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NOISE LEVELS IN THE OPEN PLAN ENVIRONMENT.

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Introduction

In acoustical terms privacy is a function of the sound pressure levels of speech and of the background against which the speech might be overheard. The higher the background level the greater the privacy; but noise can also be an annoyance (which will increase as the background noise level is increased) and has to be balanced against the distraction resulting from less privacy and more intrusion in the quieter conditions.[1] The indications are that the optimum balance point is somewhere in the region of a steady background level (assuming it contains no tones) of 45 dBA.

Effect of Background Noise

We are all familiar with the feeling of relief which occurs when a noise no matter how quiet is switched off and presumably even 35 dBA will cause some 'stress'. Normally, this feeling of relief is only obtained if the noise is switched off in conditions which are otherwise quiet. If, as is sometimes the case, other noises become more apparent then there is doubt as to which situation creates the more stress. If the noise which becomes apparent is a conversation which is sufficiently interesting to distract people from their tasks then it is possible that the stress without the background noise is higher than that with it. This is but one facet of a complex issue.

It is particularly interesting, therefore, that a number of studies have been carried out in recent years which try and assess the significance of background noise per se as well as to assess its secondary effects.

Effect of Background Noise on Speech Level

It is generally assumed that the level of speech remains constant regardless of the background level and is, therefore, a fixed parameter in design. Two studies have been carried out which create doubt in this respect without entirely replacing this doubt with a positive alternative. One study,[2] in which people were asked to read certain phrases, demonstrated that peoples' voice levels increased as their environment became less reverberant. However, this was in a situation where in effect people were being asked to communicate over a distance and in effect to compensate for what were probably perceived as changes in effective speech level at their ears (sidetone). Experience suggests that people tend to lower their voices in a quiet open environment and, of course, the less reverberant open environment tends to be significantly quieter than the reverberant one. The effect

of background noise level has to be considered therefore as well as the level of the sidetone.

Studies[3] have indicated that the higher the background noise the higher the speech levels used but that the rate of increase (or decrease) of speech level is only half that of the background noise. That is to say, a 10 dBA decrease in background will result in a 5 dBA decrease in speech power levels. This fact mitigates against the performance of the quiet open plan office as one would expect speech to obtrude relatively more above the background levels than in the more traditional open office with tiled floors and plaster ceilings.

The Effect of Background Noise on Productivity

Whilst some work on visual motor performance tasks has discovered some short term effects, it is very difficult to undertake any studies which would indicate long term effects of change in the physical environment. Absenteeism, staff turnover, management-worker relation all relate to long term productivity as well as task performance.

One study[4] carried out on bright school children suggested that for a certain intellectual task short term productivity was maximised with a background level of about 55 dBA. These experiments were carried out, however, without any extraneous intruding noises at all and so this level of 55 dBA cannot be regarded as the optimum level of masking. The significance of the study, is a little obscure but is one of the few studies relating to a high level of intellectual motivation.

The problem of maximising productivity generally is a difficult one because of trying to establish the optimum level of arousal. It is unlikely that for long periods that the optimum environment will be that in which there is no intrusion into an individual's environment. The optimum level of intrusion or arousal will, however, vary significantly depending on the person and on the task which he is carrying out. It will be less the more intellectually demanding the task is. Conceptually, the problem can be understood but in practice the main difficulty lies in measuring productivity in meaningful terms and in terms which can be measured within the scope of an experiment.

Effect Of Background Noise On Intelligibility and Privacy

This subject has been studied in considerable detail[5] for a number of years but a recent study[6] suggests an interesting complication. In an attempt to assess the significance of introducing background noise by a practical experiment it seems that at marginal levels of the Articulation Index that a background noise can improve intelligibility of the prime conversation against the background of others. This may be because extraneous conversations were being masked to a greater extent than the one being listened to (albeit with difficulty) thus making it relatively more intelligible. It may be, therefore, in the open environment that those conversations which we cannot guarantee to be private even with masking noise i.e. about 6m away from the listener may become slightly more intelligible.

The Acceptability of Background Noise

Experiments carried out to establish the acceptability of background noise have, in the main, been poorly designed. The mistake usually made is to confuse perception of the background noise with acceptability. This has resulted in the background noise being broadcast for short periods of time on an intermittent basis whereas, in

practice, it would be desirable to introduce the background noise without fuss and possibly gradually over a period of weeks.

