside	0.7777	0.1811
Relaxing outside	0.7610	0.1406
Conversation	0.7979	0.2043
Telephone conversation	0.7712	0.1673
Sleep	0.6888	0.1027
Listening to records or tapes	0.6952	0.1133
Radio or television reception	0.5862	0.0894
Reading or concentration	0.7370	0.1363
Eating	0.6306	0.1363

of the twelve-item Annoyance T, two factors were found. Varimax rotation, which tends to maximize differences in the factors, was employed. The first and stronger factor is apparently an "annoyance" factor and its loadings and weights are given in Table 17. The second factor had small negative loadings for the most part and is thus likely to be simply a reflection of the first.

The weights of Table 16 and 17 are used to generate Annoyance F and Annoyance T scores for individual respondents by multiplying them by the standardized activity disturbance scores and then summing over all activities. This was done for the combined samples. Correlations between the three annoyance scales and other selected variables are shown in Table 18. It is apparent that the G and F scales are very highly correlated; the factor analysis and scoring technique did not produce values significantly different

APPENDIX C

Table 17

FACTOR LOADINGS AND FACTOR WEIGHTS FROM PRINCIPLE-COMPONENT FACTOR ANALYSIS (AFTER VARIMAX ROTATION) ON TWELVE ITEMS DISTURBED BY AIRCRAFT NOISE (N = 8462)

Activity Disturbed	Varimax Factor Loading	Varimax Factor Weights
Relaxing inside	0.7105	0.3427
Relaxing outside	0.6593	0.3048
Children sleeping or napping	0.6089	0.4051
Conversation	0.7193	0.3355
Telephone conversation	0.8843	0.3368
Going to sleep	0.6471	0.2626
Listening to records or tapes	0.6956	0.1942
Listening to radio or television	0.6305	0.4227
Watching television	0.1921	0.0000
Late sleep	0.5738	0.1618
Reading or concentration	0.7687	0.3358
Eating	0.6564	0.7763

Table 18

CORRELATIONS BETWEEN ANNOYANCE MEASURES AND SELECTED VARIABLES (N = 8462)

	Annoyance G	Annoyance F	Annoyance T
Annoyance F	0.9738	1.0000	0.6500
Annoyance T	0.6015	0.6500	1.0000
Misfeasance	0.3050	0.2845	0.1725
Importance	0.2835	0.2513	0.1572
Fear	0.5716	0.5939	0.4673
Adaptability	-0.4341	-0.4567	-0.3371
Noise Susceptibility	0.3384	0.3949	0.1855
Distance	0.0636	-0.0591	0.5750
CNR	0.4005	0.4233	0.2691

from the simple summated-rating scheme. Annoyance T differed substantially from the other scales, however. Correlation of Annoyance F with the other variables was slightly better than that of Annoyance G, although perhaps not sufficiently so as to justify its relative complexity. Annoyance T performed much less well in this respect and would appear to have little potential for further use. It is concluded that from the standpoint of general utility Annoyance G is the best of the three measures.

APPENDIX D

FREQUENCIES

NOTE CONCERNING SYMBOLS

The following special symbols are used in the tables of this section of the Appendix:

A. All distributions are given in percentages unless otherwise indicated.

B. Numbers on Frequency and Degree Scales (Opinion Thermometer Scales)

1. "How often" frequency scale (0-4)
   0 = Never
   4 = Very often

2. "How much" degree scale (0-4)
   0 = Not at all or none
   4 = Extremely

C. Means and Standard Deviations

1. Means

   $\bar{X}_1$ = Mean of entire sample under consideration
   $\bar{X}_2$ = Mean of respondents in sample who responded to particular question

2. Standard Deviations

   S_1 = Standard deviation of entire sample under consideration
   S_2 = Standard deviation of respondent in sample who responded to a particular question

D. The symbol Δ indicates the percent of respondents who fit into one of the following categories:

1. Don't Know
2. No response
3. Not applicable

LIST OF TABLES

APPENDIX D

LIST OF TABLES - cont.

Table 1
COMPOSITE NOISE RATINGS

Rating	Chattanooga	Reno	Total
0 - 84	10.8	1.1	6.6
85 - 89	4.3	10.8	7.1
90 - 94	7.5	18.8	12.3
95 - 99	9.9	18.4	13.6
100 - 104	26.1	18.9	23.0
105 - 109	22.4	13.1	18.4
110 - 114	13.3	10.5	12.1
115 - 119	4.9	5.3	5.1
120 - 124	0.5	1.8	1.1
125 - 129	0.4	1.3	0.8
130+	0.	0.	0.
	100.1	100.0	100.1
$\overline{X}$	101.22	101.1	101.2

APPENDIX D

Table 2

FREQUENCY AIRCRAFT SMOKE, FUMES, OIL DROPOUT, AND LIGHTS NOTICED

Form D(R)

Question 14, Page 13

Variable	Chattanooga	Reno	Combined
1. Smoke			
0	47.04	38.42	43.32
1	15.53	19.15	17.09
2	17.41	16.31	16.94
3	11.31	11.82	11.53
4	8.44	13.95	10.82
Δ	0.27	0.35	0.31
$\bar{X}_1$	1.18	1.43	1.29
$\bar{X}_2$	1.18	1.44	1.29
S_1	1.35	1.45	1.40
S_2	1.35	1.45	1.40
2. Fumes			
0	78.99	85.22	81.68
1	6.73	4.96	5.97
2	7.00	3.55	5.51
3	4.58	2.25	3.57
4	2.33	2.60	2.45
Δ	0.36	1.42	0.82
$\bar{X}_1$	0.44	0.29	0.38
$\bar{X}_2$	0.44	0.30	0.38
S_1	0.97	0.85	0.92
S_2	0.97	0.86	0.93
3. Oil			
0	96.77	95.51	96.22
1	1.62	1.18	1.43
2	0.72	0.83	0.77
3	0.27	0.47	0.36

Table 2 - cont.

