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THE ROLE OF SUBJECTS AND ITS IMPORTANCE FOR DIFFERENTIAL NOISE PSYCHOLOGY

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INTRODUCTION

Research into the effect of sound has a long tradition in many parts of the world; in comparison with investigations into other environmental pollutants in water, air and the soil, this research has attained a high scientific standard, so that it is now possible to take the medical and psychological effects into account by distinguishing regulations concerning noise exposure limits. There are differing opinions with regard to this situation: whereas in Germany experts are at loggerheads over the validity of medical investigations into the effects of pollutants carried out by the Institute of Water, Soil and Air Hygiene of the Federal Environmental Agency, other countries have decided against carrying out any further noise research, because they consider that Theodore Schultz's formulation of the noise exposure limits adequately covers all the issues raised by political decision-makers. Recent studies taking stock of research appear to me to be symptomatic.

AUDITORY EXPERIMENTS AS A MEANS OF PROBLEM SOLVING

Many experiments in audioacoustics or psychoacoustics using subjects often have methods of procedure which are not clear. Experiments are well prepared as far as the physical side is concerned; but then all of a sudden a subject is led in and confronted with an auditory task which he does not understand, because he is given too little instruction in what he ought to do. I see it happen, time and again, that the person conducting the experiment gives spontaneous, oral instructions to a subject - and every time they are slightly different. Sometimes a subject is given instructions to read, but no check is made to see whether they have been properly understood. In general, too little attention is paid to the way such instructions are formulated. Interviews carried out after experiments by Schulte-Fortkamp [11] provide clear proof of the difficulties subjects experience in orientation. Since subjects are not asked about cognitions at all, they are not going to make any comments off their own bats. And frequently the subject appears quite indifferent to the result of any experiment (as can be seen, for example, when psychology students are enlisted for such experiments). Apparently little im-

portance is attached to this attitude, which can also be seen by the fact that it is seldom mentioned in the reports on experiments. Interestingly, we find that in the great days of the up-and-coming experimental psychology the instructions were given in great detail. Occasionally it happens that experimentors and subjects are one and the same, supposingly to avoid all these problems. Are instructions so very important in order to interpret data? If so, why?

The basis of my idea is this: if solving an auditory task is not only regarded as a process of perception but also as one of assessment and problem-solving, greater importance will be ascribed to the formulation of the instructions.

Instructions can present problems in very different ways: they can contain details about the starting-point for the listener, the aim of the experiment, details about the individual stages, aids and measures, strategies for coping successfully with the experiment, tips about what is particularly important. When all these points have been formulated, we speak of well-defined problems. On the other hand, I can give a subject such brief information that even at the end of the experiment he is still not clear about what he was actually supposed to do (ill-defined problems). If the point of an auditory task is to involve the most similar cognitive functions, the instructions will be given as carefully as possible. Language is the means of picking up people's thoughts, emotions, hopes, fears and fear of failure. Sometimes subjects participating in acoustical experiments are afraid of being subjected to an achievement test, even if no one says so expressly. In this respect instructions draw people's attention to particular points.

The degree to which a problem is completely formulated is significant for the quality of a solution (speed, precision, differentiation, ecological validity). This principle is vital to the psychology of instruction. It appears to me to be worth considering examining to what extent the instructions and conditions should be included in the interpretation of results. While I agree with this in principle, it doesn't solve the problem, because the question still remains whether we have anything approaching an instruction theory which could then be systematically applied when interpreting results. One conclusion of our considerations might be the suggestion to agree on standard instructions of certain basic experiments. Such standardized instructions are mostly used in neuropsychological diagnosis where much work is done with optical, tactile and acoustical stimuli. On the other hand, objections will at once be raised, for this is exactly where a patient has to be well instructed for as long as necessary until he is absolutely sure of what is expected of him. Because of this, instructions can indeed turn out to be very different, very individual. It may be concluded from this that it is important when formulating instructions that a subject understands certain points of the task, and these points could form categories, according to which the whole of the instructions could be described, even if they might then turn out to be very different.

