

Qualitative Research and Acoustics

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Not Refereed

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Abstract.

Qualitative research (QR) is that area of research which tries to uncover why people behave the way they do. This presentation looks at issues where QR can benefit both acousticians and the communities they serve.

Questions posed include why do we value acoustical privacy and why do we use dB's, but the main intention is to draw attention to a need to keep refining and revising the goals and criteria which drive our technical research.

Introduction

Qualitative Research does not propose an alternative to our traditional research methods (which obviously involve quantitative techniques) but is that branch of research specifically concerned with trying to uncover and understand what motivates people to behave the way they do.

The type of acoustics practised by members of our society (almost exclusively) has as its *raison d'être* the effects of sound on people. QR reminds us there is no value in doing objective and technical work in acoustics if we do not keep in mind that the bottom line is subjective sound.

In addition, since we - the researchers, consultants and practitioners - are people too, QR may usefully be applied to investigate our motives for the way that we react and behave in taking ownership of, and responsibility for, our discipline.

Defining our terms

First let's see the importance of defining subjective issues in addressing the theme of the conference. We - and not only in NZ - may be seen as having failed in the past to sort out strict definitions for the quantities that we are dealing

with. Hence our approach to legislation and standards can be non-scientific because of it.

In our theme we have 5 nouns mentioned - Music, Noise, Role, Sound and City - and surely we cannot proceed until we have of agreed definitions for these

City has a formal definition in NZ as an urban area having a population of 30,000 or more. Distinctions are probably needed between different city regions - e.g. inner city versus suburbs - as quality of life expectations are likely to differ between them.

Role may be translated as meaning the "the part played, or contribution made, by". This leaves Sound, Noise and Music which we will approach in that order.

Sound

Sound must be seen as potentially two quite distinct quantities - Objective sound and Subjective sound - and therefore two definitions are required:

Objective - a flow of mechanical energy in the form of vibrational waves in a transmitting medium

Subjective - the auditory sensation perceived when a suitable objective sound is received by our ears (where suitable implies it has the necessary frequency and strength to fall within the thresholds of an individual), or

any auditory sensation that we liken to the result of excitation by an objective sound.

Thus we can be clear at any time whether we are talking about something that may be quantified by a sound level meter or something that can only be identified by listeners and quantified in terms of human response. (We might also note that this clarifies that we can have an objective sound without an accompanying subjective sound, and allows, as in the case of tinnitus, a subjective sound without there being an objective sound trigger!)

Noise

A definition for Noise ideally needs to satisfy all our uses for the term - and, in particular, lead to a logical distinction between the different severities of noise exposure mentioned in our legislation. Although we may find value in having a specific objective sound defined as a noise (e.g. as in White Noise or Pink Noise) what, in general, determines whether or not a particular objective sound is judged or described as a noise is the reaction of receivers of that objective sound. Therefore, necessarily, the definition must be formulated in terms of subjective sound. Thus, apart from technical terms for specific objective sounds already

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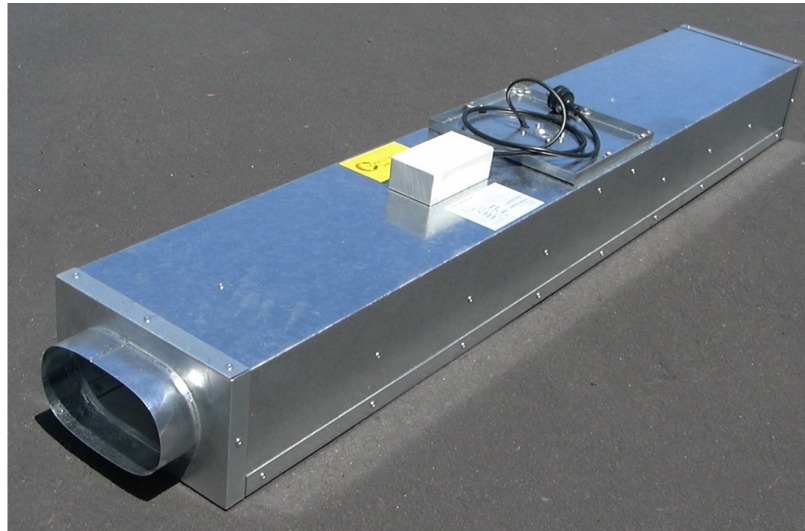
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mentioned, the definition proposed is:

Noise – subjective sound that we would choose to merely hear (as opposed to listen to) and hence from which would choose not to extract information.