FREQUENCY AIRCRAFT SMOKE, FUMES, OIL DROPOUT, AND LIGHTS NOTICED

Form D(R)

Question 14, Page 13

Variable	Chattanooga	Reno	Combined
3. Oil			
4	0.36	0.47	0.41
Δ	0.27	1.54	0.82
$\bar{X}_1$	0.05	0.06	0.06
$\bar{X}_2$	0.05	0.06	0.06
S_1	0.35	0.40	0.37
S_2	0.35	0.40	0.37
4. Lights			
0	53.86	39.83	47.81
1	13.46	20.21	16.38
2	15.17	19.98	17.24
3	9.96	10.17	10.05
4	7.27	8.87	7.96
Δ	0.27	0.95	0.56
$\bar{X}_1$	1.03	1.26	1.13
$\bar{X}_2$	1.03	1.27	1.13
S_1	1.32	1.32	1.33
S_2	1.32	1.32	1.33

APPENDIX D

Table 3

FREQUENCY OF WINDOW RATTLES AND HOUSE VIBRATIONS BY AIRCRAFT

Form D(R)

Question 21, Page 15

Variable	Chattanooga	Reno	Combined
How often aircraft rattle/ vibrate house			
0	36.45	37.23	36.79
1	27.02	22.22	24.95
2	18.85	12.29	16.02
3	9.69	7.45	8.72
4	4.85	5.67	5.20
Δ	3.14	15.13	8.32
$\overline{X}_1$	1.13	0.92	1.04
$\overline{X}_2$	1.17	1.08	1.13
S_1	1.18	1.20	1.19
S_2	1.18	1.24	1.20

Table 4

GENERAL NOISE ANNOYANCE

Form D(R)

Question 9b, Page 11

Variable	Chattanooga	Reno	Combined
1. Trucks and autos			
0	40.08	36.65	38.60
1	16.07	17.91	16.86
2	13.11	13.01	13.06
3	7.50	4.79	6.33
4	4.04	4.97	4.44
Δ	19.21	22.70	20.72
$\bar{X}_1$	0.81	0.78	0.80
$\bar{X}_2$	1.00	1.01	1.01
S_1	1.16	1.15	1.15
S_2	1.22	1.21	1.21
2. Aircraft operations			
0	36.89	30.26	34.03
1	17.77	18.20	17.96
2	18.85	20.80	19.69
3	13.55	12.41	13.06
4	9.96	15.96	12.55
Δ	2.96	2.36	2.70
$\bar{X}_1$	1.36	1.61	1.47
$\bar{X}_2$	1.40	1.65	1.51
S_1	1.38	1.45	1.41
S_2	1.38	1.44	1.41
3. Neighborhood children			
0	49.46	42.91	46.63
1	11.67	16.55	13.78

Table 4 - cont.

GENERAL NOISE ANNOYANCE

Form D(R)

Question 9b, Page 11

Variable	Chattanooga	Reno	Combined
3. Neighborhood children			
2	8.26	10.05	9.03
3	3.77	4.49	4.08
4	1.44	2.96	2.09
Δ	25.40	23.05	24.39
$\bar{X}_1$	0.45	0.62	0.52
$\bar{X}_2$	0.61	0.80	0.69
S_1	0.90	1.03	0.96
S_2	1.00	1.11	1.05
4. Dogs/other pets			
0	30.88	25.06	28.37
1	15.71	18.20	16.79
2	18.67	18.44	18.57
3	11.67	12.17	11.89
4	10.14	11.94	10.92
Δ	12.93	14.18	13.47
$\bar{X}_1$	1.29	1.39	1.33
$\bar{X}_2$	1.48	1.62	1.54
S_1	1.39	1.41	1.40
S_2	1.39	1.39	1.39
5. People			
0	33.39	37.47	35.15
1	7.45	12.17	9.49
2	4.76	6.03	5.31
3	0.72	1.42	1.02

Table 4 - cont.
GENERAL NOISE ANNOYANCE

Form D(R)
Question 9b, Page 11

Variable	Chattanooga	Reno	Combined
5. People			
4	0.36	0.59	0.46
Δ	53.32	42.32	48.57
$\bar{X}_1$	0.21	0.31	0.25
$\bar{X}_2$	0.44	0.53	0.49
S_1	0.59	0.70	0.64
S_2	0.80	0.85	0.83
6. Motorcycles/ hot rods			
0	15.35	13.36	14.49
1	12.30	12.29	12.30
2	17.15	19.03	17.96
3	18.13	18.56	18.32
4	16.70	24.47	20.05
Δ	20.38	12.29	16.89
$\bar{X}_1$	1.68	2.04	1.83
$\bar{X}_2$	2.11	2.32	2.21
S_1	1.52	1.52	1.53
S_2	1.41	1.40	1.41
7. Trains			
0	21.10	13.83	17.96
1	5.57	3.43	4.64
2	2.06	1.06	1.63
3	0.72	0.83	0.77
4	0.36	0.83	0.56
Δ	70.20	80.02	74.44

Table 4 - cont.
GENERAL NOISE ANNOYANCE

Form D(R)
Question 9b, Page 11

Variable	Chattanooga	Reno	Combined
7. Trains			
$\bar{X}_1$	0.13	0.11	0.12
$\bar{X}_2$	0.45	0.57	0.49
S_1	0.49	0.52	0.50
S_2	0.82	1.05	0.91
8. Sirens			
0	37.70	40.90	39.08
1	20.29	15.72	18.32
2	18.04	11.82	15.36
3	9.16	7.92	8.62
4	4.49	5.79	5.05
Δ	10.32	17.85	13.57
$\bar{X}_1$	1.02	0.86	0.95
$\bar{X}_2$	1.14	1.05	1.10
S_1	1.20	1.23	1.22
S_2	1.21	1.29	1.24
9. Construction			
0	9.52	15.01	11.89
1	5.21	8.04	6.43
2	3.50	4.96	4.13
3	1.53	2.96	2.14
4	0.90	2.60	1.63
Δ	79.35	66.43	73.78
$\bar{X}_1$	0.20	0.37	0.28
$\bar{X}_2$	0.99	1.11	1.05
S_1	0.66	0.91	0.78
S_2	1.15	1.28	1.22

Table 4 - cont.

