

Psychological Analysis of Complainants on Noise/Low Frequency Noise and the Relation Between Psychological Response and Brain Structure

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In Japan there are two kinds of low frequency noise (LFN) problems. One is LFN that can be heard directly in a house and causes discomfort, and the other is LFN that rattles windows or doors and causes annoyance. Authors met about 100 complainants on noise or low frequency noise. Hearing thresholds of some complainants were measured and Yatabe-Guilford personality inventories of some complainants were carried out. We observed many complainants and tried to analyze the complainants' mind by the psychoanalytical method. Their minds have three layers. The 1st layer is the basic desire for survival and good life etc. The 2nd layer is personality or consideration obtained by experience and the 3rd layer concerns movement, speech or action etc. Many complainants lack the 2nd layer on noise/low frequency noise and their movements and reactions on noise/LFN appear directly from the 1st layer of basic desire without consideration of the 2nd layer. The findings of the three layers are discussed in relation to present knowledge on how the different parts of the brain are organized.

1. EXAMPLES OF LOW FREQUENCY COMPLAINANTS

1.1 CASE 1

Figure 1 shows the hearing threshold measured in our laboratory and the low frequency noise measured in the complainant's room (windows are closed). The sound source is fan exhaust noise from duct exits in a factory. The measured low frequency noise is nearly equal to the average threshold. Complainants are annoyed very much by low frequency noise and the family moved to another rental flat. In particular a female complainant fears of physiological affection by the LFN. The countermeasures were to fit silencers and fix the base of the fan rigidly. The tone of 50 Hz disappeared and the level decreased by 5 dB. LFN in the house is now very little over the level of ISO-389-7 and the existence of LFN is not apparent. The fear disappeared and they

could live in their original house. The hearing threshold of this female complainant is almost the same to the average threshold measured in Yamanashi University. In this case psychological counseling by one of the authors helped the recovery.

1.2 CASE 2

Figure 2 shows the measured level at the complainant's house. The sound source is a textile factory and an exhaust duct. The factory worked until 10 p.m. and the level is a little over the average hearing threshold. The factory and the complainant's house are very close and audible noise can be heard at an open window. At 1 a.m. the factory did not work and the complainant (female) recognized that the factory did not operate. But at 3 a.m. she woke up and she felt that the factory was in operation. But the factory did not operate. She is very nervous and when she woke up in the night, she has some

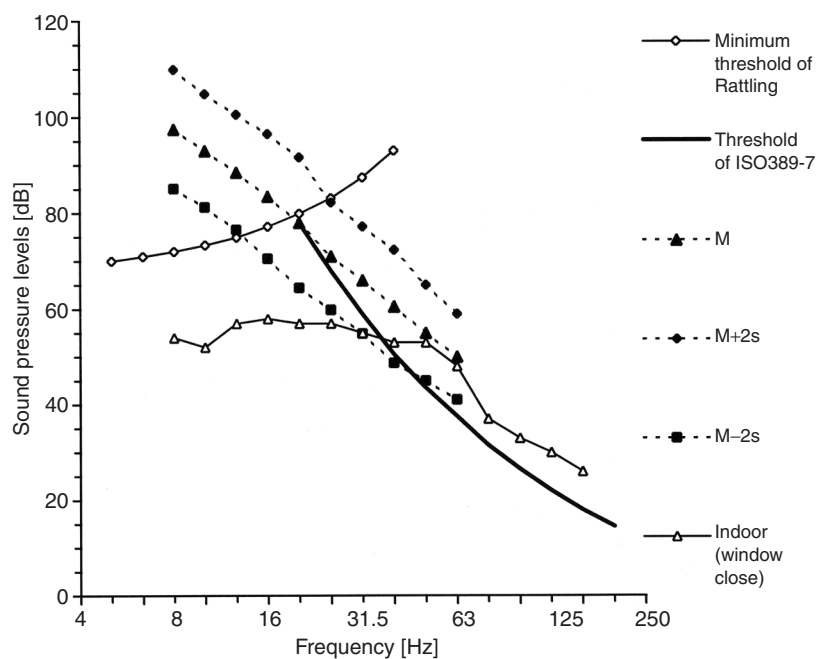


Figure 1. Hearing thresholds of LFN and the level in complainant's house.
M : Average threshold (measured in Yamanashi Univ.)
s : Standard deviation (measured in Yamanashi Univ.)

