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DISTURBANCE TO THE POPULATION DUE TO FLIGHT OPERATIONS AT LANDING FIELDS. QUESTIONAIRE ON COMMUNITY REACTION TO NON-COMMERCIAL AND SPORTING AVIATION

Bernd Rohrmann

Translation of "Die Gestörtheit der Bevölkerung durch den Flugbetrieb auf Landeplätzen. Eine sozialpsychologische Feldstudie durchgeführt im Auftrag des Bundesministeriums des Innern", Manuscript, Hamburg, West Germany, July 1975, pp. 1-108.

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16. Abstract

Questionaire to be given by an interviewer personnaly. It investates sociopsychological effects of air traffic noise experienced by residents of areas near small sporting aviation fields. It includes questions on flight restriction measures, on attitudes which moderate annoyance and on comparisons with other noise sources, etc.

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DISTURBANCE TO THE POPULATION
DUE TO FLIGHT OPERATIONS
AT LANDING FIELDS

A Social-Psychological Field Study
Commissioned by the Federal Ministry
of the Interior

Bernd Rohrmann et al.

Table of Contents

0.2: List of Tables:

0.3: List of Figures:

0.4: List of Associates:

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Remarks for the "scanning" reader: The object is located in sections 2.1 and 2.5. The locations for the study and sample areas are presented in 3.3. The questionnaire is found in 4.4, a survey of the data in 6.4 (table 15). The results described in detail in chapter 7 (especially 7.3-7.5) are evaluated in summary in 8.2 and 8.3.

The entire course of the study is illustrated in figure 11 (page 34 of the German original).

1: Abbreviated Version:

By means of a social-psychological field study, an explanation was to be prepared on the extent to which noise resulting from the flight operations of non-commercial aircraft (1974 1,800,000take-offs on 280 landing fields) represents an annoying and disadvantageous environmental influence for the affected population; in this case, an explanation was also to be presented on the extent to which non-physical factors have a determining effect on the reaction to aircraft noise, and what measures are undertaken for protecting against aircraft noise or are desired by public officials (chapter 2).

For this purpose, residents near the landing fields in Braunschweig, Bonn-Hangelar, Egelsbach and Karlsruhe-Forchheim were selected for interview -- after preliminary tests in Hartenholm; this involves a random sample of persons from 18 to 70 years from 9 areas of various exposure to aircraft noise due to take-offs, landings and fly-overs (chapter 3).

The standardized questionnaire employed contains aprox. 190 points (including several attitude scales) on 6 aspects: Disturbance due to flight operations, evaluation of the noise problem due to recreational flights, measures to reduce aircraft noise, living conditions and personality characteristics, opinions and attitude related to noise, data on the interview situation (chapter 4).

From the study conducted in April, 1975 (employing predetermined addresses), 398 interviews resulted, (with 5% rejections and 10% failures due to other causes, 85% of the contacted persons were interviewed); conversations with official persons (landing field administrator, mayors, chairmen of citizen initiatives, etc.) produced additional background information. Acoustical measurements were carried out at 5 points in Braunschweig in supplement (chapter 5).

The evaluation of the data (including corelation statistical procedures) was carried out by computer programs at the computer center in Hambourg (chapter 6).

The results show that approximately half of the affected persons evaluate flight operations as annoyance, above all because of the disturbance in relaxation and evening quiet (inside and especially outside) and an obstacle to communication; approximately one-quarter of the persons interviewed considers it a detriment at least in the reduction of recreation and leisure possibilities at home. The general noise sensitivity or the evaluation of the offices responsible for flight operations have a substantial influence for example, on the extent of their reactions. Approximately three-quarters of the persons living near airports support the demand for limitations in flight operations, while more than half are thinking about the noontime, a long period of

*Numbers in the margin indicate pagination in the foreign text.

night rest and Sunday afternoons and the majority does not want to accept any exceptions. The acoustical measurements produced average levels between 47 and 76 dB(A), i.e. values clearly above the background noise level (chapter 7).

The necessity for measures against excessive aircraft noise stress results from an evaluation of the problem of aircraft noise; the legal ordinance prepared by the Federal Government on temporal limitation of the flight operations should substantially meet the desires of the interviewed persons, at least if these are constructed consistantly. Other measures, however, -- of a technical, population planning information political type -- should be added; further research could provide assistance for decisions (chapter 8).

2: Problems:

/5

2.1: The Problem of Noise due to Sport Flights:

In no way does aircraft noise represent a problem only in the surroundings of large airports, and disturbance and annoyance are not caused only by jet aircraft of the commercial travel companies or the air force. Rather, many persons living near landing fields, opened neither to commercial nor military flight operations, consider their living conditions negatively influenced, and they announce this by protests and citizen initiatives.

In addition to the 10 large airports of civilian aviation (Frankfurt, Düsseldorf, München, Hamburg, Stuttgart, Hannover, Cologne/Bonn, Nurenberg, Bremen, Saarbrücken) and about 115 military landing fields, there are more than 280 landing fields, or commercial landing fields (compare table 1) in the Federal Republic of Germany, essentially serving private and recreational flight, including flight training and company flights.

On the average, therefore, there is one landing field for each 620km² (when assuming equal distribution, the average distance would be aprox. 25km); the survey map of the Federal Institute for Flight Safety presented in figure 1 shows this fact.

Table 1: Number of Landing Fields for Non-commercial Traffic

Tab. 1: ZAHL DER LANDEPLÄTZE FÜR NICHTGEWERBLICHEN VERKEHR.				
Schleswig-Holstein	25	Hessen	26	A Summe: 284
Hamburg	1	Rheinland-Pfalz	24	
Niedersachsen	40	Saarland	2	
Bremen	1	Baden-Württemberg	36	
Nordrhein-Westfalen	49	Bayern	80	
B Daten von 1975 nach: STATISTISCHES BUNDESAMT (Fachserie H, Reihe 3, Luftverkehr); ohne Flughäfen des Linienverkehrs.				

Key

A Total

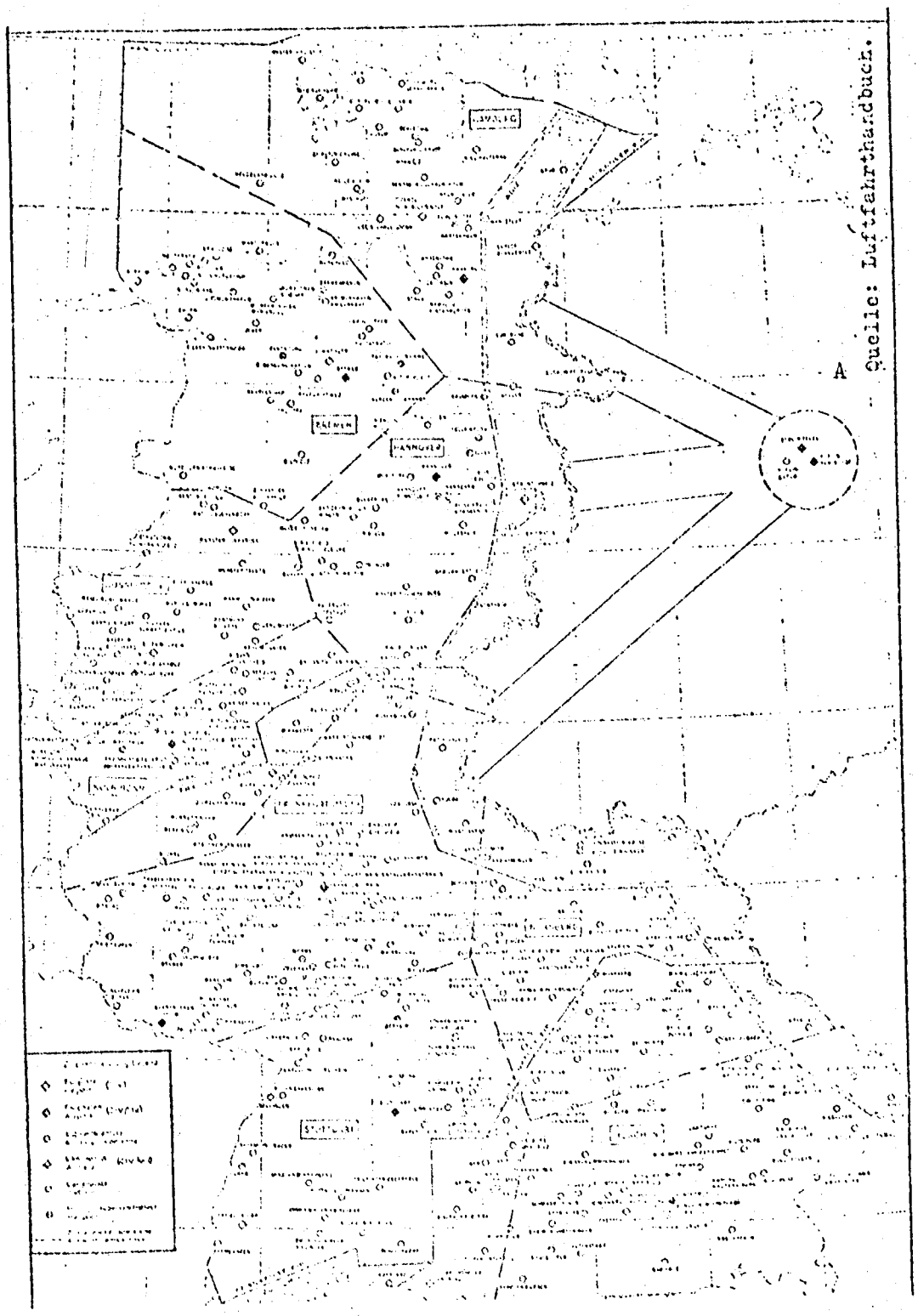
B Data from 1975 according to the Federal Office for Statistics (expert series H, III., aviation); without airports for commercial traffic.

There were aprox. 50000 aircraft take-offs at the commercial airports (chiefly jet aircraft), compared to a total of 1,738000 take-offs in 1974 in non-commercial aviation, 1/3 of which could be attributed to training flights and more than half to private flights (the remainder to company flights as well as self-starting motor gliders); as table 2 shows,

/7

Figure 1: Map of the Landing Fields in the Federal Republic of Germany:

16



Key: A. Source: Aviation Manual

this signifies an increase of more than 50% since 1968.

Table 2: Flights in Non-commercial Aviation of the Federal Republic of Germany:

A Anzahl der Starts von Motorflugzeugen (plus selbststartender Motorsegler)	1968	1 113 400
	1969	1 372 500
	1970	1 439 500
	1971	1 724 824
	1972	1 831 036
	1973	1 770 318
	1974	1 738 292
B	Daten nach: STATISTISCHES BUNDESAMT, Fachserie H, Reihe 3, Luftverkehr; 1975.	

Key

A Number of Take-Offs of Motorized Aircraft (in Addition to Self-starting motor gliders)

B Data According to the Federal Office for Statistics, Expert Series HIII., Aviation: 1975.

The non-commercial traffic cannot be neglected as a noise problem, both based on the number of affected locations and on the basis of flight frequency -- the commercial landing field with the highest frequency, Egelsbach in Hessen, has more than 100,00 flights per year. The sound levels, however, are considerably lower: While a jet aircraft taking off in the residential areas at the airport generally achieves a level between 80 and 120 dB(A), the take-offs of small propeller machines are usually heard at 50 to 80 dB(A).

Decisive for the extent of the disturbing effects, of course, is the position of the airport in relation to populated areas. When the take-off or landing line, as well as the prescribed approach path run over residential areas (or above popular recreation areas), a noise stress is unavoidable for the neighbors; although most commercial landing fields are situated at a relative distance from populated centers, still numerous cities and villages are disturbed by aircraft noise.

The non-commercial flight operations under examination here, usually with one (in part two) engine aircraft up to 2000 ton take-off weight (increased in number since 1970 by about 1/4 to about 5000) include all sport and training flights, private charter and business flights, tours and sightseeing flights, advertising flights, demonstration flights, maintenance flights etc., furthermore the towing take-offs

for gliders; in the following reference will be made, in a simplification, briefly to recreational aircraft, recreational flying and aircraft noise due to sport aircraft.

To what extent aircraft noise due to sport aircraft represents a disadvantageous and annoying environmental effect for the affected population is to be examined by the social-psychological field study presented in this report.

2.2: Considerations on Noise Protection:

In order to maintain his social, psychological and somatic wellbeing (as is the definition for health of the World Health Organization), human beings require the protection from excessive noise stress. The considerable effects of aircraft noise especially in the case of jet engines has underlined the necessity for legal noise protection; in 1971 a "law for protection against aircraft noise" was passed "for protecting the general public from danger, considerable disadvantages and considerable stress due to aircraft noise in the surroundings near airports".

This provides for the establishment of noise protection areas, two so-called protection zones I. and II., in which the equivalent constant sound level L_{eq} is greater than 75 or than 67 dB(A).

In this area residences and establishments requiring protection (schools, hospitals, and simular institutions) may, in part, no longer be constructed, partly only when maintaining defined sound protection requirements with subsidies possible to a certain extent for buildings already present.

This law, however, applies only "to (1) commercial airports, connected to commercial traffic and (2) military airports, serving the operation of aircraft with jet engines"; 42 airports are affected and, of course, none of the 280 commercial landing fields.

Propeller aircraft, of course, are also subject to the permit conditions set down by the Federal Office for Aviation for Jet Engines, in which defined sound protection requirements must be fulfilled. The basis is the aviation law, according to which an aircraft can only receive permit for travel, when "the technical equipment of the aircraft is designed in such a manner that the sound arising through the operations does not exceed the measure unavoidable according to the individual state of the art in technology" (paragraph 2). /9

The A sound level may therefore not exceed 68 dB in the case of propeller aircraft up to 600 kg take-off weight; this limit value rises up to a maximum 87 dB in the case of 5700 kg maximum take-off weight (compare News for Aviators II.-32/72). Special regulations apply partially for already

available aircraft.

Such a limitation has an effect on the volume occuring, but, of course, not on the flight frequencies. Therefore the subject has been discussed for sometime, whether the flight traffic should be limited at commercial landing fields, at least for certain times or defined routes. The corresponding draft of a legal ordainance prepared by the Federal Ministry of the Interior aims at temporal bans, applied to landing fields with more than 2000 flights anually and for the non-commercial flight operations with aircraft up to a maximum weight of 2000 kg (light aircraft and motorized gliders):

"On weekdays in the time after sunset and before 7:00 a.m. and between 1:00 p.m. and 3:00 p.m. as well as on Sundays and holidays before 9:00 a.m. and after 1:00 p.m., a) flights around the field, B0 training flights, with the exception of cross-country training flights and other training flights beyond the surroundings of the landing field, in so far as these flights continue for more than one hour, C0 tours and sightseeing flights for profit , D) advertising flights requiring a permit and E) aircraft towing take-offs, with the exception of take-offs for delivery and high-performance flights are impermissible".

The limitations in time are to be disregarded for aircraft (with the exception of night flights), meeting the raised sound protection requirements, specifically, falling below the defined emission limit values (compare above) by 5 dB (after 1978 by 8 dB0.

To what extent such a legal ordinance is appropriate (also subject to the authority of the traffic Ministry), is still being discussed at present; information on the necessity of the protection from aircraft noise at commercial landing fields can be provided by the social-scientific survey.

2.3: The Concept of Noise: /1

The concept "noise" is applied as self explanatory, and hardly anyone has difficulties of immagining something about this term; however, "noise" has proven to be extremely difficult to define for "science".

The smallest common denominator, so to speak, to which the various noise definitions can be reduced, consists in the sentence, "noise is undesirable sound".

A corresponding definition is found, for example, in the report of the "Committee on the Problem of Noise", a body appointed by the English Government to deal with noise questions (Noise -- Final Report, 1963, p.2; compare also, for example, Hörmann, 1968, p.785; Kryter, 1970 p.1; or also Glass and Singer, 1972, p.15). This characterization

of noise implies that "noise" is perceived by the listener as unpleasant, as something disturbing and annoying.

The aspect of the disturbing or the annoying is also taken into consideration in noise legislation, in standards and similar determinations, such as the VDI Guideline 2058 or the DIN Standard 1320. In the "technical directive for protection against noise" (paragraph 16 of the commercial regulations; 1969) it states, for example, "Noise is sound which can disturb (endanger, considerably annoy or provide considerable disadvantage) or would disturb neighbors or third parties".

The sounds of taking-off and landing aircraft are apparently "noise" according to this definition. In this case it is also the "third parties", i.e. the residents not proffiting from the airport, subjected to the sounds. An essential factor appears to be the fact that one is "subjected" to noise; This is not a perception (or an activity such as smoking as a risk factor of another type", which is intended.

The brief formulation of "noise as sound perceived as undesirable or disturbing" contains the problems in a concentrated form confronting noise research. Sound -- i.e. a physical process, relatively simple and precise to measure -- is defined as a necessary, but by no means sufficient component for the statement of "noise".

"Sound level" (unit: dB) is a physical measure for the acting sound pressure. The concept "volume" (unit: phon) involves the human auditory sense (determined by experimentally predetermined sound stimuli; i.e. dB can be measured with aparatus, but phons only determined by several evaluators, -- or estimated by calculations. "Loudness" (unit: sone) is the volume converted to an absolute scale.

The attempt to relate a scale of the perceived, subjective disturbance due to a sound ("Noisiness") with sufficient uniqueness to the physical characteristics of the sound has not produced especially good results (compare in this connection, e.g. Kryter, 1959; Zwicker, 1960; Stevens, 1961; furthermore the presentations in Bürck et al, 1965, or Kryter, 1970).

"Noise" is not a physical quantity, but an evaluation, implying "stimulus" and "reaction" moments. In a simplification, the evaluation of noise can be interpreted as the effect, on the one hand, of the physical characteristics of the sound event, and on the other hand, of factors used as a basis for judging sounds as noise.

Accordingly, "noise" is understood as a reaction aspect, resulting from acoustical stimulus components (e.g. level, spectrum, temporal structure and frequency etc.) and non-acoustical determinants of effect (e.g. type and location of

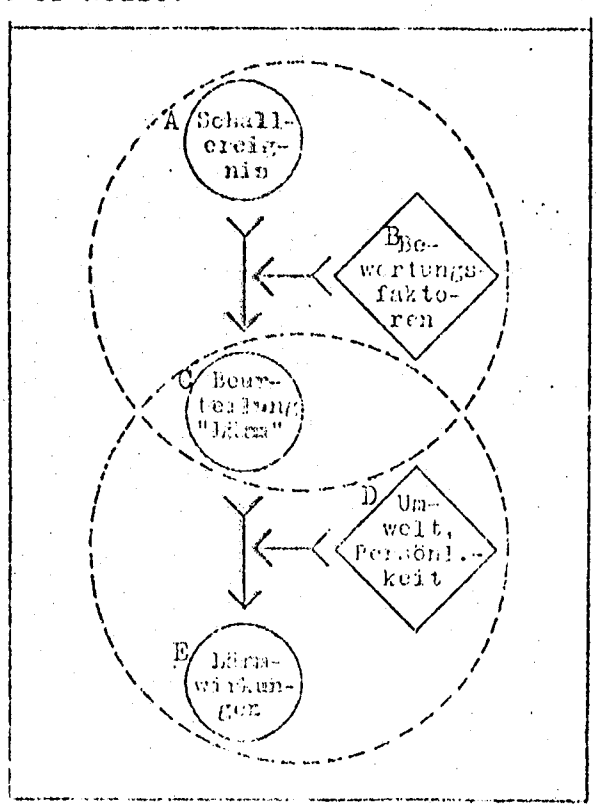
sound source, point in time, undesirability, etc.).

In a similar simplification, the social, psychological and somatic effects of noise can be interpreted as the result, on the one hand, of noise factors (acoustical as well as non-acoustical) and, on the other hand, of the circumstances of the situation and the individual and characteristics of the affected persons.

Accordingly, "noise" will be understood as a stimulus aspect (e.g. endangering, disadvantageous, annoying sound events) and "noise effects" as a reaction aspect, resulting from noise conditions and codetermining personality characteristics and environmental characteristics (e.g. dwelling situation, physical and mental condition, adaptation, etc.) as "moderators" noise processing.

The diagram in figure 2 illustrates this and simultaneously makes it clear that monocausal interpretations of noise effects are generally inappropriate; the reactions to be examined (to "sound" as to "noise") cannot be explained sufficiently on the basis of exclusively acoustical aspects.

Figure 2: Diagram on the Concept of Noise:



Key
A Sound event
B Evaluation factors
C Evaluation of "noise"
D Environment, Personality
E Noise Effects

The research on "moderators", codetermining the type and degree of noise effects (i.e. explaining differing reactions

within the same type of stimulus conditions), therefore plays a substantial role in the more recent aircraft noise research (compare especially the DFG research report on the effects of aircraft noise, 1974, or the extensive survey in Rohrmann et al., 1975). In this connection, several Swedish studies can be mentioned (Cederlöff et al., 1967, Sörensen, 1970 and others), demonstrating the considerable influence on the evaluation -- experimentally manipulated here -- of sound source on the disturbance due to (aircraft) noise.

Beyond the undesirability or the disturbance, i.e. a conscious evaluation of sound events by the affected persons, sufficiently loud noises may have direct and/or due to the annoying effect other, for example, physical consequences -- reduction of sleep depth, deterioration of performance, physiological mistakes -- without connecting this with the corresponding "annoyance" or "deterioration" experience. Accordingly, any sound reducing the psychological, social and/or physical wellbeing would have to be considered "noise". Klosterkötter (1973, p.1) formulated in summary, "noise is undesirable, disturbing or health-dammaging sound".

When aircraft sounds are almost always termed "aircraft noise", this is not conceptually correct, in the sense of the considerations presented; not all persons, perceiving aircraft acoustically, will perceive the sounds as disturbing etc., i.e. as noise (compare the critical explanations made by Guski, 1975). Outside of science as in research, however, the corresponding language useage dominates, so that the strict differentiation between "aircraft noise" and "aircraft sounds" will be dispensed with here.

"Aircraft noise" therefore means: The sound stress to the population caused by air traffic, the undesirability of which is not a matter of contention (at least for the majority of the general public or the neighborhood), and which is the object of legislative interrest.

2.4: State of the Art of Aircraft Noise Research:

The systematic research of the effect of aircraft noise on human beings began in the fifties in the USA; studies followed in numerous European countries and Japan. These are chiefly social-scientific surveys, intended to gather information, above all, on spontaneously expressed or called for data on annoyance; several more recent studies included medical studies in addition to the sociological and psychological aspects (especially psycho-physiological experiments). The studies mentioned were chiefly carried out as surveys of a representative sample from the neighborhood of civilian commercial airports and were related to predetermined flight operations; furthermore, several field studies with quasi-experimental flights made it possible to evaluate specifically the disturbance effect of individual fly-overs (e.g. Elwell, 1953; Robinson et al., 1963; Kryter et al., 1969).

Table 3: List of Several Social-Scientific Aircraft Noise studies:

A Land	B Publication	C Untersuchungsorte
USA	BORSKY (1956) BORSKY (1957) TAYLOR Inc.(1970,1972)	L Div. Flughäfen M 3 Mil. Flughäfen N New York und 8 weitere O
D Großbritannien	KRYTER et al. (1963) BBN Research Ltd.(1974)	London-Heathrow London-Heathrow N O
E Frankreich	GRIMAUD et al.(1968) ALEXANDRE (1974)	Paris und 2 weitere Paris
F Niederlande	KOSTEN et al.(1967)	Amsterdam
G Schweiz	GRANDJEAN et al.(1973)	Basel, Bern, Zürich
H Skandinavien	RYLANDER et al.(1972)	Stockh.,Kopenh.,Oslo usw.
UdSSR	KARAGODINA et al.(1969)	Moskau und 8 weitere N O
Japan	KODAMA (1971)	Yokohama
I GDR	HERRMANN et al.(1974)	Berlin-Ost
J BRD	K DFG-Forschungsübersicht Fluglärmwirkungen (1974)	Hamburg, München

P

Key

A Country
B Publication
C Locations of the Study
d Great Brittain
E France
F The Netherlands
G Switzerland
H Scandanavia
I GDR
J FRG
K DFG Research Report on Aircraft Noise Effects (1974)
L Civilian Airports
M Military Airports
N End
O Further
P The Most Important Aircraft Noise Studies are compiled in Table 3 (Especially the Studies in the USSR, FRG and Japan Included an interdisciplinary Research Program); In All Cases (With the Exception of the GDR) More than One-Thousand Persons were interviewed.

The result on the type and extent of deterioration due to aircraft noise and on the influence of non-physical factors on disturbance and annoyance can be summarized as follows (wimilar to the survey in Rohrmann et al., 1974):

-- Persons exposed to aircraft noise feel disturbed, negatively influenced, annoyed, above all in the following points: communication (conversation, radio/tv/music, telephone calls), relaxation and recreation (inside, outside), sleep, mental work, being startled and fear, sensations of pain (head, ear), vibrations, (moreover, smells and

pollution are listed). These effects constitute a generally negative attitude towards aircraft noise.

-- The aircraft noise effects mentioned increase with rising frequency, volume and duration of fly-overs, but there is only a mean correlation between stimulus and reaction variables of r=0.25 to 0.56 in different studies; i.e. the variability of the (individual) reactions to aircraft noise can only be explained to a slight portion by stimulus characteristics (expressed in other words: Even in the case of low degrees of noise, numerous persons feel disturbed, while even at high degrees of noise a portion of the neighbors remains even-tempered). When only average reaction values -- disregarding specific effects of personality and situation -- are of interest, good results of predictability of disturbance and annoyance due to acoustical aircraft noise amounts are achieved.

-- The selection of a definite acoustical measure is practically without significance for the amount of correlation between aircraft noise degree and disturbance. Whether the frequency or volume of fly-over events determine the degree of disturbance more greatly, and which equivalent relationship best reflects the influence of the parameters (to which degree a certain assumption of equal value is justified for effects of daily aircraft noise stress) does not yet seem conclusively explained.

-- The result is produced from experiments with fly-overs, among other things, that the evaluation of annoyance is determined above all by the impression of loudness gained outside.

-- Aircraft noise is considered the most unpleasant of all types of noise in the social environment (both by persons actually affected as in the imagination).

-- Personality characteristics and environmental conditions of the situation have a considerable influence on the type and degree of disturbance and annoyance due to aircraft noise. The most important moderators resulting from the research are (general) noise sensitivity, fears for health (due to noise), (no) trust in responsible persons, (negative) evaluation of air traffic, conservative attitude, (longer) duration of residence, age, fearfulness.

-- When an attempt is made to predict the disturbance reaction to aircraft noise through stimulus data and through moderator variables together (multiple regression analysis), it is demonstrated that a maximum of aprox. 2/3 of the reaction variability can be determined; the partial prediction capability of the moderators (especially of variables of general noise evaluation) is at least as large or even larger than the influence of acoustical aircraft noise characteristics)which do not make any satisfactory explanation of individual aircraft

noise reactions possible alone).

-- Clinical and experimental studies with residents near airports point to an alteration in the cardiovascular system as a result of aircraft noise exposure. The vasomotoric stimulus response to sound appears to reflect defensive activation to a greater degree in persons with more daily exposure to aircraft noise (furthermore, occasionally higher rates of premature births have been noted near airports).

-- Aircraft sounds at night reduce the sleep depth to a degree which cannot be compensated for again during the night. This disturbance is frequently not remembered the next morning, but older persons are also frequently awakened. While children in the laboratory are not awakened so easily, women residing near airports report on uneasy sleep of their children.

-- Observations of behavior in children from areas near the airports have been carried out only seldomly in a systematic form; the available findings point to the risk of behavioral disturbances in infants and small children.

-- The effects of daily exposure to aircraft noise on the general performance capability in task situations are not clear. There is a tendancy to demonstrate greater variations in performance during actual noise exposure and a reduction in concentration capacity in the case of residents near airports, who are especially annoyed about aircraft noise.

-- In the analysis of (aircraft) noise effects on performance behavior, not only direct, but also subsequent effects must be considered; adaptation and retention of performance may be connected to "post-adaptive" costs.

-- Measures against the direct aircraft noise effects, for example structural sound protection, are only realized by a small portion of the residents near airports; satisfaction with success is limited. Also, personal complaints and protests against flight operations are presented by only a few percent of the affected persons (considerably more participate in collective activities against aircraft noise).

When the aircraft noise effects gathered in the social survey are evaluated -- for example, negative influence on communication, reduced recreational value of the home, disturbance in concentration, sensation of pain, nervousness and sensation of fear -- against the claim for somatic, psychological and social well-being (i.e., against the health concept of the WHO), aircraft noise stress must be considered a serious deterioration of health; within the interpretation of the law for protection against aircraft noise, considerable disadvantages and annoyances occur.

Manifest somatic diseases, certainly attributable to flight operations, are still unknown in residents near airports. The disturbance to sleep at night and defensive action processes, more frequently ascertained in persons with a higher degree of aircraft noise stress, are statistically noticable and appear risky in the sense of a somatic concept of health.

The various results in the aircraft noise research up to now, however, have not yet been able to explain all questions (for example, on the deterioration in the daily private areas of behavior or on processes of adaptation and sensitization), and they can also not be generalized randomly, because they usually refer to adult residents of large cities as well as to airports for jet aircraft.

There has then still been no study published, at least in Germany, on the reaction of the population in small cities or in the country, and especially none on the disturbing effects of smaller propeller machines.

Although the available studies on aircraft noise represent a very great, methodological aid (especially the DFG research report on the effects of aircraft noise, 1974), they still do not make any sufficient evaluation of the noise problem from sport aircraft possible; an empirical study already appeared necessary because of the different social-psychological importance of the noise source.