GENERAL NOISE ANNOYANCE

Form D(R)

Question 9b, Page 11

Variable	Chattanooga	Reno	Combined
10. Lawn mowers/ garbage collection			
0	57.32	42.02	50.72
1	16.52	16.91	16.69
2	8.93	10.11	9.44
3	3.10	4.20	3.57
4	0.99	2.66	1.71
Δ	13.15	24.11	17.88
$\bar{X}_1$	0.48	0.61	0.53
$\bar{X}_2$	0.55	0.80	0.65
S_1	0.86	1.01	0.93
S_2	0.90	1.09	0.99
11. Sonic boom			
0	17.68	22.70	19.85
1	13.91	15.48	14.59
2	9.52	15.96	12.30
3	8.26	14.18	10.82
4	7.09	20.69	12.96
Δ	43.54	10.99	29.49
$\bar{X}_1$	0.86	1.73	1.23
$\bar{X}_2$	1.52	1.94	1.75
S_1	1.29	1.55	1.47
S_2	1.39	1.51	1.47

APPENDIX D

Table 5

DEGREE OF SENSITIVITY TO NOISE STIMULI

Form D(R)

Question 8, Page 9

Variable	Chattanooga	Reno	Combined
1. Walking on gritty floors			
0	37.43	40.07	38.57
1	15.80	13.24	14.69
2	17.32	14.30	16.02
3	11.58	12.65	12.04
4	17.06	19.27	18.01
Δ	0.81	0.47	0.66
$\bar{X}_1$	1.53	1.57	1.55
$\bar{X}_2$	1.55	1.58	1.56
S_1	1.51	1.57	1.53
S_2	1.51	1.57	1.53
2. Musical instruments in practice			
0	56.19	52.72	54.69
1	14.99	15.60	15.26
2	15.98	15.37	15.71
3	7.27	9.22	8.11
4	5.30	6.86	5.97
Δ	0.27	0.24	0.26
$\bar{X}_1$	0.90	1.01	0.95
$\bar{X}_2$	0.90	1.02	0.95
S_1	1.22	1.29	1.25
S_2	1.22	1.29	1.25

Table 5 - cont.

DEGREE OF SENSITIVITY TO NOISE STIMULI

Form D(R)

Question 8, Page 9

Variable	Chattanooga	Reno	Combined
3. Banging doors			
0	28.28	26.00	27.30
1	17.68	16.31	17.09
2	25.13	24.70	24.95
3	16.34	18.79	17.40
4	12.39	14.07	13.11
Δ	0.18	0.12	0.15
$\bar{X}_1$	1.67	1.78	1.72
$\bar{X}_2$	1.67	1.79	1.72
S_1	1.36	1.38	1.37
S_2	1.36	1.38	1.37
4. Air hammers			
0	23.97	26.00	24.85
1	9.43	7.57	8.62
2	17.24	17.02	17.14
3	19.84	19.86	19.85
4	29.26	29.55	29.39
Δ	0.27	0.	0.15
$\bar{X}_1$	2.20	2.19	2.20
$\bar{X}_2$	2.21	2.19	2.20
S_1	1.55	1.57	1.56
S_2	1.54	1.57	1.55
5. Dripping water			
0	16.43	19.27	17.65
1	11.58	10.28	11.02
2	20.38	18.56	19.59

APPENDIX D

Table 5 - cont.

DEGREE OF SENSITIVITY TO NOISE STIMULI

Form D(R)

Question 8, Page 9

Variable	Chattanooga	Reno	Combined
5. Dripping water			
3	20.83	17.97	19.59
4	30.79	33.92	32.14
Δ	0.	0.	0.
$\bar{X}_1$	2.38	2.37	2.38
$\bar{X}_2$	2.38	2.37	2.38
S_1	1.44	1.51	1.47
S_2	1.44	1.51	1.47
6. Whistling			
0	71.90	67.61	70.05
1	13.73	14.30	13.98
2	9.07	10.99	9.90
3	3.68	4.26	3.93
4	1.44	2.60	1.94
Δ	0.18	0.24	0.20
$\bar{X}_1$	0.49	0.59	0.53
$\bar{X}_2$	0.49	0.60	0.53
S_1	0.91	1.01	0.96
S_2	0.91	1.01	0.96
7. Chalk scraping on blackboards			
0	32.68	26.24	29.90
1	10.32	8.27	9.44
2	14.45	13.59	14.08
3	15.26	13.24	14.39
4	26.84	38.42	31.84

Table 5 - cont.

DEGREE OF SENSITIVITY TO NOISE STIMULI

Form D(R)

Question 8, Page 9

Variable	Chattanooga	Reno	Combined
7. Chalk scraping on blackboards			
Δ	0.45	0.24	0.36
$\bar{X}_1$	1.92	2.29	2.08
$\bar{X}_2$	1.93	2.29	2.09
S_1	1.63	1.65	1.65
S_2	1.63	1.65	1.65
8. Neighbors telephone			
0	72.17	69.74	71.12
1	12.21	12.88	12.50
2	10.32	10.40	10.36
3	3.86	4.73	4.23
4	1.26	1.77	1.48
Δ	0.18	0.47	0.31
$\bar{X}_1$	0.49	0.55	0.52
$\bar{X}_2$	0.50	0.55	0.52
S_1	0.92	0.98	0.94
S_2	0.92	0.98	0.94
9. People walking on the floor above			
0	53.14	54.14	53.57
1	11.49	10.76	11.17
2	16.16	18.32	17.09
3	11.31	8.98	10.31
4	5.92	6.03	5.97
Δ	1.97	1.77	1.89
$\bar{X}_1$	1.01	0.98	1.00

Table 5 - cont.