Severity of a noise environment is then assessed by the amount of time we listen to the sounds involved against our will. Importantly this involves not only the particulars of the objective sound but also the particulars of the exposed individual. It is to be emphasised that the severity of a noise environment must be judged by the exposed individual and not by the application of some community standard. We cannot by virtue of making an assessment against a population average – or any other statistic – determine the plight of an individual. A simple analogy with peanut allergy illustrates the mistake we would make in deciding that because exposure does not pose problems for the majority – even the

vast majority - of people that all should accept being exposed.

Noise Sensitivity

In earlier work [2] attention has been drawn to noise sensitivity. It is defined as being a person's tendency to be distracted by sound, and is a characteristic which is independent of the person's hearing acuity. This is an intervening factor in the response of persons to exposure to sound environments and the percentage of persons who are noise sensitive – based on being at least one SD away from the mean (see fig.1) – appears to be about 14% of the population – a significantly higher %age than for most physical allergies.

Music

Coming now to Music – who, given the range of expression in sound that has come to be described as music, would dare to propose a definition that would satisfy all? However, one is required if we are to deal scientifically with the issue

posed in our theme. It would seem clear that the only helpful way to proceed is to define this in the subjective sound domain. As an objective sound the varieties are simply too different to be adequately encompassed in a single definition. However, it is tempting to try – at least for humanly created music – to contrast music with other objective sounds and hence define music as objective sound in which patterning in time (e.g. rhythm) and pitch (i.e. identifiable tones) are used for specific effect in an artistic creation. (We may note that even in the times of the early Greeks it required two Muses – from which the term music is obtained – to encompass the range of music they were familiar with! Terpsichore and Polyhymnia were deemed the goddesses with specific responsibility for dance music and “sublime” music respectively).

What concerns us though is the impact which objective sound of this type has on the receiver and this therefore requires a subjective sound value judgement. Thus music must be a subset of non-noise subjective sound. In other work the term Acroma [1] has been applied to non-noise subjective sound and therefore our working definition for music might be that it is Acroma resulting from objective sound articulated by humans as an artistic creation which makes particular use of patterning in time and frequency for some of its effect.

However, this selfsame patterned objective sound may not be received as acroma. Wherever it is received and it is not be the choice of the receiver to attend to the sound it becomes noise and not music.

Music or Noise? The Role of Sound in the City

In addressing the role this objective sound has in our cities our concern is not so much with a precise identification of the role but simply