2.5: Goal of the Study:

An explanation is to be provided through a social-scientific field study to what extent noise as a result of flight operations of (light) aircraft in non-commercial aviation represents a disadvantageous and annoying environmental effect for the affected population.

The following questions were to be answered:

-- In which areas of life the residents near commercial landing fields feel disturbed by aircraft noise, to what degree are especially communication and regeneration processes reduced?
-- What portion of the affected persons evaluate the given flight operations as considerable negative influence?
-- To what extent are the type and degree of reactions to aircraft noise co-determined by the living conditions and personality characteristics (non-physical parameters, "moderators" of the noise effect)?
-- Which measures -- especially limitations of flight operations -- are desired for reducing the aircraft noise stress?

The main goal of the study was to provide a better estimation of the protection requirements of the population near landing fields with recreational flight operations.

3: STUDY PLAN:

3.1: Methodological Conception:

The study method was the survey of a random sample of residents near several well frequented landing fields of non-commercial flight operations in north, west and southern Germany by interviewers, using a standardized questionnaire.

This concept was to guarantee that the results are representative for the affected population and are comparable with other aircraft noise studies.

Only a systematic sample ensures the possibility for generalization of the results; when the emphasis is placed on those persons, who have presented protests and complaints to the appropriate officials (of their own accord) or may belong to an anti-noise initiative, the results may deviate from the opinion of the entire population of residents in the areas near airports.

In the Anglo-American aircraft noise research, a differentiation is made between the criteria "complaints" (spontaneously expressed) and "annoyance" (in answers to questions on disturbance and annoyance); the inadequacy of "complainants" studies led to the development of "annoyance" scales, i.e. standardized measurement instruments (using the methods of psychometrics) for gathering data on opinions and attitudes on the stress due to aircraft noise.

The method of a standardized survey -- i.e., the same questions for all study persons and application of predetermined answers, as well as quantitative judgement scales -- also seemed appropriate because the (computer) evaluation aimed mainly at correlation-statistical procedures and, moreover, the most direct comparability with the available studies (above all, the aircraft noise project of the German Research Association) was desired. /1

The following steps had to be taken to conduct the study plan:

-- Selection of the study locations and drawing of the samples (chapter 3);
-- Preparation and testing of the social-psychological questionnaire (with attitude scales) (chapter 4);
-- Instruction for the interviewers and conduction of the surveys (chapter 5).

A survey on content and schedual for the course of the study is provided in Figure 1 in Section 3.6.

It was not possible for finantial reasons to conduct acoustical measurements at all locations of the study, but it was possible to define the survey areas using available data on flight operations (above all, statistics on numbers of flights). In order to gain information on the usual sound level occuring in the area around the landing field, however,

sound measurements were planned at one of the landing fields. (limited in extent).

The study carried out was conceived as a pilot study, already because of the limitations in financial means and especially in time and it is not capable of course, of any exhaustive analysis of the process of aircraft noise effect or definitive statements on the various types of aircraft noise stress in the area of non-commercial air traffic; however, it should represent an aid in decisions for the evaluation of the given stresses and possible measures for the protection of the general public or the neighborhood.

3.2: Definition of the Sample:

The sample to be surveyed should be the best possible representation of the population in the area around airports. /20
It therefore appeared logical to select several study locations (on this subject see 3.3) and to pick a random selection of all citizens who could be surveyed within this determined residential area.

The sample was drawn without demographic restrictions, with the exception of the age limits from 18 years (age of discretion) and 70 years (it is usually difficult to survey older persons) (for more details see 3.4).

Through the utilization of the public residents' registration files it was possible to draw a random sample and to present these to the interviewers for the survey in the form of complete addresses.

Approximately 50 to 100 surveys in aprox. 5 cities were planned, a total of 300 to 350 interviews.

This extent of sample can be considered sufficient for the task given here; taking into consideration more than 5 airports would have produced too great a division of the sample as well as work involved in the survey. In addition, a defined location was not at the center of interest, but only the corresponding population group as a whole.

Furthermore, the sample was to be defined in such a manner that both the area directly adjacent to the aircraft take-offs was to be considered, as well as areas with fly-overs, but not situated in the direct neighborhood of the landing field; for this reason, at least 2 survey areas per location were considered in each case.

Each of these individual areas was conceived as a "cluster", i.e. as a bundle of adjacent houses with the closest possible boundaries from a residential area with about three or four streets.

By this means, the aim can be achieved of a relatively smooth spread within a survey area in a sociological and, above all, acoustical point of view (the organization of the survey is, of course, also more simple). Since noise measure-

ments were not possible at most study locations, the clear correlation of each sample area to the airport gained in significance.

The sample concept then planned, on the whole, for a cluster sample with aprox. 10 clusters at 5 airports, each cluster defined as a random sample.

3.3: Selection of the Study Locations: /21

Partially locations of large cities, partially small cities in different regions of the Federal Republic were to serve as study locations, having landing fields with comparable flight operations; a sufficiently dense population near the take-off and landing path was required for reasons of sample techniques.

The 15 most often used landing fields of non-commercial flight operations with 20,000 or more take-offs per year are compiled in table 4; aprox. 50 further landing fields have more than 10,000 take-offs anually.

After inspecting Hartenholm, Uetersen, Ganderkesee, Braunschweig, Kassel-Calden, Essen/Mülheim, Mönchengladbach, Bonn-Hangelar, Koblenz-Winnigen, Egelsbach, Mannheim-Neuostheim, Karlsruhe/Forchheim, Baden-Baden/Oos, Freiburg, Augsburg/Mühlhausen and Landshut, 5 landing fields were selected for the following reasons (after discussions with an acoustics expert):

-- Braunschweig, because of the residential area directly beneath the take-off line, the highway as a competing noise source and the possibility of acoustical measurements /22
(in cooperation with the Physical-Technical Federal Institute);

-- Bonn (or St. Augustin) because of the dense population east of the airfield and a relatively loud suburban tram, as well as the intensive public discussion (including several signature actions);

-- Egelsbach as the landing field with the most flights (aprox. 50,000 take-offs more flights than numerous commercial airports) and because of the additional disturbance factor of railway noise;

-- Karlsruhe (or Forchheim) as cities in southern Germany and also because of an active citizens' initiative.

As location for the preparatory explorations and questionnaire testing, finally, the small community of

-- Hartenholm was selected, on the one hand, situated well into the country and very quiet, on the other hand, however, having noise stress due to flight operations, a heavily trafficed Federal street and a shooting range.

Maps for the selected airfields are given in figures 3 to 6or 7 (Hartenholm) with the prescribed traffic circuit.

When several of the larger commercial landing fields have not been taken into consideration, then only because no larger residential areas are situated in the direct area of influence of the take-off and landing path, as clearly shown in figure 7, for example, Mönchengladbach, Mannheim and Augsburg.

Table 5 provides information on the development of air traffic at the survey locations and the division according tc training, company and private flights (including sport and business flights).

At many airports, there are in addition to the operation of propeller machines, flights of other machines, for example, helicopters of the police or border police or also small jet aircraft for business flights, just as important for disturbance and annoyance.

It hardly appears possible to exclude such effects; therefore the direct question was asked in Braunschweig, where a jet of the VW company takes-off almost daily, about the disturbing effect of this flight in order to establish a comparison with the annoyance about sport aircraft.

Furthermore, the individual survey areas were selected by using the residential structure. Two such clusters appeared sufficient for each location, but in St. Augustin near Bonn -- where the active participation of citizen initiatives made a better foundation of the results necessary -- a third cluster was added to enlarge the sample; for the test location (Hartenholm), however, one was sufficient. /28

A systematic correlation of the clusters to the take-off line, landing line and area of traffic circuit was, of course, not possible because of the tie to the predetermined local situation (for each cluster, an enclosed residential area of aprox. 300 residents was required; compare 3.4).

The decisions reached are compiled in table 6.

Three clusters were located almost directly beneath the take-off/landing line (ESB, ENH, HAH), two directly under the traffic circuit (BNA, BST), two at the side of take-off and landing lines (EGB, EGE) and two to the side of the traffic circuit (ENN, HAF); the distances to the airport are also divergant, as is shown in table 6 and figure 3 to 6.

Therefore, 9 areas were defined as the basis for the actual sample drawing.

3.4: Sample Drawing:

In order to achieve the desired number of interviews, at first 300, and after the addition of a third cluster in St. Augustin, 340, aprox. 38 successful interviews, were necessary for 9 clusters.

The sample calculation shown in table 7 was carried out for this purpose.

According to the estimated loss rates (taken from the DFG research report on the effects of aircraft noise, and Rohrmann, 1974), therefore approximately 500 addresses had to be employed. Since only one person per household was to be interviewed, if possible, only every 3.5th address could be considered; therefore, the size of each cluster had to be selected so that it comprized approximately 300 residents, or about 200 between the ages of 18 and 70 years.

The actual drawing of the sample was carried out in the following manner:

-- Preparing a list of street and house numbers included in the cluster (compare the illustrations in figures 3 to 6); the cluster BNA is presented as an example in figure 8.

-- Preparing a list of all residents in the cluster, if possible, all 18 to 70 year-olds, using the official residents; files (partially by computer, partially by hand).

-- Removing all persons below 18 and above 70 years, as well as all foreigners or persons with the first place of residence in a foreign country (1798 persons remained as a basis list -- the plan according to table 7 was 1764).

-- Drawing every 3.5th address (in order to avoid possible confusion, alternating between every third, fourth or every second/third/fourth or every third/fourth/fifth person, according to the size of the list per cluster).

-- Subsequent drawing of substitute persons (e.g. in-so-far as it is apparent that several persons landed in the sample from the same household).

The planned 504 addresses resulted, an average of 56 per cluster; also compare table 11 in 5.4 (these small differences between the clusters are partially accidental, and they are partially based on the number of suitable streets or houses).

A check was additionally undertaken on whether the distribution of persons according to age and sex is in sufficient agreement with the corresponding relationships in the basic list.

3.5: Acoustical Measuring Points: /31

Sound measurements in each of the 9 survey clusters were not possible, as already explained in 3.1, but measurements were to be undertaken in Braunschweig at 5 points for 50 to 100 fly-overs in order to gain data on the expected sound level for small propeller machines. The selected measurement points (in cooperation with H.-O. Finke from the Physical-Technical Federal Institute) are compiled in table 8 and plotted in a map in figure 9.

At the points b1 to b4, both take-offs and landings were measured. Moreover, the measurment points were positioned /3 in such a manner that the measurement results also provided information on the expected noise stress in the remaining 7 clusters.

3.6: Time Scheduale:

Nine months were projected for the entire study. The most important decision concerning time was the time of the data survey: Since the sport flight operations are hardly carried out during the winter months, only the summertime could be considered.

Beginning the survey too early would have meant that the study acquired data on less disturbance and annoyance because of the winter break than is actually present on the average during the year. The distribution of take-offs over the months -- shown in figure 10 using Egelsbach as an example -- now demonstrates that already in March more activity can be expected in flight operations. Moreover, since only the semester holidays could be considered (for practical reasons), the month of April (1975) was chosen for the survey, specifically the first three weeks after Easter.

/3

The time scheduale for the entire study provided for the followng steps after the preparation of the general study plan: Sample drawing, construction of the questionnaire, gathering data, evaluation, interpretation; the sequence of the individual study steps is presented in figure 11 in a graph.

Table 4: Most-Often Employed Air Fields of Non-Commercial Traffic

a Verkehrslandeplatz	b Zahl der Starts 1974	
Egelsbach	49.515	
Mönchengladbach	37.934	
Bonn-Hangelar	34.695	
Karlsruhe-Forchheim	25.653	
Bad Neuheim/Reichelsheim	24.950	
Aachen	24.830	
Braunschweig	23.237	
Arnsberg	22.715	Hartenholm
Uetersen	21.663	15.685
Landshut-Ellermühle	21.229	
Baden-Baden-Oos	20.469	
Hemsbach-Lindenhof	20.123	
Rosenthal-Field-Pl.	20.452	
Trier-Euren	19.915	
Cuxhaven	19.063	

c Daten nach: STATISTISCHES BUNDESAMT, Fachserie H, Reihe 3, Luftverkehr; 1975.

Key: a. landing field
b. number of take-offs
c. data from: Federal Office of Statistics, Series H, section 3, air traffic; 1975

Table 5: Frequency of Take-Offs at the Air Fields in the Study

a Ort	b Jahr	c Schulflüge	d Gewerbeflüge	e Privatflüge	f Insges.
Braunschweig-	1971	10.665	1.393	11.950	23.864
Wenzelo	1972	15.689	1.304	11.409	29.652
	1973	11.013	1.907	13.629	26.549
	1974	6.745	2.082	14.445	23.273
Bonn-Hangelar	1971	20.731	1.316	12.229	39.326
	1972	15.240	1.209	17.411	33.830
	1973	12.659	980	18.940	31.777
	1974	12.304	3.203	19.188	34.695
Egelsbach	1971	29.800	394	26.698	56.892
	1972	34.405	1.256	26.939	62.600
	1973	26.227	2.725	24.951	53.953
	1974	21.577	2.623	25.310	49.515
Karlsruhe/	1971	19.286	1.784	14.592	36.272
Forchheim	1972	13.807	1.746	13.168	28.619
	1973	13.330	3.325	13.102	30.099
	1974	11.187	4.114	10.392	25.653

g Daten nach: STATISTISCHES BUNDESAMT, Fachserie H, Reihe 3, Luftverkehr; 1975.

See following page for key.

Key to Table 5:
a. location
b. year
c. training flights
d. business flights
e. private flights
f. total
h. data from: Federal Office of Statistics, Series H, section 3, air traffic; 1975.

Table 6: Survey of the Areas in the Survey (Clusters)

a Name	b Flugplatz	c Ort/Ortsteil	d Entfernung u. Lage zum Flughafen	e Abb.
BSB	Braunschweig	BS-Bienrode	1.7 km; h unter g S/L-Linie	3
BST		BS-Thune	4.1; h unter i Platzrunde	
BNH	Bonn-Hangelar (St. Augustin)	St.-A.-Hangelar	1.1; j knapp f seitl. S/L	4
BNA		St.-A.-Ort	1.8; h unter i Platzrunde	
BNN		St.-A.-Niederberg	2.4; f seitl. i Platzrunde	
EGB	Egelsbach	Egelsbach	1.2; f seitl. g S/L-Linie	5
EGE		Erzhausen	1.0; f seitl. k Flugplatz	
KAH	Karlsruhe-Forchheim	KA-Heidenstücker	1.2; j knapp f seitl. S/L	6
KAF		Forchheim	2.2; f seitl. i Platzrunde	
(X)	Kartenholm	Fuhlenriie	1.0; h unter g S/L-Linie	(7)

Die Entfernung bezieht sich auf die Mitte der Start- und Lande-Bahn. - X = Ort der Testbefragungen.

Key:
a. Name (abbreviation)
b. airfield
c. location/section
d. distance and position in relation to air field
e. figure no.
f. to the side
g. line
h. below
i. traffic circuit
j. just
k. air field
1. The distance is in relation to the middle of the runway. - X = location of the test interviews.

Table 7: Calculation of the Sample for the Survey

		[a] je Cluster	[b] zus.
N_0	[c] Gewünschte Endgruppe (befragte Personen)	38	342
N_1	[d] Notwendige Adressen bei 10% Fehladressen	42	378
N_2	[e] Mehrbedarf bei 25% Interview-Verweigerungen	56	504
N_3	[f] Bei Ziehung jeder 3.5ten Adresse	196	1764
N_4	[g] Benötigte Einwohnerbasis bei 1/3 Altersausfall (< 18, > 70 Jahre)	294	2646

Key:
a. per cluster
b. together
c. desired final group (interviewed persons)
d. necessary addresses with 10 % erroneous addresses
e. required surplus in the case of 25 % rejections
f. in drawing every 3.5th address
g. required inhabitant basis with 1/3 age rejections (less than 18, older than 70)

Table 8: List of the Acoustical Measuring Points in Braunschwieg

[a] Name	[b] Ortsteil	[c] Lage zum Flugplatz	[d] Bemerkung
B1	Bienrode	[e] unter S/L-Linie, 1.5 km westl.	meist Starts
B2	Bienrode	[f] 500 seitl. S/L-Linie, 1.5 km westl.	dito
B3	Waggum	[g] unter S/L-Linie, 1.5 km östl.	meist Landungen
B4	Waggum	[h] 500 seitl. S/L-Linie, 1.5 km östl.,	dito
B5	Thune	[i] unter Platzrunde, 4 km nordwestl.	nur Überflüge

Die Entfernungen werden von Startbahnmitte gemessen. B1 liegt im Befragungs-Cluster BS3, B5 im Cluster BST.

Key:
a. name
b. section
c. position in relation to the air field
d. remarks
e. below the S/L line, 1.5 km to the west — mostly take-o
f. 500 to the side of the S/L line, 1.5 km to be west — mostly take-o
g. below the S/L line, 1.5 km to the east — mostly landin
h. 500 to the side of the S/L line, 1.5 km to the east — mostly landin
i. below traffic circuit, 4 km to the northwest — only fly-over

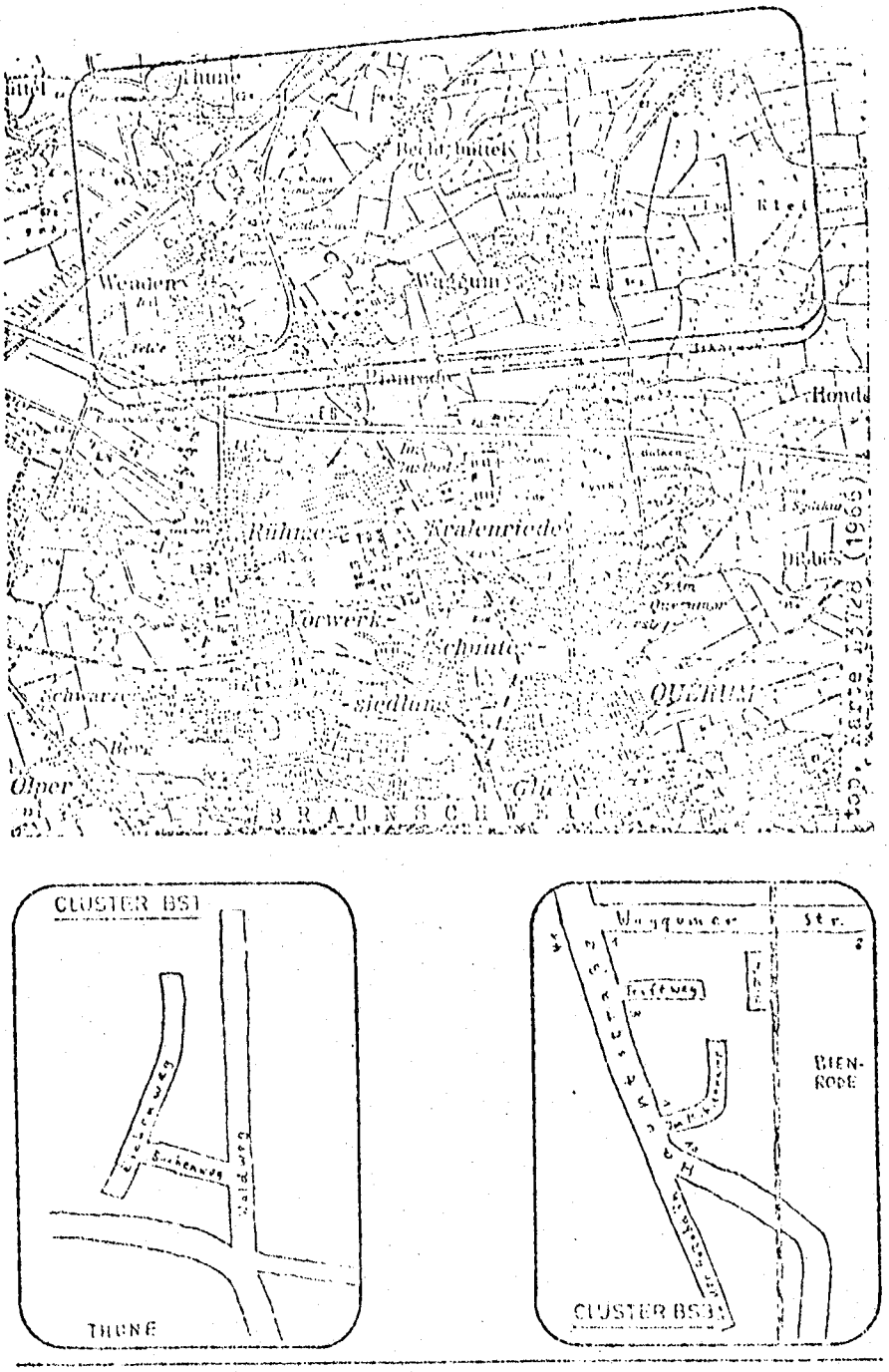


Fig. 3: Maps for the clusters BSB, BST

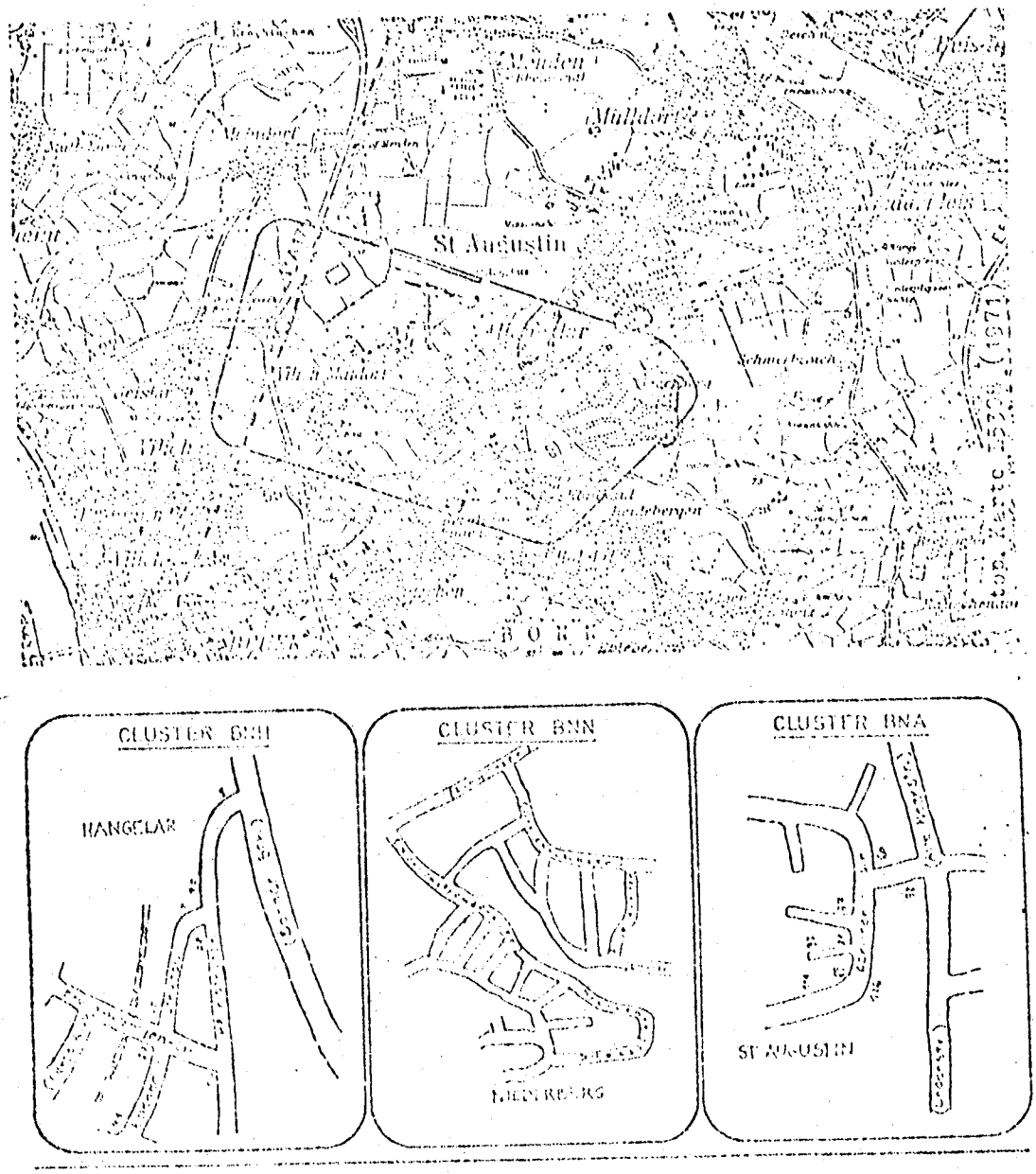
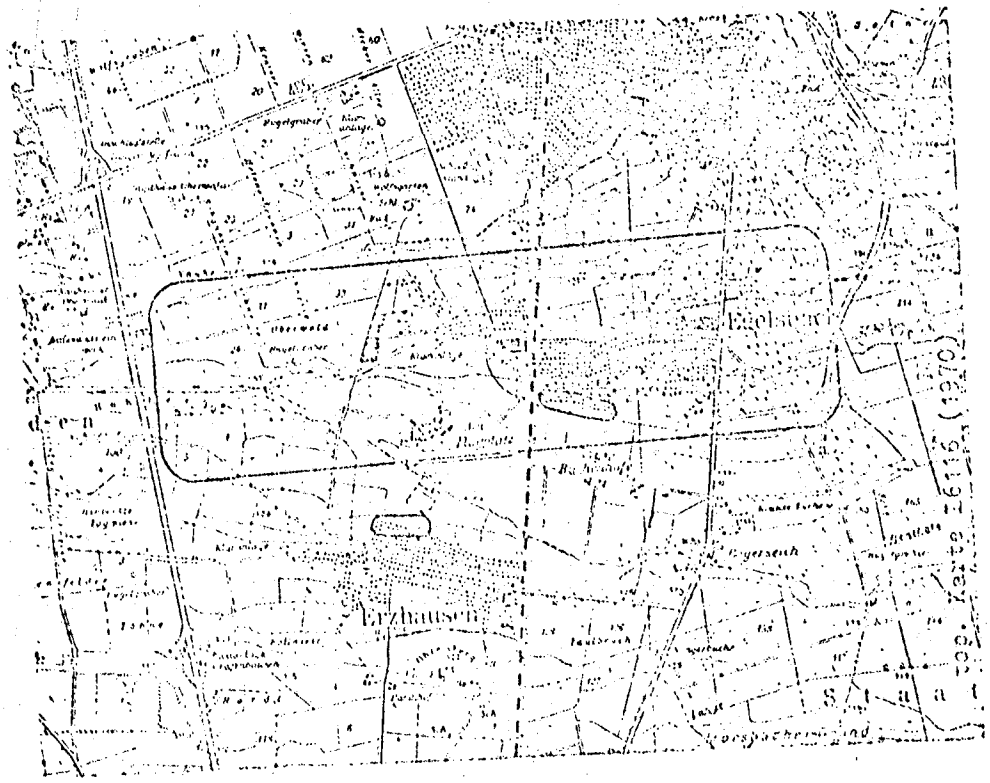