DEGREE OF SENSITIVITY TO NOISE STIMULI

Form D(R)

Question 8, Page 9

Variable	Chattanooga	Reno	Combined
9. People walking on the floor above			
$\overline{X}_2$	1.03	1.00	1.02
S_1	1.30	1.28	1.29
S_2	1.31	1.29	1.30
10. Chairs scraping on floors			
0	37.25	39.95	38.42
1	19.48	17.02	18.42
2	22.53	24.35	23.32
3	13.11	11.47	12.40
4	7.45	6.97	7.24
Δ	0.18	0.24	0.20
$\overline{X}_1$	1.34	1.28	1.31
$\overline{X}_2$	1.34	1.28	1.31
S_1	1.30	1.29	1.29
S_2	1.30	1.29	1.29
11. Neighbors laughing or quarreling			
0	43.99	44.09	44.03
1	12.12	12.65	12.35
2	17.95	20.92	19.23
3	12.66	11.47	12.14
4	12.84	10.40	11.79
Δ	0.45	0.47	0.46
$\overline{X}_1$	1.37	1.30	1.34
$\overline{X}_2$	1.38	1.31	1.35
S_1	1.46	1.40	1.44
S_2	1.47	1.40	1.44

Table 5 - cont.

DEGREE OF SENSITIVITY TO NOISE STIMULI

Form D(R)

Question 8, Page 9

Variable	Chattanooga	Reno	Combined
12. Typewriters			
0	78.10	80.73	79.23
1	11.40	12.06	11.68
2	7.99	4.85	6.63
3	1.89	1.89	1.89
4	0.54	0.35	0.46
Δ	0.09	0.12	0.10
$\overline{X}_1$	0.35	0.29	0.32
$\overline{X}_2$	0.35	0.29	0.32
S_1	0.75	0.68	0.72
S_2	0.75	0.68	0.72

APPENDIX D

Table 6

ALIENATION

	Variable	Form D(R) Quest.	Pg.	Chattanooga	Reno	Combined
1.	Politics controlled by handful	31	17			
	T			46.86	39.95	43.88
	F			48.74	55.79	51.79
	Δ			4.40	4.26	4.34
2.	Next fellow	33	17			
	T			54.04	48.46	51.63
	F			45.06	50.71	47.50
	Δ			0.90	0.83	0.87
3.	Live day by day	34	17			
	T			51.53	36.17	44.90
	F			47.76	63.48	54.54
	Δ			0.72	0.35	0.56

Table 7

ADAPTABILITY TO AIRCRAFT NOISE

Variable	Form D(R) Quest.	Pg.	Chattanooga	Reno	Combined
1. Four times more noise	19A	14			
No			91.47	82.15	87.45
Yes			5.03	10.05	7.19
Δ			3.50	7.80	5.36
2. Two times more noise	19A	14			
No			51.71	50.59	51.22
Yes			44.79	41.61	43.42
Δ			3.50	7.80	5.36
3. Adjust to aircraft frequency	19B	14			
0 = Neither			0.	0.	0.
1 = Frequent, not very loud			83.30	81.09	82.35
2 = Infrequent, but loud			12.21	12.77	12.45
3 = Undecided			3.50	4.49	3.93
Δ			0.99	1.65	1.28

APPENDIX D

Table 8

ACTIVITIES DISTURBED BY AIRCRAFT NOISE

Form D(R)

Question 20A, Page 15

Variable	Chattanooga	Reno	Combined
1. Relaxing/resting outside			
0	29.53	27.42	28.62
1	6.37	7.92	7.04
2	9.34	10.99	10.05
3	4.67	5.91	5.20
4	1.71	4.26	2.81
Δ	48.38	43.50	46.28
$\bar{X}_1$	0.46	0.65	0.54
$\bar{X}_2$	0.89	1.14	1.00
S_1	0.96	1.15	1.05
S_2	1.18	1.32	1.26
2. Relaxing outside			
0	30.43	28.01	29.39
1	6.73	6.86	6.79
2	9.78	9.46	9.64
3	6.28	7.33	6.73
4	2.87	4.85	3.72
Δ	43.90	43.50	43.72
$\bar{X}_1$	0.57	0.67	0.61
$\bar{X}_2$	1.01	1.19	1.09
S_1	1.08	1.20	1.13
S_2	1.27	1.39	1.33
3. Sleeping			
0	29.89	27.54	28.88
1	4.49	2.48	3.62
2	6.46	5.56	6.07

Table 8 - cont.

ACTIVITIES DISTURBED BY AIRCRAFT NOISE

Form D(R)

Question 20A, Page 15

Variable	Chattanooga	Reno	Combined
3. Sleeping			
3	3.32	4.26	3.72
4	2.96	4.96	3.83
Δ	52.87	55.20	53.88
$\bar{X}_1$	0.39	0.46	0.42
$\bar{X}_2$	0.83	1.03	0.92
S_1	0.96	1.10	1.02
S_2	1.26	1.45	1.35
4. Conversation			
0	29.53	28.25	28.98
1	7.99	10.05	8.88
2	10.23	12.06	11.02
3	7.36	8.39	7.81
4	6.55	9.22	7.70
Δ	38.33	32.03	35.61
$\bar{X}_1$	0.77	0.96	0.85
$\bar{X}_2$	1.24	1.42	1.32
S_1	1.27	1.37	1.32
S_2	1.42	1.46	1.44
5. Telephone conversation			
0	29.62	28.49	29.13
1	7.27	7.33	7.30
2	6.64	10.64	8.37
3	7.00	8.27	7.55
4	5.75	10.17	7.65
Δ	43.72	35.11	40.00

Table 8 - cont.