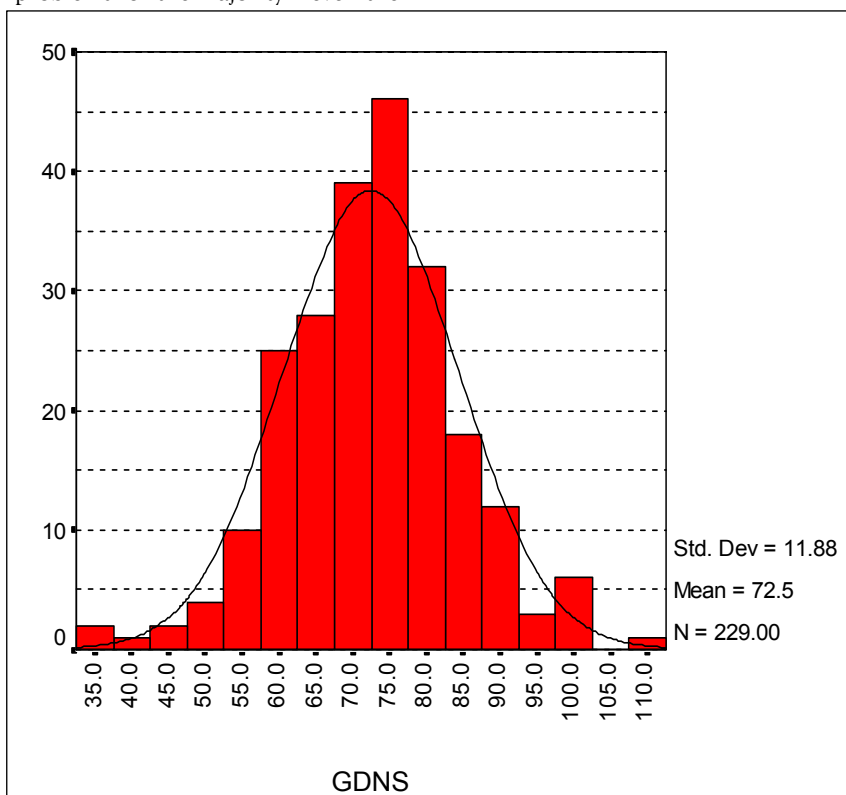


Figure 1: Distribution of noise sensitivity (GDNS) in the population

whether the role is positive or negative. Clearly it contributes positively for those who purposefully choose to listen, and negatively for those who would choose not to attend yet who are powerless to prevent their attention and activities being influenced by it. This is especially the case for those whose dwellings are close to venues of public music making.

Medium and high-density housing developments in our cities have intensified the mix of private dwellings with public spaces and venues. In determining policies and controls for what is desirable and permissible with respect to sound creation and propagation it is necessary to try to preserve and maximise what characterises the private dwelling as distinct from a public space.

The issue that obviously concerns us is the conflict over noise - perhaps specifically for this conference entertainment noise. Given the above definition for noise we might propose a research scenario where we attempt to collect data on peoples' reaction to noise by measuring in some way the %age of time they are distracted or annoyed by differing degrees of music-noise exposure. We then plot a dose-response curve and choose a limit for acceptability based on what would appear to keep a majority of persons relatively undistracted or not annoyed.

But what if persons' reactions are not so obligingly straightforward and their response to the music-noise is not a direct reaction but a by-product of something more fundamental? This is where an initial stage of QR might be helpful in answering this and is thus necessary to guide us towards a more appropriate research approach.

We might suspect that noise entering a dwelling is likely to be received on a different basis from how it is received in other environments because a dwelling - or home - is unique amongst

environments in being the space where one's personal privacy is a maximum. If entering noise is therefore primarily sensed as an invasion of privacy then our relevant responses can be expected to be different from what is measured in a distraction or annoyance experiment or survey. If we consider the Cocktail Party Effect (in its original meaning i.e. not referring to the Café Effect) then we have a clear example of how input which impinges on very personal matters can elicit a strongly differing reaction. Why, therefore, would it not be that a violation of personal privacy produces a stronger reaction than mere distraction or annoyance by sound?

To test this hypothesis we need to identify those features which characterise the amenity of privacy. This then would allow us to construct a suitable definition allowing us to see if we can devise an experiment capable of discriminating reaction to noise invading privacy from noise simply being distracting or annoying. The results from such an experiment will provide the foundation for noise protection criteria for dwellings.

A pilot survey was therefore carried out on a small sample of adults to see if common factors occur in views about privacy, and to find if people

differ significantly in their need for - or sensitivity to - privacy. The questionnaire comprised 8 questions which included asking for a meaning for privacy, examples of what constitute invasions of privacy, and a self rating of personal need for privacy. A final "personal profile" section of the questionnaire also elicited detail which - in the future with a larger number of respondents - can be analysed to look for correlations with type of housing, number of cohabitants etc.

Privacy Questionnaire analysis

Meaning for Privacy

In the analysis of respondents' answers 14 different response categories were necessary to capture the nuances in the replies but they condensed into 3 main groups where the issues could be described as (1) protection from unauthorised outflow of personal information, (2) freedom from the sense of others and (3) provision of safety.

