A combined qualitative/quantitative approach to the design of noise annoyance studies

Ian Flindell
Institute of Sound and Vibration Research, University of Southampton, UK.

Paul Le Masurier
SYSTRA Ltd, Woking UK.

Summary

The objective of this paper is to discuss the strengths and weaknesses of the combined qualitative/quantitative approach for understanding community attitudes to aircraft noise. Obtaining exposure-response relationships for environmental and transportation nosie which are capable of predicting differences in relative acceptability across the wide range of different contexts under which policy relevant information is required has been an elusive research goal for many years. In our recent experience, an initial qualitative approach based on limited numbers of extended depth interviews has been much more capable of providing meaningful insights into community perceptions of noise than any standardised questionnaire based approach, and can crucially transform the design of any subsequent, more traditional, quantitative study, if statistically representative information is required.

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1. Introduction

The traditional approach to designing noise/annoyance studies using large scale ***ISO standardised questionnaire*** [1] ***based (quantitative) surveys*** has two main issues as follows;

- Considerable statistical uncertainty – where every new study obtains different patterns of results even when deploying standardised research methodology and measurement instruments because of differences over time, differences in context, and considerable variation in sensitivities and priorities by different research participants, and;
- The traditional approach is essentially cross-sectional, which means that even if the resulting L_{Aeq}/annoyance exposure/response relationships were statistically consistent (which they usually are not), extrapolation for the purpose of predicting the effects of change depends on assumptions which are of unknown validity. Because decision-making is always about changing something, this is not particularly helpful and leaves decision makers having to make presumptions about the community's views and preferences which might not be justified.

Our proposed solution to these problems is to design research which is specifically and directly addressed to policy relevant questions by using whichever combination of both qualitative and quantitative methods is the most appropriate at the time. For example, if a research sponsor simply wishes to investigate to what extent average community annoyance in specific areas around an airport varies from historic harmonised exposure-response relationships [2], then a traditional (and usually rather costly) large scale quantitative research study design using standardised methodology and measurement instruments will exactly fit the bill. Statistical relationships between community noise annoyance and L_{Aeq} have presumably been found extremely useful when deciding whether, and how, industry might benefit from having quieter aircraft – by deriving the increase in the number of aircraft that could be accommodated and stay within the overall noise exposure metric.

However, if a research sponsor wishes to understand community priorities and attitudes in respect of possible management actions such as;

- altering noise limits and/or restrictions on night-time traffic;
- providing new runway capacity to accommodate increasing traffic (and thereby contribute to

economic growth, and which could be as popular as increased noise is unlikely to be);
- altering the balance by which the smaller numbers of residents exposed to the highest aircraft noise levels through living close to the airport, or the much larger numbers of residents exposed to lower aircraft noise levels because they live further away, should be prioritised to benefit from quieter aircraft and/or improved operating procedures, and/or noise compensation or other mitigation;
- introducing or increasing noise fines and distributing the proceeds amongst community projects; and/or
- providing and/or managing noise respite periods

… then a more enlightened, and direct, approach which includes qualitative and comparative (trading) methodologies is required.

Both in the UK and elsewhere, traditional comparisons over time between the results of large scale quantitative aircraft noise surveys around major airports have shown increases in reported aircraft noise annoyance when plotted out against standard measures of aircraft noise exposure such as 16 hour L_{Aeq} or 24 hour L_{den} metrics [3]. In the UK, the recently published 2012 National Noise Attitudes Survey [4], compared against the results of the previous National Noise Attitudes Survey carried out in 2002, the proportion of UK residents reporting that they were bothered, annoyed, or disturbed by aircraft noise had increased from 20% to 31% and that the proportions reporting that they were very or extremely bothered, annoyed, or disturbed by aircraft noise had doubled from 2% to 4%. From the available quantitative data, while it is possible to speculate, it is impossible to determine the actual cause of these differences. Has noise actually increased, or have community perceptions of, and attitudes to, noise changed, or is the true explanation a combination of the two?

And then on the other hand, the NNAS 2012 survey showed that *'respondents were overwhelmingly positive about the area or neighbourhood that they lived in (88%)*', and very few respondents reported that they *'definitely did not like*' the area or neighbourhood that they lived in (1%). These statistics suggest that for many of the significant numbers of respondents who had reported being bothered, annoyed or disturbed by aircraft noise, or who had reported being very or extremely bothered, annoyed, or disturbed by aircraft noise, this had not affected their positive attitudes to the areas where they lived. Spontaneous comments recorded in ***qualitative depth*** surveys, or in ***open-ended questions*** put at the beginning of standardised quantitative questionnaire based surveys, often suggest that for many respondents, while they may have been disturbed, bothered, or annoyed by aircraft noise events on occasion, they have also largely habituated to any aircraft noise present to the extent that it does not significantly interfere with their overall quality of life.