In psychology itself such ideas are by no means new. Wilhelm Wundt insisted on the training of subjects. "Thus it is said that no observer who had performed less than 10,000 of these introspectively controlled reactions was suitable to provide data for published research from Wundt's laboratory" [2, p. 216]. Edward Titchener established in his lab drill courses to provide the proper training that was needed as a basis for research [1, p. 413]. Concealed behind the ideas of these experimental psychologists is the search for generally valid laws in psychology.

In this connection I should like to mention, though only very briefly, the concept of orientation, as it is assuming ever greater significance in psychoacoustics. For hearing tasks orientation means being aware of what is given and what is being sought. Orientation means: being aware of the conditions for the action before and during the task. For this, sufficient time is always required. Scaling experiments, for example, in which subjects have to reply under pressure, often appear to be dubious, even when the oriented category scale is used. When Otto Heller introduced the method of "oriented category scaling" one of the main intentions was to grant a subject time to orientate himself as regards perception.

CARE IN THE PLANNING OF HEARING EXPERIMENTS

Critical statements such as those presented by Schulte-Fortkamp [11], for example, owe their origin to the realization that the principles listed above are too little heeded, as I see it.

Although the intention to typologize subjects according to their willingness to take part in psychoacoustical experiments suggests itself, in the long term it cannot form the basis of a psychoacoustical theory. That is why it hardly appears sensible to cultivate such disoriented experiments and then to submit them to critical discussion afterwards. Rather, what is important, as I see it, is to plan experiments carefully, i.e. for example to make preliminary experiments for so long until a subject understands the task from the very beginning and is inwardly prepared to carry out the experiment. It would be quite inappropriate to make the subject of a scandal, as so-called "critical psychologists" of the Frankfurt School of Sociology mould tried to do at one time.

By interviewing subjects after the event we can find out how he structured and coped with the auditory task. I can imagine that in this way it will be possible to present different interindividual ways of finding solutions and ascertaining results. Perhaps concepts of problem-solving theories could be used as means of interpretation.

As I have already mentioned, the subject has been the object of experimental psychology from the very beginning. In the sixties this problem was discussed very widely, particularly by "critical" French and German psychologists: whereas under the banner of emancipation for subjects experiments were banned from psychology [4], others formulated demands on ecologically valid experiments [6-8]. We collated the various arguments for improving experimental procedures [5]. In the meantime acousticians have become familiar with dissertations weighing up the advantages and disadvantages of laboratory and field experiments, e.g. [3].

PERSONAL NOISE SENSITIVITY - OFTEN AN ARTEFACT?

In the discussion so far I have maintained that instructions are important in understanding results. By means of the instructions we form the conditions for an experiment. I should now like to go into another problem which is connected with it, any that is the typical, widespread interpretation errors which occur both from a physical and a psychological viewpoint. These are the errors made by psychologists who fail to distinguish physical conditions and physicists who disregard psychological conditions.

Let us take the following situation as the starting point for our discussion: we present the same sound to different people and assume that if different people assess the annoyance of the same sound differently, people

must be sensitive to sound in different ways. That is the usual way of thinking.

For a while this general assumption certainly proves to be exceedingly fruitful - particularly for that branch of psychology that deals with differences between people. However, if one considers, for example, how many physically describable conditions are able to influence the effect of sound pressure from the sound source to the eardrum it becomes a problem to make any statements about the generality from the physical aspect. We can certainly produce the same sound pressure, but that is only the beginning of a physically describable process of effect. Between the instant of sound production and the eardrum varying physical phenomena occur. The effect of sound only becomes explainable against the background of the whole physical situation.

In this way we should be in a position to call a more differentiated physical model for the varying effect of sound into play. Thus the possibility of comprehending a number of differences in experience and behaviour during acoustic irradiation as a function of physically different situations would present itself. If the physical conditions are not carefully checked a phenomenon will tend to be sought in the personal sphere, and the psychologist will perhaps even enlist the help of personality theories in order to explain the difference. Once the physical conditions have been systematically registered, they may then be presented as an explanation for the phenomenon.

Analogous to this, it is possible for the physicist to make a wrong interpretation, namely when he disregards the cognitive conditions of the subject. The physicist, too, interprets overhastily with Personal Noise Sensitivity, which would have been ruled out had the cognitive conditions established in accordance with the instructions been observed.