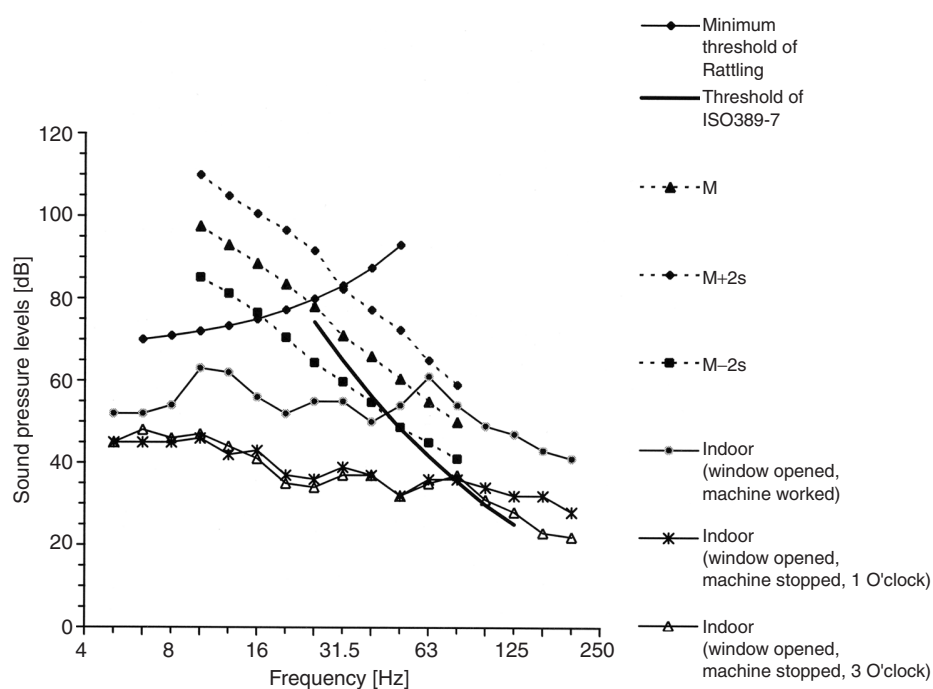


Figure 2. Hearing thresholds of LFN and the level in complainant's house.
M : Average threshold (measured in Yamanashi Univ.)
s : Standard deviation (measured in Yamanashi Univ.)

confusion and misunderstood that the factory operated. The owner of the factory said that in the night the factory does not operate. The human relationship between the owner and the complainant is very bad.

Many complainants are classified into three groups as shown in Table I. The first group includes ordinary low frequency complainants. They are annoyed indoors with window closed. When they open windows, the annoyance decreases. They hear music indoors for masking the LFN.

Another complainants complain of LFN and audible noise. When the windows are closed, they feel LFN and when the window is opened, they complain of audible noise.

LFN is difficult to understand scientifically and sometimes misunderstandings occurs. Some complaints have no correspondence with facility operation. Even if a machine stops, he/she complains. In many cases they have bad relationships with neighbours. Sometimes they have much hearing loss and tinnitus. They think that the noise in the ear comes from outside.

2. HEARING THRESHOLD OF COMPLAINANTS

Figure 3 shows the threshold of young listeners and the threshold of complainants measured in our laboratory. Sometimes it is said that the complainants are more sensitive than ordinary people and the thresholds of

complainants are lower than that of ordinary people. But this figure shows that the thresholds are almost the same. The individual thresholds are included in the range of $M \pm 2s$ (M : average, s : standard deviation) of ordinary people. These complainants are not sensitive to LFN but they are sensitive to annoyance. When the level of LFN just exceeds the threshold, then they are easily annoyed.

3. THE YATABE-GUILFORD PERSONALITY INVENTORY(SEE APPENDIX I)

The Yatabe-Guilford Personality Inventory was used to assess 12 low frequency complainants. The result is shown in Table II. In the table the numbers show the number of complainants.