ACTIVITIES DISTURBED BY AIRCRAFT NOISE

Form D(R)

Question 20A, Page 15

Variable	Chattanooga	Reno	Combined
5. Telephone conversation			
$\bar{X}_1$	0.65	0.94	0.77
$\bar{X}_2$	1.15	1.45	1.29
S_1	1.21	1.41	1.31
S_2	1.43	1.52	1.48
6. Listening to records/tapes			
0	29.44	27.66	28.67
1	3.77	3.19	3.52
2	5.03	5.91	5.41
3	4.22	7.68	5.71
4	1.97	5.56	3.52
Δ	55.57	50.00	53.16
$\bar{X}_1$	0.34	0.60	0.46
$\bar{X}_2$	0.77	1.21	0.97
S_1	0.90	1.22	1.06
S_2	1.23	1.50	1.38
7. TV/radio reception/watching			
0	30.07	28.49	29.39
1	16.97	9.69	13.83
2	14.90	12.06	13.67
3	13.91	11.58	12.91
4	8.89	13.71	10.97
Δ	15.26	24.47	19.23
$\bar{X}_1$	1.24	1.23	1.24

Table 8 - cont.

ACTIVITIES DISTURBED BY AIRCRAFT NOISE

Form D(R)

Question 20A, Page 15

Variable	Chattanooga	Reno	Combined
7. TV/radio reception/watching			
$\bar{X}_2$	1.46	1.63	1.53
S_1	1.38	1.51	1.44
S_2	1.38	1.54	1.45
8. Reading, concentration			
0	29.26	27.78	28.62
1	3.50	2.48	3.06
2	5.12	5.91	5.46
3	3.32	5.32	4.18
4	1.35	4.37	2.65
Δ	57.45	54.14	56.02
$\bar{X}_1$	0.29	0.48	0.37
$\bar{X}_2$	0.68	1.04	0.84
S_1	0.82	1.10	0.96
S_2	1.14	1.43	1.29
9. Eating			
0	29.44	27.66	28.67
1	0.90	0.83	0.87
2	1.08	1.65	1.33
3	0.54	1.42	0.92
4	0.27	1.06	0.61
Δ	67.77	67.38	67.60
$\bar{X}_1$	0.06	0.13	0.09
$\bar{X}_2$	0.18	0.39	0.27
S_1	0.37	0.60	0.48
S_2	0.64	1.00	0.82

APPENDIX D

Table 8 - cont.

ACTIVITIES DISTURBED BY AIRCRAFT NOISE

Form D(R)

Question 20A, Page 15

Variable	Chattanooga	Reno	Combined
10. Children sleeping or napping			
0	29.35	27.90	28.72
1	1.71	2.13	1.89
2	2.33	2.60	2.45
3	1.62	3.78	2.55
4	2.33	4.85	3.42
Δ	62.66	58.75	60.97
$\bar{X}_1$	0.21	0.38	0.28
$\bar{X}_2$	0.55	0.92	0.72
S_1	0.77	1.05	0.90
S_2	1.18	1.47	1.33
11. Late Sleep			
0	29.44	27.66	28.67
1	3.23	2.13	2.76
2	4.13	3.43	3.83
3	3.23	4.37	3.72
4	1.44	4.73	2.86
Δ	58.33	57.68	58.16
$\bar{X}_1$	0.27	0.41	0.33
$\bar{X}_2$	0.65	0.97	0.79
S_1	0.80	1.07	0.93
S_2	1.14	1.47	1.31
12. Listening to TV			
0	30.07	28.25	29.29
1	9.16	7.45	8.42
2	10.86	10.64	10.77

Table 8 - cont.
ACTIVITIES DISTURBED BY AIRCRAFT NOISE

Form D(R)
Question 20A, Page 15

Variable	Chattanooga	Reno	Combined
12. Listening to TV			
3	10.05	10.28	10.15
4	6.10	11.23	8.32
Δ	33.75	32.15	33.06
$\bar{X}_1$	0.85	1.04	0.94
$\bar{X}_2$	1.29	1.54	1.40
S_1	1.30	1.46	1.37
S_2	1.40	1.54	1.47

Table 9

ANNOYANCE CAUSED BY AIRCRAFT SMOKE, FUMES, OIL DROPOUT, AND LIGHTS

Form D(R)

Question 15, Page 13

Variable	Chattanooga	Reno	Combined
1. Smoke			
0	26.75	30.50	28.37
1	6.91	7.21	7.04
2	6.91	7.57	7.19
3	5.66	7.09	6.28
4	5.12	8.63	6.63
Δ	48.65	39.01	44.49
$\bar{X}_1$	0.58	0.78	0.67
$\bar{X}_2$	1.13	1.28	1.20
S_1	1.16	1.34	1.24
S_2	1.41	1.51	1.46
2. Fumes			
0	10.50	5.20	8.21
1	2.60	1.77	2.24
2	2.96	1.89	2.50
3	2.24	1.89	2.09
4	1.80	2.36	2.04
Δ	79.89	86.88	82.91
$\bar{X}_1$	0.22	0.21	0.22
$\bar{X}_2$	1.12	1.58	1.27
S_1	0.76	0.77	0.77
S_2	1.38	1.55	1.46
3. Oil			
0	0.72	0.59	0.66
1	1.35	0.47	0.97
2	0.45	0.59	0.51
3	0.27	0.47	0.36

Table 9 - cont.