Fig. 4: Maps for the clusters BNH, BNA, BNN



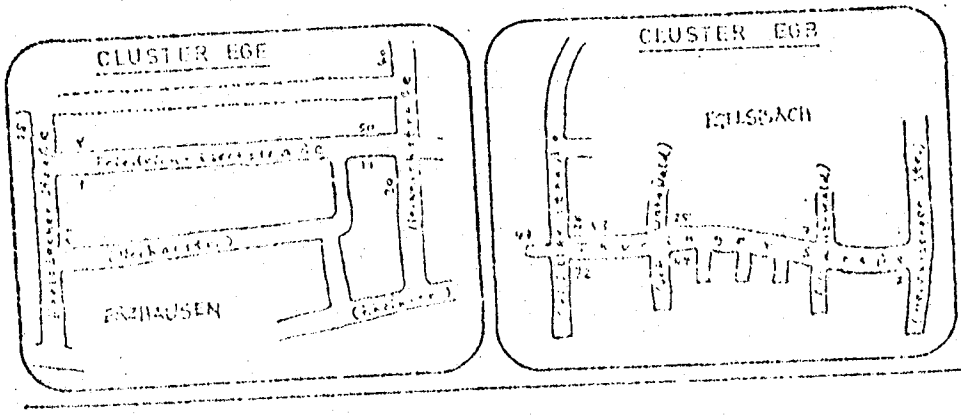


Fig. 5: Maps for the clusters EGB, EGE

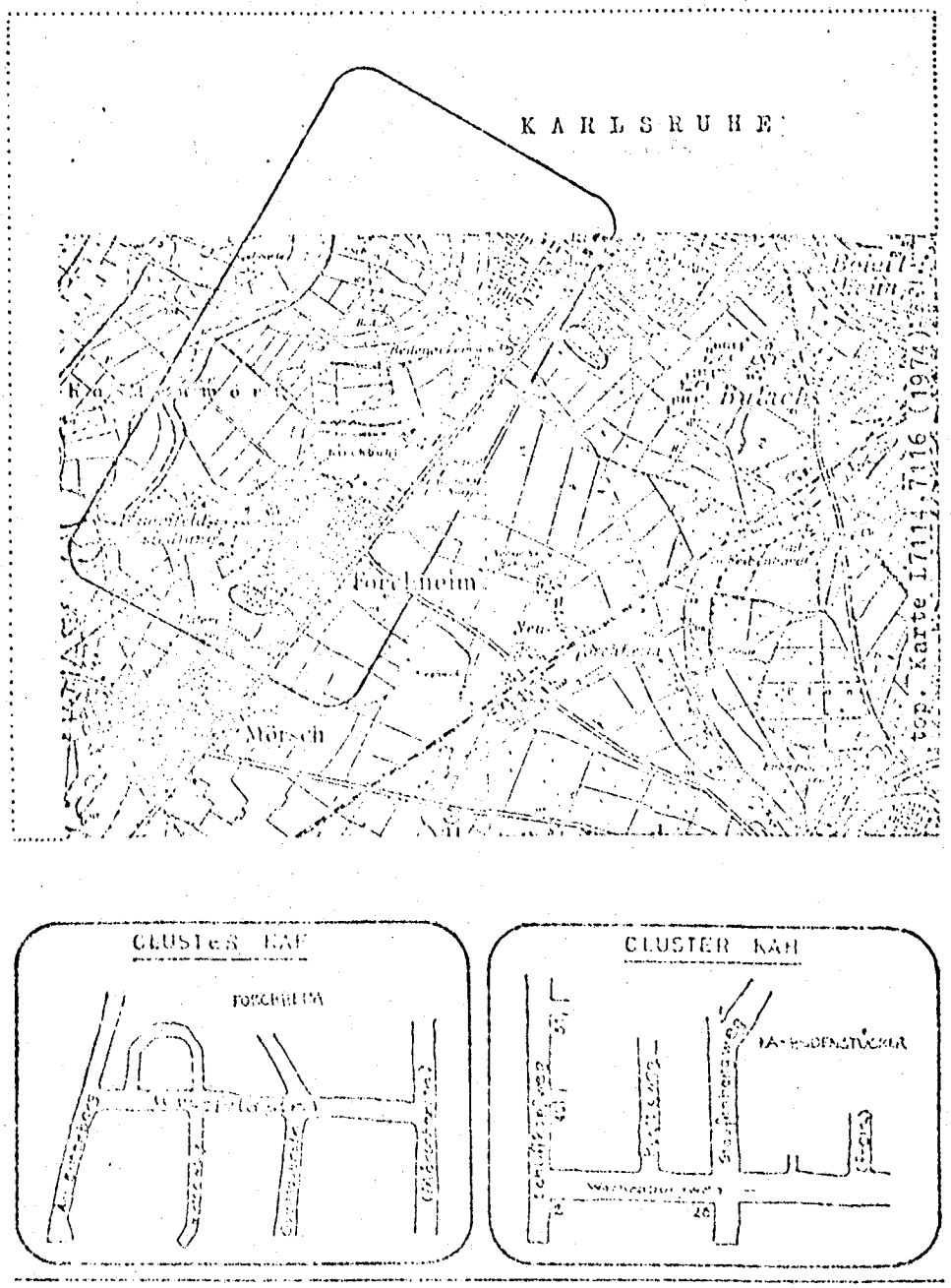


Fig. 6: Maps for the clusters KAH, KAF

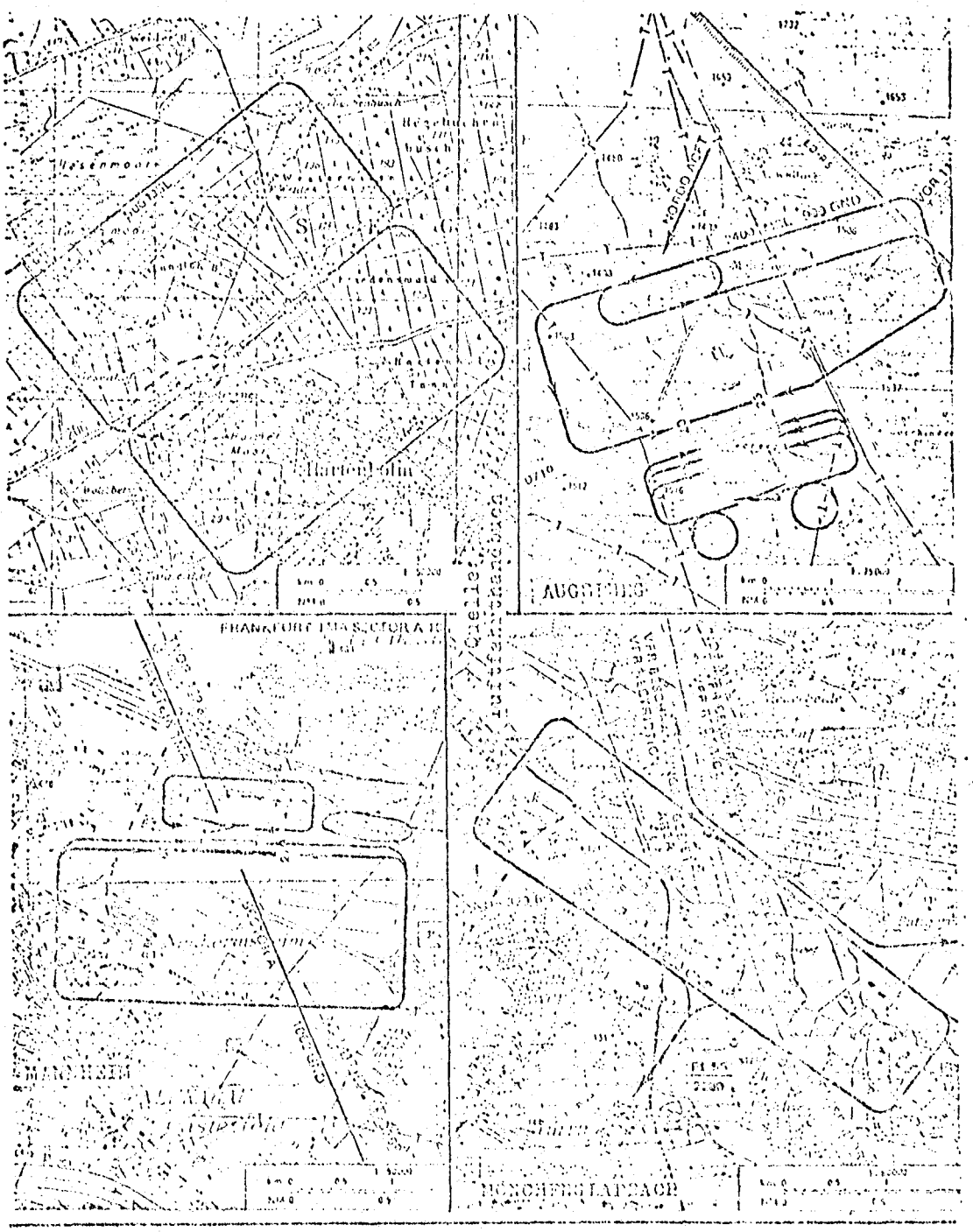


Fig. 7: Maps of the Landing Fields in Hartenholm, as well as Augsburg, Mannheim and Mönchengladbach

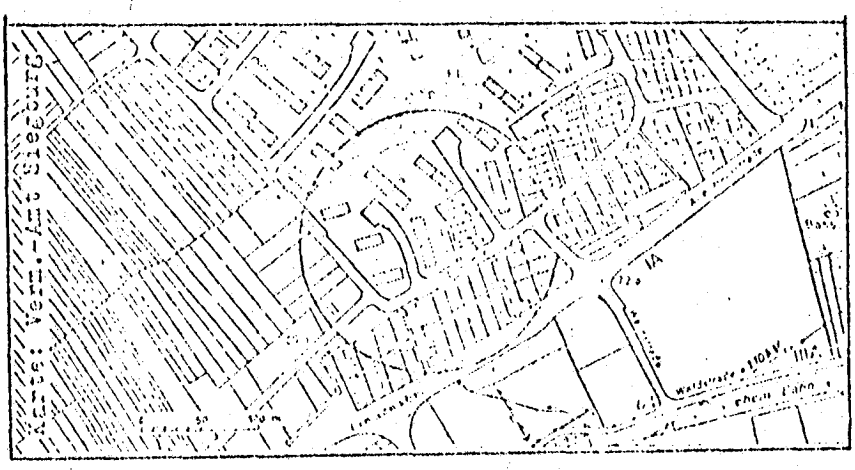


Fig. 3: Map of the cluster BNA (St.-Augustin)

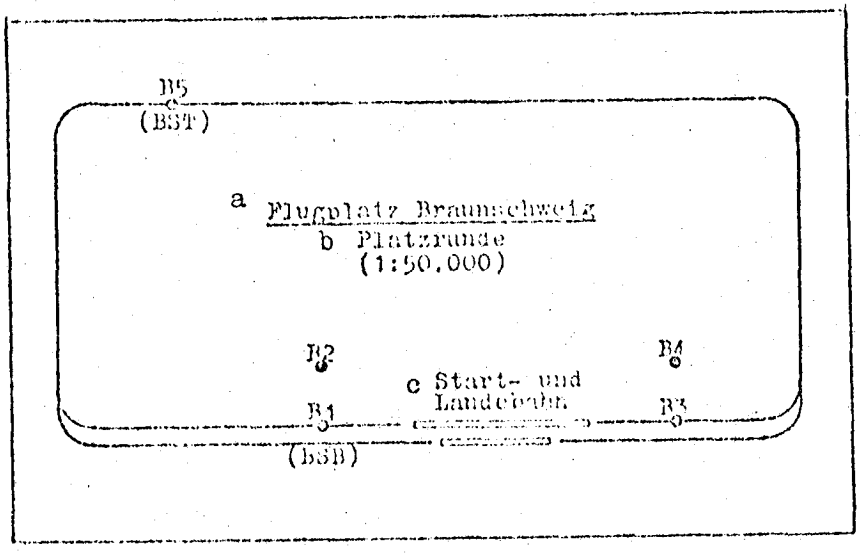


Fig. 9: Map of the acoustical measuring points in BS

Key: a. Air field in Braunschweig
b. Traffic circuit
c. runway

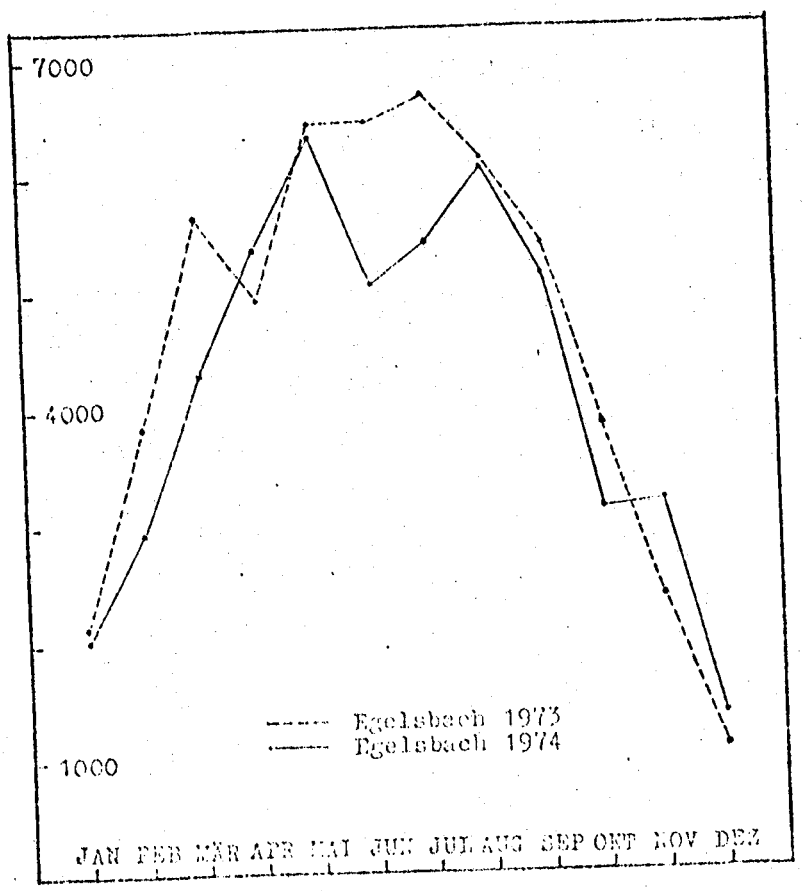


Fig. 10: Monthly Distribution of Take-Offs in Egelsbach.

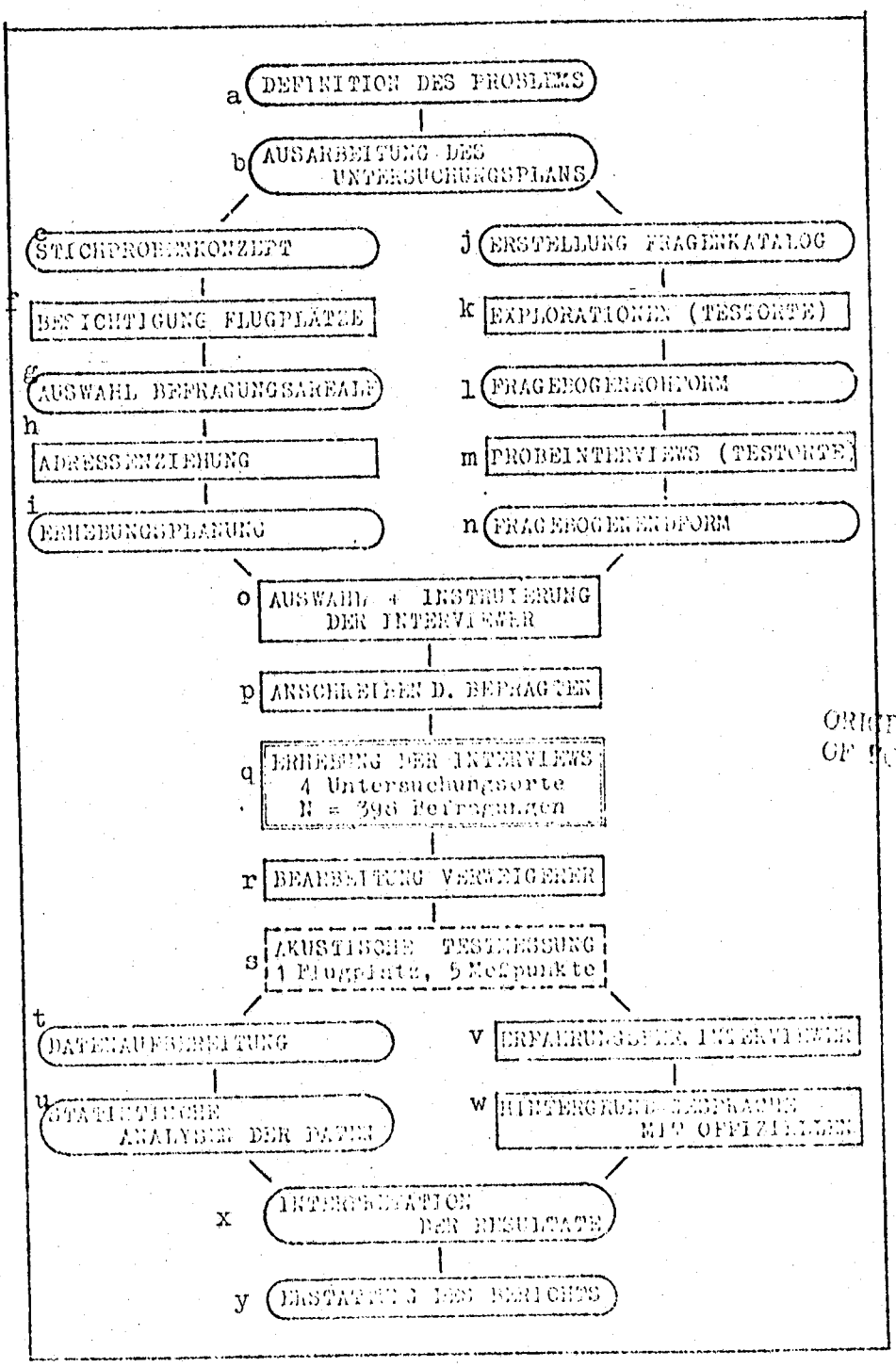


Fig. 11: Diagram on the entire course of the study on noise stemming from sport flights

(see following page for key)

Key to Fig. 11:

a. definition of the problem
b. preparation of the study plan
c. concept of the sample
f. inspecting air fields
g. selection of areas for the interview
h. drawing addresses
i. survey planning
j. preparation of list of questions
k. exploration (in test locations)
l. raw questionnaire
m. sample interviews (in test locations)
n. final form of questionnaire
o. selection and instruction of interviewers
p. contacting the persons to be interviewed
q. gathering the interviews
   4 study locations
   N = 398 interviews
r. processing rejections
s. acoustical test measurements
   1 air field, 5 measuring points
t. data processing
u. statistical analysis of data
v. experience reports of the interviewers
w. background conversations with officials
x. interpretation of the results
y. presentation of the report

4: PREPARATION OF THE QUESTIONNAIRE:

4.1: Contents of the Study:

The subjects for questions resulted, on the one hand, from the results of aircraft noise research at large airports (compare the summary in 2.4) and, on the other hand, from the special questions on the possible limitations of air traffic (compare 2.5).

The main subjects can be compiled as follows:

Table 9: Survey of the Questionnaire Variables:

Reaction variables I - disturbance due to sport flight operations
Contents: disturbed activities (type, extent, time of disturbance), especially communication and recreation.

Reaction variables II - evaluation of the noise problem due to sport flights
Contents: degree of annoyance due to aircraft noise and the (non-)acceptance of flight operations; evaluation of importance.

Reaction variables III - measures for reduction of aircraft noise
Contents: measures undertaken by the affected persons (social, physical); standpoint on limitations in flight operations.

Moderator variables I - living conditions + personal data
Contents: age, sex, dwelling situation (house, garden, neighborhood), income, education, health, etc.

Moderator variables II - attitudes and opinions on noise
Contents: general noise sensitivity, fears for health due to aircraft noise, trust in the responsible officials, etc.

Control variable - data on the interview situation
Contents: behavior of the person interviewed, data on time, etc.

All variables are termed reaction variables here, from which it can be assumed for reasons of subject matter (and according to the results of other studies) that they depend upon the extent of aircraft noise stress. Moderator variables comprise variables, from which a moderating (weakening or intensifying) influence is expected on the disturbance and annoyance due to aircraft noise, but the degree of these factors does not depend upon the intensity of aircraft noise (also compare in this aspect, the graph in figure 14 in 7.4).

The control variables serve for analyzing possible effects of the interview situation on the "actual" subject matter of the study.

In order to gain a direct view about the consequences and the evaluation of sport aircraft noise, about 10 explorations were carried out with persons affected by aircraft noise at a medium-sized sport landing field in Hartenholm (compare figure 7); these conversations and the evaluation of available aircraft noise questionnaires led to the final catalogue of variables.

The variables to be examined then had to be operationalized, i.e. in this case, answers extracted by a well formulated question (compare on this subject table 15 in 6.4); in the case of more complex subjects, frequently a block of interrelated subquestions is required in order to gather data on interesting variables with sufficient certainty.

4.2: Construction of Scales:

Gathering standardized information on attitudes (opinions and values in relation to the social environment), individual questions conceived adhoc are insufficient. Instead, special methods have been developed for this purpose by social-psychology.

In the so-called measurement of attitudes, psychor tric survey instruments are employed applying a scale value for the degree of intensity of the examined attitude in various subjects using a set of statements on defined aspects of the social environment; usually, statements are employed which are claims in the first person, to be answered in various positive or negative degrees by the person being surveyed. (On methods, compare, for example, Edwards, 1957, König, 1969, Hofstätter, 1973).

Scales, especially for the measurement of disturbance and annoyance due to aircraft noise have been developed in almost all aircraft noise studies (compare especially McKennell, 1963, Irle and Rohrmann, 1968, Tracor, 1970, 1972, and others).

For the present study, a series of statement scales and question blocks, were taken from the aircraft noise study of the German Research Association (the development of these is described by Irle and Rohrmann (1968) as well as by

Schümer and Schümer-Kohrs (1974):

-- Satisfaction with the neighborhood (8 subpoints),

-- General noise sensitivity (8 statements),

-- Complaints about health (6 statements),

-- Fears for health due to aircraft noise (4 statements),

-- Consequences of aircraft noise stress (17 subpoints),

-- Disturbance due to aircraft noise (10 statements),

-- Measures undertaken against aircraft noise (12 subpoints),

-- Belief in the effort of responsible persons (4 subpoints).
(Compare on this subject the questionnaire presented in 4.5).

Moreover, for most questions subdivided answer scales are employed, explained numerically and verbally, based on the experience that, on the one hand, quantitative answers are required but on the other hand, many surveyed persons have difficulties with abstract, non-verbal, predetermined answers. The scales employed here, partially developed for the DFG aircraft noise project (compare Irle and Rohrmann, 1968) and partially developed in this study are presented in 4.5 (after the questionnaire); they concern the agreement on statements and other expressions (in five stages) and the evaluation of the intensity degree of a subject matter (partially in stages of five, partially of eleven).

4.3: Structure and testing of the Questionnaire:

The questionnaire is designed in such a way that all questions are carefully formulated and generally provided with fixed answers; the questions are to be read aloud by the interviewer, but the person being surveyed receives all statements and longer question blocks, as well as of course, the answer scales, in the form of a list.

The sequence of the questions should be logically and psychologically correct; especially, the key words "noise", "landing field" and "aircraft noise" should be strictly avoided at the beginning of the questionnaire in order to make spontaneous, unaffected remarks by the persons being surveyed possible (through this method, information on the importance of the problem of aircraft noise results); general variables such as the evaluation of the dwelling situation or the general noise sensitivity are arranged before the aircraft noise questions.

It was possible to take the contents of numerous questions from the questionnaire of the DFG study (presented in Irle and Rohrmann, 1968, as well as in the apendix to the DFG research report on the effects of aircraft noise, 1974), in turn, connected to the previous aircraft noise research (and a corresponding OECD research recommendation of 1963).

Moreover, it had to be taken into consideration in the construction of the questionnaire that the time for the interview was not to exceed 30 minutes, if possible.

The draft of questions was discussed with colleagues, tested for understandability, uniqueness and completeness and tested after revision in test interviews, carried out at the airfield in Hartenholm.

The final questionnaire was designed in such a way that it ensured rapid keying in of the data.

4.4: Presentation of the Questionnaire

The original questionnaire is presented in the following nine pages, followed by the answer scales and lists, not found directly in the questionnaire.

A systematic outline of the subject matter is found in Table 15.

Furthermore, the directions to the interviewer can be seen in the questionnaire, to be dealt with later (in 5.2).

QUESTIONNAIRE "ENVIRONMENTAL CONDITIONS IN RESIDENTIAL AREAS"

Interview Number ___ ___ ___

ATTENTION INTERVIEWER, PLEASE NOTE BEFORE EACH INTERVIEW:

- ALL TEXTS WRITTEN IN CAPITAL LETTERS ARE DIRECTIONS ONLY FOR YOU THE QUESTIONS TO THE SUBJECT ARE PRINTED IN LOWER CASE LETTERS. DO NOT DEVIATE FROM THE TEXT AND SEQUENCE.

- MAKE SURE THAT YOU PRESENT ONLY ONE LIST AT A TIME. THE ANSWER SCALES ARE TO BE EXPLAINED IN SPECIAL DETAIL. EVEN IN ANSWERING LONGER LISTS, THE SUBJECT MUST ALWAYS REMAIN CONSCIOUS OF THE INDIVIDUAL ANSWER POSSIBILITIES.

- ALL ANSWERS ARE ENTERED AS NUMBERS IN THE BOXES TO THE RIGHT. THESE NUMBERS ARE IN PARENTHESIS IN THE QUESTION TEXT OR ARE ON THE ANSWER SCALES. PLEASE USE A PENCIL.

- IF NO PRECISE ANSWER IS GAINED IN SPITE OF REPEATED EXPLANATION, WRITE AN ESTIMATION OF THE ANSWER BESIDE THE BOX.

- EXPRESSIONS BEYOND THE GIVEN ANSWERS ARE TO BE NOTED ON THE OPPOSITE BACKSIDE OF THE PAGE (INSOFAR AS THEY ARE RELATED TO AIRCRAFT NOISE)!

- PRESENT YOUR IDENTIFICATION WHEN CONTACTING THE SUBJECT IN EVERY CASE! AVOID THE WORDS AIRCRAFT NOISE IN EXPLAINING THE GOAL OF THE STUDY! KEEP A COPY OF THE CONTACT LETTER READY.

- ENTER THE INTERVIEW NUMBER ON EACH PAGE AT THE UPPER RIGHT!

0 Hello. My name is ... I am from the university in Mannheim. You received a letter from us, informing you about our scientifi study. This deals with the living conditions of residents in cities and in the country, especially with the environmental conditions in residential areas. Would you now please answer several questions?

UPON REJECTION, PRESENT AN ARGUMENT ALONG THE LINES OF THE CONTACT LETTER.

For example: Your help is very important for us, because the persons have been selected for the survey as a representative sample (one cannot then simply survey other people).

ALWAYS OFFER ANOTHER DATE, IF IT IS USEFUL. AVOID A FINAL REJECTION.

I can assure you that all your answers will be evaluated statistically and without your name.

ENTER DATE AND SUCCESS FOR EACH VISIT HERE:

a Besuch	b Datum	c Zeit	d Erfolg	e Mißerfolg: Grund genau angeben!
1.				
2.				
3.				
4.				
5.				

Key:
a. visit
b. date
c. time
d. success
e. failure: indicate precise reason

CONCLUDE THE CONVERSATION POLITELY IN THE CASE OF A FINAL REJECTION.

/40

01 Could you please tell me first how many years you have already been living here?

01.1	In this city	( )( )
01.2	In this section (.....)	( )( )
01.3	In this house	( )( )

02 Are you or your family roomers (1), renters (2), owners of the apartment (3) or owners of the house (4)? ( )

03 I would like to ask you now how satisfied you are with a number of things, for example with your apartment. PRESENT THE YELLOW SCALE! The yellow answer scale shows you five possibilities for answers: very satisfied (5), rather satisfied (4), moderately satisfied (3), hardly satisfied (2), not satisfied (1). Please simply tell me the answer corresponding to your satisfaction with your dwelling. PRESENT LIST 03 AND GO THROUGH IT (READ ALOUD)! ENTER ANSWERS AS NUMBERS BETWEEN 1 AND 5 TO THE RIGHT. REPEAT EXPLANATION OF THE ANSWER SCALE IF NECESSARY!

03.1	Apartment	( )
03.2	House	( )
03.3	Neighborhood	( )
03.4	Neighbors	( )
03.5	Health conditions in the area	( )
03.6	Quiet in the area	( )
03.7	Recreational possibilities	( )
03.8	The city in general	( )

04 STILL THE YELLOW SCALE!
How would you estimate your present state of health?
How satisfied are you? ( )

05 Will you remain here or are you thinking of moving away? How probable is it that you will move away: not at all (1), probably not (2), perhaps (3), rather probable (4), certain (5)? ( )

*06 IF MOVING IS CONSIDERED:
Why are you considering moving?

06.1 INTERVIEWER: REASON MENTIONED = "noise" (yes=1, no=0) ( )
06.2 NOISE MENTIONED = "aircraft noise" (yes=1, no=0) ( )
06.3 OTHER (INSOFAR AS RELATED TO THE ENVIRONMENT).....

07 Do you have a garden, a terrace (veranda), a balcony? (yes = 1, no = 0)

07.1 garden ( )
07.2 terrace ( )
07.3 balcony ( )

*08 IN CASE OF ONE OF THESE:
How often do you sit outside in the summer time or how often are you lying outside? On approximately how many days in a month ( )( )

*09 WHEN LESS THAN 4 TIMES PER MONTH:
Why are you not outside more often?

09.1 INTERVIEWER: REASON MENTIONED = "noise" (yes=1, no=0) ( )
09.2 NOISE MENTIONED = "aircraft noise" (yes=1, no=0) ( )
09.3 OTHER (INSOFAR AS RELATED TO THE ENVIRONMENT).....

10 Are there any living conditions in this area disturbing to you, which should be altered? (Which?)

10.1 INTERVIEWER: MENTIONED = "noise" (yes=1, no=0) ( )
10.2 NOISE MENTIONED = "aircraft noise" (yes=1, no=0) ( )
10.3 OTHER (INSOFAR AS RELATED TO THE ENVIRONMENT): .....

11 PRESENT LIST 11!
Here several things are listed which sometimes lead to complaints. Please tell me which point applies most closely to you, what is most disturbing (1)! And which comes second? And third? And what leads to the least complaints (6)? Please list these in the order of importance.

FIRST THE ORDER 1, 2, 6. OR ASK FOR 1, 5, 6.

ENTER THE POSITION NUMBER:

11.1	Not enough gardens and parks	( )
11.2	Unfriendly neighbors	( )
11.3	Unpleasant smells	( )
11.4	Too much noise	( )
11.5	Insufficient public transportation	( )
11.6	A lack of shops	( )

12 You have placed noise in the ... position. What type of noise are you thinking of?
..... INTERVIEWER: MENTIONED = "aircraft noise" (yes=1, no=0) ( )

13 PRESENT SCALE A!
How noise sensitive do you consider yourself? Please classify your noise sensitivity on this scale from "not at all" to "extremely"! You may select any classification between 0 and 10; 0 means "not at all", 10 means "maximum noise sensitivity". ( )

14 PRESENT LIST 14 AND THE RED SCALE!
I now have a number of standpoints and opinions, expressed by others on the subject of noise, such as these... PRESENT LIST 14! What do you think about these statements? After each sentence in the list, please tell me to what extent this also applies to you, whether you do not (1), hardly (2), moderately (3), rather (4), or very much (5) agree. Please answer with the aid of the red scale. PRESENT RED SCALE (IF NECESSARY REPEAT THE EXPLANATION); THEN GO THROUGH LIST 14 (READ EACH STATEMENT ALOUD). ATTENTION: TAKE NOTICE OF POSSIBLE MISUNDERSTANDINGS (FOR EXAMPLE IN THE DIRECTION OF THE ANSWER)!