This apparently contradictory evidence can be reconciled by concluding that general and often **open-ended questions about overall quality of life** and **standardised questions about specific aircraft noise and disturbance** are often measuring entirely different things. The difficulty here for administrators and regulators is to first understand why these apparently contradictory patterns of response emerge and then to decide which evidence to take into account when formulating policy.

In many, if not most, of these cases, it seems clear that more focused research with the affected community is needed. And, in the view of the authors, typically this research should be qualitative and comparative in nature – at least initially, in order to tease out the key information on context and options that residents need to know in order to provide informed views on the issue. Any differences between initial uninformed, and subsequent informed, views are often particularly relevant because they can often help to highlight the important role that effective communications can play in public engagement [5].

2. Strengths and weaknesses of standardised quantitative questionnaires

Standardised questions (such as the standardised ISO annoyance scale - [1]) are used primarily because they eliminate variation associated with detailed differences in questionnaire wording, and if coded sensibly, they also facilitate numerical comparisons between, and within, different sub-samples of respondents.

The fundamental problem with this approach is that by 'forcing' a wide range of people with very different circumstances and experiences to respond on a single metric, the researchers may lose the subtleties and sentiment of the individual's view on aircraft noise; its effect on the family's quality of life; and the wider pros and cons of residing near to an economically vibrant airport. Without this insight the researcher, and ultimately the policy-maker, may be unaware of the 'true' attitudes of

respondents to aircraft noise, and most crucially, on the specific policy question(s) of the day.

For example, it is questionable to what extent any averaged L_{Aeq}/annoyance relationship based on traditional cross-sectional research can usefully inform major decisions such as where to provide additional runway capacity to accommodate increasing demand. Not all residents who report significant annoyance under present-day conditions would necessarily oppose future airport expansion if they expected social and economic benefits from development which would not be enjoyed if expansion did not take place. In addition, nearby residents who might find themselves living under new flight tracks if expansion were to take place would not necessarily qualify to be included within the sample population under the current traditional approach. Only by first providing relevant (and unbiased) information and then by asking direct comparative questions can policy-makers be confident about what the community actually wants or at least prefers out of the available options under consideration by policy-makers.

For quantitative research based around standardised structured questionnaires, response variance (for a given level of noise exposure) is usually hypothesised as being ***caused by:***

- differences in individual sensitivity to noise;
- differences in the extent to which local media, pressure groups, etc. may have heightened local awareness;
- differences in situational variables, such as whether respondents are at home (with windows open or closed) at different times of the day, and;
- a large random component which cannot be explained by any systematic variables, and is generally considered to contribute around 1/3rd of the total variance [6].

There is, of course, one further and potentially significant source of variance which is difficult to deal with and impossible to measure without qualitative research. Individual differences in interpretation and understanding of what the specific question actually means cannot be assessed by standardised questionnaires unless all possible nuances of opinion have already been provided for in standardised response categories. For example, there is no simple explanation for the finding in the 2005-6 ANASE study [7] that respondents with noise insulating windows were marginally more 'annoyed' (on average) than respondents who did not have noise insulating windows. This might be because:

- some respondents might have reported particular annoyance values because they were more influenced by the apparent, or perceived, loudness of the source outdoors rather than the reduced loudness indoors with the windows closed (i.e. they were judging some assumed or projected quality of the source rather than the actual effect of the sound at the position of the person who is exposed to it, or;
- some respondents may have been inclined to report higher annoyance values because the perceived effect of noise insulation did not meet expectations, or;
- only the more annoyed residents had gone to the bother of having double glazing fitted.

The data is further confounded by the increasing likelihood over time that double glazing may in fact have been fitted simply as replacements for older worn out windows, or for thermal insulation purposes, in which case the respondent might have never given the possibility of reduced sound levels indoors any consideration at all.

This leads to a further and probably really important issue; what does 'noise annoyance' actually mean? Academic researchers have provided various definitions in the past, mostly based around emotional experiences and which can rather obviously be highly dependent on individual personality traits, but which more importantly require explanation if they are to be understood by different people with any degree of consistency. Standardised questionnaires provide no opportunity for clarification, bearing in mind that the real issue here is not what the researcher wishes the respondent to understand by the concept, but instead, what the respondent actually understands; and, crucially, whether the requested form of response enables the respondent to state or reveal their 'true' sentiment on the issue of aircraft noise. In terms of scientific method, it is quite amazing that acoustics researchers continue to use indeterminate instruments to measure key outcome variables without actually being able to define exactly what the '*defined*' metrics (such as annoyance) actually mean. A key question for policy is, or should be, ***how important is it*** that, for example, x% of a population report y% annoyance. How many traditional noise/annoyance studies can answer this question?