The first and second concerns can be seen as having potential implications for required acoustical conditions. In the first case (i.e. preventing an outflow of personal information) this suggests the need for Speech Confidentiality plus the

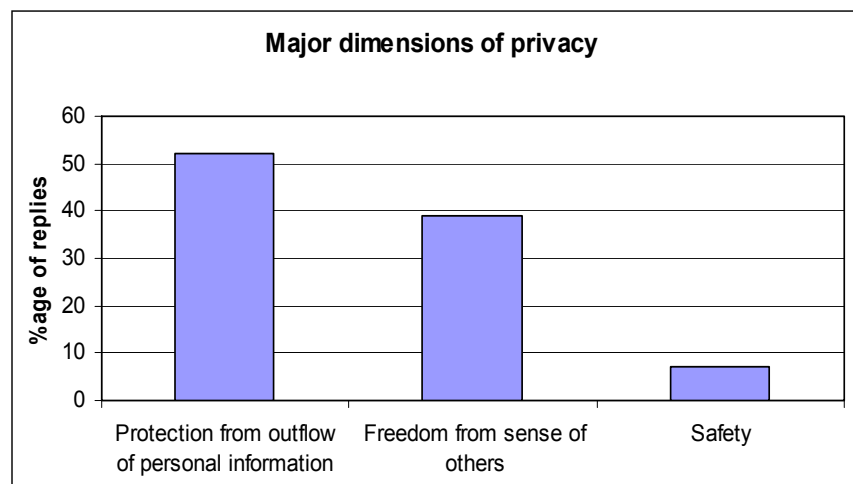


Figure 2: The relative importance of the main issues for privacy in terms of the percentage of mentions by respondents

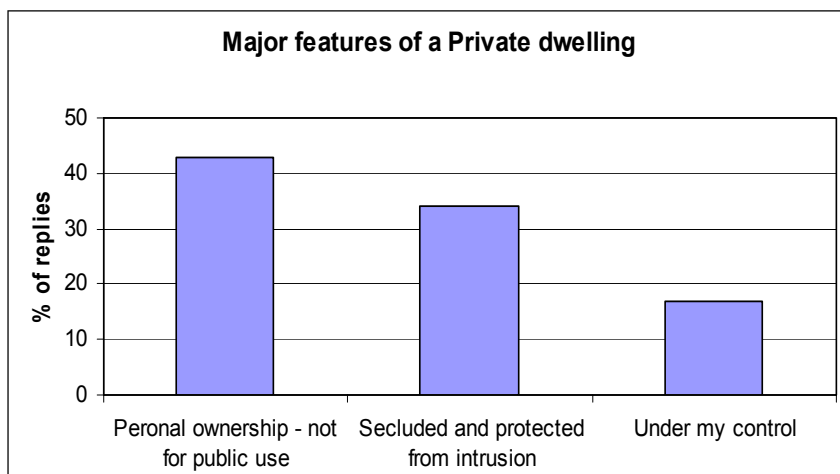


Figure 3: Features distinguishing a dwelling as private.

attenuation of other-than-speech sounds which may communicate information. However, the second issue (i.e. freedom from the sense of others), which was identified as a concern by 39% of respondents, more obviously involves the need to prevent the transmission of sound into our dwellings.

What makes a Dwelling Private?

Respondents' views on the features which make a dwelling private were generally along the lines of their definitions for privacy and reinforced the finding that an important feature is the protection of intrusion in the form of the uninvited sound/noise of others.

Invasion of Privacy

To further refine the significance of sound transmission without biasing the respondents by a specific question about sound or noise the questionnaire invited specific examples to illustrate violations of privacy.

Again a reasonably large number of coding categories were needed to capture the range in the examples but nearly all could be fairly accommodated in a condensed set of 5 groups: (1) obtaining personal information without permission, (2) uninvited entry to property, (3) noise coming in, (4) insensitivity by co-habitants (5) noise of one's activities being heard outside.

It is interesting that based on the frequency of mentions that noise intrusion (i.e. sound coming in) has a greater significance for the sense of loss of privacy than the fact of others receiving the sound of one's own activities.

Assessment of dwelling Privacy

Respondents were invited to rate the privacy of their own dwellings on a continuous scale. For the purposes of analysis this was subsequently converted to a 5-point scale where 5 indicated an assessment of complete privacy and 1 an indication that privacy was grossly lacking. There were no assessments of a gross lack and 17% of respondents were fully satisfied and gave a 5 rating. A

majority (60%) felt that their dwellings were category 4. There were, unfortunately, few respondents living in apartments or town houses and therefore a comparison of detached and attached dwellings cannot be fairly made but none-the-less no apartments or townhouses were rated at 4 or 5. 22% of subjects gave their places of abode a rating of either 3 or 2.