14.1	I become nervous when a dog barks continuously.	( )
14.2	I can only fall asleep when it is really quiet.	( )
14.3	It disturbs me when doors are always slammed.	( )
14.4	I get annoyed when the cars perform a loud honking concert in front of our house.	( )
14.5	The noise of screeching brakes upsets me.	( )
14.6	I don't care how loud other people play their radios.	( )
14.7	I enjoy it when children play loudly and happily with one another.	( )
14.8	Rustling paper is very disturbing to me.	( )

15 PRESENT LIST 15 AND THE RED SCALE!
I would like to come back to health. Several complaints about health are listed here. Please tell me again, to what extent these points apply to you personally. As before, there are five possible answers for you from "applies greatly" to "does not apply" on the red scale.

15.1 Sometimes I have a pain in the heart area. ( )
15.2 I become dizzy at times. ( )
15.3 I suffer with headaches. ( )
15.4 I am rather nervous and jittery. ( )
15.5 I suffer from sleeplessness ( )
15.6 I often feel simply miserable or terrible. ( )

16 PRESENT LIST 16!
People are exposed to a variety of noise sources today. Here on this list you see various causes for noise, also heard within the dwelling. What is actually the most annoying in your area (1)? And second, third? What do you suffer under the least (6)? Please form an order of importance.
FIRST THE POSITIONS 1, 2, 6 OR ASK ABOUT 1, 5, 6!

ENTER THE POSITION NUMBER:
16.1 Construction noise ( )
16.2 Automobile noise ( )
16.3 Radio noise ( )
16.4 Aircraft noise ( )
16.5 Factory noise ( )
16.6 Railroad noise ( )

17 PRESENT SCALE B!
Do you believe that people can adjust to noise in the course of time or do you consider adaptation impossible? Please judge with the aid of this scale how well or how poorly one can adjust to noise according to your opinion! You may select any classification ( )( )

18 Has the disturbance due to aircraft noise increased (1) or decreased (0) in the past years according to your opinion? (REMAINED THE SAME = 0) 18.1 ( )

When did you feel annoyed by the noise of aircraft last: today (1), yesterday (2), within the past 8 days (3), within the past 4 weeks (4), earlier (5), not ever (6)? 18.2 ( )

IN THE CASE OF ANSWER 1-5: What type of aircraft was that? 18.3 ( )

19 PRESENT LIST 19 AND THE YELLOW SCALE!
Several consequences are listed here resulting from noise for the affected residents. Please tell me, using the yellow scale, to what extent such things occur here at your house as a consequence of recreational flight operations: not at all (1), hardly (2), moderately (3), rather (4) or very greatly (5).

19.1 Shaking house and room walls ( )
19.2 Rattling of window panes/dishes ( )
19.3 Interference in radio reception ( )
19.4 Disturbances in listening to records or cassettes ( )

19.5 Interference in the TV picture ( )
19.6 Volume on the radio or television had to be turned up ( )
19.7 One has to speak louder ( )
19.8 Disturbs telephone conversations ( )
19.9 An obstacle to reading or thinking ( )
19.10 Disturbs working ( )
19.11 Prevents relaxation and evening quiet (inside) ( )
19.12 Disturbs leisure time outside ( )
19.13 It startles people ( )
19.14 Prevents falling asleep ( )
19.15 Awakens one at night ( )
19.16 Causes headaches ( )
19.17 Leads to earaches ( )
19.xx Other

20 PRESENT LIST 20!
At what time are you disturbed most greatly by aircraft noise: early in the morning (1), late in the morning (2), during the morning (3), noon-time (4), during the afternoon (5), early evening (6), late evening (7), at night (8)? 20.1 ( )

And when else? ENTER 2 NUMBERS BETWEEN 1 AND 8! 20.2 ( )

21 PRESENT SCALE A!
I have asked you in what manner the recreational aircraft are disturbing. (INTERVIEWER: LOOK AT THE ANSWER TO QUESTION 19!) Now how greatly are you annoyed about recreational aircraft on the whole? Please classify your annoyance again on the scale from "not at all" to "extremely"! 21.1 ( )

22 Here a number of things are listed, about which one may be annoyed. Please imagine you would experience these things. In what situation would you be most annoyed (1)? What would cause you the least annoyance (5)? Please form an order of importance!
ENTER THE ORDER NUMBERS OF ANNOYANCE!

22.1 An argument in the family ( )
22.2 Poor service in shops ( )
22.3 Noise of aircraft ( )
22.4 Difficulties at work ( )
22.5 Poor quality work by craftsmen ( )

23 PRESENT LIST 23 AND RED SCALE!
Here is a list of opinions on the problem of aircraft noise. Do you agree with these attitudes or not? Please again use the red scale!

23.1 I have often been angry about the noise of aircraft. ( )
23.2 Sawing wood loudly disturbs me more than aircraft noise. ( )

23.3 I have often thought of complaining about aircraft noise. ( )
23.4 I have become so accustomed to the aircraft that I hardly hear them anymore. ( )
23.5 I don't exactly die because of aircraft noise, but it does affect my nerves. ( )
23.6 Even loud aircraft have never bothered me. ( )
23.7 The noise of aircraft can spoil my evenings. ( )
23.8 I find it rather interesting to listen to aircraft ( )
23.9 Aircraft noise is so awful that I will gladly move away. ( )
23.10 I feel that many people get more excited about aircraft noise than necessary ( )

24 Are there children in the family under the age of ten? (Yes = 1, No = 0) ( )

25 IF THERE ARE CHILDREN
How do the children react to aircraft?
INTERVIEWER: NOTE ALL DATA, PRESENT QUESTIONS ON THE GIVEN POINTS (Yes = 1, No = 0)

25.1 Disturbs homework ( )
25.2 Are disturbed during sleeping ( )
25.3 Are startled and fearful ( )
25.4 Other reasons... ( )

26 PRESENT LIST 26 AND THE RED SCALE!
Now again a list with opinions. Please tell me whether you agree with these opinions or not!

26.1 Loud aircraft noise is not good for the cardiovascular system. ( )
26.2 One may become annoyed about aircraft noise, but it is not damaging. ( )
26.3 Aircraft noise reduces concentration capabilities ( )
26.4 Aircraft noise causes no permanent damage to health ( )

27 PRESENT YELLOW SCALE!
Do you think that noise due to recreational aircraft is at least in part unnecessary? To what extent do you consider it avoidable? ( )

28 When someone wants to do something against too much aircraft noise, who should do that in your opinion: pilots, airport administration, local officials, government? (WHEREVER APPLICABLE, ENTER A 1 IN THE LEFT HAND BOX COLUMN).

	28	29
28.1 Pilots	( )	( )
28.2 Airport administration	( )	( )
28.3 Local officials	( )	( )
28.4 Government	( )	( )

29 PRESENT YELLOW SCALE!
What do you think about how much these offices make an effort to reduce the disturbance to the population due to aircraft noise? Please answer with the aid of the yellow scale! ASK ABOUT POINTS 1-4, ENTER THE ANSWER CLASSIFICATIONS AT THE RIGHT (see preceding page).

30 PRESENT LIST 30!
Have you ever undertaken any measure especially against aircraft noise? Something from this list? (Yes = 1, No = 0; left-hand box column)

		30	31
30.1	Install double windows	( )	( )
30.2	Sound insulation on doors, walls	( )	( )
30.3	Ventilation and fans	( )	( )
30.4	Ear plugs	( )	( )
30.5	Taking tablets	( )	( )
30.6	Write a letter of complaint	( )	( )
30.7	Place telephone calls to the appropriate office	( )	( )
30.8	Visit an office to place a complaint	( )	( )
30.9	Discuss the subject with neighbors	( )	( )
30.10	Visit a protest	( )	( )
30.11	Sign a petition, or similar action	( )	( )
30.12	Join an antiaircraft noise group	( )	( )
30.xx	Other	( )	

31 STILL LIST 30!
Are you considering undertaking one of these measures (from the list) against aircraft noise? (Yes = 1, No = 0; the right-hand box column) . . . .

32 Have you ever been at the airfield here? (Yes = 1, No = 0) ( )

33 Have you ever flown? (Yes = 1, No = 0) ( )

34 Could you please tell me whether you are involved professionally with the airfield or with aircraft? (Yes = 1, No = 0) ( )

35 PRESENT YELLOW SCALE!
To what extent do you feel that the airfield here and the possibilities offered by it represent an enrichment for this area, an advantage for the community? What do you think of there? 35.1 ( )
35.2 ( )

36 STILL YELLOW SCALE!
What is your personal opinion on recreational flying, how much understanding do you have for this type of leisure activity? ( )

37 PRESENT LIST 37 AND THE RED SCALE!
Here are 5 standpoints on recreational flight operations.
What opinion do you have on this?

37.1 Recreational flying is an egotistical activity: one person flies and hundreds have to suffer under the noise. ( )
37.2 It must be a lot of fun to fly around with a recreational aircraft. ( )
37.3 There is no reason to become annoyed about recreational flight operations. ( )
37.4 Sometimes the sport pilots act like "playboys of the air". ( )
37.5 The recreational pilots have just as much right to exercise their hobby. ( )

38 Do you think that recreational light operations ought to be accepted and tolerated on the whole in spite of aircraft noise? (Yes = 1, No = 0) ( ) /4

39 Occasionally demands have been made to place legal limitations on recreational flight operations in order to counteract the noise stress of the population. Do you support this demand? (Yes = 1, No = 0) ( )

40 Do you feel that recreational flight operations should be banned at certain times, for example noon or Sunday afternoon, or do you consider this unnecessary? (Yes = 1, No = 0) ( )

41 PRESENT LIST 41!
Times are listed here, included by some people in flight ban demands. Which times do you consider this personally desirable? (Yes = 1, No = 0)
NOTE SPECIAL TIMES SEPARATELY:
INTERVIEWER: WRITE DOWN AN EXCLAMATION MARK IN THE CASE OF ESPECIALLY DESIRED TIMES!

41.1 Every day from 1:00 [illegible]. to 3:00 p.m. ( )
41.2 Also from noon to 1:00 p.m. ( )
41.3 At night from 7:00 p.m. to 7:00 a.m. ( )
41.4 Also from 7:00 a.m. to 9:00 a.m. ( )
41.5 Saturdays after 1:00 p.m. ( )
41.6 Sundays after 1:00 p.m. ( )
41.7 All day on Sunday ( )

42 According to your opinion, should fly-overs over defined areas, for example residential areas, be forbidden, or doesn't that appear necessary? (Yes = 1, No = 0) ( )

43 PRESENT LIST 43!
When area limitations or limitations of flight operations in time are considered, who should that apply to? Please state what type of aircraft should be excluded according to your opinion from this list, i.e. should not be limited.
GO THROUGH THE LIST INDIVIDUALLY, ENTER A 1 BY TYPES OF FLIGHTS TO BE EXCEPTED!

43.1	Private recreational flights	( )
43.2	Training flights of flight schools	( )
43.3	Towing starts for gliders	( )
43.4	Flights during recreational flight demonstrations	( )
43.5	Tours and sight-seeing flights (undertaken by flight companies)	( )
43.6	Test flights made by aviation or aircraft companies	( )
43.7	Advertising flights	( )
43.8	Military flights	( )

44 PRESENT LIST 44!
There are four types of aircraft in the next list, which you have certainly heard about at sometime. What type of aircraft do you find most unpleasant in the development of noise? And at what position would you arrange automobile noises in a comparison of unpleasantness?
ASK ABOUT THE TOTAL SERIES AND ENTER THE POSITION NUMBERS (OF GENERAL UNPLEASANTNESS)!

44.1	large passenger machines	( )
44.2	sport aircraft	( )
44.3	pursuit jets	( )
44.4	helicopters	( )
44.5	automobiles	( )

45 Would you take a positive or negative stand about opening the airfield here to larger aircraft? ( )

In finishing the interview I would like to ask a few questions on statistical data:

46 Could you please tell me your age? (YEARS) ( )( )

47 ENTER SEX: MALE = 0, FEMALE = 1 ( )

48 How many people belong to the household in which you live? (CHARACTERISTIC: COMMON KITCHEN) ( )

49 PRESENT LIST 49!
I hope you can understand that we also have to ask about income in order to ensure the statistical comparison of this study with other surveys. We are interested in the net income, i.e. after taxes and legal insurance, for all members of the household

together per month. It is sufficient if you simply mention the appropriate number from the list, but remember for all wage-earners together (49.1) 49.1 ( )

Which number applies to your earnings? (49.2) 49.2 ( )

50 How long did you go to the elementary school? Have you also attended other schools? How many years?
ENTER THE YEARS FOR ALL SCHOOL TYPES ATTENDED!

50.1	Grammar school	( )
50.2	Middle school	( )
50.3	High school	( )
50.4	Occupational schools	( )
50.5	Technical high schools	( )
50.6	Technical university	( )
50.7	University	( )
50.8	.....	( )
50.9	.....	( )

51 Had you heard about this survey before? (Yes = 1, No = 0) ( )

00 Now we have finished. Thank you very much for helping us in our study. Please don't talk about this interview yet, since maybe neighbors or acquaintances belong to the survey persons and of course should not be influenced.

ATTENTION INTERVIEWER: PLEASE FILL OUT 51 TO 55 AND SIGN THE INTERVIEW!

52 ENTER DURATION OF THE INTERVIEW (IN MINUTES)! ( )( )

53 TO WHAT EXTENT WAS THE INTERVIEW DISTURBED BY AUTOMOBILE NOISE (AL) AND AIRCRAFT NOISE (FL)? (YELLOW SCALE) AL ( )
FL ( )

54 HOW GREAT WAS THE READINESS OF THE SUBJECT FOR THE INTERVIEW? (YELLOW SCALE) ( )

55 HOW EASY WAS IT FOR THE SUBJECT TO UNDERSTAND THE INTERVIEW? (YELLOW SCALE) ( )

56 WOULD THE SUBJECT BE READY FOR A FURTHER INTERVIEW? (YELLOW SCALE) ( )

I ENSURE THAT I HAVE CARRIED OUT THE INTERVIEW CORRESPONDING TO THE INSTRUCTIONS AND WITHOUT FALSIFICATION:

SIGNATURE

Presentation of the Answer Scales Belonging to the Questionnaire

--	-	.	+	++
a nicht	b wenig	c mittelmässig	d ziemlich	e sehr
1	2	3	4	5

Yellow Scale

Key:
a. not
b. hardly
c. moderately
d. rather
e. very

--	-	.	+	++
a stimmt nicht	b stimmt wenig	c stimmt mittelmässig	d stimmt ziemlich	e stimmt sehr
1	2	3	4	5

Red Scale

Key:
a. does not apply
b. hardly applies
c. applies moderately
d. applies rather well
e. applies very much

a	überhaupt nicht	0
I		1
II		2
III		3
IIII		4
IIIII		5
IIIIII		6
IIIIIII		7
IIIIIIII		8
IIIIIIIII		9
IIIIIIIIII	außerordentlich	10

Key: a. not at all
b. extremely

a	frühmorgens	(6 - 8)
b	spätmorgens	(8 - 10)
c	vormittags	(10 - 12)
d	mittags	(12 - 15)
e	nachmittags	(15 - 17)
f	frühabends	(17 - 20)
g	spätabends	(20 - 22)
h	nachts	(22 - 6)

Key:
a. early morning
b. late morning
c. morning
d. noontime
e. afternoon
f. early evening
g. late evening
h. nighttime

a	außerordentlich gut	+5
b	sehr gut	+4
c	gut	+3
d	ziemlich gut	+2
e	mehr gut als schlecht	+1
f	mittelmäßig	0
g	mehr schlecht als gut	-1
h	ziemlich schlecht	-2
i	schlecht	-3
j	sehr schlecht	-4
k	außerordentlich schlecht	-5

Key:
a. extremely well
b. very well
c. well
d. rather well
e. more well than not
f. moderately
g. more bad than well
h. rather bad
i. bad
j. very bad
k. extremely bad

49

a Nettoeinkommen
abzüglich Steuern und gesetzlichen Versicherungen

1	4 000 und mehr
2	3 000 - 4 000
3	2 500 - 3 000
4	2 000 - 2 500
5	1 500 - 2 000
6	1 000 - 1 500
7	750 - 1 000
8	500 - 750
9	250 - 500
0	unter 250

b Bitte nennen Sie einfach die zutreffende Ziffer!

Key:
a. net income after subtracting taxes and legal insurance
b. please simply mention the appropriate number!

5: GATHERING THE DATA:

5.1: Interviewers:

The survey was conducted with an interviewer team of our own in order to take direct control of the Survey and instruct the interviewers ourselves. Students of psychology and sociology in the universities at Braunschweig (for Braunschweig and St. Augustin) and Mannheim (for Egelsbach/Erzhausen and Karlsruhe/Forchheim) in higher semesters were employed, in all, 12 students.

The instruction of the interviewers was carried out in 3 steps:

-- Introduction into the objects and discussion of the questionnaire (and the correlated answer scales);

-- Conducting a test interview (in Braunschweig outside of the sample area, or in Mannheim, compare figure 7);

-- Discussion of the experience from the test interview (including the difficulties and faults occuring during the interview).

Payment was partially made on the basis of completed work (with respect to the interviews), partially on an hourly basis (with respect to the discussions etc.), although unsuccessful visits were also paid in order to achieve the most complete processing of addresses possible.

The selected interviewers were accquainted with the special situation in the survey clusters by a tour through the location before beginning the survey.

5.2: Contacting the Surveyed Persons:

The degree to which a sample is representative, of course, is reduced when the number of persons drawn and not surveyed increases. Therefore, an important object was to maintain the rejection and other drop-out rates at the lowest possible level.

In order to achieve the greatest acceptance possible, for the survey, all selected persons received a personal letter before the interview, with Dr. H. Irle, professor for social-psychology at the University in Mannheim, providing his personal and very helpful support (this letter is presented in figure 12).

Figure 12: The Letter to the Persons for the Survey:

UNIVERSITY OF MANNHEIM

Faculty for Social-Sciences,
-- Social Psychology --

Dr. Martin Irle,
Dr. Bernd Rohrmann,

(Address)

(Dear .....),

We request that you help us in a study concerned with the environmental conditions in residential areas. Such work is necessary due to the variety of problems in German cities in order to gain assistance for planning decisions.

Conversations and interviews with residents of various cities also belong to the clarification of the social-scientific questions in such a survey. We would like to make an unprejudiced picture of the living conditions given here; therefore, your participation and aid is important to us.

Since we can survey only a portion of the population here, as in other locations, we have selected a representative cross-section from a scientific standpoint.

You are also in this selection. We therefore request that you tell us your opinion of questions concerning the living conditions in your city, representative for other citizens. We are not concerned in this case about the answers presented by experts, but rather about your own personal view.

The interviewer who will visit you in the next few days and can identify himself as one of our associates is required to be discrete and fill out the surveys anonymously. We will only see the answers of the persons surveyed, but not learn their names.

This study serves exclusively for scientific research and is not one of the usual surveys for commercial purposes; it will be evaluated strictly on statistics.

We will be pleased if you answer a number of questions for our associate. If this is not immediately possible, you may certainly make a later date for the interview.

Please remember that each rejection of an interview reduces the accuracy of our results, because the representative sample is reduced; therefore, we hope you will be willing to participate.

I would like to thank you already for your readiness to participate.

Sincerely,

Signature

Figure 13: The Supplement to the Contact Letter for Persons Rejecting the Interview

WHY WE ARE REQUESTING COOPERATION FOR OUR SURVEY:

We are presently studying "environmental conditions in residential areas" and are conducting discussions and interviews with residents in various locations for this purpose. Only in this manner, can we learn about the views of the citizens and construct an unprejudiced picture of the dwelling situation in certain areas.

Of course, it is not possible for us to survey all residents; however, we cannot merely limit ourselves to contacting only certain groups (for example, only housewives or retired persons, because they are often at home and perhaps have more time for us). Instead, the selection for the surveys must be carried out in such a manner that it is representative. Our interview sample, to which you belong, is also constructed in such a manner that it produces a characteristic cross-section of the population. Especially for this reason, it would be unfortunate, if we could not survey you.

(Each rejection of an interview reduces the accuracy of our results, because we are tied to our first selection).

Another word on anonymity: Since our survey exclusively serves scientific research (and not, for example, commercial purposes), the names of surveyed persons play no role in the evaluation (they are also not noted on our answer sheets). Our only purpose is to gain information on the personal opinions of the citizens.

Therefore, we ask you again to give our interviewer time for a discussion (we will be glad to make a date suitable to you).

The arguments employed (scientific project anonymity, representative sample, free selection of date etc.) become clear in the letter; they were also employed in contacting the person to be surveyed by the interviewer (compare page 1 of the questionnaire in 4.4). Furthermore, all interviewers obtained an identification card.

The actual study goal has been somewhat masked by the formulation "living conditions in residential areas"; this should help avoid possible prejudice and make it possible to observe to what extent the persons surveyed mentioned the subject of aircraft noise spontaneously (for example, in the questions 3, 8, 9, 10, 12).

All addresses were visited until either an interview was attained or the negative result (moved away, away on a trip, rejected etc.) was definite.

In the case of rejections, an attempt was made to deal with the objections and still achieve an interview.

For this purpose, a further letter, composed individually, according to the data of the interviewer, was sent together with a separate explanation of the project (see figure 13) and a new interviewer was employed.

In this manner, approximately half of the original rejections were overcome the second time.

The party commissioning the study is never mentioned to the person being surveyed (if necessary, the interviewers refer to the study manager).

5.3: Time schedulefor the Interviews:

The first three weeks in April were available as the time period for the survey.

The interviewers were deployed in such a manner that the Braunschweiger interviewers were first employed in the clusters there (begin on April 1), then in St. Augustin (begin on April 4) and then distributed in both cities; the Mannheimer interviewers began in Egelsbach/Erzhausen (April 2), then changed to Karlsruhe/Forchheim (April 5) and were then also employed alternately.

Processing of the rejection addresses began after completion of the first week. The interviewers received a street map of the cluster and the address sheet for a partial area; they reported the processing of addresses regularly to the central survey management, especially giving precise information on the drop-out reasons and possible information for a second interviewer.

The interviewers worked according to the instruction mainly with previously arranged dates; the times were between 8:00 a.m. and 11:00 p.m., with more than half of the interviews conducted between 3:00 p.m. and 8:00 p.m. the average duration was about 38 minutes.

It was possible to complete most addresses in the first 10 days, but processing the rejections was only completed after 3 weeks in order to maintain the smallest possible rejection rate and survey some persons, who were first away on trips.

5.4: Statistics on persons Surveyed:

A total of 398 interviews resulted from the 504 addresses handed out.

The different reasons for mistaken addresses and interview drop-outs are listed in table 10: the complete interview statistic is compiled in table 11 for 9 clusters and the total sample.

With 7% mistaken addresses (calculated in table 7: 10%; the official files were more up-to-date than assumed) 470 persons remained for the survey, of whom 85% were surveyed. This is clearly more than the calculated value of 75% and is therefore a confirmation for the relatively great amount of work put into the survey.

(for comparison: in the two studies in London (McKennell, 1963: MIL Research Ltd 1971) 79% were interviewed in each case, in the Munich DFG study (Schümer and Schümer-Kohrs, 1974) 77% were interviewed).

The most important drop-out reasons were: "away on a trip" (partly because of the Easter vacation) and rejections.

The rejections were chiefly based on lack of interest or time, on the whole, however, they appeared largely irrational and could not often be removed by the greatest amount of work with specific arguements related to the individual. In Bienrode (BSB) and Erzhausen (EGE), the rejection rate was somewhat higher. In both cases the population consisted mainly in villagers who had lived there for a long time and were mistrustful (compare duration of residence and level of income in table 16).

Even when the interview drop-outs and the mistaken addresses are added together a success rate result of almost 4/5.

Table 12 shows in supplement that the comparison of drawn and surveyed sample does not produce deviations in any case of more than 2% according to age and sex (the slight under-representation of the younger people may be based on the fact that they are more often away from home and are therefore more difficult for the interviewers to reach).

On the whole, the final sample can also be considered sufficiently representative.

5.5: Supplementary Studies:

A number of discussions and conversations was to provide supplementary information on the problem of noise from sport aircraft. The following persons were interviewed:

-- The mayor of Egelsbach, Dr. G. Simon (also on the board of the airport company and member of the aircraft noise commission for Egelsbach);

-- U. Eppendahl, engineer, as speaker for the Egelsbacher citizen initiative against aircraft noise;

-- F. Fluch (engineer in Egelsbach) from the planning department of the airport company in Frankfurt (concerned with Egelsbacher planning);

-- Mr. K. Olscheffsky, speaker for the action against the airfield in Karlsruhe-Heidenstücker (working together with H.H. Wuestenhagen, Federal Chairman of the Association of Citizen Initiatives for Environmental Protection);

-- H.-O. Finke, engineer, from the Physical-Technical Federal Institute in Braunschweig;

-- Mr. H. Thienemann, manager of the Nordflug Company and flight directed in Hartenholm.

All of the persons mentioned reside in the survey area or directly in the vicinity.

Since the interviewers also received numerous additional pieces of information beyond the defined survey, an extensive questionnaire on their experience was given to them to be answered after the conclusion of the survey.

Both sources of information proved to be helpful for interpreting and evaluating the data.

5.6: Noise Measurements:

After the interviews, noise measurements were carried out at the selected measurement points (compare 3.5). A total of 377 fly-overs were measured in the course of aprox. 10 measurement times, (chiefly on weekends). These were recorded on tape (to be registered at a later time in the laboratory) and the type (type of machine, possibly glider towing flight, etc.) and direction were also noted. The results are found in section 7.2.

Table 10: List of Reasons for Interview Drop-Outs /54

Erroneous Addresses (/):

S deceased
Z moved away
Y foreigner (no knowledge of German language)
F incorrect address

Interview Drop-Outs (-):

W refusal
R away on a trip
N never found at home (in spite of repeated attempts)
H another member of the household was already interviewed
E time allotted for the study had ended.

Table 11: Interview Statistics for Clusters and Entire Sample

	S_0	S	Z	Y	F	Σ/	S_I	W	R	N	U	H	E	Σ-	S_+	$\frac{S_I}{S_0}$	$\frac{S_+}{S_I}$
BSB	53	0	2	0	0	2	51	5	3	1	2	1	0	15	39	.96	.76
BST	60	1	6	0	0	7	53	3	2	1	0	0	0	10	47	.88	.89
ΣBS	113	1	8	0	0	9	104	8	5	2	2	1	0	25	86	.92	.83
BNH	53	0	3	0	0	3	50	1	3	0	1	0	2	7	43	.94	.86
BNA	55	0	3	0	0	3	52	2	4	0	0	0	0	6	46	.95	.88
BNN	57	0	5	0	0	5	52	1	5	1	0	0	3	10	42	.91	.81
ΣBN	165	0	11	0	0	11	154	4	12	1	1	0	5	23	131	.93	.85
EGB	58	0	6	0	0	6	52	1	1	4	1	0	2	9	43	.89	.83
EGE	55	0	2	0	1	3	52	3	2	2	3	0	1	11	41	.95	.79
ΣEG	113	0	8	0	1	9	104	4	3	6	4	0	3	20	84	.92	.81
KAH	55	1	1	0	0	2	53	4	0	1	0	0	1	6	47	.88	.87
KAF	58	0	2	1	0	3	55	2	2	0	0	0	1	5	50	.91	.91
ΣKA	113	1	3	1	0	5	108	6	2	1	0	0	2	11	97	.90	.90
ΣTOT	504	2	30	1	1	34	470	22	22	10	7	1	10	79	398	.93	.85

a
S_0 bezeichnet die ausgegebenen, S_I die prinzipiell befragbaren, S_+ die tatsächlich befragten Adressen. Zu den Clustern vgl. Tab. 6.

Key: a. S_0 designates the addresses which were handed out,
S_I the persons who can be interviewed in principle,
S_+ the actually employed addresses. On the clusters, compare table 6.

Table 12: Comparison of the planned and the actual sample

a Geplant/ erzielt	b Jahrgänge 06-13	14-23	24-33	34-43	44-53	54-57	c Summe
d absolut:							
e Männer:	22/19	38/32	66/58	60/49	46/27	23/13	255/198
f Frauen:	27/18	38/32	47/43	69/58	47/35	21/14	247/200
c Summe	49/37	76/64	113/101	129/107	93/62	44/27	504/398
g relativ:							
e Männer	4/ 5	8/ 8	13/15	12/12	9/ 7	5/ 3	51/49
f Frauen	5/ 4	8/ 8	10/10	13/15	9/ 9	4/ 4	49/51
c Summe	9/ 9	16/16	23/25	25/27	18/16	9/ 7	100/100

h "Geplant" bezieht sich auf 504 zur Befragung ausgegebene Adressen; "erzielt" betrifft die durchgeführten 398 Interviews (vgl. Tab. 11).

Key:
a. planned/attained
b. age
c. total
d. absolute
e. men
f. women
g. relative
h. "planned" refers to the 504 addresses handed out for interviews;"attained" concerns the 398 interviews which were conducted (compare Table 11).

6: PROCESSING THE STATISTICS: /57

6.1: Punching the Data:

All questionnaires were checked for completeness and logical correctness (for example in branching questions or in the case of position numbers); furthermore, systems of categories for some open questions had to be developed (18.3, 25.4, 35.2).