3. Strengths and weaknesses of qualitative - depth interviews

The only way to find out, or to attempt to find out, what people actually think about different issues, is to discuss these issues with them, in as much depth as the respondent is prepared to go, and to provide whatever information the respondent may need in order to be able to make properly informed judgements or decisions. In contrast, the ISO question deliberately avoids setting any context when asking about annoyance with noise over the past 12 months etc, - in this respect it simply measures degrees of negativity which are only defined in terms of the specific wording. It cannot, therefore, be suitable for interpreting community views to any new policy – at least not without making presumptions about community attitudes and opinions which may or may not be true.

In general, and in order to achieve common understanding, it is better to position issues as choices or trade-offs where respondents can state direct opinions about hypothetical policy choices, rather than seek opinions about affective issues where particular subtleties could still intrude upon interpretation. For example, while a more considered understanding between researcher and respondent of poorly defined concepts such as 'noise annoyance' might be achieved during qualitative discussions, this does not necessarily mean that any third party reader of the research will also achieve a similar conformity of understanding. More concrete issues, '*would it be better for you, or your neighbours, or for society as a whole, if the airport does x or y?*, can be much more meaningful for policy, but in all such cases it is vitally important to ensure that the respondent understands the implications of any policy-relevant choices rather than making the kind of ill-considered snap judgements that are unfortunately encouraged by standardised questionnaires. There is an unfortunate tendency amongst acoustic researchers to assume that this kind of snap judgement is somehow more '*truthful*' than fully considered opinions because they (hypothetically) reduce the possibility of policy bias and similar issues to intrude, but a moment's reflection shows this is not the case. In the past, standardised questionnaires have even been designed to conceal the true purpose of the survey (i.e. to measure noise annoyance) from respondents by asking lots of general and mostly irrelevant questions before getting to the key annoyance questions, but this is now rightly considered to be a) not entirely ethical, and b) not particularly helpful anyway.

The possibility of researcher bias is a tricky issue. Interpretation of responses to open-ended discussion questions is essentially subjective, and there are obvious opportunities for bias throughout the process of informing respondents, by emphasising some 'facts' more than others. While it is important that researchers are fully independent of parties on either side of any debate, it might still be impossible to avoid unintentional or subconscious 'bias'. Conducting interviews with two researchers at a time, although considerably more costly in terms of resources, probably helps to reduce unintentional bias and it certainly helps with note taking.

Statistical analysis of open ended interviews can be equally problematical, since respondents often prefer to express opinions in their own words rather than being constrained to use defined categories required for numerical analysis. The solution to this problem seems to be to include a limited number of structured questions within open-ended qualitative topic guides, where the detailed wording for these have been chosen and tested in previous interviews in any particular study. Or, better still, invest time and resources to undertake a thorough qualitative research exercise with a spectrum of different people potentially affected by a policy, followed by a complementary quantitate survey with a representative sample of the population of interest. The qualitative research will dictate the design of the subsequent quantitative questionnaire by gaining insight into residents' current understanding of the issue; the additional information they need to make fully-informed judgements on the issue; and the terminology/metrics they choose to use when describing the options and their preferred way forward.

4. The combined qual/quant approach

The first step in our suggested combined approach is to properly understand the potentially relevant policy objectives of any proposed study, and if necessary to constrain those objectives to within feasible or realisable limits. If this step is carried out correctly, the detailed design of the study should then be almost trivial. For example, for any study for which the primary objective is simply to investigate how responses measured in a particular way might have changed over time, it is obviously necessary to use the same measuring instruments, and if this means using standardised scales of annoyance, then this is what has to be done. However, study designers also need to be aware that simply discovering that reported annoyance

may have changed (up or down) over an intervening period of years is not necessarily helpful for informing policy because, by itself, it does not expose how policy might need to be changed in order to reverse any increases in annoyance which might have occurred, or vice versa. To achieve this level of understanding requires insights into causes and effects of particular behaviours and underlying attitudes which can only be obtained from in-depth qualitative interviews. Statistical quantification may then be desirable, not to provide any further insights but instead simply to provide a sense of scale/perspective, and numerical re-assurance for policy makers.