Subjects who rated their dwellings as lacking in complete privacy were asked in a subsequent question to detail reasons for the lack. Noise transmission was cited as a concern by 40% of the respondents.

Self assessment of 'need for privacy'.

We might expect that the need for privacy will vary between individuals and this will be a confounding factor when drawing conclusions from occupants' ratings. Knowledge of how varied this is in the population is therefore needed and it will also indicate whether privacy is an amenity which might be acceptable at differing levels without loss of quality of life provided the level matches the specific occupant(s).

Subjects were asked to indicate their perception of personal need for privacy on a semantic differential

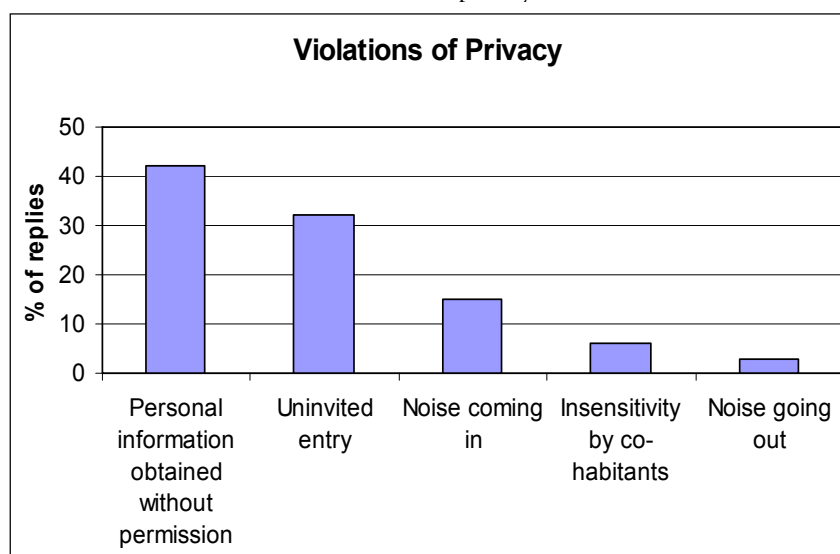


Figure 4: Examples of events resulting in a loss of privacy

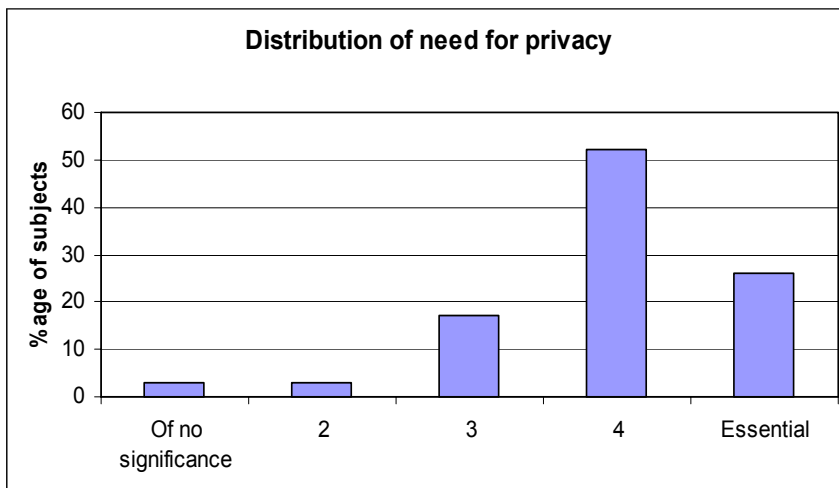


Figure 5: Distribution of personal need for privacy by self assessment

scale with the extremes being 'Of no significance' and 'Essential' respectively. For analysis purposes this was converted to a 5-point scale with 5 representing Essential.

The small sample size for this survey so far does not allow any detailed conclusions beyond the observation that the data suggest a bell-shaped

distribution with a skew indicating an overall need for a high level of privacy.

The subjects were asked to mention the issues they felt underpinned their degree of need for privacy. Only a minority mentioned sensitivity to sound/noise transmission but this amounted to

14% of the respondents.