This result shows that the personality of “stable and active” appears a little more and “mediocrity” appears a little less. “Stable and positive” is a good personality in normal life. There are not very clear personalities in these complainants but the number of the subjects is not sufficient. By the observation of one of the authors, complainants may be normal citizens in ordinary life.

4. PSYCHOLOGICAL ANALYSIS OF COMPLAINANTS

Complainants are annoyed and they have many problems on their minds. We meet these complainants and do

Table I. Classification of complainants

Ordinary LFN complainant	Annoyed, especially indoors Open window decreases annoyance
Complex complainant of LFN and noise	Window open: annoyed by audible noise Window closed: annoyed by LFN
Complainant with misunderstanding	Complains, but level is too low Can not recognize operation of the source Bad relationship with neighbours Sometimes complain of radio etc. Tinnitus

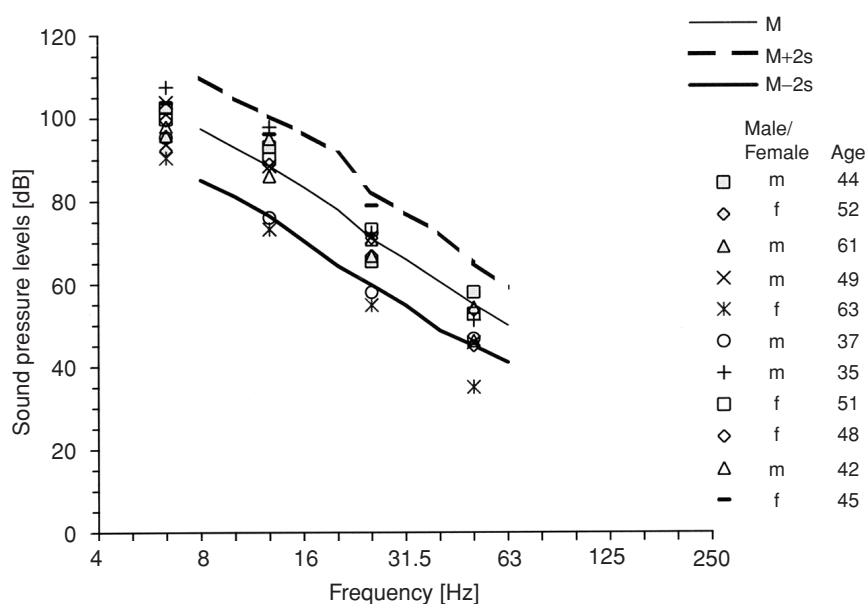


Figure 3. Threshold of complainants.
M : Average threshold (measured in Yamanashi Univ.)
s : Standard deviation (measured in Yamanashi Univ.)

Table II. Result of Yatabe-Guilford Personality Inventory of 12 low frequency complainants

A	0	B	1	C	0	D	1	E	0
A ^I	1	B ^I	1	C ^I	0	D ^I	4	E ^I	2
A ^{II}	0	AB	1	AC	0	AD	0	AE	1
Mediocrity		Unstable		Stable		Stable		Unstable	
		Active		Passive		Active		Passive	

psychological counseling for them. In counseling we analyze their mind by the psychoanalytical method. Much data on the psychoanalysis of complainants shows that normally human being have three layers in the mind.

1st layer: The human being has the desire for existence, appetite, sexual desire etc. in the base of mind. Commonly these desires are not clearly conscious. But in the base of mind these desires support human life and behaviour. The origin of these desires is the limbic system in the brain (1).

2nd layer: This layer is the main layer of the 'consideration' system and is derived from many experiences, in the learning and development of each

human being. A human being can be conscious of this layer partially or vaguely. This gives rises to logical consideration of stimuli etc.

3rd layer: Speech, movement, behaviour which can be observed from outside.