There were gaps in the data in some cases (question was forgotten by the interviewer or refused by the person being surveyed); sometimes the average value of the individual cluster was inserted here as estimated value in order to have a co plete data set for certain statistical analyses.

After punching and checking the punch-cards, it was possible to evaluate the data gathered statistically.

6.2: Methods of Statistical Evaluation:

The data was evaluated by computer programs (compare table 13) at the computer center in Hamburg.

The concept for evaluation was directed to multivariables and correlation statistics, i.e.. the statistical analyses were to reflect the total relationship of all variables examined to the greatest possible extent. This approach resulted from the interpretation of reactions to aircraft noise (and the co-determination by moderators) as a complex interdependent structure (as figures 2 or 14 demonstrate).

The most important statistical procedures employed are explained here briefly for those not accquainted with the subject: /58

Multiple Correlation: Relationship between several "predictor" variables, on the one hand, and a "criterium" variable (quantity to be determined), on the other hand; the predictors are connected in a linear combination in such a fashion that the closest possible connection with the criterium results (maximum =1.); the beta weights express the contribution to prediction.

Factor Analysis: Computer procedure, defining a reduced system of statistically independent ("orthogonal") characteristics, the "factors" (dimensions" or "axes" of an hypothetical variable closed space) from a number of covarying (and therefor partially redundant) variables; the correlation to each of the factors (the "load") can be determined for each of the variables; the system of axes can be subjected to a rotation in order to obtain the clearest possible loads on the variables.

Discrimination Analysis: This deals with a multivariant procedure, noted, in which the individual variables examined are calculated with such weights in a combined quantity ("discrimination function") that the difference between the compared groups becomes a statistical maximum; the weights are given as loads or beta weights.

These procedures are based on correlations, i.e. measured numbers (r) for the relationship between two value series, X and Y with positive values (up to +1) indicating a relationship in the same direction (Y increases when X increases) negative values (up to -1) indicating a relationship in opposite directions, (Y decreases when X increases); values around 0 signify no relationship. Correlations are significant (statistically reliable) with N=298 above r=0.10) (probability of coincidence "alpha" < 5%) or 0.12 (alpha < 1%).

The main purpose of the evaluation was to determine statistical characteristics for the extent of disturbance and annoyance due to the noise of sport aircraft; moreover, the relationships between the study variables were to be analyzed (factor analysis), the effect of the moderators on the aircraft noise reactions made visible (multiple regression) and the differences between certain groups of affected persons demonstrated (discrimination analysis).

6.3: Formation of Characteristics:

Individual data, constructed as an interconnected block (for example, the statements for an attitude scale, compare 4.2) or highly correlated to one another, are usually collected together to a total measure (summation or averaging of the answer values poled in the same direction). A total of 14 such quantities has been defined (compare table 14).

The formation of characteristic values was preceeded by factor analyses of the question blocks; sufficiently correlated, unifactorial questions of homogeneous content were grouped together.

6.4: Description of the Data Set:

All 81 questionnaire variables have been compiled in table 15 (two pages), corresponding in content to table 9. (For the actual wording of the question, please refer to the original questionnaire presented in 4.4).

In this case, simultaneously "abbreviations" of 3 letters have been introduced for the variables frequently employed in the result tables of the next chapter (reference is made to table 15 whereever necessary).

In addition to the answer scales, the average values (N=398) and the standard deviations (in-so-far as they have been calculated) or, in the case of yes/no questions, the resulting percentual values have also been supplied.

The intercorrelation matrix for 48 variables is also given in table 16. These are the Pearson-rv Bravais product-moment correlation coefficients (r) or, in-so-far as 0/1 data are calculated, point biserial correlations (r_{pbi}) or point-for-field correlations (phi). These two tables provide a first survey on the results.

Table 13: List of the Computer Programs Employed

(1) Counter program (counting by columns) of the Computer Center in Hamburg.

(2) SPSS Program System (Statistical Package for the Social Sciences): treatment of data, statistical characteristics, multiple regression; literature: Nie, 1970; Brunn & Lapp, 1973.

(3) Fortran Program System according to D.J. Veldman in the adaptation of R. Guski, Psychological Institute of the Free University in Berlin: correlation, factor analysis, discriminance analysis; literature: Veldman, 1967.

Table 14: List of Comprehensive Variable Characteristics

[a]Frage	[b]Kürzel	items	[a]Frage	[b]Kürzel	items
19	FFK	3,4,5,6,7,8	03	ZWG	3,5,6,7
19	FFR	9,11,12,14,15	15	GBL	1,2,3,4,5,6
19	FFP	1,2	26	GBF	1,2,3,4
19	FFS	16,17	14	LEG	1,2,3,4,5,8
23	SFL	1,3,4,5,6,7,10	29	GBV	1,2,3,4
37	BSF	1,3,4,5			
30	LMF	1,2,3,4,5	48	MHE	EDH:PTH
30	SMF	6,7,8,10,11,12	49		

[c]Vgl. Tab. 15. - "Items" verweist auf die einbezogenen Unterpunkte der Frage.

Key: a. question
b. abbreviation
c. compare Table 15. - "Items" refers to the subpoints included in the question.

Table 15: List and description of all questionnaire variables

Tab. 15: LISTE UND BESCHREIBUNG ALLER FRAGEBOGENVARIABLEN.

a Nr.,	b Kürzel,	c Name der Frage	d Unterpunkte	e Skala	X	s
		f R e a k t i o n s v a r i a b l e n I: Gestörtheit durch Sportflugbetrieb:				
g 10	SHF	Spontan-Nennung Fluglärm	1	0/1	45%	/
12		Spontan-Nennung Fluglärm zu Fr.11	1	0/1	70%	/
19	FFK	Fluglärm Folgen für Kommunikation	6	1.0-5.0	1.58	0.72
19	FFR	Fluglärm-Folgen für Regeneration	5	1.0-5.0	1.92	0.86
19	FFP	Fluglärm-Folgen physikalischen 17	2	1.0-5.0	1.27	0.55
19	FFS	Fluglärm-Folgen: Schmerzen	2	1.0-5.0	1.16	0.47
19		Erschrecken wegen Flugzeugen	1	1-5	1.80	
20		FL-Störung: Tageszeiten	2	---	/	/
18	ZSF	Zunahme Störung Fluglärm	1	0/1	59%	/
10	KAF	Kürzlicher Ärger Fluglärm	1	0/1	42%	/
25*		Neg.Reaktion v. Kindern auf FL	3	0/1	18%	/
		h R e a k t i o n s v a r i a b l e n II: Bewertung des Sportfluglärmproblems:				
i 21	SFA	Sportfluglärm-Ärger (global)	1	0-10	3.78	3.28
23	SFL	Störbarkeit Fluglärm	10/7	1.0-5.0	3.10	1.19
23	SFG	Flugzeuggeräusch interessant	1	1-5	1.85	1.19
38	ASF	Akzeptierung Sport-Fliegerei	1	0/1	83%	/
37	BSF	Bewertung Sportfliegerei (neg.)	5/4	1.0-5.0	2.74	1.02
37	BS2	Spaß am Fliegen	1	1-5	4.14	1.10
36	VSF	Verständnis Sport-Fliegerei	1	1-5	3.58	1.13
44		Rangreihe Fluglärmarten	5	(R)	/	/
44	RFS	Rangr.Fluglärmarten;Rang Sportfl.	1	1-5	3.6	-
16		Rangreihe Lärmarten	6	(R)	/	/
16	RLF	Rangreihe Lärmarten;Rang Fluglärm	1	1-6	1.6	-
22		Rangreihe Ärgernisse	5	(R)	/	/
22	RAF	Rangreihe Ärgernisse;Rang Fluglärm	1	1-5	3.3	-
35	FVG	Flugplatz Vorteil der Gegend	1	1-5	2.18	1.30
35		Gründe für Flugplatz	1	---	-	-
		j R e a k t i o n s v a r i a b l e n III: Maßnahmen zur Fluglärmminderung				
k 30	PMP	Physikal.Maßnahmen gegen FL 13	5	0.0-1.0	19%	-
30	SMF	Soziale Maßnahmen gegen FL	6	0.0-1.0	42%	-
31		Erwogene soziale Maßnahmen geg.FL	5	0/1	-	
31		Erwogene physik. Maßnahmen geg.FL	6	0/1	-	
30	PFF	Petition für Flugplatz unterzeichn.	1	0/1	2%	/
09*		Kein Draußen-Sitzen wegen FL	1	0/1	-	/
06*		Umzugsintention wegen Fluglärm	1	0/1	2%	/
39	GBS	Gesetzl.Beschränk.Sportfliegerei	1	0/1	73%	/
28		Erwartete FL-Verantwortlichkeiten	4	0/1	-	/
42	FBR	Forderung nach Flugroutenbeschränk.	1	0/1	73%	/
40	ZBF	Zeitl.Beschränkung Flugverkehr	1	0/1	78%	/
41		Gewünschte Flugverbotszeiten	7	0/1	-	/
41	FMF	Forderung auf Mittags-Flugverbot	1	0/1	57%	/
41	FWF	Forderung auf Wochenend-Flugverbot	1	0/1	28%	/
43		Nicht zu beschränk. Art von Flügen	8	0/1	-	/
45	ZGF	Zulassung größerer Fluggeugtypen	1	0/1	8%	/

Forts. k.w.

(See page 64 for key)

6.4 Table 15 - continued

Forts. Tab.

a Nr.,	b Kürzel,	c Name der Frage	d Unterpunkte	e Skala	X	s
		l Moderatorvariablen I: Lebensbedingungen und persönliche Daten:				
m 47	GDB	Geschlecht des Befragten (♀=1)	1	0/1	51%	/
46	ADB	Alter des Befragten	1	18-70	41.58	13.03
48	PIH	Personen im Haushalt	1	1-12	3.48	1.30
49	EDB	Einkommen des Befragten	1	(DM)	~1320	-
49	EIH	Einkommen der Haushalts	1	(DM)	~2700	-
49	MHE	Mittleres Haushaltseink.(EIH/PIH)	2	(DM)	~ 770	-
50	SBB	Schulbildung des Befragten	1	1-24	10.44	3.31
02	EWH	Eigentümer Wohnung/Haus	1	0/1	58%	/
07	BEG	Besitz eigener Garten	1	0/1	72%	/
07	BTB	Besitz Terasse oder Balkon	2	0/1	80%	/
08*		Häufigkeit Draußen-Sitzen (Tage)	1	1-30	~17	-
05	WWZ	Wahrscheinlichkeit Weg-Ziehen	1	1-5	2.04	0.07
01	WDO	Wohn-Dauer Ort	1	0-70	12.35	13.45
01	WDH	Wohn-Dauer Haus	1	0-70	9.38	9.60
03	ZWG	Zufriedenheit Wohn-Gegend	8/4	1.0-5.0	3.73	0.86
04	DGZ	Derzeitiger Gesundheits-Zustand	1	1-5	3.61	1.12
15	GBL	Gesundheitliche Beschwerdenliste	6/6	1.0-5.0	2.15	0.91
		n Moderatorvariablen II: Lärm-bezogene Meinungen und Einstellungen:				
o 26	GBF	Gesundheitl.Befürchtungen weg.FL	4/4	1.0-5.0	3.53	0.98
14	LEG	Lärmempfindlichkeit (generell)	6/6	1.0-5.0	2.94	0.65
13	SEL	Selbst-Einschätz.Lärmempfindl.k.	1	0-10	4.82	2.53
17	SEG	Selbst-Einschätz.Gewöhnbark.Lärm	1	0-10	4.90	2.70
11		Rangreihe Lebensbedingungen	6	(R)	/	/
11	RLL	Rangreihe Leb.bed.; Rang Lärm	1	1-6	2.6	-
27	MFL	Meidbarkeit Fluglärm	1	1-5	3.0	1.23
29	GBV	Glaube an Berufen Verantwortl.	4/4	1.0-5.0	2.42	0.77
32	PKF	Persönliche Kenntnis Flugplatz	1	0/1	89%	/
33	PEF	Persönliche Erfahrung Fliegen	1	0/1	48%	/
34	BBF	Beruflicher Bezug Flugplatz	1	0/1	7%	/
		p Kontrollvariablen: Daten zur Interview-Situation:				
q 54	BBI	Bereitschaft des Befragten z.Int.	1	1-5	4.05	0.98
55		Interviewverständnis des Befragten	1	1-5	3.83	1.05
56	BWB	Bereitschaft zu weiterer Befragung	1	1-5	3.82	1.11
53		Interviewstörung durch Fluglärm	1	1-5	1.64	1.01
51		Vorinformiert von Umfrage	1	0/1	14%	/
52		Interviewdauer	1	(Min)	38.3	10.56
---		Tag der Befragung	1	1-24	~7	-
---		Tageszeit der Befragung	1	8-23	-	-
---		Name des Interviewers	1	---	-	-
---		Zunächst verweigert	1	0/1	5%	/
---		Cluster des Befragten	1	---	-	-

r die Nummern verweisen auf den Fragebogen, der in Abschn. 4.4 wiedergegeben ist. - Die unterstrichene Anzahl von Unterpunkten wurde zu einer zusammenfassenden Kennwert (vgl. 6.3) verarbeitet. - Mittelwert ($\bar{x}$) und Standardabweichung (s) sind für die Gesamtstichprobe (N = 398) bestimmt. *: Frage ging nicht an alle.

(See pages 64 and 65 for key)

Key to Table 15:

a. No.
b. abbreviation
c. name of the question
d. subpoints
e. scale
f. Reaction Variables I: disturbance due to sport aircraft

a.	b.	c.
g. 10	SNF	spontaneous mentioning of aircraft noise
12		spontaneous mentioning of aircraft noise (question 11)
19	FFK	consequences of aircraft noise for communication
19	FFR	consequences of aircraft noise for recreation
19	FFP	physical consequences of aircraft noise
19	FFS	consequences of aircraft noise: pain
19		fright due to aircraft
20		aircraft noise disturbance: time of day
18	ASF	increase in disturbance due to aircraft noise
10	KAF	recent annoyance due to aircraft noise
25		negative reaction of children to aircraft noise

h. Reaction Variables II: evaluation of the noise problem due to sport aircraft

i. 21	SFA	(global) annoyance due to noise of sport aircraft
23	SFL	disturbance due to aircraft noise
23	SFS	listening to aircraft is interesting
38	ASF	acceptance of recreation flying
37	BSF	evaluation of recreational flying (neg.)
37	BS2	enjoyment of flying
36	VSF	understanding of recreational flying
44		importance of types of aircraft noise
44	RFS	importance of types of aircraft noise: importance of sport aircraft
16		importance of noise types
16	RLF	importance of noise types; placement of aircraft noise
22		importance of annoyance
22	RAF	importance of annoyance; placement of aircraft noise
35	FVG	air field as advantage for the area
35		reasons for the air field

j. Reaction Variables III: measures for reducing aircraft noise

k. 30	PMF	physical measures against aircraft noise
30	SMF	social measures against aircraft noise
31		social measures considered against aircraft noise
31		physical measures considered against aircraft noise
30	PPF	signing a petition for the air field
09		not sitting outside because of aircraft noise
06		moving away intended because of aircraft noise
39	GBS	legal limitations to sport flying
28		expected aircraft noise responsibilities
42	FBR	demand for limitations to flight routes
40	ZBF	limitations in time for flight traffic
41		desired times for flight banns
41	FNF	demand for bann in early afternoon
41	FWF	demand for week-end flight bann
43		type of flights not to be limited
45	ZGF	permit for larger aircraft types

Key to Table 15 continued:

l. Moderator Variables I: living conditions and personal data

m.

47	GDB	sex of person interviewed
46	ADB	age of person interviewed
48	PIH	persons in the household
49	EDB	income of person interviewed
49	EDH	income of the household
49	MHE	average household income (EDH/PIH)
50	SBB	education of the person interviewed
02	EWH	owner of the apartment/house
07	BEG	own a garden
07	BTB	own terrace or balcony
08		frequency of sitting outside (in days)
05	WWZ	probability of moving away
01	WDO	duration of living in the community
01	WDH	duration of living in the house
03	ZWG	satisfaction with the neighborhood
04	DGZ	present condition of health
15	GBL	list of complaints about health

n. Moderator Variables II: attitudes and opinions related to noise

o.

26	GBF	fear for health due to noise
14	LEG	(general) noise sensitivity
13	SEL	individual estimation of noise sensitivity
17	SEG	individual estimation of adaptability to noise
11		importance of living conditions
11	RLL	importance of living conditions: placement of noise
27	MFL	avoidability of aircraft noise
29	GBV	Belief in the efforts of responsible persons
32	PKF	personal knowledge of the air field
33	PEF	personal experience with flying
34	BBF	work related to the air field

p. Control Variables: data on the interview situation

q.

54	BBI	readiness of the person to be interviewed
55		understanding for interview on part of person interviewed
56	BWB	readiness for further survey
53		disruption to interview due to aircraft noise
51		previous information about the survey
52		duration of interview
--		day of interview
--		time of day of interview
--		name of interviewer
--		first refused
--		cluster of the person interviewed

r. The numbers refer to the questionnaire presented in Section 4.4 The underlined number of subpoints was processed in a comprehensive characteristic (compare 6.3). Average value ($\bar{x}$) and standard deviation (s) are for the entire sample (N = 398).
*: question was not directed at all persons.

Table 16: Matrix of the Intercorrelations of 48 Questionnaire Variab

Tab. 16: MATRIX DER INTERKORRELATIONEN VON 48 FRAGEBOGENVARIABLEN.

	FKF 1	BBF 2	BS2 3	FMF 4	FW6 5	FW7 6	FBR 7	ZGF 8	BBI 9	MHE 10
1	1.00	0.09	0.07	-0.11	0.02	0.04	-0.07	0.02	-0.00	-0.02
2	0.09	1.00	0.05	-0.12	-0.04	-0.05	0.00	0.15	0.03	-0.02
3	0.07	0.05	1.00	-0.06	-0.13	-0.14	-0.09	0.10	0.12	0.15
4	-0.11	-0.12	-0.06	1.00	0.12	0.06	0.24	-0.14	0.01	0.01
5	0.02	-0.04	-0.13	0.12	1.00	0.54	0.32	-0.17	-0.02	-0.08
6	0.04	-0.05	-0.14	0.06	0.54	1.00	0.20	-0.06	-0.06	-0.03
7	-0.07	0.00	-0.09	0.24	0.32	0.20	1.00	-0.19	0.13	0.06
8	0.02	0.15	0.10	-0.14	-0.17	-0.06	-0.19	1.00	-0.07	-0.02
9	-0.00	0.03	0.12	0.01	-0.02	-0.06	0.13	-0.07	1.00	0.12
10	-0.02	-0.02	0.16	0.01	-0.06	-0.02	0.06	-0.03	0.12	1.00
11	0.07	0.07	0.06	0.01	0.01	0.03	0.00	-0.03	0.16	0.20
12	0.09	0.03	0.11	-0.13	-0.21	-0.17	-0.14	0.10	-0.03	0.0
13	-0.04	-0.00	0.24	-0.00	-0.23	-0.26	-0.01	0.17	0.05	0.12
14	-0.03	-0.09	-0.11	0.11	0.08	0.10	0.04	-0.03	-0.26	-0.12
15	-0.00	-0.17	-0.08	0.09	0.06	0.11	0.15	-0.02	0.09	0.03
16	-0.02	0.02	-0.12	-0.04	0.14	0.17	0.11	-0.12	0.05	-0.17
17	0.04	0.01	-0.07	0.10	0.32	0.24	0.23	-0.15	0.16	-0.12
18	-0.03	-0.06	-0.13	0.22	0.44	0.32	0.35	-0.10	0.16	-0.01
19	-0.08	-0.05	-0.01	0.12	0.23	0.26	0.17	-0.09	0.05	-0.13
20	-0.04	-0.08	-0.24	0.19	0.52	0.39	0.37	-0.20	0.05	-0.04
21	0.00	-0.20	-0.07	0.18	0.22	0.19	0.32	-0.23	0.07	0.02
22	-0.09	-0.10	-0.31	0.29	0.47	0.42	0.36	-0.25	0.08	-0.04
23	-0.03	0.0	-0.10	0.14	0.26	0.23	0.17	-0.12	0.08	-0.03
24	0.07	0.04	-0.11	0.15	0.32	0.13	0.26	-0.18	0.02	0.03
25	0.05	0.10	-0.16	-0.03	0.18	0.17	-0.02	-0.02	-0.26	-0.22
26	0.08	0.04	-0.14	-0.03	0.15	0.16	-0.04	-0.04	-0.27	-0.24
27	0.0	-0.06	-0.18	0.07	0.14	0.14	0.18	-0.11	0.05	-0.02
28	0.10	0.03	0.06	-0.12	-0.10	-0.14	-0.19	0.10	-0.11	-0.02
29	-0.03	-0.03	-0.21	0.25	0.47	0.40	0.36	-0.22	0.13	0.01
30	0.05	-0.04	0.16	-0.07	-0.36	-0.29	-0.15	0.03	0.12	0.03
31	-0.05	0.04	-0.14	0.06	0.06	0.10	0.02	0.01	-0.47	0.02
32	-0.06	-0.02	0.17	0.00	-0.08	-0.02	0.01	-0.05	0.39	0.27
33	0.04	-0.09	-0.15	0.05	0.19	0.15	0.07	-0.11	-0.06	-0.04
34	0.05	-0.02	-0.09	0.01	0.21	0.12	0.09	-0.04	-0.06	-0.03
35	0.07	0.00	0.10	0.02	0.01	0.03	0.15	-0.02	0.14	0.10
36	0.03	-0.04	-0.12	0.17	0.36	0.27	0.17	-0.13	0.05	0.01
37	0.01	-0.03	-0.16	0.0	0.31	0.25	0.10	-0.11	0.0	-0.12
38	-0.09	-0.04	-0.24	0.12	0.32	0.26	0.16	-0.20	0.01	-0.13
39	-0.09	-0.05	-0.03	0.20	0.37	0.26	0.30	-0.21	0.08	0.1
40	0.10	0.13	0.06	-0.02	-0.13	-0.06	0.04	0.09	0.15	0.2
41	0.12	0.12	0.15	-0.11	-0.23	-0.23	-0.17	0.20	0.11	0.01
42	0.10	-0.02	0.13	-0.08	-0.34	-0.36	-0.24	0.15	0.02	0.0
43	0.03	0.01	0.17	-0.10	-0.26	-0.36	-0.17	0.11	0.04	-0.06
44	0.00	0.02	-0.13	0.02	0.28	0.21	0.43	-0.20	0.06	0.0
45	0.01	-0.05	0.08	-0.03	-0.22	-0.23	-0.22	0.00	-0.06	-0.0
46	0.04	-0.00	0.05	0.00	-0.02	-0.02	0.11	0.07	0.48	0.19
47	0.06	0.06	0.16	-0.12	-0.11	-0.09	-0.01	0.04	0.09	0.03
48	-0.05	-0.02	-0.03	0.06	0.04	0.05	0.01	-0.00	-0.13	-0.0

6.4

Table 16 continued

Forts. Tab. 16

	EEB 11	GBV 12	ZEG 13	GBL 14	LEG 15	FFP 16	FFK 17	FFR 18	FFS 19	SFL 20
1	0.07	0.09	-0.04	-0.03	-0.00	-0.02	0.04	-0.03	-0.08	-0.34
2	0.07	0.03	-0.09	-0.09	-0.17	0.02	0.01	-0.[illegible]	-0.05	-0.38
3	0.06	0.11	0.24	-0.11	-0.06	-0.12	-0.07	-0.13	-0.01	-0.2[illegible]
4	0.01	-0.13	-0.00	0.11	0.09	-0.04	0.18	0.22	0.12	0.1[illegible]
5	0.01	-0.21	-0.23	0.03	0.06	0.14	0.32	0.44	0.23	0.52
6	0.03	-0.17	-0.26	0.10	0.11	0.17	0.24	0.32	0.26	0.35
7	0.03	-0.14	-0.01	0.04	0.15	0.11	0.23	0.35	0.17	0.3[illegible]
8	-0.03	0.16	0.17	-0.03	-0.02	-0.12	-0.15	-0.19	-0.09	-0.[illegible]
9	0.16	-0.03	0.05	-0.20	0.09	0.05	0.16	0.16	0.05	0.79
10	0.36	0.0	0.12	-0.10	0.08	-0.17	-0.10	-0.01	-0.13	-0.64
11	1.00	0.03	0.07	-0.27	-0.00	-0.07	-0.07	0.03	-0.16	0.2[illegible]
12	0.03	1.00	0.13	-0.06	-0.02	-0.17	-0.23	-0.25	-0.12	-0.26
13	0.07	0.13	1.00	-0.10	-0.04	-0.30	-0.31	-0.21	-0.29	-0.37
14	-0.27	-0.06	-0.10	1.00	0.36	0.05	0.16	0.15	0.23	0.15
15	-0.00	-0.02	-0.04	0.36	1.00	0.02	0.10	0.24	0.10	0.26
16	-0.07	-0.17	-0.30	0.05	0.02	1.00	0.45	0.35	0.26	0.27
17	-0.07	-0.23	-0.31	0.16	0.10	0.45	1.00	0.63	0.39	0.52
18	0.03	-0.25	-0.31	0.15	0.24	0.35	0.63	1.00	0.43	0.71
19	-0.16	-0.12	-0.29	0.23	0.10	0.26	0.39	0.43	1.00	0.52
20	0.03	-0.36	-0.37	0.15	0.26	0.27	0.52	0.71	0.52	1.00
21	0.04	-0.21	-0.18	0.09	0.26	0.07	0.25	0.33	0.18	0.46
22	0.07	-0.28	-0.29	0.19	0.21	0.25	0.42	0.50	0.23	0.61
23	-0.01	-0.18	-0.29	0.07	0.07	0.13	0.35	0.35	0.27	0.57
24	0.10	-0.18	-0.15	0.03	0.03	0.13	0.31	0.35	0.10	0.42
25	-0.12	-0.09	-0.26	0.05	-0.03	0.12	0.05	0.01	0.15	0.17
26	-0.14	-0.09	-0.28	0.05	0.01	0.16	0.35	0.02	0.16	0.17
27	-0.04	-0.20	-0.26	0.25	0.46	0.15	0.22	0.70	0.12	0.41
28	-0.03	0.27	0.09	-0.10	-0.[illegible]7	-0.04	-0.19	-0.2[illegible]	-0.11	-0.4[illegible]
29	0.09	-0.31	-0.35	0.09	0.18	0.30	0.51	0.79	0.38	0.7[illegible]
30	-0.01	0.31	0.37	-0.13	-0.02	-0.26	-0.35	-0.[illegible]6	-0.26	-0.64
31	0.12	-0.02	-0.04	0.22	0.08	0.22	-0.02	0.[illegible]4	0.10	0.1[illegible]
32	0.35	-0.03	0.09	-0.21	0.11	-0.0[illegible]	-0.03	-0.0[illegible]	-0.07	-0.2[illegible]
33	0.04	-0.09	-0.04	0.06	0.15	0.11	0.0	0.17	0.06	-0.19
34	-0.01	-0.08	-0.02	0.02	0.10	0.11	-0.01	0.[illegible]1	-0.10	0.1[illegible]
35	0.09	-0.04	0.21	-0.02	0.01	-0.01	0.05	0.[illegible]	0.02	-0.[illegible]
36	0.11	-0.17	-0.31	0.04	0.08	0.16	0.13	0.44	0.18	0.4[illegible]
37	-0.01	-0.15	-0.16	0.10	0.04	0.26	0.28	0.22	0.22	0.4[illegible]
38	0.06	-0.18	-0.30	0.18	0.11	0.13	0.33	0.60	0.24	0.4[illegible]
39	0.09	-0.16	-0.20	0.05	0.13	0.16	0.35	0.44	0.18	0.4[illegible]
40	0.31	0.09	0.10	-0.18	-0.0[illegible]	-0.01	-0.04	-0.05	-0.10	-0.[illegible]
41	-0.02	0.20	0.22	-0.06	-0.00	-0.12	-0.11	-0.24	-0.18	-0.3[illegible]
42	0.01	0.17	0.[illegible]1	-0.13	-0.[illegible]9	-0.17	-0.17	-0.[illegible]0	-0.17	-0.3[illegible]
43	-0.06	0.15	0.12	-0.11	-0.10	-0.04	-0.27	-0.30	-0.10	-0.5[illegible]
44	0.09	-0.12	-0.15	0.06	0.[illegible]6	0.17	0.28	0.38	0.14	0.4[illegible]
45	-0.11	0.13	0.11	-0.03	-0.07	-0.15	-0.30	-0.42	-0.14	-0.4[illegible]
46	0.03	0.01	0.08	-0.11	0.05	0.03	0.15	0.[illegible]3	-0.03	0.0[illegible]
47	0.17	0.09	0.12	-0.73	-0.23	-0.04	-0.12	-0.11	-0.21	-0.1[illegible]
48	0.06	-0.04	0.03	0.30	0.13	0.01	0.05	0.02	0.09	-0.2[illegible]

