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BRITISH ACOUSTICAL SOCIETY

Progress towards the
Unification of Noise Criteria
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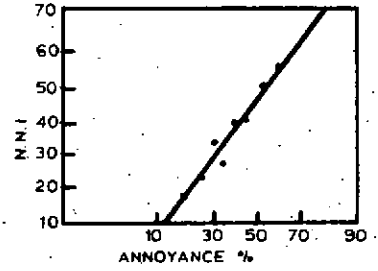
The Economics of Annoyance by R. A. Waller

Studies have been carried out in a number of fields aimed at establishing a physical measurement of an environmental effect which relates to people's subjective response. The social survey[1] carried out around Heathrow Airport in 1961 is an example of such studies. The effect was the noise from aircraft and the response in question was the extent to which people were annoyed in the home environment. The Noise and Number Index (NNI) was deduced as a measure of the noise which correlated best with the response of the population. Figure 1 shows the experimental results using the preferred physical measure NNI and using what I have called 'annoyance' expressed as a percentage for the response scale.

Fig.1. NNI v Annoyance



In this case annoyance is broadly speaking either the percentage of people who are significantly annoyed or alternatively the average annoyance score expressed as a percentage of the total available range of the score. The scale of annoyance is a normal probability one such that if opinions are distributed in a statistically normal fashion the relationship with a suitable physical measure will be linear.

A number of similar studies have been carried out for other sources of noise, for example, traffic noise[2] and for other effects such as Lamp Flicker[3] (see Figure 2).

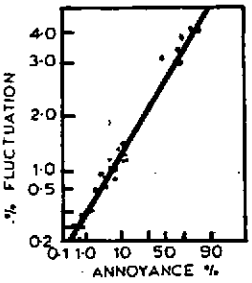


Figure 2 Lamp Flicker v Annoyance

What is required in order to compare such differing sources of annoyance is a common scale of annoyance which can be measured in the same context and on the same basis for all sources of annoyance. This I suggest should be 'annoyance' as above.

The assumption that I have then made is that in a given context, in this case the home environment, a given percentage annoyance will reflect a given degree of loss of the environment whatever the specific cause of the annoyance. That is to say an annoyance of 50% generated by aircraft noise represents the same loss to the community as 50% annoyance generated by traffic noise. Further if 50% annoyance is due to air pollution then this in turn represents an equal loss to the community.

As Dr. Robinson[4] has shown it is possible to use the Noise Pollution Level as a means of unifying noise criteria. It is also possible to relate the NPL to annoyance and hence to relate it to some more general measure of environmental defects (see Figure 3).

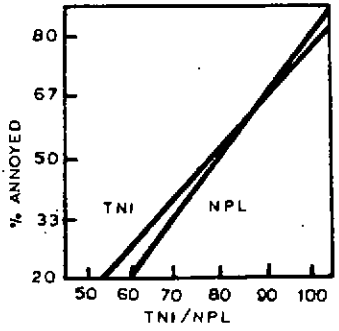


Figure 3 NPL v Annoyance

The step which I am proposing is different and additional to that proposed by Dr. Robinson. NPL is a means of generating a physical measure of noise whatever its type which will relate to annoyance. It is through this measurement of annoyance that I suggest we can relate noise criteria to other environmental criteria

There is, however, yet a further step which needs to be taken and that is to assess the significance of annoyance itself. What is the significance of 50% of people being annoyed by noise in their home environment? What action is merited in such a situation? What is an acceptable level of annoyance?

Following the now somewhat ancient studies[5] of the effectiveness of party walls 45 - 50% annoyance is considered a bit high but 25 - 30% is considered reasonable. On the face of it there is no logic in this.

This difficulty led myself and my colleagues some 5 years ago to investigate whether or not it would be possible to measure annoyance in more tangible terms[6]. One must bear in mind that the result of any decision is ultimately going to result in the expenditure of money or alternatively in a decision that it is not worthwhile abating the nuisance. As a matter of policy therefore we decided that we ought to try and relate annoyance to some monetary equivalent which we could compare directly with the costs of an environmental improvement scheme. We have tried therefore to relate annoyance with losses in market value of average houses.

I will not reiterate the fundamental arguments[7] underlying our proposed relationship between annoyance and loss of market value, suffice it to say that we expected the relationship shown in Figure 4 to be a linear one with a slope as indicated. What we did not know and could not assess without actual data was the 'height' of the line in relation to value. The significance of the data must be judged therefore in the context of to what extent it raises or lowers the line in the figure bearing in mind that it remains parallel to line shown.

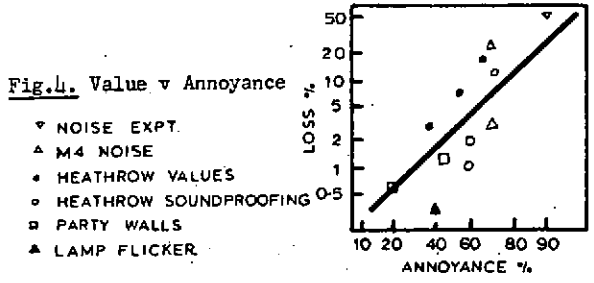


Fig.4. Value v Annoyance

We felt that the only way which was at all reliable was to obtain market data which would show directly what people would be prepared to pay in order to reduce annoyance or alternatively what they were not prepared to pay. I recognise of course that in the market situation those people faced with having to remove a nuisance by spending their own money may be able to afford less than they would be prepared to accept to sell their loss of amenity voluntarily.

Using this relationship it is now possible to apply a cost benefit criterion to all situations. It would be possible to say that one invests money in environmental improvement so long as the benefit obtained is on a certain ratio (greater than Unity) to the costs. It would be possible in the case of an urban motorway to decide how much it would be worth spending to reduce noise by way of building barriers, by way of double windows, perhaps by way of putting the road in a cutting. In some situations the costs of doing so might be justified and in other situations perhaps not. An alternative would be to consider the generality of urban roads and to conceive a national policy on the basis of a cost benefit analysis.

One thing is quite clear to me at the moment, viz. noise standards themselves are not comparable one with another. One has only to look at BS 4142 and its application to industrial noise in mixed industrial and residential areas to see that it is much more stringent than the proposals put forward by the Wilson Committee in relation to traffic noise and that these in turn are much more stringent than its proposals for acceptable levels of aircraft noise.

How less likely is it that standards of air pollution, visual environment, etc. will be on a common basis with noise standards.

The methodology described above is a way of remedying the situation and allocating our national resources to the best advantage.

References

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