THE SIGNIFICANCE OF LANGUAGE IN HEARING EXPERIMENTS

Instructions frequently contain terms that ordinary listeners do not understand, because they are not part of their vocabulary, for example: roughness. Perhaps we are in the position of only being able to experience certain sounds as beeing rough (for example, a voice), without, however, being able to transfer this attribute to other sounds.

For a long time a particular branch of psychoacoustics underestimated the fundamental importance of language for understanding the intellectual order of experience and knowledge: it was even despised, principally by S. S. Stevens and Eberhard Zwicker: for behaviouristically and operationalistically oriented psychoacoustics language became a mere 'linguistic report'; The *vagueness of language*, the semantic relativity in the use of language was an important reason for acousticians to do without its services as far as possible. The idea of language as a carrier and conveyer of meaning was repudiated as being uninvestigable from a scientific viewpoint. Statements relevant to this are also to be found in various studies by Zwicker & Feldtkeller [13, p. 43], when they write: "When the spectrum of the stimulus has audible values according to frequency and sound pressure, the stimulus triggers off a sensation. The subject is not able to describe this sensation precisely in words. Language has only a few words like loud and quiet, shrill, booming, murmuring and so on to full back on. It has to get out of this difficulty with the aid of unspecific words from other fields of perception, such as low and high, light and dark, soft and hard and so on. None of these words is sufficiently precise, which is why an attempt has been made, analogous to the natural sciences, to report on the relations between stimulus and sensation with the aid of contours rather than words. The subject becomes qualified to

do so, because he concentrates his attention on a single component of his sensation, abstracting it from all other components." In quite general terms, the two authors underestimate the fundamental importance of language in psychophysical experiments: without language it would be impossible to explain a task to be carried out as an experiment; it is quite logical for the experimenter to go into the significance of certain terms; he provides, as it were, the essential interpretations of a task, in doing so guides the subject's attention and occasionally points out things that can be of help.

Stevens' psychophysical experiments in which he circumvented language by using finger and hand grip provide a clear-cut proof of this. In my book "Sound Evaluation" [10] I looked at this - as I see it - untenable point of view in various ways. Nevertheless, we ought to be aware that even nowadays there are both psychologists and psychoacousticians who share Zwicker's and Stevens' opinion and are engaged in experiments along these lines.

Even if the existence of non-linguistic terms is assumed, the way taken by all instructions for experiments must lead via linguistic symbols to these "language-free" scales. On the other hand such misgivings about the use of language may tempt the experimenter to use as few words as possible, which means there is the danger of the "normal" subject either not understanding the experiment at all or in an entirely different way from what was intended. I came across an old reference in work by Steudel [12], a fellow of Barkhausen's: "On several ocasions a person was observed working out a reproducible but wrong concept of volume and using it to measure certain, but wrong, contours."

SUBJECTS LEARN WHILE LISTENING

In psychoacoustics and hearing research we are faced with one problem constantly: the perception ability of listeners' is constantly changing: they learn and practise so that frequently it is impossible to say exactly where the apparently biologically determined limits of these hearing abilities are (the problem of highly trained listeners). If engineers in the car industry take several months to perceive particular differences in sound, the question arises as to what it is that these subjects learn and what conditions this learning depends on.

Scharf [9] showed the way subjects' hearing changed, years ago. The basic question must then be: which particular hearing performances are applicable to which condition a test person is in during an experiment?

SUMMARY

The contribution deals with some of the widespread concepts and habits involved in experiments using human beings as listeners. It is based on the assumption that listening tasks are often complex cognitive exercises and that listeners are not properly oriented. The proposal is made that instructions for experiments should be designed on the basis of the psychology of action and problem solving and to integrate them in the formation of psychoacoustical theory. The underevaluation of language as part of an experiment is also discussed, although language-free experiments are seldom possible. The fact that test persons learn from hearing experiments and differentiate between their own listening performances remains unexplained. The contribution also goes into the line of thought which leads to the artefact of varying noise sensitivity being constructed in an effort to counteract the lack of suitable interpretations.

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