Our recommended procedure is therefore, and depending on the specific application, to carry out initial exploratory interviews to identify key issues, ensure that these issues (whatever they are) are included within subsequent topic guides and to gradually introduce quantitative trade-offs and choice sets as experience is gained regarding the type of questions that resonate most strongly with the particular interests of the respondents concerned. If required for informing policy, it is then perfectly possible to carry out a conventional quantitative study with a representative sample of the population of interest using questionnaire items developed, and to at least some extent validated, during the preceding qualitative phase. This step is not needed to obtain any further insights as such, but instead is simply included to provide statistically representative numerical data.

5. A case study example

Recent trials of flight track concentration around a major UK airport provided an opportunity to carry out qualitative research to investigate to what extent residents had noticed any consequent changes in flight tracks; whether they thought there had been an improvement or deterioration in the noise climate; and if a monetary value (positive or negative) could be associated with the changes occurring during the trials. Using the ISO standard scale of annoyance [1], approximately one in four respondents reported being very or extremely annoyed by aircraft noise during the previous year while more than one in three reported that they were not at all annoyed by aircraft noise. Given this wide variation in views, and also noting that the trials had been widely publicised by the airport, it is interesting that, while just over half of the respondents expressed some awareness of changes in flight paths, nobody was able to provide any details and there appeared to have been very little previous interest in how the airport actually operated and how it might be changed in the future. From a list of potential (hypothetical) management policies, the future adoption of flight track concentration associated with precision navigation was amongst the least preferred options.

The specifics of what had actually been happening during the trials were then explained in some detail so that all further responses could be fully informed. Informing the respondent can take appreciable time, depending on prior knowledge and technical interest which can both vary over a very wide range, and can require considerable sensitivity to avoid alienating respondents with little interest in such matters. Most respondents easily understood that precision navigation could offer considerable efficiency and safety benefits, but that the resulting flight track concentration could lead to significant additional burdens for people living directly underneath the concentrated flight tracks unless mitigated in some appropriate way.

Based on a quantitative Stated Preference questionnaire, respondents in these particular sampling areas that were at risk of being under increasingly concentrated flight-paths placed a mean value of approximately £100 per household per annum on **retaining** wide flight track dispersal compared with having a single concentrated route; and approximately £45 per household per annum on the airport adopting alternated concentrated routes compared with a single concentrated route option. These values are based on theoretical flight track options where respondents have not been told exactly where new routes would be located (i.e. they could be over their houses or they could be over somewhere else) but they are informed by actual experience during the trials. In practice, and for obvious reasons, actual monetary values could be different between people living underneath concentrated flight tracks and people living elsewhere, but such values could only be determined after the new flight tracks had been permanently introduced, and by then it would be too late for them to be taken into account in policy.

Any evaluation of single concentrated routes made purely on the basis of an assumed L_{Aeq}/annoyance relationship for the affected population would show that a minority of residents would receive an increase in noise exposure and considerably more people would experience corresponding reductions. This might lead to policy-makers concluding that the community would, overall, benefit – hence

providing the '*evidence*' to support a policy of minimising the number of people flown over by aircraft, even if it meant considerably more aircraft overflights for those particular people.

The qualitative research findings, however, showed that the vast majority of respondents in the overall area likely to be affected by the possible change in policy preferred the existing wide dispersion of flight tracks – on the basis of ***perceived fairness*** - even if they themselves might thereby have been denied the opportunity to benefit from reduced aircraft overflights.

The authors have conducted a series of different social studies with residents on the subject of a variety of different airport policies, and ***perceived fairness*** is commonly observed as a prime motivator for residents' preferences and support/opposition for proposed actions. Perceived fairness appears to be such a fundamental property for British society that it should be taken into account more often, and in order to do so, it is necessary to discover which management options are considered to be the most 'fair'.

6. Concluding remarks

Unfortunately, over-reliance on the standardised quantitative approach to the design of airport noise studies has contributed to a general lack of consensus throughout the airport noise stakeholder community. Various attempts to either explain [8] or otherwise investigate [2] significant differences in average results between different studies have not resolved the main outstanding problem, which is that reported annoyance, as measured in traditional cross-sectional quantitative studies, is not a particularly useful metric for informing policy. Qualitative in-depth research has been showing that different respondents have different sensitivities and priorities in different situations and are often much more interested in whether or not airport and regulatory authorities are taking practical steps to reduce aircraft noise disturbance and annoyance, and what those steps are, than in any absolute levels of either noise or annoyance. This is where combined qualitative/quantitative research that includes useful and unbiased information materials that are presented to research participants can play an important role in informing future policy by obtaining insights; focusing on practical steps; and establishing informed community preferences;

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