Table 16 continued

Forts. Tab. 16

	GBF 21	BSF 22	PMF 23	SMF 24	WLO 25	WDH 26	SEL 27	SEG 28	SFA 29	RAF 30
1	0.09	-0.09	-0.03	0.07	0.05	0.08	0.0	0.10	-0.08	0.05
2	-0.20	-0.10	0.0	0.04	0.10	0.04	.06	0.04	-0.03	-0.04
3	-0.07	-0.31	-0.20	-0.11	-0.16	-0.14	0.16	0.09	-0.21	0.18
4	0.15	0.29	0.14	0.15	-0.03	-0.03	0.07	-0.12	0.25	-0.07
5	0.22	0.47	0.26	0.32	0.18	0.15	0.14	-0.10	0.47	-0.36
6	0.19	0.42	0.23	0.13	0.17	0.16	0.14	-0.14	0.40	-0.29
7	0.32	0.36	0.17	0.26	-0.02	-0.04	0.18	-0.19	0.36	-0.15
8	-0.23	-0.25	-0.12	-0.18	-0.02	-0.04	-0.11	0.16	-0.22	0.21
9	0.07	0.05	0.08	0.02	-0.26	-0.27	0.05	-0.11	0.13	0.12
10	0.02	-0.04	-0.02	0.05	-0.22	-0.24	-0.01	-0.02	0.01	0.09
11	0.04	0.07	-0.01	0.10	-0.12	-0.14	-0.04	-0.03	0.09	-0.01
12	-0.21	-0.22	-0.18	-0.16	-0.09	-0.09	-0.23	0.27	-0.31	0.31
13	-0.18	-0.29	-0.29	-0.15	-0.26	-0.28	-0.26	0.09	-0.35	0.37
14	0.09	0.19	0.07	0.03	0.05	0.05	0.25	-0.10	0.09	-0.13
15	0.26	0.21	0.07	0.03	-0.03	0.01	0.46	-0.27	0.18	-0.02
16	0.07	0.25	0.13	0.13	0.12	0.16	0.15	-0.04	0.30	-0.28
17	0.25	0.42	0.25	0.36	0.05	0.05	0.22	-0.19	0.51	-0.32
18	0.38	0.56	0.35	0.36	0.01	0.02	0.36	-0.27	0.74	-0.46
19	0.13	0.23	0.07	0.10	0.15	0.16	0.12	-0.11	0.38	-0.28
20	0.46	0.61	0.37	0.45	0.17	0.17	0.41	-0.40	0.78	-0.64
21	1.00	0.40	0.25	0.23	0.01	0.05	0.32	-0.33	0.35	-0.29
22	0.40	1.00	0.31	0.28	0.09	0.05	0.23	-0.27	0.02	-0.37
23	0.25	0.31	1.00	0.25	0.16	0.17	0.16	-0.15	0.40	-0.32
24	0.23	0.28	0.28	1.00	0.09	0.02	0.15	-0.17	0.42	-0.51
25	0.01	0.09	0.16	0.09	1.00	0.80	0.06	0.04	0.09	-0.27
26	0.05	0.05	0.17	0.02	0.80	1.00	0.13	0.01	0.08	-0.31
27	0.32	0.23	0.16	0.15	0.06	0.13	1.00	-0.40	0.32	-0.25
28	-0.33	-0.27	-0.15	-0.17	0.04	0.01	-0.40	1.00	-0.31	0.23
29	0.35	0.62	0.40	0.42	0.09	0.08	0.32	-0.31	1.00	-0.57
30	-0.20	-0.37	-0.32	-0.31	-0.27	-0.31	-0.25	0.23	-0.57	1.00
31	0.00	0.05	0.11	0.09	0.34	0.33	0.08	-0.03	0.07	-0.25
32	0.10	0.10	-0.02	0.03	-0.27	-0.24	0.02	-0.03	-0.02	0.13
33	0.12	0.18	0.14	0.15	0.26	0.26	0.11	-0.05	0.15	-0.18
34	0.04	0.15	0.12	0.19	0.22	0.25	0.05	-0.04	0.11	-0.15
35	-0.05	-0.02	-0.03	0.10	-0.19	-0.24	-0.03	-0.09	0.07	0.01
36	0.17	0.34	0.32	0.41	0.13	0.16	0.22	-0.16	0.46	-0.41
37	0.16	0.29	0.21	0.13	0.20	0.19	0.16	-0.13	0.32	-0.32
38	0.16	0.36	0.23	0.13	0.19	0.20	0.26	-0.19	0.37	-0.41
39	0.27	0.48	0.26	0.36	-0.02	-0.02	0.23	-0.19	0.51	-0.29
40	-0.12	-0.07	-0.06	-0.02	-0.10	-0.15	0.00	0.03	-0.06	0.12
41	-0.19	-0.33	-0.21	-0.15	-0.25	-0.22	-0.15	0.18	-0.32	0.31
42	-0.15	-0.35	-0.23	-0.15	-0.17	-0.14	-0.11	0.19	-0.40	0.29
43	-0.19	-0.48	-0.24	-0.29	-0.06	-0.04	-0.21	0.29	-0.45	0.29
44	-0.29	-0.43	-0.16	0.31	0.08	0.05	0.15	-0.19	0.42	-0.17
45	-0.13	-0.34	-0.23	-0.21	-0.11	-0.02	-0.12	0.13	-0.45	0.29
46	0.04	0.00	0.10	0.03	-0.18	-0.16	0.04	-0.07	0.08	0.12
47	-0.05	-0.14	-0.04	-0.03	-0.08	-0.09	-0.14	0.08	-0.10	0.17
48	-0.07	-0.02	0.01	-0.03	-0.00	-0.01	0.13	-0.04	-0.02	0.03

Table 16 continued

Forts. Tab. 16

	ADB 31	SBB 32	EWH 33	BEG 34	BTB 35	SNF 36	ZSF 37	KAF 38	MFL 39	PEF 40
1	-0.05	-0.06	0.04	0.05	0.07	0.03	0.01	-0.09	-0.09	0.10
2	0.04	-0.02	-0.09	-0.02	0.06	-0.04	-0.03	-0.04	-0.05	0.13
3	-0.14	0.17	-0.15	-0.09	0.10	-0.12	-0.16	-0.24	-0.03	0.08
4	0.06	0.00	0.05	0.01	0.02	0.17	0.0	0.12	0.26	-0.02
5	0.06	-0.08	0.19	0.21	0.01	0.36	0.31	0.32	0.37	-0.13
6	0.10	-0.02	0.15	0.12	0.03	0.27	0.23	0.26	0.26	-0.05
7	0.00	0.01	0.07	0.09	0.15	0.17	0.19	0.16	0.30	0.04
8	-0.01	-0.05	-0.11	-0.04	-0.02	-0.18	-0.11	-0.20	-0.21	0.03
9	-0.47	0.39	-0.06	-0.06	0.14	0.05	0.0	0.01	0.08	0.15
10	0.02	0.27	-0.04	-0.06	0.10	0.01	-0.12	-0.12	0.10	0.25
11	0.13	0.35	0.04	-0.01	0.09	0.11	-0.01	0.00	0.09	0.51
12	-0.02	-0.03	-0.09	-0.03	-0.04	-0.17	-0.15	-0.18	-0.16	0.09
13	-0.04	0.09	-0.04	-0.02	0.21	-0.31	-0.18	-0.30	-0.20	0.1
14	0.22	-0.21	0.06	0.02	-0.02	0.04	0.13	0.18	0.05	-0.12
15	0.08	0.11	0.15	0.10	0.01	0.08	0.04	0.11	0.13	-0.03
16	0.02	-0.02	0.11	0.11	-0.01	0.16	0.26	0.13	0.16	-0.01
17	-0.02	-0.03	0.0	-0.01	0.05	0.33	0.23	0.33	0.35	-0.04
18	0.04	-0.02	0.17	0.11	0.09	0.44	0.32	0.40	0.44	-0.05
19	0.10	-0.07	0.06	-0.00	0.02	0.18	0.22	0.24	0.18	-0.10
20	0.17	-0.03	0.19	0.14	-0.02	0.49	0.42	0.47	0.45	-0.10
21	0.00	0.10	0.12	0.04	-0.05	0.17	0.16	0.16	0.27	-0.12
22	0.05	0.10	0.18	0.15	-0.02	0.34	0.29	0.36	0.48	-0.07
23	0.11	-0.02	0.14	0.12	-0.03	0.32	0.21	0.33	0.26	-0.06
24	0.09	0.03	0.15	0.19	0.10	0.41	0.12	0.13	0.36	-0.07
25	0.34	-0.27	0.26	0.22	-0.19	0.18	0.28	0.19	-0.02	-0.13
26	0.33	-0.24	0.26	0.25	-0.24	0.16	0.19	0.20	-0.02	-0.15
27	0.08	0.02	0.11	0.05	-0.03	0.20	0.16	0.20	0.20	0.01
28	-0.03	-0.03	-0.05	-0.04	-0.09	-0.16	-0.13	-0.16	-0.19	0.03
29	0.07	-0.02	0.15	0.11	0.07	0.46	0.32	0.37	0.51	-0.02
30	-0.29	0.13	-0.26	-0.15	0.06	-0.41	-0.32	-0.41	-0.26	0.12
31	1.00	-0.21	0.18	0.15	-0.03	0.13	0.05	0.09	0.02	-0.09
32	-0.21	1.00	-0.04	-0.02	0.09	0.03	-0.11	-0.06	0.19	0.02
33	0.18	-0.04	1.00	0.63	0.11	0.15	0.08	0.04	0.12	-0.12
34	0.15	-0.02	0.63	1.00	0.14	0.10	0.08	0.03	0.08	-0.09
35	-0.03	0.09	0.11	0.14	1.00	-0.04	-0.05	-0.09	0.04	0.11
36	0.13	0.03	0.13	0.10	-0.04	1.00	0.17	0.31	0.31	-0.04
37	0.05	-0.11	0.08	0.08	-0.08	0.17	1.00	0.31	0.12	-0.01
38	0.09	-0.06	0.04	0.03	-0.09	0.31	0.31	1.00	0.15	-0.09
39	0.02	0.19	0.12	0.08	0.04	0.31	0.12	0.15	1.00	0.01
40	-0.05	0.22	-0.12	-0.09	0.11	-0.04	-0.01	-0.02	0.01	1.00
41	-0.16	0.04	-0.19	-0.16	0.06	-0.25	-0.16	-0.20	-0.22	0.04
42	-0.09	0.07	-0.16	-0.12	0.02	-0.27	-0.19	-0.24	-0.23	0.13
43	-0.13	-0.10	-0.16	-0.07	0.01	-0.25	-0.13	-0.18	-0.33	0.24
44	-0.01	0.05	0.16	0.10	0.04	0.25	0.13	0.11	0.36	-0.11
45	-0.08	0.03	-0.09	-0.04	-0.19	-0.22	-0.18	-0.17	-0.32	0.06
46	-0.18	0.16	0.02	-0.01	0.12	0.09	-0.05	-0.03	0.05	0.14
47	-0.30	0.17	-0.06	-0.04	0.04	-0.06	-0.07	-0.17	-0.05	0.13
48	-0.05	-0.20	0.03	0.09	-0.01	-0.06	-0.11	0.03	-0.02	-0.05

Conclusion of Table 16

Schluß Tab. 16

	FVG 41	VSF 42	ASF 43	GBS 44	RFS 45	BWB 46	DGZ 47	GDB 48
1	0.12	0.10	0.03	0.00	0.01	0.04	0.08	-0.06
2	0.12	-0.02	0.01	0.02	-0.05	-0.00	0.06	-0.02
3	0.15	0.42	0.17	-0.13	0.08	0.05	0.08	-0.03
4	-0.11	-0.08	-0.16	0.32	-0.08	0.06	-0.12	0.04
5	-0.23	-0.34	-0.26	0.28	-0.22	-0.02	-0.11	0.04
6	-0.23	-0.35	-0.36	0.21	-0.23	-0.02	-0.09	0.05
7	-0.17	-0.24	-0.17	0.43	-0.22	0.11	-0.01	0.01
8	0.28	0.15	0.11	-0.26	0.06	0.07	0.04	-0.00
9	0.11	0.02	0.04	0.06	-0.06	0.46	0.29	-0.13
10	0.01	0.06	-0.06	0.05	-0.06	0.10	0.06	-0.05
11	-0.02	0.01	-0.06	0.09	-0.11	0.06	0.17	-0.66
12	0.20	0.17	0.15	-0.12	0.13	0.01	0.09	-0.04
13	0.22	0.21	0.12	-0.15	0.11	0.08	0.12	0.03
14	-0.06	-0.13	-0.11	0.06	-0.01	-0.11	-0.73	0.30
15	-0.00	-0.09	-0.10	0.16	-0.07	0.05	-0.23	0.13
16	-0.12	-0.17	-0.14	0.10	-0.15	0.03	-0.04	0.01
17	-0.11	-0.17	-0.27	0.28	-0.30	0.15	-0.12	0.05
18	-0.24	-0.30	-0.31	0.36	-0.42	0.13	-0.11	0.02
19	-0.10	-0.17	-0.10	0.14	-0.14	-0.08	-0.21	0.09
20	-0.36	-0.39	-0.38	0.42	-0.42	0.00	-0.15	-0.02
21	-0.10	-0.18	-0.19	0.29	-0.13	0.04	-0.05	-0.07
22	-0.33	-0.55	-0.46	0.43	-0.34	0.00	-0.14	-0.02
23	-0.21	-0.23	-0.24	0.16	-0.23	0.10	-0.04	0.01
24	-0.13	-0.14	-0.09	0.31	-0.21	0.08	-0.03	-0.03
25	-0.25	-0.17	-0.06	0.06	-0.11	-0.16	-0.03	-0.00
26	-0.22	-0.14	-0.04	0.05	-0.01	-0.16	-0.09	-0.01
27	-0.10	-0.11	-0.21	0.16	-0.12	0.04	-0.14	0.13
28	0.16	0.19	0.22	-0.19	0.13	-0.07	0.05	-0.04
29	-0.32	-0.40	-0.45	0.42	-0.45	0.06	-0.15	-0.02
30	0.31	0.29	0.29	-0.17	0.25	0.12	0.17	0.02
31	-0.16	-0.09	-0.13	-0.01	-0.08	-0.15	-0.30	-0.05
32	0.04	0.07	-0.10	0.05	0.03	0.10	0.17	-0.20
33	-0.19	-0.16	-0.16	0.16	-0.09	0.02	-0.06	0.03
34	-0.16	-0.12	-0.07	0.10	-0.04	-0.01	-0.04	0.09
35	0.06	0.02	0.01	0.04	-0.10	0.12	0.04	-0.01
36	-0.25	-0.27	-0.25	0.25	-0.22	0.03	-0.06	-0.00
37	-0.16	-0.19	-0.12	0.19	-0.18	-0.05	-0.07	-0.11
38	-0.26	-0.29	-0.16	0.11	-0.17	-0.03	-0.17	0.03
39	-0.32	-0.29	-0.33	0.33	-0.32	0.05	-0.05	-0.02
40	0.04	0.15	0.02	-0.06	0.06	0.14	0.13	-0.25
41	1.00	0.25	0.15	-0.20	0.19	0.07	0.11	0.03
42	0.25	1.00	0.09	-0.33	0.26	0.06	0.11	-0.09
43	0.15	0.38	1.00	-0.24	0.23	-0.05	0.14	0.0
44	-0.20	-0.33	-0.24	1.00	-0.25	0.03	-0.04	0.01
45	0.19	0.26	0.23	-0.25	1.00	-0.05	-0.04	0.05
46	0.07	0.06	-0.05	0.03	-0.05	1.00	0.19	-0.05
47	0.11	0.11	0.14	-0.04	-0.04	0.19	1.00	-0.20
48	0.03	-0.09	0.0	0.01	0.05	-0.05	-0.20	1.00

Korrelationen ab .10/.12 signifikant (Alpha<5%/1%). Zu den Variablenabkürzungen siehe Tab. 15.

Correlations significant when greater than .10/.12 (alpha < 5%/1%). See Table 15 for abbreviations.

7: ANALYSIS OF THE DATA:

7.1: Demography of the samples:

To what extent the sample deviates in age and sex from the common denominators in the clusters and these deviate from the average data from the Federal Republic of Germany is shown in table 17.

The data demonstrate that the portion of older residents (60-70 years) in the survey areas is comparatively less and the middle-aged persons (30-50 years) are proportionately more frequently represented than in Germany as a whole; this effect was intensified still more in the actually surveyed sample.

Some demographical characteristics of the study persons are compiled in table 11. /68

The data on education, income and home ownership document the fact that the socio-ecconomic status in the cluster St. Augustin-Niederberg (ENN), an area including chiefly officials and self-employed persons with condominiums and numerous large homes, is clearly the highest and in Erzhausen (EGE) as well as the Braunschweiger clusters (BSF, BST,), the more "countrified" areas, it is at the lowest level.

Erzhausen and Thune are also the areas with the longest duration of residence by far of the persons surveyed (on an average of 20 years in the same house), while the other areas (with the exception of Ka-Heidenstücker) are all newer residential areas of the past decade; construction is still going on in some of the clusters, especially in St. Augustin (ENH, ENN).

In summary (compare also, table 15), the population near the airfields examined can be described as follows: 42 years old on the average, average net income, about 1300 German Marks, usually 1-2 children, 1/3 have more than eight years of schooling, chiefly the owner of the appartment or of the house (58% and 3/4ths are the owners of their own gardens.

All clusters (perhaps with the exception of BSF and EGE) essentially demonstrate the characteristics of quiet suburbs (compare the maps in figures 3 to 6) and are chiefly situated at the edge of field or forest areas (BST, ENN ENA, EGE, KAH, KAF) -- a situation which probabaly applies to the majority of populated areas near recreactional airfields, and of course, having considerable influence on the evaluation of the problem of aircraft noise, considering the structure of expection of the persons residing there.

7.2: Acoustical Results:

The results of the aircraft noise measurements (compare 3.5) are summarized in table 19.

They show that directly under the approach and departure line (measured at a distance of 1.5km from the middle of the runway) take-offs can be heard on the average at a level of 74-75 and landings at about 63 dB(A); at 0.5km to the side, take-offs were measured on the average at 63 and landings at 47, and the traffic circuit measuring point B5 produced 61 dB(A).

(For comparison: Egelsbacher measurements of 411 flight events produced values between 60 and 78 or about 65 dB(A) on the average according to Apfel and Neber, 1973. Jokiel (1975) sets L_{eq} values between 45 and 55 or a maximum level of 70 to 80 dB(A) for landingfields). /69

The value at measuring point B5 can be taken over, directly for the cluster in Thune (BSD); an estimated value of almost 70 dB(A) can be assumed for the cluster Bienrode (BSE), with take-offs dominating.

It must be taken into consideration, however, that the measurements also included several machines larger than the usual recreational aircraft.

This noise stress is, without a doubt, lower than that expected near commercial airports; for example, the average value of the fly-over peak level for the 32 survey clusters in the Munich study of the DFG research project varied between 80 and 101 dB(A). (compare Finke and Martin, 1974). When a comparison is made, however, with other noise sources such as street-car noise, the measured sound levels do prove to be considerable.

For comparison, the L_{10} value (the sound level exceeded 10% of the time) for street-car noise is situated in residential areas primarily between 45 and 65 dB(A); for example, the average value for the 32 clusters in Munich amounted to 52.9 dB(A). Buchtan and Kaska (1974) mention average L_{eq} values between 55 and 77 dB(A) for four partially heavily traveled streets in Düsseldorf.

The aircraft noise levels measured in Braunschweig are certainly clearly differentiated from the usual background level; in addition, "quiet" recreational aircraft does not have a problem

direction from above) are usually perceived and one becomes conscious of them. /70

The acoustical data mentioned here, however, should not be over evaluated, since the test measurements had to be limited to a relatively brief measuring period and serve only as a preliminary source of information.

Therefore, it is also hardly possible to apply the results to the other clusters in St. Augustin, Egelsbach / Erzhausen and Karlsruhe/Forchheim. Only in a rough approximation can the following sequence of aircraft noise stress

be estimated from the available data as well as the position of clusters: ESB; ENA; KAH, ENH; EGE, ENN; KAF, EGE; Est.

The extent of noise stress, of course, not only results from the levels, but just as much and possibly even more, from the flight frequencies, (compare table 5). Several thousand take-offs or landings may be expected per month, and on some days several hundred in the summertime in Braunschweig as well as at other study locations, and in the main traffic hours, the take-offs or landings follow one another at intervals of only a few minutes.

7.3: Reaction to Aircraft Noise:

To what extent the noise stress described near the recreational airfields triggers disturbance and annoyance will be explained in detail in the following: (compare also table 15 in 6.4 and the questionnaire in 4.5).

It is first obvious that the surveyed persons consider aircraft noise the most annoying, compared to all other noise sources -- automobile, construction, railroad, factory and radio noise. In judging the order of importance (question 16), aircraft noise was placed at position 1.6 on the average (the other types of noise recieved 2.9 to 4.6).

Some special local noise sources (highway and railway ESE, street-cars ENH, partially construction noise in ENN and railway EGB) had no important effect on this order of sequence.

To the general question (No. 10) about disturbing living conditions, 50% of the persons surveyed spontaneously mentioned "noise" and 45% "aircraft noise"; to the question about the type of noise in the residential area (No. 11/12), even 70% mentioned aircraft noise.

Type and extent of the consequences of the aircraft noise, especially the disturbance to daily activities, result from the answers compiled in table 20.

The most important aspect of disturbance is the recreation: 55% feel "moderately", "rather" or "very", in leisure time outside (on balcony, terrace or in the garden,), 40% consider their relaxation and evening quiet (inside) negatively affected; 30 or 44%, however, mention that they are "not" affected.

(When the answers "Rather" and "very" are interpreted as an expression of "considerable" disturbance, the percentual values of 30 or 24 result).

Even 16% also mentioned disruptions to sleep, partially related to the noon quiet (especially on Sunday).

Also, obstacles to communication, the second most important aspect, are mentioned (on the average by one of five of the persons surveyed), for example, the necessity of

speaking more loudly or turning up the volume on radio and the television.

The data on negative effects on work are also notable (and to reading or thinking) with 16 or 28%; furthermore, furthermore, on being frightened as a result of the aircraft (20%). On the other hand, pain and physical effects (e.g. rattling) are hardly ever mentioned (max 10%).

The times at which these disturbing effects are chiefly present can be seen in table 21 (the data of question 20); the times of the day most negatively affected are, above all, noon, afternoon and early evening, i.e., aprox. 12-8:00 p.m.

How often the residents near airports are annoyed by aircraft noise is illustrated by the question about the "lost time": 9% answered, "today", 9% "yesterday", 24% mentioned the past week and 16% the past month. (In addition, 59% felt that the "disturbance " due to aircraft noise has become greater in the past years", although the number of flights had been more or less stagnant since 1971, only increasing in Bonn-Hangelar from 1972 to 1084; the sensitivity to disturbing effects of the environment has possibly increased).

The extent of annoyance due to the aircraft noise effects examined was to be included collectively in the following question: "How greatly are you annoyed about recreational aircraft on the whole"? The distribution of answers, given in table 22, shows that approximately one-quarter of the persons surveyed are not annoyed whatsoever, one-half moderately, (answer categories 1-5) and one-quarter greatly (categories 6-10). At the same time, the considerable scattering becomes obvious (plotted in figure 15).

A question parallel to this subject produced 50% each for not/hardly and for moderately/rather/very annoyed (rather/very: 28%). In this connection, the total estimations of the interviewers (taken from their experience reports, compare 5.5) are of interest -- according to them, 50% appeared disturbed and about 1/3 expressed serious negative effects on daily life (also outside of the interview). (The impressions of the interviewers are congruent with the survey data).

At least half of the affected persons then experience flight operations as annoyance, certainly to the extent that it concerns leisure time and recreation at home.

The question also presents itself here to what extent other aircraft besides the small propeller machines, of interest here, cause the disturbance determined.

For this reason, in the question about the last annoyance (No. 18), the type of aircraft was to be mentioned: 2/3 of the persons interviewed listed recreational/training/private aircraft or similar answers and 1/3, other types (12% passenger (jet) aircraft, 9 helecopters, 12% military jets and 3% other).

According to informal data of the interviewers, the annoyance appears to be determined substantially in a portion of the residents near airports by defined individual events -- for example, the VJ jet in Braunschweig or helicopters (border police, police, e.g. Hangelar or Egelsbach).

Of course, how the recreational and private flight operations are evaluated, to what extent they are accepted as leisure time activity play a role in the disturbance and annoyance due to aircraft noise.

The data gathered on this subject as compiled in table 23 now demonstrate that about one-half of the persons surveyed have personal understanding for flying and tend toward a positive evaluation.

51% however, consider recreational flight an "egotistical matter" (question 37.1) and 53% feel that at least some sport pilots act "like playboys of the air" (question 37.4); 51% have "reasons for becoming upset about recreational flight operations" (37.3). /74

83% of the persons interviewed still want to "accept and tolerate recreational flight operations in spite of aircraft noise" (although not without limits as will be seen in section 7.5). In spite of this tolerant attitude, only 1/3 of the residents surveyed consider the airfield "an enrichment of this area, an advantage for the community".

In-so-far that this was explained in content (question 35), 15% mentioned the leisure possibilities, 14% ecconomic advantages, 6% a better reputation and 4% other useful effects (e.g. rescue possibilities by helicopter).

The question can be posed on the importance which the aircraft noise problem has for the affected persons in relationship to other environmental factors and private sources of annoyance.

The subject matter already mentioned in the introduction, that aprox. one-half list aircraft noise spontaneously as a negative environmental condition, points to the evaluation.

Two comparison questions (compare the average classification in table 24) now show that aircraft noise is perceived on the one hand, apparently as being the most negative living condition in the residential areas examined, but on the other hand, measured against typical sources of annoyance in daily life, is by no means the most negative which anyone could immagine.

The importance of the aircraft noise problem, however, also becomes clear through the fact that 1/3 of the persons interviewed had signed an anti-noise petition and 3/4 desire a limitation of flight operations; the opinions on reducing aircraft noise will be treated later (in 7.5) in more detail. /75

In conclusion to this section, the connection between the various variables, of the reaction to aircraft noise is shown, using a factor analysis (compare 6.2).

From the solution in table 25 (including 54% of the variable covariation), 4 main aspects can be interpreted: /76

-- The extent of disturbance to daily activities due to aircraft noise,

-- The evaluation of the (local) aircraft noise and of recreational flight operations,

-- The general disturbance and annoyance due to aircraft noise,

-- The tendancy to undertake measures against aircraft noise and flight operations.

To what extent the aircraft noise reactions described are influenced by moderators discussed in the following:

7.4: Moderators of aircraft Noise Effects:

Since the reaction of aircraft noise extends from complete indifference to very annoyed (compare for example table 22) and a considerable scattering of reactions is also observed within one and the same area (with the same amount of aircraft noise), the question presents itself about which non-physical factors contribute to the explanation of this variation.

Such variables, termed moderators, have already been /77
mentioned in the discussion of the concept of noise (compare 2.3 furthermore, 4.1) (analyses and results on this subject are found in e.g. DFG research report on the effects of aircraft noise and in Schümer 1974). The problem is illustrated by a diagram (figure 14 in accordance with with Rohrmann, 1974x.

The moderator variables defined in this study can be seen in tables 9 and 15.

To what extent the variability of disturbance and annoyance in multiple regression models (compare 6.2) can be determined by personality characteristics, especially opinions and attitudes correlated to noise can be seen on table 26.

It is then shown that 5 variables are important moderators of annoyance about (sport aircraft) (SFA, model 3 in table 26): belief in the (anti-aircraft noise) effort of the responsible persons (GEZ), general noise sensitivity (LEG), an estimation of the adaptability to noise (SAG), belief in the damaging effect to health of aircraft noise (GEF), and the fact evaluate recreational flight operations negatively, fear /79
annoyed by it, and desire limitations, as well as the corresponding opposite group, and compare the two groups in the moderator variables.

Such a comparison can be made statistically with the aid of the discrimination analysis (compare 6.2). Two analyses are found in table 27, one for the above-mentioned classification ("VFF"), another for a division according to general disturbance and annoyance due to aircraft noise ("SFL").

The results essentially correspons to the regression analyses.

In summary, (and somewhat in generalization) the following can be stated on the influence of moderators, i.e. non-physical variables on the disturbance and annoyance due to aircraft noise; the affected persons react more negatively on the average, with increasing

-- fears for health,
-- general sensitivity to noise,
-- belief that no adaptation to the noise stress is possible,
-- doubt that the appropriate officials are prepared to help, as well as, at least in tendency,
-- with increasing age,
-- with increasing time of residence in the noise area,
-- in-so-far as the people live in their own home with a garden.

The considerable scattering of reactions to aircraft noise is therefore not only explained by differences in aircraft noise stress in a physical sense, but also as an effect of various personality structures, especially the attitude to the environment, i.e. factors not directly dependent on the extent of disturbing and annoying aircraft noise. When considering this subject matter, a concept for noise protection can only be appropriate, when it takes into consideration, the given range of variation, instead of the reference to average values of negative effects (and therefore, for example, also provide sufficient protection for the "sensitive persons" in the interpretation of Bryan and Tempest, 1971 (people less robust to environmental stress).

7.5: Opinions on Reducing Aircraft Noise:

/80

The measures for protection against aircraft noise realized or planned by the affected residents, near airports, on the one hand, and, on the other hand, demanded of appropriate officials, will be discussed in the following.

42% of the persons interviewed report on social activities against aircraft noise beyond a conversation with a neighbor (compare table 28): More than 1/3 had signed petitions for similar documents prepared by citizen initiatives, 12% participated in protests demonstrations, and at least one in ten has presented a personal complaint. Only 2% however, has considered the consequence of moving away.

Possible physical measures (level windows, sound insulation, or earplugs), however, are mentioned by only a few of the persons interviewed (a total of 19%) and these have a useful effect only inside the dwelling.

With respect to the success of such measures, as well as of social measures, however, there appears to be little room for optimism (as resulted from informal conversations).

