

## PROCEEDINGS OF THE INSTITUTE OF ACOUSTICS

### INFORMATION - IMPORTANT PARAMETER FOR NOISE?

Dipl. - Ing. ERICH SCHNODER

DEUTSCHER ARBEITSRING FÜR LAIRMBEKÄMPFUNG E.V., DAL

Noise is in general described by its sound level; this parameter can be well-defined measured and represents, too, the primary sensation of noise. But with regard to the 5 most important factors that change "sound" to "noise".

- the sound level is too high for the listener;
- the sound contains frequencies distasteful for the listener;
- the sound structure does not correspond with the listener's conception;
- the sound bears a meaning unpleasant for the listener;
- the listener cannot or will not be receptive for this sound;

It can easily be found that only the first two factors are regarded by usual noise rating methods. The last three factors, however, may even be more important for the sensation "noise" and can be summarized by a comprehensive meaning of "information".

Besides, there is the experience that not all loud sounds are disagreeable (f.e. a concert) and that on the other side some low sounds are very disagreeable (f.e. continuous falling water drop). Here, too, the sound information is obviously the decisive factor.

In this study the term "information" is rendered more precise, then the effects of sounds on man are discussed in variation with their information content.

#### 1. WHAT IS INFORMATION?

In colloquial speech information is the content and the meaning of a notice. Information then

- reduces an ignorance of the recipient,
- corresponds with the degree of newness of the notice,
- is thus a subjective value,
- is called in the following "subjective" or "pragmatic information".

The pragmatic information is the meaning of a notice for one special recipient.

An objective description, however, is in a qualified sense possible for an absolute meaning of a notice, independent from the recipient, we call this meaning semantic information. In any case, an objective description is possible for the syntactic information; this is - within the meaning of the

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Information theory - a pure mathematical term of information that is derived from defined probabilities of appearance of single elements.

With the specifications

$T$  = time period,

$n$  = number of different elements,

$h_i$  = probability of appearance of the  $i^{\text{th}}$  element,

the average flow of information (information per time period) is calculated as follows:

$$H = \sum_{i=1}^n H h_i = \sum_{i=1}^n h_i \log \frac{1}{h_i} \quad (\text{bit/s})$$

The syntactic information describes only the structure of a notice, irrespective of its content and meaning.

Thus, three defined aspects of information turn out, which are to study separately at best, because of their differences in objectivity, possibility of quantification and abstract wideness.

Concerning to the information of sounds which are to explore in this study, there are the following deductions:

- The syntactic information as a measure of the sound's structure can on principle be described mathematically, that means objectively and quantifiedly; for this the sound is divided into discrete elements, f.e. into single tones.
- An objective and quantified description of the semantic information, the general meaning of a sound, is possible on certain premises, f.e. when the number of possible meanings is limited.
- No objective and quantified description, however, can be made for the pragmatic information, that is the very special meaning of a sound for any single listener.

An objective and quantified description of the sound information, however, is the prior condition for the application of this parameter in practical noise abatement.

### 2. EFFECTS OF NOISE ON MAN RELATED TO THE SOUND INFORMATION

An influence of the sound information can primarily be expected over the following effects of noise -

- annoyance, general disturbing effects,
- disturbance of sleep and relaxation,
- activation of the central and vegetative nerve system,
- disturbance of communication,
- disturbance of certain activities.

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That means, most of the important effects of noise are influenced by the sound information.

The influence of sound information on the effects of noise on man can be described - at the actual level of knowledge - on the basis of an extensive review of literature, practical experiences and experimental research with the following four sentences:

- The higher the syntactic information of a sound, the more this sound will be regarded as disturbing; the reactions by activation (f.e. GSR) and the degree of attention, however, will follow favouredly any changes of syntactic information.
- Recognizing the meaning of a sound structure, which has been unknown, decreases primarily the "costs" of information processing, because then it is no longer necessary to analyse the sound structure.
- In the same direction with the pragmatic sound information differs
  - the subjective sound rating and corresponding the annoyance and disturbing effects caused by the sounds,
  - the readiness for reacting on an acoustic stimulus,
  - physiological responses as the muscular tension and the auditory threshold shift.

These reactions are stronger on unpleasant and unwelcome than on pleasant and welcome information.

- The disturbance of activities by noise follows
  - the information flow of the sounds,
  - the information flow of the actual activity

### 3. APPLICATION IN PRACTICAL NOISE ABATEMENT

Although the sound information is obviously at least as important for the rise of a noise sensation as the sound level, an application of this knowledge in practical noise abatement is not expected.

Whereas the syntactic information may be measurable with very complicated measuring systems, the pragmatic information, although probably more important, cannot be measured objectively by its definition.

Just the objective measurability by simple measuring systems and - if possible - one value only to describe a noise situation, there are most important demands concerning the possibility to enforce decrees for noise abatement.

Measures of sound level and time will therefore furthermore be taken to describe noise situations. We do not expect that one day a producer of noise will receive a penalty because his high-fidelity radio exceeded an information flow of 5 bit/s.