BRITISH ACOUSTICAL SOCIETY

71SBB8

B.A.S. Spring Meeting.
5 - 7 April, 1971.

Individual differences in performance changes due to loud noise - by G. R. J. Hockey.

Effects of noise on performance

Research into the effects of noise on the efficiency of mental performance has a long history in experimental psychology, dating from the considerable interest in attention and distraction at the turn of the century. Much of the early work used sudden noises as distactors when subjects were carrying out intelligence tests or doing simple reaction-time (RT) tasks. Even allowing for the crudeness of experimental techniques then available it is perhaps surprising that very few effects of noise of this kind were found. There are a number of possible reasons for this. Broadbent (1957), lists the principal requirements for demonstrating effects of noise as (1) tasks must be long and possess considerable uncertainty as to where and when relevant information will arrive, (2) the noise must be loud - above about 90 dB. The establishment of reliable performance - measuring techniques, with the increased interest in human efficiency since the war, has since enabled these effects to be consistently demonstrated, not only with impulsive noise, such as sonic bangs, but with continuous broad-band noise. Unlike sonic bangs, continuous, unchanging noise of this kind does not have any specific distracting characteristics, so that its effects on performance, from a theoretical viewpoint at least, are more interesting. It is this kind of noise I will be concentrating on.

Work in the 1950's by Broadbent and by Jenson demonstrated effects of noise on vigilance performance. Vigilance is an activity required in tasks such as radar or sonar watchkeeping, conveyor belt quality control and security monitoring in prisons. The operator has to be on the constant alert over long periods, for important events (signals) which require actio' . The signals are, on the whole, infrequent, and occur irregularly in time so that alertness cannot be reduced safely at any time. This is the kind of task implied by Broadbent's first requirement (above). Both he and Jenson found effects with loud continuous noise,but only towards the end of prolonged work periods (30 mins to an hour). Effects were not always found, however, and it is now apparent that performance is more likely to be adversley affected when the task has either a high rate of arrival of signals, or requires the operator to monitor more than one source of information.

In other studies, however, noise has been found to actually improve efficiency. McGrath, at the Los Angeles Human Factors research centre, has shown better performance at the end of a

vigilance task when the level of background noise was continuously varied. It is not that improvement occurs only with varied noise. An experiment of noise (with D.R. Davies) shows a similar facilitation with an increase in the level of white noise from 65 to 95 dB. A review of the whole field suggests, in fact, that it is the characteristics of the task that determines whether it will be affected by noise, and in what direction. Generally speaking, simple tasks (those supplying information at a slow rate and in only one place) are improved by noise, and complex tasks (high information load and several sources) will be impaired.

Selectivity and noise

Recently I have been carrying out experiments to try and describe the way in which noise affects performance more analytically. It is not enough to say that efficiency is better in this situation, and worse in that. These epxeriments, using complex displays, lead to the conclusion that what noise does is to make attention more restricted, in the sense that it is biased more strongly to "priority" activities, at the expense of less obviously relevant aspects of the task. I have called this an increase in degree of selectivity. It is a more general effect than a narrowing of the visual field or increased looking in a particular place. It may best be regarded as an amplification of all strengths of attentional priorities being used in the task, leading to an increased tendency to attend to these aspects of the task already receiving most attention. It may be readily seen that such an effect can explain both improvement in simple tasks and impairment in complex tasks. The former benefit from increased attention to the little work that needs to be done (normally there would be some tendency for this task to give rise to boredom and inattention). The complex task, on the other hand, requires a balanced, flexible pattern of attention, and may suffer from a tendency to neglect some aspects and over-attend to others. The impairment should be mainly of peripheral, or low priority, components, rather than the principal task requirements. In most complex laboratory tasks all components are equally important, or, at least, priorities are not specified.

Individual differences.

Little is known of the relation between personality and susceptibility to stress. There have been very few systematic studies using noise, and results have, in any case been equivocal. This is perhaps not surprising in view of the hitherto inconsistencies in the overall effects of noise. I have used the introversion - extroversion questionnaire in all my experiments, and, although subject numbers are small for this kind of analysis, the pattern is, on the whole, a consistent one. Introverted subjects are less affected by noise, whether the general trend of performance change is towards improvement or impairment. (The same is true, incidentally, for the effects of sleep deprivation). Introverts behave with greater selectivity, and it is mainly extroverts who become more selective with noise. Eysenck (1967) has proposed that extroverts are characterisied by "stimulus hunger". They are always underaroused and need to seek additional stimulation to function efficiently. This hypothesis receives some support from a number of our studies on noise-preferences during vigilance. Davies, Hockey & Taylor (1969) found that extroverts chose to receive more varied selections of noise when performing a vigilance task, while introverts chose more to turn

the noise off when given the opportunity to do so. An experiment by Miss P. Norris at Durham showed that this liking of extroverts for noise extended to preferred levels of continuous white noise in the same kind of situation. Extroverts set the noise level consistently above introverts throughout a 30 minute session.

It is not yet clear what these differences in behaviour of individuals in the presence of noise represent. Clearly, noise can be regarded as stimulating, and some individuals not only prefer more to work in stimulating circumstances, but benefit more from then. The variety of everyday habits relating to working with radio or television on testify to this. The explanation of these findings will, I think, be of central significance to the theory of individual differences in general. At the moment, all that can be said is that they imply differences between people in the extent to which they (a) require external stimulation to maintain arousal, and (b) are able to control the effects of changes in stimulation. Introverts seem to need less and to have better control. On the other hand, they seem to be less happy when having to work in noise.

Refs:

BROADBENT, D.E. (1957) The effects of noise on behaviour. In C. M. Harris (Ed.) Handbook of noise control. McGraw-Hill: New York.

DAVIES, D.R., HOCKEY, G.R.J. & TAYLOR, A. (1969) Varied auditory stimulation, temperament differences and vigilance performance. Brit. J. Psychol., 60, 453 -

EYSENCK, H. J. (1967) The Biological basis of personality. Thomas: Springfield, Illinois.