We observed about 100 complainants and analyzed their minds from observation, conversation and measured sounds. They are all normal citizens but sometimes they lack the 2nd layer, especially with respect to low frequency noise or audible noise. Apart from the noise problems they have normal comprehension and they have the 2nd layer. But when they are annoyed by low frequency noise, they feel the annoyance directly at the 1st

layer without the 2nd layer and they have no reasonable understanding of LFN problems.

5. THE STRUCTURE AND ROLE OF BRAIN

By the survey of literature (1) the structure and the role of brain in the human body are as stated in Table III.

The limbic system controls emotion, appetite, sexual behaviour and basic learning or memory. Emotion means anger, fear, unpleasantness, pleasantness, and award and aversive systems. Pleasantness and award systems means 'profitable' conditions for the living body and unpleasantness and aversive systems means 'non-profitable' conditions for the living body. The corpus amygdaloideum evaluates, whether the value of the phenomenon is 'profitable' or 'non-profitable' for the living body. Unpleasantness or annoyance occurs when the phenomenon or noise is harmful or 'non-profitable' to the living body.

The 1st layer of complainants corresponds to the limbic system.

The limbic system is an old brain and common with animals. It is a very important system for the survival existence of animals. Complainants may comprehend the biological evaluation of low frequency noise for the living body

without consciousness.

The frontal association area controls the emotion or unpleasantness by means of knowledge, learning and memories. This frontal association area has many neural connections to the limbic system. The 2nd layer of complainants corresponds to this frontal association area.

The hypothalamus is the centre of the autonomic nervous system for respiration, circulation, digestion, and the control of internal secretions. When annoyance occurs, it affects respiration, heart rate and internal secretion (3).

6. TO SUPPORT COMPLAINANTS AND TO SOLVE PROBLEM

Complainants complain of low frequency noise, and psychological and physical discomfort. When we accept a complaint from a complainant, we make efforts to solve the problem by the following procedure, considering the psychological counseling methods.

1. When we receive complaints from a complainant by phone, we hear the complaints for one hour or a half. Basically at first we do not deny the contents of the complaints. We make an effort to get a good relationship with the complainant. Psychologically this good relationship means "rapport".
2. We analyze the contents of the

Table III. Part of brain and role of brain

Part of brain	Role
Frontal association area	Comprehension, understanding, judgement, thinking, control
Limbic system	Control of emotion, affection, instinct, instinctive behaviour, pleasantness, unpleasantness
Hypothalamus	Centre of autonomic nervous system for respiration, circulating system, digestion, control of internal secretion
Corpus amygdaloideum	Biological value evaluation, judgement of value
Hippocampus	Memory, including memory of vision and audition Increase of pleasantness and unpleasantness by the memory of audition In the memory of emotion there is a connection between the hippocampus and the corpus amygdaloideum

complaints and classify them into acoustic, psychological and physical phenomena.

3. Sometimes complainants have fear of low frequency noise (LFN). We try to decrease the fear. We explain simply that there are high levels of LFN in a car or in an airplane but we are not damaged directly.
4. We ask the complainant if there is measured data or not. If not, we ask the complainants to contact the city (local) authority and to measure the sound. If possible, we visit the complainant's house and measure the sound.
5. At the end of the conversation we say "You can contact us at any time" to keep the complainant's mind calm.
6. If there is a real LFN problem, we help the complainant to solve the problem. We recommend them to complain to the city authority or speak directly to the source without aggression. There are many methods to reach a settlement by the complainant, by the city authority, by mediation, by arbitration or by judge.
7. If the measured data is very small and he/she can not identify the on/off of an assumed source, we ask carefully about the time history of the complaint and the relationship with the neighbour etc. We try to assess the complainant's attitude and personality and make an effort to understand his/her mind totally. Normally there is a cause why he/she feels discomfort not by LFN but by another cause. In some cases there was formerly a sound problem but countermeasures were done and now the complainant cannot identify the on/off of the source. This situation is a psychological after-effect and normally there is a bad relationship with a neighbour.

We discuss this situation gently with the complainant. But the complainant does not accept this easily. We wait

for some months. The situation of the complainant changes in everyday life and there arises some chance to solve the problem. The role of counseling is to help and support the complainant to solve the problem by the complainant's own will.