ANNOYANCE CAUSED BY AIRCRAFT SMOKE, FUMES, OIL DROPOUT, AND LIGHTS

Form D(R)

Question 15, Page 13

Variable	Chattanooga	Reno	Combined
3. Oil			
4	0.18	0.83	0.46
Δ	97.04	97.04	97.04
$\bar{X}_1$	0.04	0.06	0.05
$\bar{X}_2$	1.27	2.16	1.66
S_1	0.29	0.45	0.37
S_2	1.11	1.49	1.36
4. Lights			
0	35.55	53.78	43.42
1	3.50	2.96	3.27
2	2.69	1.42	2.14
3	2.51	0.47	1.63
4	1.08	0.47	0.82
Δ	54.67	40.90	48.72
$\bar{X}_1$	0.21	0.09	0.16
$\bar{X}_2$	0.46	0.15	0.31
S_1	0.71	0.44	0.61
S_2	0.99	0.57	0.82

Table 10

FREQUENCY OF DISCUSSION OF MOST DISLIKED THING WITH FAMILY AND FRIENDS

Form D(R)

Question 5C, Page 7

Variable	Chattanooga	Reno	Combined
0*	22.17	24.00	22.96
1	20.92	21.87	21.33
2	13.11	6.86	10.41
3	8.71	4.61	6.94
4	5.12	3.90	4.59
>5	5.03	5.20	5.10
Δ	24.96	33.57	28.67
$\bar{X}_1$	1.19	0.91	1.07
$\bar{X}_2$	1.58	1.37	1.50
S_1	1.48	1.42	1.46
S_2	1.51	1.54	1.53

*Respondents reported the number of times per week aircraft noise was a topic of discussion among friends, neighbors, or relatives

Table 11

FREQUENCY OF VISITATION WITH FAMILY AND FRIENDS

Form D(R)

Question 73, Page 26

Variable	Chattanooga	Reno	Combined
Relatives and friends			
0	3.14	6.15	4.44
1	22.08	23.40	22.65
2	35.10	31.44	33.52
3	20.38	22.10	21.12
4	18.94	16.78	18.01
Δ	0.36	0.12	0.26
$\bar{X}_1$	2.29	2.20	2.25
$\bar{X}_2$	2.30	2.20	2.26
S_1	1.11	1.16	1.13
S_2	1.11	1.15	1.13

Table 12

ORGANIZATIONAL INVOLVEMENT

Form D(R)

Question 63B, Page 21

Variable	Chattanooga	Reno	Combined
Lodges	9.25	10.76	9.90
Church groups	4.94	5.67	5.26
Sports and athletic groups	2.87	5.67	4.08
Social groups	2.78	3.66	3.16
PTA	13.55	10.16	12.09
Political groups	1.98	9.69	5.31
Farm organizations	0.	0.	0.
Educational	0.	0.59	0.26
Labor unions	2.78	3.78	3.21
General business or professional	1.44	14.18	1.43
Special business or professional	8.08	5.67	7.04
Neighborhood groups	6.19	2.72	4.69
Any others	9.87	15.01	12.09
Veterans organizations	3.59	2.36	3.06
Church	54.67	12.17	36.33
Local government	0.	0.	0.
Civil and human rights	0.	0.	0.
Aircraft noise associations	0.	0.12	0.05

Table 13

KNOWLEDGE OF PERSONS MOVING BECAUSE OF AIRCRAFT NOISE

Form D(R)

Question 25, Page 16

Variable	Chattanooga	Reno	Combined
Neighbors Moving			
No	97.94	97.52	97.76
Yes	1.35	2.13	1.68
Δ	0.72	0.35	0.56

APPENDIX D

Table 14

ATTITUDES TOWARD THE AIRCRAFT INDUSTRY

Variable	Form D(R) Quest.	Pg.	Chattanooga	Reno	Combined
1. Aircraft designers doing all they can	36	17			
T			62.48	65.60	63.83
F			27.20	24.82	26.17
Δ			10.32	9.57	10.00
2. Airport operated in best interest of city	37	18			
T			84.92	76.83	81.43
F			10.77	18.20	13.98
Δ			4.31	4.96	4.59
3. Airport authorities doing all they can to eliminate noise	40	18			
T			56.10	53.55	55.00
F			32.05	33.33	32.60
Δ			11.85	13.12	12.40
4. Airport authorities not very much concerned with average citizen	44	18			
T			32.50	27.07	30.15
F			64.63	68.79	66.43
Δ			2.87	4.14	3.42
5. Airline companies will do nothing unless forced	54	19			
T			52.87	51.30	52.19
F			40.39	42.08	41.12
Δ			6.73	6.62	6.68

Table 14 - cont.

ATTITUDES TOWARD THE AIRCRAFT INDUSTRY

Variable	Form D(R) Quest.	Pg.	Chattanooga	Reno	Combined
6. Air travel only practical means for future	55	19			
T			72.17	77.54	74.49
F			26.93	21.75	24.69
Δ			0.90	0.71	0.82

APPENDIX D

Table 15

ATTITUDES TOWARD THE IMPORTANCE OF THE AIRPORT

Variable	Form D(R) Quest.	Pg.	Chattanooga	Reno	Combined
1. City proud of aircraft services	42	18			
T			87.07	78.84	83.52
F			9.78	15.48	12.24
Δ			3.14	5.67	4.23
2. Advantages outweigh disadvantages	43	18			
T			83.84	78.96	81.73
F			13.73	17.61	15.41
Δ			2.42	3.43	2.86
3. Business leaders pawns of government	46	18			
T			35.46	20.57	29.03
F			52.06	69.86	59.74
Δ			12.48	9.57	11.22
4. Leaders doing all possible to reduce noise	39	18			
T			41.38	32.62	37.60
F			43.45	52.25	47.24
Δ			15.17	15.13	15.15

Table 16
FEAR OF CRASH

Variable	Form D(R) Quest.	Pg.	Chattanooga	Reno	Combined
. Too low for safety	10	12			
0			45.60	53.07	48.83
1			20.83	18.56	19.85
2			14.99	12.06	13.72
3			10.95	6.62	9.08
4			7.09	8.04	7.50
Δ			0.54	1.65	1.02
X_1			1.12	0.95	1.05
X_2			1.13	0.96	1.06
S_1			1.29	1.29	1.29
S_2			1.29	1.29	1.30
2. How often fear crash	11	12			
0			46.41	57.45	51.17
1			21.54	20.09	20.92
2			14.63	10.05	12.65
3			9.52	5.08	7.60
4			7.45	6.26	6.94
Δ			0.45	1.06	0.71
X_1			1.09	0.80	0.97
X_2			1.10	0.81	0.97
S_1			1.29	1.19	1.25
S_2			1.29	1.19	1.26