A similar situation also applies to the activities of the "competent officials". 55% of the persons interviewed do express the opinion that aircraft noise is partially unnecessary and avoidable and about three-quarters expect from the government or the local officials, one-half from the airport administration and about one-third from the pilots, that they do something about too much aircraft noise (73/71/50/36%). But on the average, less than half believed that the responsible persons are making a sufficient effort (35/41/32/35%). /31

Only one-third then, trusts the government. In spite of this pessimism, on the other hand, three-quarters of the persons surveyed support the demand for legal limitations of flight operations, as can be seen from table 29, i.e. they apparently expect an initiative of public officials.

This applies both for limitations in routes and in time.

Furthermore, table 29 points out the times for which a bann on flights is demanded. The majority is therefore not only in favor of maintaining quiet in the early afternoon (1-3:00 p.m.) and quiet at night (already after 7:00 p.m.), but also in favor of banning flights on Sunday afternoon; at least one-third demands this for Saturday afternoon, too, and more than one-quarter also for Sunday morning.

At least half of the persons surveyed also have the opinion (see table 30) that there should be no exceptions whatsoever from such limitations in flight operations (not even for the armed forces or border police).

When the times mentioned for a bann on flights is especially desired for "recreational fliers on private flights", this also includes business and commercial flights; the persons interviewed do not appear to differentiate substantially in this case (as was shown in informal additional questions). The fact that towing starts also should be included under the flights to be limited according to two-thirds of the persons interviewed is caused by the circumstance that the machines employed for this purpose are usually perceived as louder than average (moreover, the possibility of motor winches is also mentioned). /32

At this point, a brief mention is made of the actual limitations to flight operations existing at the locations in the study:

Braunschweig: No defined limitations;
Bonn/Hangelar: Traffic circuit is not permissible between 1 and 2:30 p.m. (only flights for more than 1/2 hours are permissible);

Egelsbach: No training flights after 7:00 p.m., after 1:00 p.m. on Saturdays and all day on Sundays (from May 1 to September 30);

Karlsruhe/Forchheim: No training flights on Saturdays, Sundays and holidays and only those flights are permissible, leaving the traffic circuit for 1/4 hours;

Hartenholm: No limitations.

The operating times are customarily 7:00 a.m. to sunset (in the summer approximately until 9:00 p.m.). Jet planes are permitted in Braunschweig and Egelsbach (only one type).

Finally, for 92% of the residents near airports, a permission for larger types of aircraft would not be acceptable, as are all other measures for extending flight operations (see table 29).

This therefore also includes those persons who did not feel annoyed by the previously given situation.

The following results in summary from the data. Although the population near commercial landing fields has a certain amount of understanding for the gliding flights, and also motorized flights and, in particular, accepts these as leisure time activity, well defined limitations are demanded by the majority (specifically, no fly-overs over certain residential areas and maintaining quiet in the early afternoon, night and on Sunday), which are then to apply to the greatest variety of types of flights, as is the expressed desire.

7.6: Results in the Individual Clusters:

The study conducted did not apply to the individual clusters, and with an average of 100 interviews per study location, statements for specific airfields are only possible when made with great care. Some noticable differences, however, should be mentioned briefly in order to demonstrate the range in variation of the reactions to the aircraft noise.

First, figure 15 shows that the disturbance and annoyance (measured with the variables SFL and SFA compare also table 30) were highest in the clusters especially exposed to aircraft noise of Bienrode (BSB), Augustin-center (BNA) and K A -Heidenstücker (FAH), as well as in Augustin-Niederberg (BNN) and were the lowest in Thune (BST), Hangelar (BNH), as well as Egelsbach (EGF) and Forchheim (FAF): Within each cluster the scattering (S) is considerable.

The scattering of the indications of stress is especially noticable in the 3 survey clusters in St. Augustin, where the negative reactions in the cluster Hangelar (BNH) near the airport are less, somewhat surprisingly, than in the more distant clusters Augustin-center (BNA) and Niederberg (BNN), compare the map in figure 4.

The mean value of annoyance due to the aircraft noise (SFA) on the scale of 10 is only 2.0 for BNH, but 4.8 and 5.2 for BNA and BNN; a similar contrast also applies for the general evaluation of the recreational flight operations (BSF, especially FSL furthermore ASF, FVG), or for indications

on disturbance during rest and relaxation (table 31 ... outside compare FFR as well as F11 and F12 in table 31). In Niederberg (FNA), which is, of course, not situated directly at the airfield and also not directly in the traffic circuit, especially many people consider themselves disturbed during leisure time, especially outside, probabaly in connection with the higher social status characteristic of this residential area -- numerous self-employed people, greater education and income, many large homes, compare 7.1.

Correspondingly, the acceptance of flight operations is greatest in FNH (ASP; 93%), while it is least in FNA and FKN (70% each), where the demand for legal limitations is greatest (GFS; 87 of 88%) and the portion of those complaining about aircraft noise or signing a petition (SKF, especially F11) is greatest with a total of 2/3. It should be noted, in addition, that the discussion of the problem of aircraft noise and the activity of citizens' initiative is much more intensive in St. Augustin than at the other study locations (and probabaly also all other landingfields) and the airfield Hangelar has become a political problem.

Without being able to go into details here, it is merely mentioned that both a "Civil Association Against the Aircraft Noise" (chairman: D. lange; contribution to the discussion, e.g. in Junkt 10, 1974), as well as a "Citizen Initiative for Retaining the Air Field in Bonn-Hangelar" (chairman: W. Wolff; contribution to the discussion, e.g. in Wochenblatt 6, 1977) have each collected several thousand signatures, and in the city council in St. Augustin several debates took place, especially in 1974 and at the beginning of 1975, leading to several resolutions in the direction of limitation or even halting motorized flight operations in Hangelar in spite of considerable divergencies in party lines. Among other things, because St. Augustin holds only 12% of the capital of the carrier (the City of Bonn: 49.6%), they are, of course, very limited as to what they can actually carry out, and the persons in favor of the airport point to the function of this airport for the capital and prestige value for Bonn; compare also articles in the press by Quasten or Ullrich (1975) etc.

An active citizens' initiative also is working in the cluster FA-Heidensteeken, where, for example, the speakers, Olschewsky and [illegible] demanded a complete bann on flights on the weekends and a halt to all expansion plans at a demonstration toward the end of the survey. A similar situation applies for Kelstach (on this subject see 8.3).

An inclusive cluster comparison on the reaction of aircraft noise is presented by a discrimination analysis " (compare 6.2) of two groups of 3 clusters each, apparently with the relatively greatest or least stress due to aircraft noise according to available acoustical data (compare 7.2).

As can be seen from table 32, the variable disruptions in communication (FFK) discriminates the greatest, i.e., it is that variable resulting as the most important aspect of negative effect in almost all studies at large commercial

airports.

In spite of the clear differences in the disturbance data (as well as in the conviction, aircraft noise is avoidable, and in the trust placed in responsible persons), the evaluation of recreational flying (ESF, VSF) is hardly altered, and the demand for legal regulations of flight operations (GFS) is raised almost as often in the compared groups.

Finally, in the comparison of the clusters the observation is mentioned that the tolerance to the given noise situation is apparently greatest in the communities most closely identified with "its" airfield, specifically in Egelsbach, the largest commercial landing field in the Federal Republic of Germany, and in Hangelar as one of the oldest German sport airfields (an example for such an effect is provided by Bürck, 1969). /87

In the clusters, FNH and EGF -- compare table 31 -- the acceptance of sport flight operations is greatest (ASF; 93% each), the airfield is considered more frequently as an advantage for the area (FVG) and there is a larger trust in the efforts of the responsible persons (GFV), also the goodwill of the pilots and the airfield administration (aprox 50% of the persons surveyed in each case compared to aprox. 20% in Bienrode or in KA-Heidenstücker, as well as in Erzhausen, where the airfield is probabaly perceived more as "determined by foreign influence").

The cluster comparison presented confirms the previously discussed subject matter (in 7.4), that the differences in disturbance and annoyance due to aircraft noise is only partially correlated to differences in the noise stress in a physical sense; social-psychological factors are at least just as important.

7.7: Comparison with Other Studies:

It remains in the presentation of the reaction to aircraft noise to ask in what relationship the data gained at the landing fields mainly in reference to flight operations with small propeller aircraft stand to the results at commercial airports (i.e. the disturbance and annoyance due to the noise of the larger jet engines).

Such a comparison is possible in a relatively direct manner, because numerous questions employed here were already employed in the MVG project on the effects of aircraft noise (compare Irle and Rohrmann, 1968, and Schümer and Schümer-Kohrs, 1974).

Table 33 provides a compilation for 6 characteristics reaction variables.

The MVG data gathered in Munich in 1969 are combined in two groups for simplification; 16 clusters with greater noise exposure (cited in table 32) had aprox. 70 to 80 take-offs or landings per day with fly-over levels between aprox. 80 and 120 dB(A); for the 16 clusters included in "Lab" there are 30 to 60 fly-overs or 70-100 dB(A). The aircraft noise area /88

partial areas mentioned with respect to noise exposure; in the area HHk (in another city section) there were hardly any fly-overs (for comparison: In the survey cluster FSE, 100 take-offs or landings can be expected daily at levels between 50 and 80; compare 7.2).

The first results from table 33 show that the problem of aircraft noise near the examined landing fields is subjectively just as acute and just as dominating as a negative environmental factor for the affected persons as in the area around commercial airports: The value of 45% spontaneous mentions (SNF), for example, is situated between the two corresponding percentages from the Munich study and almost as high as the Hamberg result (from 1966).

The order of importance given to aircraft noise as an actual disturbance factor in relation to other noise sources (street noise, construction noise, etc.), also documents this fact (see the variable RLF).

When the disturbances in communication (conversation, television, etc.) and recreation (FFK, FFR; scale 1-5), the results gained in this study are lower than the 3 listed aircraft noise areas of the DFG study, but (at least for FFK) clearly higher than in the control area, HHk; it is shown with the mean values of general sensitivity to disturbance due to aircraft noise (SFL) that the residents near landing fields do not feel that the effects are much less negative than the population near commercial airports. /8

The values mentioned at the conclusion for the acceptance of flight operations (or in the DFG study: "or tolerability of aircraft noise) also correspond to the situation (see ASF in table 33).

In summary, this comparison of results (somewhat rough and brief), that large passenger aircraft do produce a much greater negative effect in the direct vicinity of the take-offs and landings (especially for communication of human beings), than in the disturbance range of the commercial landing fields; the disturbance and annoyance determined here, however, can be directly compared with the aircraft noise effects in the further surroundings of commercial airports and are clearly greater than in areas removed from an airfield.

Table 17: Comparison of Sample and Population with respect to age and sex

%	a Jahrgänge						b Geschlecht	
	05-13	14-23	24-33	34-43	44-53	54-62	M	W
c BRD-Daten:	15	16	19	23	21	6	48	52
Cluster:	16	14	22	26	20	8	51	49
d Adressen:	9	16	25	25	19	9	51	49
e Befragte:	9	16	25	22	16	7	49	51

f BRD-Daten: 1974. STATISTISCHES BUNDESAMT, Statistisches Jahrbuch für die BRD, 1974.
Cluster: 1798 Bewohner von 18-70 Jahren in den 9 Clustern.
Adressen: 504 zur Befragung ausgegebene Adressen.
Befragte: 398 befragte Personen.

Key:
a. age
b. sex
c. data from the Federal Republic of Germany
d. addresses
e. persons interviewed
f. FRG data according to the Federal Office of Statistics, Statistical Yearbook for the FRG, 1974.
cluster: 1798 residents between 18-70 years in the nine clusters.
addresses: 504 addresses handed out for the survey.
persons interviewed: 398.

Table 18: Demographic Characteristics of the Clusters

Cluster:		BSB	BGT	BTH	BWA	BUN	EGB	EGE	KAU	KAF
a ADB	Alter	46.7	41.1	37.1	40.6	40.8	41.1	43.1	43.6	39.8
GDB	Männer %	46	43	51	52	48	49	51	49	48
SDB	Schuljahre	9.4	9.1	11.5	11.1	13.6	10.6	9.0	9.8	9.9
EDB	Einkommen 'B'	1062	1023	1396	1433	1857	1263	1202	1215	1381
EHB	Einkommen 'H'	526	671	833	795	932	783	720	757	826
EWH	Wohn-Eigentum %	67	64	63	24	91	30	78	75	42
BGG	Gartenbesitz %	80	77	72	35	93	61	88	92	56
WTO	Wohndauer Ort	26.3	6.9	7.7	5.0	3.8	8.6	32.9	13.9	10.0
WDH	Wohndauer Haus	22.2	6.6	6.0	4.3	3.1	5.3	18.8	13.6	6.7

b Angegeben sind %-Werte bzw. die arithmetischen Mittelwerte.- EPB = persönl.Einkommen des Befragten; HHB = mittleres Einkommen aller Haushaltsmitglieder. Vgl. Tab. 15 mit den Werten der Gesamtstichprobe.

See following page for key.

Key for Table 18:

a. ADB age
GDB men %
SBB years of school
EDB income of persons interviewed
MHE income of household
EWH ownership of home
B&G ownership of garden
WDO duration of residence in the community
WDH duration of residence in the house

b. Percentual values are supplied, or the arithmetic mean values. - EDB = personal income of the person interviewed; MHE = mean income of all members of the household. Compare Table 15 with the values of the entire sample.

Table 19: Results of the Aircraft Noise Measurements in Braunschweig.

a Meß-punkt	b Zahl und Art der Überflüge	c Spitzenpegel in dB(A) $\bar{x}$	s
B1	42 d Starts nach e W	73.1	3.0
B3	52 Starts nach O	76.3	4.2
B2	52 d Starts nach W f (seitlich)	61.3	3.2
B4	46 Starts nach O (seitlich)	64.8	5.2
B1	40 h Landungen aus W	62.8	6.4
B3	28 Landungen aus O	62.5	5.3
B2	22 h Landungen aus W g (seitlich)	46.8	3.0
B4	26 Landungen aus O (seitlich)	47.2	5.6
B5	53 i Überflüge (Platzrunde)	61.4	5.0

j Ausführung der Messungen: Physikal.-Techn. Bundesanstalt Braunschweig. Zur Beschreibung der Meßpunkte vgl. Tab. 8 bzw. Abb. 8.

Key: a. measuring point
b. number and type of fly-overs
c. peak level in dB(A)
d. take-offs to
e. west
f. east
g. to the side
h. landing from
i. fly-overs (traffic circuit)
j. Conducting the measurements: Physical-Technical Federal Institute in Braunschweig. Compare Table 8 or Fig. 8 for a description of the measuring points.

Table 20: Consequence of Aircraft Noise: Type and Extent of disturbed activities.

a Gestörtheits-Aspekt	b % der Anworten 1-2	3-4-5	$\bar{x}$
c FFK Fluglärmfolgen für Kommunikation			1.58
Störungen im Radioempfang	85	15	1.5
Störungen im Fernsehbild	86	14	1.5
stört Platten-/Kassetten-Hören	88	12	1.4
Radio/Fernsehen muß lauter gestellt werden	78	22	1.7
man muß lauter sprechen als sonst	72	28	1.9
stört Telefonieren	86	14	1.5
d FFR Fluglärmfolgen für Regeneration			1.92
hindert Entspannung und Feierabendruhe(drin)	60	40	2.3
stört die Freizeit draußen	45	55	2.8
hindert am Einschlafen	84	16	1.5
weckt einen nachts auf	97	3	1.1
man erschrickt sich	80	20	1.8
hindert Lesen oder Nachdenken	72	28	1.9
stört bei der Arbeit	84	16	1.5
e FFS Fluglärmfolgen: Schmerzen			1.16
man bekommt Kopfschmerzen	96	4	1.2
führt zu Ohrenschmerzen	97	3	1.1
f FFP Fluglärmfolgen physikalisch			1.27
zitternde Haus- und Zimmerwände	95	5	1.2
Klirren von Fensterscheiben/Geschirr	90	10	1.3

g Antwortskala: nicht (1), wenig (2), mittelmäßig (3), ziemlich (4), sehr (5) stark gestört.- FFK, FFR, FFS und FFP sind Summenvariablen aus den nachfolgenden Punkten (vgl. Tab. 14).

Key: a. disturbance aspect b. percent of answers

c. FFK consequence of aircraft noise for communication
disruption in radio reception
disruption in television reception
disturbance in listening to records and cassettes
volume must be turned up on radio / television
conversation must be louder
disturbs telephone conversation

d. FFR consequence of aircraft noise for recreation
prevents relaxation and evening quiet (inside)
disturbs leisure time outdoors
prevents one from falling asleep
---
causes fright
prevents one from reading or thinking
disrupts work

e. FFS pain as a consequence of aircraft noise
headaches
earaches

f. FFP physical consequences of aircraft noise
house and room walls tremble
window panes and dishes rattle

(continued on next page)

Table 20 key continued:

g. answer scale: not (1), hardly (2), moderately (3), rather (4), very (5) greatly disturbed. - FFK, FFR, FFS and FFP are summated variables from the subsequent points (compare Tab. 14).

Table 21: Times of Disturbance due to Aircraft Noise

		a % 1. / 2. Nennung
b frühmorgens	(6- 8 Uhr)	5 2
spätmorgens	(8-10 Uhr)	6 2
vormittags	(10-12 Uhr)	13 8
mittags	(12-15 Uhr)	24 13
nachmittags	(15-17 Uhr)	31 27
frühabends	(17-20 Uhr)	9 22
spätabends	(20-22 Uhr)	3 6
nachts	(22- 6 Uhr)	0 1
immer		2 0
nie		7 19

Key a. percent of first and second mentions
b. early morning
late morning
morning
early afternoon
afternoon
early evening
late evening
at night

always
never

Table 22: Annoyance due to Noise from Sport Flights (distribution)

			a "überhaupt nicht"									b "außerordentlich"	
	$\bar{x}$		0	1	2	3	4	5	6	7	8	9	10
SFL	3,78	%:	23	9	10	12	8	11	6	5	4	2	10

Key: a. not at all b. extremely

Table 23: Opinions on Recreational Flight Operations

a Fragebogenvariablen		%	X
b BSF	(Neg.) Bewertung Sportfliegerei	/	2.74
BS5	Recht der Sportflieger auf ihr Hobby	(56)	3.9
BS3	Kein Grund, sich ü. Sportflugbetr. aufzuregen	(49)	2.6
VSF	Verständnis für Sportfliegerei	(56)	3.6
FVG	Flugplatz ist Vorteil für Gegend	(35)	2.2
ASF	Akzeptierung Sportflugbetr. trotz Lärm	83	-
c Vgl. Tab. 15. - (..) = % der Antworten 3/4/5 = mittel/ziemlich/sehr der 5-stufigen Skala.			

Key: a. questionnaire variables
b. BSF (neg.) evaluation of recreational flying
BS5 right of the sport pilot to their hobby
BS3 no reason to become upset about recreational flight operations
VSF understanding for recreational flying
FVG air field is advantage for the area
ASF acceptance of recreational flying in spite of noise
c. Compare Table 15. - (..) = % of answers 3/4/5 = moderate/rather/very of the 5-step scale.

Table 24: Importance of the Problem of Aircraft Noise

a Rangreihe Lebensbedingungen		b Rangreihe Ärgernisse	
Zu wenig Grünanlagen/Parks	4.1	Streit in der Familie	2.5
Unfreundliche Nachbarn	4.3	Schlechte Bedienung im Geschäft	3.4
Unangenehme Gerüche	3.8	Lärm von Flugzeugen	3.3
Zuviel Lärm	2.6	Schwierigk. bei d. Arbeit	3.2
Schlechte Verkehrsverbind.	3.1	Pfuscharbeit v. Handwerkern	2.6
Fehlende Einkaufsmöglichk.	3.1		
c Die Befragten sollten die Vergleichsobjekte in eine Rangreihe bringen (Negativstes = 1). Vgl. Frage 11 bzw. 22 im Fragebogen.			

Key: a. Order of importance of living conditions
not enough parks
unfriendly neighbors
unpleasant smells
too much noise
poor transportation
lack of shops
b. Order of importance of annoyances
family fight
poor service in stores
noise of aircraft
problem at work
low quality work of craftsmen
c. the persons interviewed were to arrange in order of importance the objects to be compared (the most negative = 1). Compare question 11 or 22 in the questionnaire.

Table 25: Factor Analysis of the Reactions to Aircraft Noise

a Faktor	1	2	3	4		
b Eigenwert	7.25	1.54	1.22	1.07		
c Variablen-Ladungen (nach Rotation) und h^2						d Oberbegriff
FPK	.31	.70	-.08	.29	(67)	e Fluglärm-Folgen (2) (gestörte Aktivitäten)
FPR	.50	.55	-.25	.32	(72)	
FPS	.08	.64	-.15	.07	(44)	
FPP	.09	.70	-.08	-.04	(51)	
BSF	.71	.21	-.40	.03	(71)	
VSF	-.62	-.01	.44	.20	(61)	f Bewertung Sportflug-Lärm und Sportflug-Betrieb (1)
SFA	.58	.39	-.37	.36	(75)	
ASF	-.60	.09	.27	-.14	(46)	
GBS	.66	.09	.03	.20	(48)	
MFL	.62	.15	-.02	.35	(53)	
RPS	-.53	-.22	.06	-.11	(35)	
FVG	-.25	.13	.58	-.09	(43)	
SPL	.49	.36	-.60	.37	(76)	
RAF	-.16	-.25	.62	-.33	(59)	g Fluglärm-Ärger generell (3)
KAF	.06	.23	-.68	.08	(52)	
ZSF	.11	.43	-.43	-.13	(40)	
ZWG	.03	-.38	.45	-.23	(40)	
SMF	.29	.03	-.06	.75	(65)	h Maßnahmen gegen Fluglärm (4)
PMF	.12	.21	-.38	.40	(37)	
SHF	.19	.10	-.37	.61	(56)	
i Var.-Ant.	17%	13%	14%	10%		

j 'Principal-components-solution' mit 'varimax'-Rotation; Kommunalitäten als 1.0 gesetzt (rückgerechnete: h^2). - Zu den Variablen-Kürzeln vgl. Tab. 15.

Key:
a. factor
b. inherent value
c. variable loads (after rotation) and h^2
d. comprehensive concept
e. consequence of aircraft noise (disturbed activities)
f. evaluation of noise from recreational flights and flight operations
g. general annoyance due to aircraft noise
h. measures against aircraft noise
i. variable answer
j. principal components solution with varimax rotation; communalities set at 1.0 (back-up calculations; h^2). See Table 15 for abbreviations.

Table 26: Moderators of Aircraft Noise Effect - Multiple Regression

a Kriterium:	FFR		FFK		SFA		SFL		BSF	
mult. R:	.47		.35		.48		.61		.50	
R^2:	.22		.12		.23		.37		.25	
b Prädiktor ↓	beta	r	beta	r	beta	r	beta	r	beta	r
GDB	/	-	/	-	/	-	/	-	/	-
ADB	/	-	/	-	/	-	/	-	/	-
FHS	/	-	-.09	-.10	/	-	/	-	.13	.10
SBB	/	-	/	-	/	-	/	-	/	.18
EMR	.10	.17	/	-	.09	.15	.08	.19	/	.15
BEG	/	.11	/	-	/	.11	/	.14	/	
WDO	/		/	-	/	.10	.11	.12	.07	-
GBL	.07	.15	.12	.16	/	-	/	.15	.16	.19
GBF	.23	.38	.21	.25	.23	.35	.31	.46	.30	.40
LEG	.10	.24	/	.10	.05	.18	.11	.26	/	.21
SEG	-.09	-.27	/	-.19	-.14	-.31	-.19	-.40	-.09	-.27
GBV	.17	-.25	-.18	-.23	-.22	-.31	-.22	-.36	-.17	-.28

c Links jeweils Betagewichte aus einem multiplen Regressionsmodell (/ = Variable nicht benutzt), rechts zum Vergleich die einfachen Korrelationen (aus Tab. 16). Zu den Variablennamen vgl. Tab. 15. Angegeben sind nur signifikante Korrelationen.

Key:
a. criterium
b. predictor
c. Beta weights at the left in each case from a multiple regression model (/= variable not used), to the right for comparison the simple correlations (from Table 16). See Table 15 for abbreviations. Only significant correlations are given.

Table 28: Social Measures of Affected Persons against Aircraft Noise

a Lärmabwehr	b % ja-Sagen	c % erwägen
d Petition o. ä. unterzeichnen	36	13
Beschwerdebrief schreiben	7	14
mit zuständiger Stelle telefonieren	10	12
Beschwerdebesuch machen	4	7
Sache mit Nachbarn besprechen	49	8
Protestversammlung besuchen	12	14
Anti-Flugplatz-Verein beitreten	4	10

e Daten zu Frage 30/31. - Anteil der Befragten, die eine oder mehrere der Maßnahmen (außer Gespräch mit Nachbarn) ergriffen: 42 % (Variable SEF).

See following page for Key.

Table 28 key:

a. measure
b. carried out
c. considered
d. sign a petition or similar step
e. write a letter of complaint
   telephone call to an official
   place a personal complaint
   talk to neighbors about the matter
   attend a protest meeting
   join an anti-aircraft-noise association
e. Data on question 30/31. Proportion of persons surveyed, who had undertaken one or more of the measures (with the exception of talking to neighbors): 42 % (variable SKF).

Table 29: Demands for Limitations on Flight Operations

Variable	%
Generally for legal limitations	73
For limitations in flight routes	73
For limitations in flight times	78
every day from 1 to 3 p.m.	57
also from 12 to 1 p.m.	19
at night from 7 p.m. to 7 a.m.	63
also from 7 to 9 a.m.	15
Saturday after 1 p.m.	33
Sunday after 1 p.m.	57
all day on Sunday	28
Against permits for larger aircraft	8

Data on question 41. - Compare questionnaire in Section 4.4

Table 30: Flights to be excepted from limitations on flight operations.

Type of Flight	% for exception
sport pilots on private flights	13
training flights for schooling	21
towing take-offs for gliders	33
flights during sports meetings	49
tours and inspections flights (by flight companies)	19
test flights by aviation or aircraft companies	23
advertising flights	10
flights by military or border police	52

The percentage of persons interviewed is given, who would make exceptions for the above-mentioned type of flight (question 43).

Table 31: Reaction to Aircraft Noise in the Clusters.

Variable[a]	BSB	BST	BSH	BSA	BSH	LSB	EGE	KAH	KAF
SNF Spontannennung FL	77	13	44	61	52	61	68	55	30
FFK FL-Folgen Kons.	1.7	1.3	1.3	2.0	1.5	1.5	1.5	1.8	1.5
FFR FL-Folgen Reken.	1.9	1.7	1.4	2.1	2.2	1.8	1.8	2.1	2.1
F11 Entspan.drin	2.3	1.9	1.6	2.7	2.7	2.2	2.0	2.7	2.5
F12 Freiheit draußen	2.8	2.4	2.0	3.2	3.6	2.5	2.9	2.9	2.9
ZSF Zunahme FL	92	60	42	48	43	58	66	60	64
KAF Aktl. ärger FL	82	19	23	30	52	30	44	47	54
SFA FL-Ärger	3.7	2.5	2.0	4.8	5.2	3.3	4.2	4.7	3.7
SF Störbarkeit FL	3.6	2.7	2.4	3.3	3.5	2.5	3.2	3.4	3.3
ASF Akzeptierbark. SFL	90	89	93	70	70	93	81	75	90
BSF neg. Bew. Sportfl.	2.8	2.4	2.4	2.8	3.2	2.6	2.9	2.9	2.8
BS1 (Egoismus)	3.1	2.4	2.3	2.2	3.1	2.4	2.9	2.8	2.3
BS5 berecht. Hobby	3.8	4.3	3.9	3.7	3.5	4.0	4.0	3.9	3.9
VSF Verständn. Sportfl.	3.4	3.8	3.9	3.9	3.5	3.5	3.2	3.4	3.5
FVG Flugpl.-Vorteil	1.6	2.0	2.8	1.9	2.1	2.9	1.6	1.6	2.4
PMF physikal. Maßn. g. FL	31	9	14	20	31	12	24	28	8
SMF soz. Maßn. g. FL	26	13	33	67	69	44	59	51	18
M11 Petition 'contra'	13	0	33	67	57	42	56	47	10
M12 Mgl. Anti-FL-Verein	3	0	0	0	10	0	5	19	0
GBS gesetzl. Beschränk.	91	57	70	87	86	63	90	85	70
GBV Glaube an Inst.	2.2	2.5	2.7	2.3	2.2	2.6	2.5	2.0	2.5
PFF Petition 'pro'	0	0	7	2	5	0	0	2	0

[b] Zu den Variablen vgl. Tab. 15. Angegeben sind % bzw. Mittelwerte (Skala: 1-5).

Key:
a. SNF spontaneous mentioning of aircraft noise
FFK consequence of aircraft noise - conversation
FFR consequence of aircraft noise - recreation
F11 relaxation inside
F12 leisure time outdoors
ZSF increase in aircraft noise
KAF recent annoyance due to aircraft noise
SFA annoyance due to sport flights
SF disturbance due to aircraft noise
ASF acceptability of aircraft noise
BSF neg. evaluation of aircraft noise
BS1 (egotism)
BS5 right to hobby
VSF understanding of sport flying
FVG advantage of air field
PMF physical measures against aircraft noise
SMF social measures against aircraft noise
M11 petition against aircraft noise
M12 membership in anti-aircraft noise association
GBS legal limitations
GBV belief in institutions
PFF petition for an air field

b. Compare Table 15 on the variables. Percentual values or average values are given.