8. If there is the possibility of tinnitus, we ask them to measure the hearing threshold. And we ask them whether they feel something in an anechoic room. Many people hear tinnitus easily in an anechoic room. And if the tinnitus sound resembles the sound in the house, we do a matching test, if possible.
9. Human beings have complex patterns of thinking and behaviour. We try to understand them totally, including LFN.

CONCLUSION

A complainant is a human being and human being has a control system to keep them stable. To solve low frequency or other noise problems it is important to think of the complainants totally psychologically and socially, and to help them not only with countermeasures but with counseling.

LITERATURE

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- (2) Shinji Yamada et al., Difference of low frequency noise influence between sufferers and students, Inter-noise 85 in Munich, pp. 1001-1003, Sept. 1985.
- (3) S. Yamada et al., Physiological effects of low frequency noise, J. LFN, vol. 5, no. 1, pp. 14-25, 1986.

APPENDIX I

Yatabe-Guilford Personality Inventory
This personality inventory is basically developed by J.P. Guilford and improved by T. Yatabe, and is widely

used in Japan.

This personality inventory has 200 questions and a subject selects one from three answers (yes, ?, no).

One example of a questionnaire

Are you joyful? yes ? no

This inventory classifies the personality

into 5 categories. 5 categories are

A (Average: Mediocrity), B (Blacklist: unstable and active), C (Calm: stable and passive), D (Director: stable and active), and E (Eccentric: unstable and passive).

PEAK-HOUR NOISE MONITOR METERS AT 30 KEY CROSSINGS

Alarmed at rising noise pollution, the West Bengal Pollution Control Board has decided to monitor sound levels at 30 road intersections across the city of Calcutta. The move follows a sample survey conducted recently by the board in Salt Lake, Lake Town, Belegkata, Behala, Minto Park, Burrabazar, Jadavpur, Rabindra Sarani and Shyambazar. The peak-hour noise at all these places were found to be between 70 and 80 decibel (dB). According to the norms set by the Board, the permissible daytime sound level in residential zones must not exceed 55 dB. For commercial and industrial areas, the permissible limits are 65 and 75 dB. The corresponding figures for night are 45, 55 and 65 dB. "There is no denying that the peak-hour noise at some places is really unbearable. Indiscriminate blowing of air horns disturbs students and adds to the patients' woes in hospitals. We are trying to evolve some effective means to curb the menace," said pollution control board member-secretary Shyamal Sarkar. The projects lined up by the Board include installation of sophisticated sound meters at 30 locations. An action plan will be prepared based on the findings, Sarkar added.

USEFUL NOISE

Noise is usually nothing more than a disturbance, but sometimes it can be useful. Researchers have discovered that noise could bring order to chaotic systems, protect and maintain entire marine ecosystems, and even make the chemical industry greener. Changsong Zhou and a group of physicists at the University of Potsdam, Germany, are studying chaotic systems, known as excitable media. The firing of neurons in the brain is an example of such a system, as is the growth and receding of blooms of plankton in the sea. Such systems do not become excited by small signals but if they are stimulated above a threshold amount, then they give it their all: neurons fire and plankton blooms. "Similarly, excitable non-linear behaviour is also found in chemical reactions," explains Zhou, "where an external pressure or light can push a reaction down one route instead of another." Zhou and his colleagues have found that the key to this sort of excitation is chaotic mixing and noise. The researchers demonstrated how a non-linear system can be controlled to become synchronized even when its stimulus is below the threshold by the addition of noise to the system. The results based on their model study imply that oscillatory behaviour in many natural systems, rather than being disturbed by noise, is thus sustained by it. For instance, the "noise" in a marine ecosystem due to temperature changes, ocean currents, wind-driven waves, fluctuations in nutrient levels, the movement of schools of fish, and wind-drive waves affect how plankton blooms grow and recede. If the conditions are below an optimum the plankton do not grow, but they can be forced into action by noise, and once they are stimulated the whole system is activated and a marine landscape is quickly blanketed by the bloom. Zhou's results suggest that without noise such blooms might be physically unable to flourish in some areas or might not follow the usual seasonal cycles. "Noise might be essential to maintaining the stability and the persistence of marine ecosystems," Zhou says. This research might therefore help environmental scientists predict or even prevent toxic plankton blooms by observing the natural noise that affects them. Zhou and his colleagues also suggest that noise might usefully be used to control chemical reactions. They explain that random disturbances in industrial mixing tanks could be promoted to make a reaction proceed more efficiently and so reduce chemical waste, making the chemical industry a little more environmentally friendly.