It may be coincidental but it is interesting to note that this is very similar to the percentage of the population that earlier work has identified as being noise sensitive (see section 2.2.1).

As this is a "work in progress" and the above are only results from a small pilot survey it is inappropriate to try to draw complete conclusions. However, we can say:

1. Noise must be assessed from the point of view of its impact on privacy as well as for its potential to mask, annoy, distract etc
2. Although a small minority claim privacy has little significance for them the vast majority are aware of it being a major requirement in their lives.

The next step is to construct a privacy definition and devise experiments to measure the part noise - or the lack of it - plays in privacy.

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Qualitative Research on Practitioners

Finally, let us turn to QR with respect to practitioners in the profession and discipline of acoustics. The question to be addressed is – “Are we adequately aware of our motivations for the ways in which we variously serve clients, the population at large, and our students?”

In a world characterised by evolution and change we cannot rely on established practice handed down by our teachers and those to whom we have been apprenticed in practice, as necessarily being correct and appropriate. Let's take as a simple example our continuing use of the dB.

Although the dB has value in that it conveniently compresses quantities (for example the pressure range spanning the dynamic range of hearing), we should consider the disadvantages of its adoption.

First it is too easy for students – and practitioners also – to regard it as a unit (e.g. like metres or kilograms) which uniquely indicates the physical quantity being measured.

Consequently this results in confusion when we appear to measure totally different quantities (e.g. pressure, intensity and power) by means of the same unit.

Second, and more significant, however, is the error perpetuated by texts which frequently introduce the topic of dB's via the Weber-Fechner law claiming that the ear has a logarithmic response to sound pressure hence therefore it is appropriate to use a logarithmic measure (i.e. the dB) for expressing the magnitude of sounds. (Those texts which do not do this overtly seem often to manage to do it covertly and still imply that this is the reason for using dB's.)

The obvious and logical deduction from this is that, in adopting the dB, the early acousticians were aiming to obtain a magnitude measure for

objective sound which would relate linearly to the magnitude of the associated subjective sound – i.e. its loudness.

Thus we should expect simple mathematical predictability of loudness changes from dB values. However, as we all know well this is definitely not the case and increasing the SPL of a sound from 40 dB to 80 dB for example does not double the loudness of the subjective sound.

In this example we have a case either of ignorance or an unwillingness to move – as our modern technology would allow us – to a more satisfactory true-loudness scale. If we did this then it is reasonable to expect, given the ease of the loudness concept for the non-specialist/lay person, that the general public would eventually – and usefully – develop a sense of absolute loudness just as daily familiarity with temperatures develops in us, or calibrates us for, the ability to relate temperature to the associated feeling of warmth or coldness.

Other examples illustrating how we focus our energies on technical precision for objective sound measures, in preference to refining our measures relating to subjective issues are our retention of:

1. A and C frequency weighted SPL's (only very recently has the B weighting disappeared from our formal specification for SLMs) – despite more refined measures such as loudness, sharpness and roughness being available, and
2. STC ratings which ignore the crucially important low frequencies below 100 Hz.

Commonly acousticians strive to measure and predict these quantities as accurately as possible, e.g. to within a dB, whilst knowing that difference limen values for humans are much bigger and therefore such accuracies are unwarranted.

Conclusion

Qualitative Research has been described and researchers are encouraged to regard it as an important and necessary precursor to traditional, technical/quantitative research. In telling us the reasons and motivations for peoples' behaviour QR can direct our experiments and criteria to focus on pertinent issues and not merely those that convenience and precedent indicate are obvious candidates.

Definitions have been reviewed for the issues involved in the questions raised by the generation and propagation of music from public venues close to dwellings. Without precise definitions it is not possible to know how or what to quantify when defining norms for what is socially acceptable behaviour.

Since dwellings are special places for privacy, noise which intrudes and invades this privacy may require special consideration.

A pilot survey has been carried out in the first stage of research aimed at determining if criteria for noise for protection of privacy are significantly different from the criteria for noise for the prevention of distraction or annoyance. Results from the survey suggest that an overwhelming majority of the population have a very strong need for privacy, and many experience noise as a destroyer of privacy. The next stage (after proposing a definition!) is to find a way of monitoring when privacy is disturbed by noise.

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