APPENDIX D

Table 17

TECHNICAL KNOWLEDGE OF JET AIRCRAFT

Variable	Form D(R) Quest.	Pg.	Chattanooga	Reno	Combined
1. Jet engines quiet with mufflers	26	17			
Yes			71.45	65.84	69.03
No			13.11	12.77	12.96
Δ			15.44	21.39	18.01
2. Necessary for jets to sit and roar engines	27	17			
Yes			57.36	68.09	61.99
No			25.49	18.91	22.65
Δ			17.15	13.00	15.36
3. Fly lower due to weather	30	17			
Yes			39.50	38.89	39.23
No			43.36	43.26	43.32
Δ			17.15	17.85	17.45

Table 18

PERCEIVED INCREASE IN AIR TRAFFIC

Variable	Form D(R) Quest. Pg.	Chattanooga	Reno	Combined
1. Perceived increase in air traffic	17 14			
0		12.75	12.53	12.65
1		6.82	6.74	6.79
2		25.04	23.76	24.49
3		28.10	22.22	25.56
4		12.03	10.17	11.22
Δ		15.26	24.59	19.29
$\overline{X}_1$		1.89	1.62	1.77
$\overline{X}_2$		2.23	2.14	2.20
S_1		1.39	1.43	1.41
S_2		1.24	1.25	1.24

Table 19

AWARENESS OF AIRCRAFT OPERATIONS BEFORE MOVING TO PRESENT RESIDENCE

Variable	Form D(R) Quest. Pg.	Chattanooga	Reno	Combined
1. Awareness	16 13			
Yes		44.43	41.84	43.32
No		53.32	51.65	52.60
Δ		2.24	6.50	4.08

APPENDIX D

Table 20

CHANCES FOR ORGANIZATION TO IMPROVE AIRCRAFT NOISE SITUATION

Variable	Form D(R) Quest. Pg.	Chattanooga	Reno	Combined
1. Chances	5G 8			
1 = very good		5.12	2.96	4.18
2 = good		12.39	6.97	10.05
3 = fair		12.12	9.93	11.17
4 = not very good		15.26	7.33	11.84
5 = poor		25.85	32.98	28.93
Δ		29.26	39.83	33.83

Table 21

INCREASE OR DECREASE IN LAND VALUE

Variable	Form D(R) Quest. Pg.	Chattanooga	Reno	Combined
1. Land value changed	23A 16			
0 = not changed		6.10	2.13	4.39
1 = gone down		4.31	1.65	3.16
2 = gone up		82.05	88.42	84.80
Δ		7.54	7.80	7.65
2. Aircraft operations responsible for change	23B 16			
Yes		4.76	6.62	5.56
No		79.53	81.09	80.20
Δ		15.71	12.29	14.23

Table 22

TYPES OF COMPLAINT

Variable	Chattanooga N = 59	Reno N = 106	Combined N = 165
Discussed with someone	10.16	7.55	8.48
Phoned or wrote someone	3.39	3.77	3.64
Signed a petition	1.69	0.	0.61
Visited an official	1.69	0.	0.61
Attended a meeting	1.69	0.	0.61
Helped set up a committee	0.	0.	0.
Wrote letters to editor	0.	0.	0.
Filed suit	0.	0.	0.
Other	1.69	0.	0.61

*Those eligible to complain were those who mentioned aircraft noise as the most disliked thing in the neighborhood. The N's at the top of each column reflect the number in each city who qualified. Each potential complainant was asked whether or not he actually did any of the items listed above. The percents reflect those who reported "yes." For this reason the column percents do not total to 100 percent.

APPENDIX D

Table 23

AIRCRAFT INTEREST ORGANIZATIONS*

Form D(R)

Question 63C, Page 21

Variable	Chattanooga	Reno	Combined
First organization mentioned	0.	0.12	0.05
Second organization mentioned	0.	0.24	0.10
Third organization mentioned	0.	0.	0.
Fourth organization mentioned	0.	0.	0.
Fifth organization mentioned	0.	0.	0.

*The percents in each row represent that portion of the total sample for that particular category. For this reason the individual colums do not add up to 100 percent.

Table 24

CITY OF RESIDENCE*

Chattanooga	1114	56.84
Reno	846	43.16
Total	1960	100.00

*Interviewing completed fall and winter, 1970-1971.

Table 25
DISTANCE FROM AIRPORT

Distance in Miles	Chattanooga	Reno	Combined
Less than one mile	11.85	10.99	11.48
1.0 - 1.9	21.63	23.17	22.30
2.0 - 2.9	36.62	37.71	37.09
3.0 - 3.9	15.26	17.49	16.22
4.0 - 4.9	3.32	2.13	2.81
5.0 - 5.9	1.80	4.26	2.86
6.0 - 6.9	0.	4.26	1.84
7.0 - 7.9	8.80	0.	5.00
8.0 - 8.9	0.72	0.	0.41
9.0 - 9.9	0.	0.	0.
10+	0.	0.	0.

APPENDIX D

Table 26
HEAD OF HOUSEHOLD OCCUPATION

Form D(R)
Question 66C

Occupational Score	Chattanooga	Reno	Combined
No Response/ Don't Know	3.95	3.19	3.62
Retired	14.00	11.11	12.76
01 - 09	0.	0.35	0.15
10 - 19	1.71	4.26	2.90
20 - 29	0.90	2.71	1.68
30 - 39	4.32	7.09	5.51
40 - 49	5.30	7.21	6.10
50 - 59	7.10	6.74	6.95
60 - 69	18.06	18.90	18.42
70 - 79	19.30	19.15	19.24
80 - 89	14.10	10.63	12.60
90 - 99	11.32	8.63	10.15
$\bar{X}$*	69.22	63.38	66.64
S*	18.91	21.42	20.27

*$\bar{X}$ and S are excluding Retired's, No Response's and Don't Know's.