Table 32: Discrimance Analysis applied to Cluster Comparison

Clustergruppen: BSB/SFA/KAH--LAF/EGE/BST	
Lambda	o.87
a Variablengewichte:	
FFK* Fl-Folgen f.Kommunikation	.80
FFR Fl-Folgen f. Regeneration	.31
SFA* Sportfluglärm-Ärger	.39
SFL* Störbarkeit Fluglärm	.41
ASF* Akzeptierbarkeit Sportfliegerei	-.35
BSF Bewertung Sportf. Betrieb	.14
VSF Verständnis Sport Fliegerei	.10
MFL* Meidbarkeit Flug.lärm	.39
GBV* Glaube an Bemün. Verantwortlicher	-.50
GBS Gesetz. Beschr. Sportflugbetrieb	.09
b Diskriminanzfunktion signifikant.- * Einzeltest zwischen den Clustergruppen ("t-Test") für diese Variable signifikant. - Zu den Variablen vgl. Tab.15.	

Key: a. Variable weights
- FFK consequence of aircraft noise for communication
- FFR consequence of aircraft noise for recreation
- SFA annoyance about sport flights
- SFL disturbance due to aircraft noise
- ASF acceptance of sport flights
- BSF evaluation of sport flights
- VSF sympathy for sport flying
- MFL avoidability of aircraft noise
- GBV belief in the efforts of responsible officials
- GBS legal limitations to sport flight operations

b. discrimance function significant. -
* individual test between the cluster groups ("t-test") significant for this variable. - See Table 15 for the variables.

Table 33: Comparison with Studies at Large Airports.

Variable	a SFL-Studie BS/F…/BU/KA	b DFG-Untersuchungen HH_k	HH_e	M_{ab}	M_{cd}
c (SNF Spontannennung FL)	(45)	10%	55%	29%	60%
RLF Lärmarten, Rang FL	1.6	2.4	1.0	1.3	1.0
FFR FL-Folgen f. Regener.	1.9	1.3	2.8	2.1	3.0
FFK FL-Folgen f. Kommunik.	1.6	1.5	3.6	2.7	4.0
SFL Störbarkeit FL	3.1	2.2	3.3	2.8	3.7
(ASF Akzeptierbarkeit FL)	(83)	95%	66%	90%	54%

d HH_k = Kontrollgebiet (o. Fluglärmbel.) Hamburg; Daten nach IRLE & ROHRMANN, 1968
HH_e = Expon. Gruppe (nahe Flughafen)
M_{ab} = Areale m. geringer/mittl. FL-Bel. München; Daten nach SCHÜMER & SCHÜMER-KOHRS, 1974
M_{cd} = Areale m. großer/sehr gr. FL-Bel.

e Zu den Variablen vgl. Tab. 15; sie wurden in den DFG-Untersuchungen durch dieselben Fragen (bzw. SNF und ASF dem Sinne nach gleichartig) operationalisiert.

Key: a. Sport flight noise
b. DFG studies
c. (SNF spontaneous mentioning of aircraft noise)
RLF types of noise, position of aircraft noise
FFR consequence of aircraft noise - recreation
FFK consequence of aircraft noise - communication
SFL disturbance due to aircraft noise
(ASF acceptance of aircraft noise)

d. HH_k = control area (without aircraft noise) Hamburg: data from ...
HH_e = exposed group (near the airport)
M_{ab} = area with slight or moderate aircraft noise exposure Munich: data from ...
M_{cd} = area with great or very great aircraft noise exposure

e. See Table 15 for the variables. They were operationa in the DFG studies by the same questions (or SNF and in the same sense).

C - 2

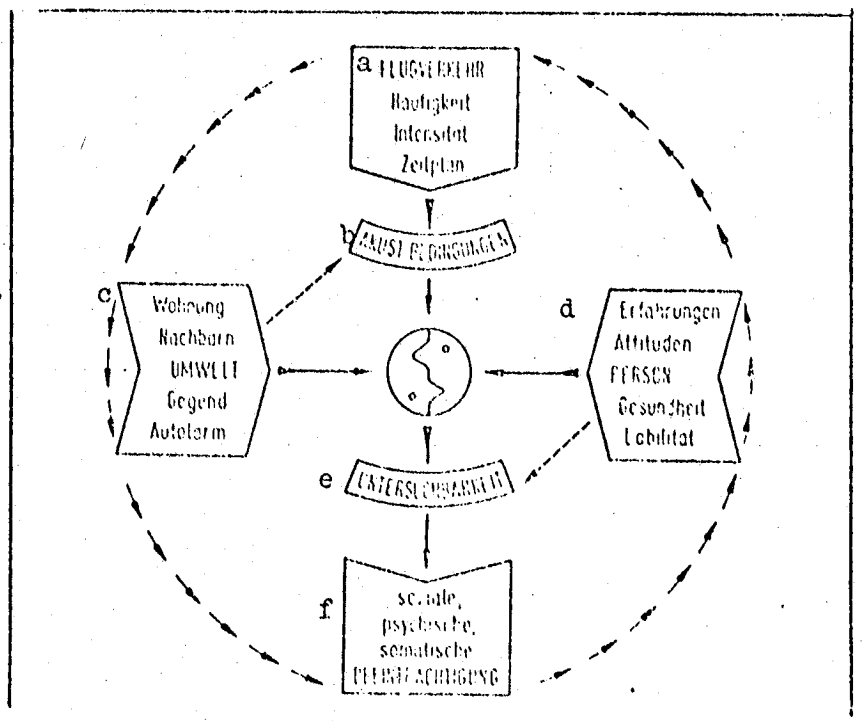
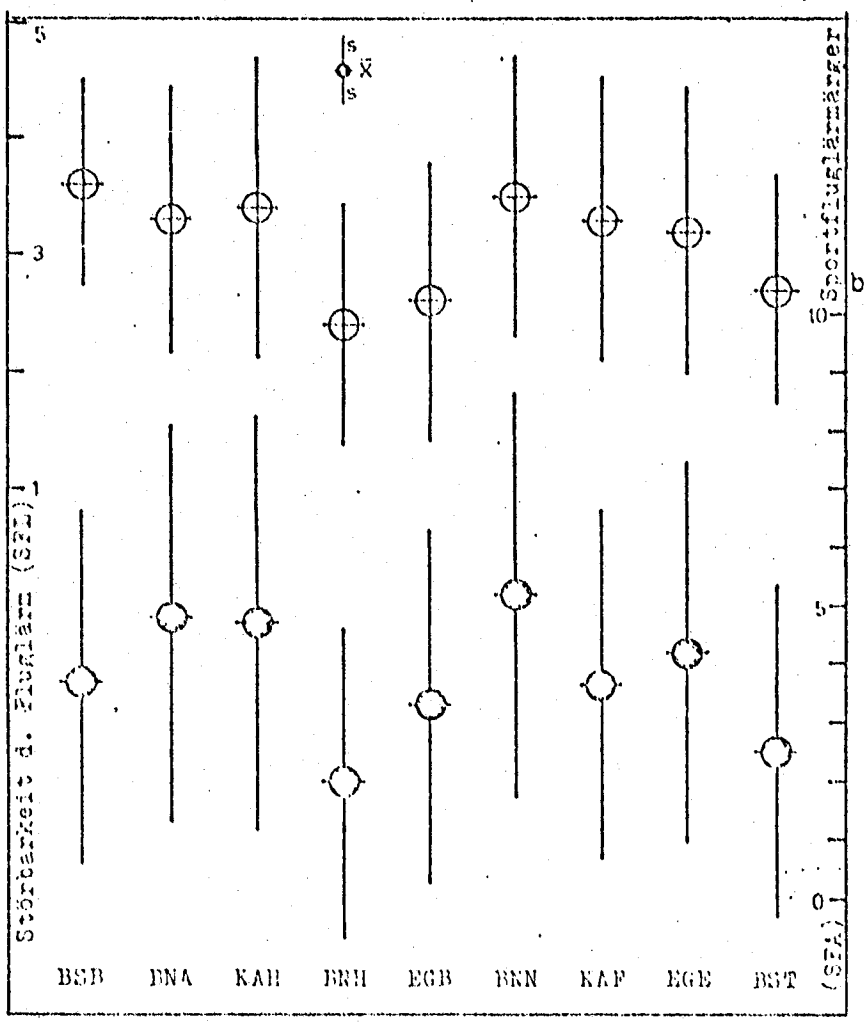


Fig. 14: Parameters for the Effects of Aircraft Noise

Key:
a. AIR TRAFFIC
frequency
intensity
schedule
b. ACOUSTICAL CONDITIONS
c. dwelling
neighbors
ENVIRONMENT
area
automobile noise
d. experience
attitudes
PERSON
health
sensitivity
e. EXAMINABILITY
f. social,
psychological,
somatic
detrimental effects



a

b

Fig. 15: Disturbance and Annoyance due to Aircraft Noise

Key: a. disturbance due to aircraft noise
b. annoyance caused by recreational flights

8: EVALUATION OF THE RESULTS:

8.1: The Problem of Social-Scientific Data:

It is expected from social-scientific studies on the effect of aircraft noise on humans that they provide an aid in decision-making for questions which are, in the final analysis political. How great is the risk to health of constant exposure to aircraft noise? Where is the exposure limit situated beyond which the extent of aircraft noise becomes unreasonable for the population or the negative effects are so considerable that government interference for the protection of the general public or the neighborhood appears required?

In a strict scientific sense, the researcher can, of course, hardly provide a foundation for such absolute statements.

Several points may clarify the problems:

-- The correlations of aircraft noise effects with acoustical variable stimulus variables are too low to make a monocausal cause-effect interpretation possible; the extreme variability in the reactions to aircraft noise alone (even within one and the same noise zone) is already an obstacle.

-- The negative effects on the social, psychological and somatic well-being are quantified on individual relative scales; data on the extent of negative effects (e.g. percentual data on disturbed persons) are then always arbitrary to a certain degree.

-- In the case of the same acoustical noise exposure, various aspects of negative effects lead to different numbers of negatively affected persons; the disturbance threshholds diverge.

-- Finally, what percent of negatively influenced residents near airports are "tolerable"? Whether at 50 or 25 or 10% (or similar value) of disturbed and annoyed persons that degree of annoyance or danger or disadvantage is reached, which is not acceptable, cannot be deduced from social-scientific data (the only clear statement is "no noise -- no noise effect").

The social-scientific description of the effects of noise exposure therefore, does not yet supply any decision on political questions (empirical research results ordinarily state something about how a subject is, but nothing about how it should be; see also the remarks made by Irle (1974) on the "applicability" of results in aircraft noise research).

It must also be considered that the evaluation of the noise sources or the environmental consciousness or the sensitivity to noise, i.e. the social standards on reasonableness (as well as an interacting, acceptable lower limit)

wander just as do the technologies and, moreover, that point, considered by the researcher or legislator as threshhold of unreasonableness with respect to provable effects or non-provable effects, must not necessarily correspond to what the affected person himself considers reasonable or unreasonable.

The points discussed, of course, should not signify that an evaluation and limitation of the aircraft noise stress is not appropriate; there is, indeed, a very pressing need for adequate measures to protect citizens from stresses, disadvantages and dangers. However, in the application of social-scientific data, it must be considered that noise protection regulations are much more social and political "regulations" (also requiring a value judgement on the usefulness and stress in the case of noise sources, on the one hand, and noise reductions on the other hand) as empirical-statistical determinable matters.

8.2: Evaluation of the Aircraft Noise Problem at Landing Fields

The social and psychological survey presented has provided information on the extent to which the flight operations of non-commercial air traffic at commercial landing fields represent a negative and stressful environmental effect for the affected population. The problem presented in 2.5 can be answered in summary in the following manner:

-- The residents near the examined airfields feel disturbed and negatively affected primarily in possibilities for recreation ; i.e. in relaxation and evening quiet (inside and especially outside on the balcony, terrace or in the garden), but also when sleeping (including an afternoon rest); secondly, the negative effect on communication is listed, during listening to the radio, watching television, conversations etc., furthermore, the disturbance when reading and thinking.
-- Approximately half of the affected persons evaluate flight operations as an annoyance; aprox. one-quarter sees a considerable negative effect at least, in the reduction of leisure time and recreation possibilities at home.
-- The extent of reactions to aircraft noise is substantially co-determined by non-physical parameters, especially general noise sensitivity, fears for health due to aircraft noise and the evaluation of the competent authorities (examined statistically, the variability of the aircraft noise effects is determined at about 1/4 by such moderators).
-- About 3/4 of the residents near airfields support the demand for limitations in flight operations, more than half considering the early afternoon, long night quiet after 7:00 p.m.) and Sunday afternoon and the majority not wanting to accept any exceptions.

The affected persons consider aircraft noise as the most unpleasant type of noise in the social environment, and they evaluate it mainly as the most negative factor in their concrete living conditions.

Several causes are obvious for explaining these empir results:

-- The populated areas near the landing fields are comple residential areas with a quiet suburban character, frequently situated in garden areas and chiefly withou main thoroughfares and other loud noise sources, such industry and commercial activities.

-- Flight operations are carried out especially frequentl at those times, specifically, afternoons, evenings and during the entire weekend, in which the residents near airport are at home and undertake leisure time activit or also only look for quiet.

-- The levels which occur do not reach the noise levels o large commercial airports or military airports, but th do clearly exceed the given background level as a rule (or even limit values, as established for residential areas in the Technical Ordainance on Noise, or the VDI guideline 2058 or the DIN 18005, specifically $L_{eq} \geq 50dB($ In this connection, two remarkable judgements of the County court in Krefeld are mentioned (quoted according to Lamers, 1977?, and Dahl, 1975); in the first case, the airfield cooperation, Krefeld/Egelsberg -- with ref erence to the VDI guideline 2058 -- is subjected to a "limitation in flight operations, through which the cor stant sound level is limited to 50dB(A)", since a con- siderable (in the interpretation of paragraph 906 of th German Civil Code) effect and, additionally, not custom for the location is given at the affected property (sit uated in a purely residential area) and the residents have "the right to rest, relaxation and recreation, especially on weekends"; in the second decision, commer advertising flights were forbidden in the time from 12:30 p.m. to 3:00 p.m.

-- Even when the given sound level is considered reasonabl (for example, under the aspect that the above-mentioned guidelines permit the levels to be exceeded up to 30dB for short periods), on the other hand, the considerable frequency of take-offs, landings and traffic circuit fl overs (at the landing fields examined here, between 25 and 50-thousand take-offs anually) must be considered; The result at certain times, is an almost continuous sequence of noise events (but without constant noise, possibly easier to tolerate).

-- For the number of aircraft, a further increase in the number of flights must be assumed; Jokiel (1957) predic a tripling up to 1990.

-- Especially in the case of citizens, who have settled ou side the large city centers, higher demands on the acou stical environment must be expected; just these are disappointed in view of aircraft noise stress.

(The residents may have already been conscious of this fact, but not of the extent of continuously increasing flight operations, which have increased considerably in the 9 years of average residence (compare 7.1).

In this connection, several social-psychological considerations are presented.

Aircraft noise is not self-generated noise (as in the case of lawn mowers) and cannot be generated by the residents (if they are not pilots); such noises are possibly easier to accept (compare, for example, Sader, 1966).

Noise, understood as undesirable stimulus, is inescapeable: there is no choice between perception and nonperception (you can close your eyes, but not your ears). Furthermore, flight operations are neither subject to a scheduale which can be understood by the residents, nor can it be influenced at all in detail; the possibly resulting feeling of a certain powerlessness may be a factor in the evaluation of aircraft noise (noise experiments carried out by Glass and Singer (1972) on the influence of "predictability" and "controlability" point in such a direction; Irle (1974) interprets this with the statement, "aircraft noise is also a stress factor in the environment, to which the affected persons are subjected passively due to a lack of predictability and controlability").

Finally, it must be considered that the persons interviewed are chiefly owners of the apartment or the house and already for reasons of ecconomics, very limited in possibilities for escaping the noise stress.

When the noise stress due to flight operations at landing fields is measured against the health definition of the World Health Organization (WHO), it can be stated that the right to social, psychological and somatic well-being is not satisfied to an appropriate degree.

There may be no damage to health in a physical sense, measured against the medical criteria of Jansen (1967, 1973, among others) or Klosterkötter (1972, and 1973 among others) or even manefest diseases, at least not in the case of healthy persons but the continuous disruption to daily activities as was determined here, signifies at least a psychological and social deterioration of individual possibilities, for fulfillment and it cannot be excluded that a permanent reduction of recreational functions (although only during the day) has long-term somatic consequences (Glass et al. (1969), for example, point to the "psychological costs" of the adjustment of performance behavior to noise). Referring directly to aircraft noise, Alexandre (1973) reaches the conclusion: in a comparison of European and American studies, frequent disruptions to language communication represent the limit of tolerability (even Klosterkötter (1973) sees this as a decisive limitation in living quality"; such noise effects are also listed by the persons interviewed.

A definitive evaluation of aircraft noise stress (this was already demonstrated in the considerations of the "Committee on the Problem of Noise", 1963, or Grandjean et al., 1969), however, is difficult -- as was already explained in 8.1 -- and that also applies when reference is made to the concepts "dangers", "annoyances" and "disadvantages", assuming central significance in numerous legal regulations and also in the Federal Immission Protection Regulation (1974).

According to predominant interpretation of these concepts (compare for example the Immission Protection Regulation Commentary by Feldhaus, 1974, or the evaluation under noise aspects by Klosterkötter 1974), danger to health can probabaly not be considered near landing fields due to aircraft noise or only in the broader sense of AHC; annoyances, understood as "negative effects on the physical and mental well-being" and as disturbing effect on performance, mutual communication and recreation, are clearly present; when not only losses in capacity are considered disadvantages, but also (less material the negative effect on the personal living state (e.g. usually having to close windows, or being continuously annoyed by noise outside (on the terrace, in the garden, on the balcony)), then a disturbing environmental effect can also be stated in this interpretation.

When the interest of a representative, intelligent citizen in a living space protected from environmental dangers is taken as a measure (Feldhaus, 1974, p.12), it can be stated in summary that the population near landing fields is annoyed continuously by aircraft noise and subjected to disadvantages; a substantial portion of the affected persons assesses this negative effect as considerable for certain times and with respect to certain activities.

8.3: Measures for Reducing Aircraft Noise Stress:

The necessity for measures against excessive aircraft noise stress results from the evaluation of aircraft noise problems. Such measures have also been demanded for the landing fields for years (not included in the Regulation for the Protection Against Aircraft Noise (1971)), and the Federal Government hopes to pass an appropriate legal regulation soon.

The ideas about desirable and achievable possibilities in combating aircraft noise, however, are divergent, as was recently demonstrated in the podium discussion on "recreational flight and noise" (essen, May 9, 1975); of course, the demands, on the one hand, of pilots (represented by the German Aero-Club DAeC -- see for example Luftsport 5, 1975 or Flugrevue 7, 1975) and, on the other hand, the persons affected by aircraft noise (organized in the Federal Association Against Aircraft Noise; see for example Ceser, 1974) differ considerably and even the public offices -- cities, states, nation -- are often involved in conflicts of interest.

Some information on the situation in Egelsbach is given as an example (the landing field with the greatest number of flights in the Federal Republic of Germany):

-- The airfield corporation apparently intends more emphasis on business travel to the detriment of training flights and recreational flights (according to the "development plan", 1971, and Fluch, 1975): The classification as landing field class I. will be achieved by expansion.

-- According to the State development plan in Hessia for 1980, expansion should put Egelsbach in a position to assume the so-called general aviation and a portion of the regional air traffic to reduce the load on Frankfurt (compare Apfel and Weber, 1973).

-- An increase in the load on Egelsbach resulted due to traffic limitations for lighter aircraft at the large airport in Frankfurt.

-- The expansion of motorized flight operations (up to 1955 only gliders) was already cause for annoyance to the farmers, who threw hay on the runways ("hay farmers").

-- The citizens' initiative against aircraft noise is against any expansion of flight operations (according to Eppendahl 1975) and demands, among other things, a total bann on flights for the early afternoon and weekend (but does want to accept recreational flying in Egelsbach) and places emphasis on increased sound protection requirements the desired criterium is the Technical Ordainance on Noise.

-- There is a regular aircraft noise commission (on the pattern in Frankfurt), in which the state of Hessia, the affected communities (Egelsbach, Erzhausen), the airfield company, the citizen initiatives, etc. are represented.

-- Since 1972 time limitations on flight operations were introduced, but only for training flights (compare 7.3).

-- The success of flight regulations related to noise protection depends mainly on whether the tower is occupied and by whom.

-- The mayor of the community points to a medical opinion commissioned as an aid to planning; zones exposed to high levels of noise and not yet developed should also be kept free of homes with the aid of the development plan, and an expansion of the airfield should only be accepted under the aspect of safety; the work of the aircraft noise commission is considered successful (Simon, 1975).

-- An area of new construction with appartment buildings (Bayerseich) was almost positioned in the area of the approach and departure flight path (further expansion, however, of this appears to be stopped).

-- Several hundred places of work exist at the airfield in Egelsbach (especially because of an aviation company); in contrast, there are no ecconomic advantages for the community of Erzhausen on the other side, also affected by the noise.

Numerous problems and conflicts of interest presented here, exist in similar form at other landing fields.

While the pilots insist on the "freedom in air traffic based on legal regulations up to now" (Luftsport 5, 1975 p.4), the affected population demands extensive limitations at numerous locations or even a bann on motorized flight operations (as partially in St. Augustin); the decisive conflict is centered in the fact that the time in which most pilots exercise their sport (perhaps the only time available to them), is precisely that time in which the residents near airports are usually at home and wish to pursue their interests without any disruptions (the fact that many flights are aimed at areas with lovely landscapes serving for recreation, intensifies the problem).

Under these circumstances, the Federal Association Against Aircraft Noise is demanding a bann on training, tour, towing and advertising flights on weekends and holidays, ... procedures for reducing aircraft noise, minimum of flight altitudes, of 800m over cities, otherwise 500m, and a bann on night flights from 10:00 p.m. to 7:00 a.m. (according to Ceser, 1974, p.21).

In view of the contradicting demands, the "legal ordainance on the temporal limitation of flight operations with light aircraft and motorized gliders at landing fields" prepared by the Federal Ministry of the Interior (in coordination with the Traffic Ministry) apparently represents a compromise; this should "take into consideration the requirements for protecting the population as well as the justified interests of recreational flight" (Vogel, 1974 p.101).

How well does this draft coinside with the opinions of the interviewed residents near airports? The result presented in detail in 7.5 produced the following:

-- All times in which a bann on flights was demanded by the majority, by taking into the consideration in the ordinance

-- In addition, however, better protection for early evenings, approximately after 7:00 p.m., is desired (for example in Egelsbach, but only for training flights).

-- Generally, the majority of persons surveyed does not desire any exceptions to the flight limitations; this also applies to test flights of aviation or aircraft companies (or demonstration and sale flights), not specially named in the ordinance draft.

(There is even only limited understanding for deployment of the army, police and border police in the times to be protected.)

Whether an actual reduction in aircraft noise stress would be experienced when the ordinance is put into effect will probabaly depend upon how consistantly it is interpreted with respect to the times, and above all, the types of flights included in the ordainance.

Two unfavorable effects appear possible:

-- The time limitations, of course, lead to a shift to other times of the day; in-so-far as these are not the limited evening hours (e.g. 6:00 to 9:00 p.m.) as well as Saturday afternoon and Sunday morning, causing a considerable increase in the flight frequencies at these times, other times, in turn will be especially negatively influenced, important for the psychological and physical recreation of human beings.

-- If it should become possible to receive permission for flights and flight equipment which would be included in the banns in a strict interpretation because of possible weaknesses in definition (for example in the limitation of recreational and business flights etc.) or deficiencies in technical controls with respect to sound protection data, the goal of stress reduction for the residents near the airports would be more difficult to obtain.

Such arguements lead to a certain skepticism with respect to the ordinance in the case of the surveyed citizen initiatives (as reported by Eppendahl).

Since the limitation on flight operations at certain times can only reduce the flight frequencies to a certain degree, the reduction of the sound level attains special significance. In this case, the ordinance gains substantial momentum due to the regulation on exceptions for aircraft fulfilling the increased sound protection demands.

Last but not least, psychological aspects -- such as the observation that the louder aircraft apparently contribute an over-proportional amount to the arisal of disturbance and annoyance -- make it important to interpret the concept "state of the art in technology" according to environmental protection, i.e. to place more strict demands, not only on new permits but also on the presently available aircraft (corresponding recommendations were presented by the expert commission for environmental questions; compare also Jokiel, 1975). Higher taxation of louder aircraft types is also demanded (Eppendahl, 1975).

Much informal information from the interviews also points to the importance of especially loud fly-overs (example: towing aircraft). On this topic, Rylander and Sörensen (1972, 1973) are mentioned, who begin with a maximum level concept for the aircraft noise annoyance at commercial airports -- specifically, the loudest individual aircraft type is a determining factor.

The fundamental problem, continuously increasing the extent of the aircraft noise stress, is the spatial growing together of residential areas and areas emitting noise, such as the airports.

The interviewed residents near airports point to the fact that they did not move away from the city to live in a noisy environment; the recreational pilots present the arguement that the airfield was usually there before. Both arguements are correct in principle, but it must be considered, on the one hand, that the air traffic has increased to an extreme degree in the past 10 years, (compare 2.1) -- probataly more than even careful contractors suspected -- and in addition, the expansion of the landing fields was often carried out only in recent times (Egelsbach: 1977; Fonn: 1970), but on the other hand, it must also be stated that in numerous areas exposed to noise, construction is being continued without any thoughy) as is also demonstrated in the sample drawing).

The consequence can only be to develop better possibilities of construction planning, above-all, extensive in area as in time.

Precisely because human settlements cannot be made into cement bunkers, sound protection measures on the part of the receiver (with respection to immission) can only produce a reduction but no solution to the problem of aircraft noise, but the measures on the part of the transmittor (the emitter) produce less results with a decrease in the distance between transmittor and receiver of the noise, the population and area planning near airfields gains in significance if excessive noise stress is to be prevented at least in the future (compare on the subject the considerations, also relevant for landing fields, presented by Foewer, 1968, 1969, or the information in Sandia, 1975).

The success of measures for reducing aircraft noise effects is, of course, not only dependent on physical, but also on psychological factors. First of all, the extent of the noise stress must be noticably decreased but, moreover, it may be important that the limitations in flight operations are controlable and predictable for the affected persons, that a regulation -- even when it cannot satisfy all parties as a compromise -- is perceived as an actual agreement and is maintained; also, an appropriate public office to which questions or complaints can be presented (similar in type to the ombudsmen) may have a useful function as reduction factors. (The effect of moderators of aircraft noise effect presented in 7.4 above-all, the social evaluation of the airport situation, supports such considerations).

Finally, any noise protection regulation is situated between two extremes: If the basis employed is that hardly anyone becomes ill as a direct result of aircraft noise (as is the case with poisoned food), or employ the adaptation capacities of human beings, there is hardly any need for restrictions; however, when it is considered that even beyond the direct flight paths considerable portions of the population feel the negative influence of aircraft noise, only a complete halt of air traffic would be a promise for an end to the stress.

Then, whether measures, such as the legal ordinance discussed, is evaluated as sufficient or insufficient for the annoyances and disadvantages to the affected population studied and documented in this research, depends on the premise of the consideration of values (compare 8.1); it certainly contributes to "assuring human beings an environment which they require for health and a dignified existence" (environmental program of the Federal government, 1971).

8.4: Considerations for Further Research:

The social-psychological field study presented has produced numerous data for evaluating the aircraft noise problem at landing fields; it is probably obvious that the analysis of the complex interdependent structure of aircraft noise effects on humans could not be exhaustive.

A criticism on the content of the questionnaire employed (which was not as detailed in some points as would have ... perhaps been desirable upon later consideration) would lead too far here. This report, however, should be concluded by several, more fundamental remarks about further research, produced from the interpretation of results:

-- A survey with a standardized questionnaire will only be able to demonstrate the effects of aircraft noise on ... daily behavior to certain limits (just as experiments in the laboratory); research methods, in which the real-life situations and spontaneous reactions of affected persons in their customary circumstances are limited as little as possible (explorations, observations of behavior, perhaps physiological telemetry) would have been better capable of demonstrating the behavioral areas negatively affected.

-- Cross-sectional studies (such as the one presented here) acquired data on continuous manifest effects of aircraft noise. How noise processing develops should be examined by longitudinal studies (for example, also with persons who first moved to the neighborhood or in the case of new examples of aircraft noise conditions).

-- It still appears unclear how aircraft noise should be evaluated in the relationship to the affect of other types of noise (on the one hand, with respect to the reactions of the affected persons, perhaps interacting with one another, on the other hand, under the aspect of competing noise protection regulations).

-- It must also be considered unexplained, also in the case of aircraft noise, whether the peak level or frequency of the noise events are more responsible for the resulting disturbance and annoyance (this also has effects on the appropriate evaluation measure, but also the strategy of combatting aircraft noise).

-- When the extent of a noise protection regulation is considered suitable by individual officials (such as in the case of the projected legal protection regulation on flight operations with light aircraft and motorized gliders), then, suitable social-scientific data should be gathered for such a decision (especially on the structure of the population and its density).

-- Procedures may possibly be developed for political information measures (beyond what results from the area utilization plans) to inform citizens at least, about the possible consequences for personal well-being before moving into an area subject to noise, so that such a decision can be made after sufficient consideration (especially persons who are less robust in relation to environmental stress should be able to estimate expected negative influences, wherever necessary).

Finally, research should not only serve the purpose of provising more data on what must be protected and what can be protected, but also contribute to the search for an empirical foundation and control for actual measures of aircraft noise protection. In this interpretation, a type of accompanying research appears necessary, in order to observe the effects (and repercussions) of noise protection regulations and to learn from these for further planning of environmental protection.

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