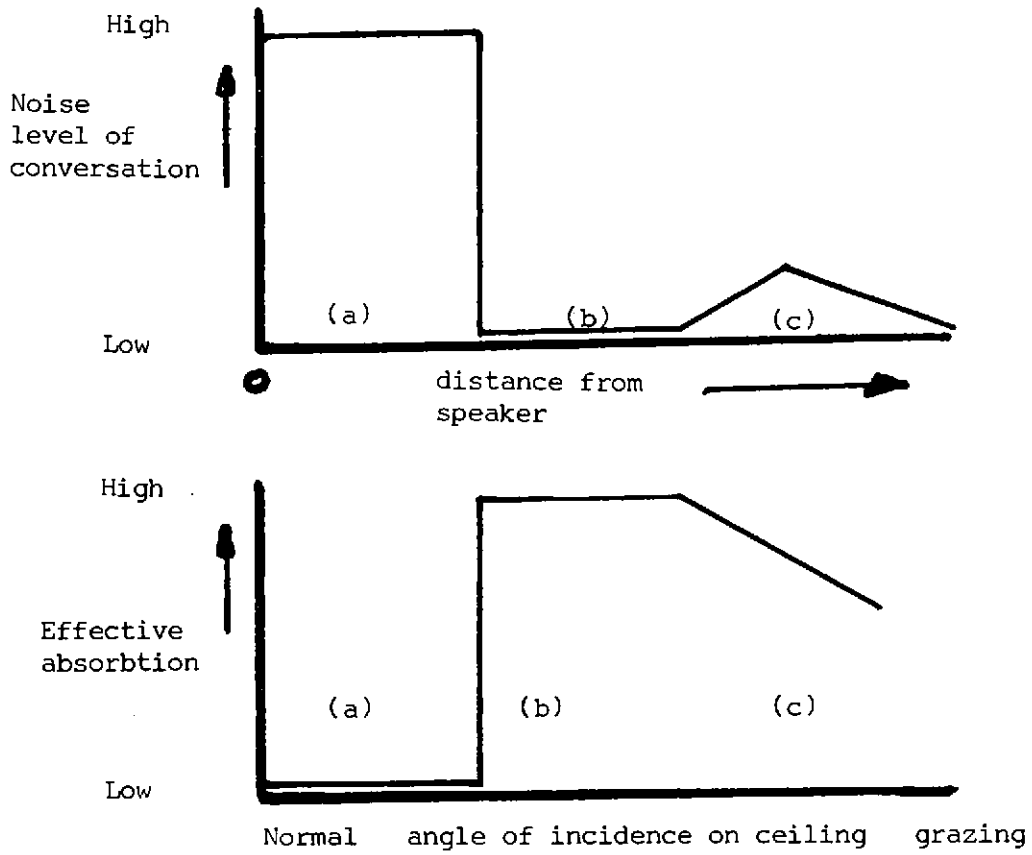
In a particular case[7] the personnel perceived the background noise at about 37 dBA. As a postscript to another experiment[8] on similar lines the background noise was reintroduced after people had been told that the experiment was over and was gradually increased and a level of 46 dBA was obtained before people started complaining (ambient 41 dBA). This again is likely to be a little suspect because of the nature of the main experiment and the adverse reaction of people to it. In any case, the perception of an artificial noise will depend on the pre-existing ambient noise.

The apparent origin of a noise significantly affects its acceptability. 65 dBA is a fairly common 'self-generated' noise level for an office and usually is accepted without comment. 50 dBA is probably the limit for noise from ventilation systems without complaint and 45 dBA for an artificial background noise perceived as such. The introduction of 'artificial' noise needs to be undertaken with considerable care in the 'psychological sense' as well as the technical.

Why all this fuss with the open landscape offices when the traditional office (lino and plaster) does not seem to have the problem to nearly the same extent? Inevitably the newer office will be quieter to improve communication but the techniques which reduce noise levels (absorbent surfaces etc) also reduce privacy. Screens only work effectively beneath a highly absorbent ceiling, thus reducing background noise still further.

What can we do? Artificial background noise is a partial answer but a carefully designed ceiling would also help.

The Figure indicates the sound level and acoustic absorbtion required as a function of distance from a speaker.



In the vicinity of the speaker (region (a)) a significant sidetone is required to allow and persuade people to talk efficiently at 'low' speech levels. This is assisted by a reverberant environment e.g. reflecting desk tops, screens and ceiling (to near vertical sound rays).

The region (b) however contains the people near to the speaker who do not want to hear him. They require the noise to be absorbed (by the ceiling) and attenuated (by screens) as much as possible.

For privacy in region (b) some background noise is essential and can come from conversations and other noise sources further away. Thus, some noise is required to be transmitted into region (c).

The design of a ceiling with the directional characteristics suggested can only be approximated to at the present time. As testing techniques improve we shall be able to discern more clearly what physical characteristics correspond with these acoustic requirements.

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