Table 27
TOTAL FAMILY INCOME

Form D(R)
Question 69, Page 24

Response	Chattanooga	Reno	Combined
0 - $3,999	11.58	9.81	10.82
$4,000 - $9,999	40.39	37.00	38.93
$10,000	33.85	47.28	39.64
No Response	14.18	5.91	10.61

Table 28
RESPONDENT'S HIGHEST LEVEL OF EDUCATION

Form D(R)
Question 70A, Page 24

Response	Chattanooga	Reno	Combined
Grade school (1-8)	14.27	13.00	13.73
High school (9-12)	53.41	52.60	53.06
College 1-3 years	16.61	22.34	19.08
College graduate	9.25	7.80	8.62
College 4 years+	6.01	3.66	5.00
No Response/ Don't Know	0.45	0.59	0.51

APPENDIX D

Table 29
POPULATION OF HOUSEHOLD (PERSONS)

Form D(R)
Question 65, Page 23

Number	Chattanooga	Reno	Combined
1	6.37	6.86	6.58
2	28.55	23.88	26.53
3	22.08	20.33	21.33
4	22.17	21.75	21.99
5	12.84	13.12	12.96
6+	7.81	14.07	10.51
No Response/ Don't Know	0.18	0.	0.10
$\overline{X}$ (Δ out)	3.30	3.53	3.40
S	1.38	1.50	1.43

Table 30
AGE OF RESPONDENT

Form D(R)
Question 70B, Page 25

Response	Chattanooga	Reno	Combined
Under 30	19.30	21.28	20.15
30 - 39	18.49	23.88	20.82
40 - 49	22.08	21.87	21.99
50 - 59	16.07	16.43	16.22
60 - 69	14.45	11.11	13.01
70+	9.25	4.96	7.40
No Response	0.36	0.47	0.41
$\overline{X}$ (Δ out)	3.16	2.87	3.03
S	1.59	1.46	1.54

Table 31
SEX OF RESPONDENT

Form D(R)

Question 89, Page 28

Response	Chattanooga	Reno	Combined
Male	26.48	30.38	28.16
Female	73.52	69.62	71.84
No Response	0.	0.	0.

Table 32
TIMES MOVED IN LAST TEN YEARS

Form D(R)
Question 72, Page 25

Response	Chattanooga	Reno	Combined
Has not moved	37.43	20.69	30.20
Moved one time	20.56	17.14	19.08
Moved two times	12.84	10.64	11.89
Moved three times	10.41	13.12	11.58
Moved four times	6.10	9.46	7.55
Moved five times or more	11.94	28.26	18.97
No Response/Don't Know	0.72	0.71	0.71
Mean (Δ out)	1.86	3.22	2.45
Standard deviation	2.30	2.93	2.68

APPENDIX D

Table 33

LENGTH OF RESIDENCE IN CITY

Form D(R)

Question 2, Page 2

Years	Chattanooga	Reno	Combined
0 - 5	17.14	35.46	25.05
6 - 10	8.45	20.21	13.53
11 - 15	7.37	12.17	9.44
16 - 20	11.95	10.28	11.24
21+	55.18	21.87	39.77
No Response/ Don't Know	0.	0.	0.
Mean	25.20	13.22	20.03
Standard deviation	17.81	12.84	16.93

Table 34

LENGTH OF RESIDENCE IN NEIGHBORHOOD

Years	Chattanooga	Reno	Combined
0 - 5	43.90	60.40	51.02
6 - 10	20.29	20.33	20.30
11 - 15	12.83	8.63	11.02
16 - 20	9.87	4.37	7.50
21+	13.05	6.28	10.08
No Response/ Don't Know	0.09	0.	0.05
Mean	9.83	6.83	8.53
Standard deviation	9.40	8.65	9.21

Table 35
HOUSING OWNER OR RENTER

Form D(R)
Question 71A, Page 25

Response	Chattanooga	Reno	Combined
Own	81.06	75.30	78.57
Rent	18.85	24.59	21.33
No Response/ Don't Know	0.09	0.12	0.10

Table 36
ETHNICITY OF RESPONDENT

Form D(R)
Question 90, Page 28

Response	Chattanooga	Reno	Combined
Anglo	95.33	95.74	95.51
Spanish/ American	0.	1.77	0.77
Negro	4.04	0.59	2.55
Other	0.27	1.42	0.77
No Response	0.36	0.47	0.41

Table 37
AIRLINE INDUSTRY EMPLOYMENT

Form D(R)
Question 68A, Page 24

Response	Chattanooga	Reno	Combined
Yes	2.06	6.03	3.78
No	97.94	93.85	96.17
No Response/ Don't Know	0.	0.12	0.05

APPENDIX D

Table 38
BUILDING ATTENUATION

Variable	Quest.	Pg.	Chattanooga	Reno	Combined
Building attenuation	74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85	26, 27			
Unknown			0.	0.	0.
<20			0.	0.	0.
20			0.	0.	0.
21			0.	0.	0.
22			0.	0.	0.
23			0.09	0.	0.05
24			0.45	0.12	0.31
25			0.81	0.36	0.61
26			4.31	1.07	2.91
27			14.36	4.27	10.02
28			22.98	13.17	18.75
29			32.32	24.91	29.13
30			13.64	30.96	21.10
31			10.23	16.01	12.72
32			0.27	7.71	3.47
33			0.45	1.19	0.77
34			0.09	0.24	0.15
35+			0.	0.	0.
$\overline{X}$			28.67	29.65	29.09

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