INFAMY, INFAMY ...

Ripple Effects, a nightclub in Boiling Springs, near Cleveland, Ohio, managed to get six citations for noise over a two-night New Year's celebration. But owner David Grayson sees conspiracy. Sometimes, when the police arrived at the club, responding to a citizen's complaint, the band wasn't even playing, yet Mr Grayson was given a 'ticket'. Grayson went on to say that the club has had complaints even when it's not been open. He believes that people are targetting the club, and town officials, including the police, are not doing their duty to protect his and his club's constitutional rights.

TRAIN WHISTLES

Train whistles in Fargo and in neighboring Moorhead, Minnkola, may be hushed as early as summer 2006, more than a decade after discussion of the idea began. City officials say they have reached a tentative deal with railroad officials on about \$7 million in safety measures the cities will need to purchase to allow trains to go whistle-free for about three miles through the heart of Fargo-Moorhead. Moorhead City Engineer Bob Zimmerman and Mark Bittner, Fargo's city engineer, said that lawyers for Burlington Northern Santa Fe Railway are drafting a deal based on negotiations the city officials had with the railroad in November and December. Bittner said the deal will likely not be final until after April 1, when new federal standards for train whistles come into effect. The rules, which replace railroad procedures and state whistle laws, require trains to sound their horns at all intersections unless they meet specific safety standards. Having those rules in place as well as the death of 10 pedestrians, killed by trains in Fargo-Moorhead since 2000, likely helped hasten the deal, Zimmerman said. "I think both the city and the railroad are both somewhat anxious to get started because of the accidents that have happened in the last few years," he said. The railroad will need about a year to install the city-paid safety improvements once an agreement is reached, meaning the quiet zone could be in place by the summer of 2006. Zimmerman said he expects the project will cost about \$4.7 million in Moorhead. Federal and state grants will cover about \$3.9 million of that, with the city paying the balance with state transportation aid. In Fargo, Bittner expects the improvements to cost about \$2.1 million, of which \$750,000 will be paid with a federal grant. The city will pay the balance, he said. Twenty railroad crossings on two lines between Fargo and Moorhead will be affected by the quiet zone. Four of those crossings will be closed. An assortment of safety measures are planned at the other 16 crossings, including nine sets of four-armed safety gates. Each crossing with a sidewalk across the tracks will also have separate gates blocking pedestrians and bicyclists, Zimmerman said.

EFFECTING LOCAL REGULATION

The town of Ossining is now expected to become quieter after the passage of a new noise law. The proposal puts limits on noise by neighborhood – residential, commercial, industrial – at certain times of the day. It also includes sections on vehicle noise, car stereos and construction sites. First-time violators would face fines of \$100. Town Supervisor John Chervokas said the proposal would eliminate an older law that was difficult to enforce, and it would rely on devices that can measure noise levels. "We had a noise ordinance, but it was very general, and subjective. This one is objective, not subjective. Once people read it, they'll say it's fair and honest," Chervokas said. To help draft a new law, the town hired Eric Zwerling, director of the Rutgers (N.J.) University Noise Assistance Center as a consultant. His company has prepared noise laws for about 50 communities around the country, including Lafayette, La., Traverse City, Mich., and Newport, R.I. It also trains municipal staff in noise-detection technology, the next step in Ossining. Zwerling's group started with a review of what neighboring towns do to minimize noise, and drafts were prepared to accommodate suggestions from the town administration, the police and the public. "It was a very collaborative process. We came up with a law I think everybody is comfortable with," Zwerling said. "What we look for is a code that's objective, content neutral (not singling out certain types of music or noise), easy to enforce, and can stand up in court."