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Constructing noise-reaction questions for community noise surveys in nine different languages. Experiences and lessons learned

Truls Gjestland

SINTEF Digital, Norway

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ABSTRACT

Studies of peoples' reaction to community noise had been published since the early 1960ties, but differences in survey questions' wordings had interfered with inter-survey comparisons. In 1993 an ICBEN team set the goal of creating high-quality survey questions that would yield internationally comparable measures of overall reactions to noise sources. After 7 years of discussions and research the team presented their recommendations. This paper presents some of the issues that were discussed by the ICBEN team and describes how they were dealt with.

1. Introduction

Studies of peoples' reaction to community noise have been carried out since the early 1960ties. Researchers conducted social surveys and constructed various types of exposure response curves. The objectives of these surveys were often related to land use and to find out limits for unacceptable noise exposure. In earlier surveys the inhabitants of a community were typically asked whether and how much they were impacted by a certain noise and whether this noise interfered with their daily activities such as sleep and rest, conversation, listening to radio/TV etc. Then their responses were combined to quantify the total negative impact of the noise. Later on, the researchers realized that a person's negative experience with the noise, the degree of annoyance, could be more simply determined from the response to a direct question: How annoyed are you by the noise from xxx? Several research papers using this direct approach were presented at the International Congress on Noise as a Public Health Problem in Dubrovnik, Yugoslavia, in 1973 [9,14].

In 1978 TJ Schultz published his paper "Synthesis of social surveys on noise annoyance" [16]. This was the first serious attempt to find a general relationship between negative impact and exposure to transportation noise. Schultz used the term annoyance to describe the negative impact of noise, and he used the prevalence of high annoyance to quantify the impact. According to Schultz, people who responded to the upper 27 – 29 percent of a continuous annoyance scale should be considered *highly annoyed*. This was a new way of dealing with annoyance. He used the parameter *highly annoyed* instead of just *annoyed* in order not to trivialize the issue. One of his arguments was that when the results from a survey should be used for setting limits for acceptable noise exposure, one should look to those to whom noise was a really serious issue, and not to those that were just *somewhat annoyed.*

This way of dealing with annoyance and community response to noise was considered quite controversial at the time, and caused a long and at times quite aggressive discussion between supporters and opponents of the idea [11,12,15].

Later the US Federal Interagency Committee on Noise, FICON, declared that *annoyance* was its preferred *summary measure of the general adverse reaction of people to noise,* and that *the percentage of the area population characterized as "highly annoyed" by long-term exposure to noise* was its preferred measure of annoyance [3]. This has later become a *de facto* standardized way of reporting a community's response to environmental noise.

Schultz [16] pointed to the lack of standardization as a major obstacle for his work. He had experienced that the researchers in their surveys would use many different annoyance questions and a multitude of response scales both verbal and numerical. Schultz' observations and the FICON declaration triggered the International Commission on Biological Effects of Noise, ICBEN, to initiate the development of standard procedures for conducting social surveys on noise annoyance. A working group was established at the ICBEN congress in Nice in 1993, and after 7 years of discussions and research the ICBEN team presented its recommendations. In 2001 the paper "Standardized noise-reaction questions for community noise surveys: Research and a recommendation" was published

E-mail address: truls.gjestland@sintef.no

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[5]. This paper provided standardized annoyance reaction questions and a verbal response scale for noise surveys in nine different languages, and it also described a procedure for constructing similar questions in other languages. The paper was re-written and published as an ISO Technical Specification in 2003 and subsequently revised in 2021 [10].

This technical note describes the initial development process of the ICBEN recommendations and discusses some of the difficulties and obstacles that the ICBEN team encountered.

2. Development of high-quality, multi-purpose, comparable noise reaction questions

The ICBEN team very soon realized that the development of a complete survey questionnaire would be futile. There were too many individuals with a strong opinion on how a social survey should be conducted, and there were ongoing longitudinal studies that relied on specific questionnaires and fixed response scales.

As a minimum solution the ICBEN team decided to propose two standardized questions that could be included in any survey. That should be sufficient to anchor the survey results to a common reference, and thus allow inter-survey comparisons.

The ICBEN Team had members with diverse language backgrounds but used English as their working language. They decided on the following procedure to develop a set of recommended noise reaction questions.

- Review previous research and team members' experience to set the basic form of the question.
- Rely on reviews and expert judgement to refine the wording of the question stem in English
- Translate and back-translate to develop and adapt the question stem for languages other than English
- Conduct parallel studies following a uniform protocol to select verbal modifiers for the response scales

In their review work they soon found out that important pieces of information were often missing in previous survey reports. As an intermediate action the team therefore developed and published guidelines on how social surveys should be reported [4]. This would, in their opinion, facilitate and simplify inter-survey comparisons. In parallel they struggled with the tedious work of developing the reference questions and response scales. They agreed on two relatively simple questions that asked the respondent to assess the annoyance from a certain source with respect to a specific time period (last year, last 6 months, etc.) using 1) a 5-point verbal scale, and 2) an 11-point numerical scale.

One would assume that after the initial work of formulating the standardized questions in one language, English, the translation of the questions into other languages would be a simple and straight forward task. This was not the case.

3. What is annoyance and where it is experienced

Schultz [16] used the word *annoyance* to characterize the negative impact of the noise. It turned out that annoyance was by no means a precise and unambiguous concept. Guski *et al.* studied how the concept annoyance was interpreted among international experts [8]. Annoyance was associated with words and concepts like disturbance, dissatisfaction, displeasure, irritation, nuisance, discomfort and so on. In order to include the full range of negative environmental conditions, the ICBEN Team decided to use several words for the initial survey question. The more obvious question: "How does noise from < this source > annoy you?" was expanded to "How does noise from < this source > bother, disturb, or annoy you?" Note the use of the conjunction OR and not AND. This indicate that the three words bother, disturb, and annoy may have slightly different meanings that may all be included in the final annoyance concept.

There was also another issue that caused a lot of discussions. The ICBEN noise team wanted to register the reaction when the respondents were inside their dwelling and also in the immediate proximity of the dwelling like out on a balcony, in their garden, on their front porch, etc. They concluded that the English phrase *at home* included all these locations.

An inspection of the final questions in other languages shows that these issues were solved in different ways. One to three words have been used to describe the general negative reaction, and the location *at home* in some languages has been described without even using a word for *home.*

4. Translation and back-translation

The English version of the two questions were translated by the Noise Team members into their respective native languages. Since they had participated in the development of the original questions, they were familiar with the special issues that had been discussed in the development process. The objective of the translation was not to produce an exact word by word replica of the questions but rather using terms from their own language that would convey the same general intention.

Then a back-translation was done by a naïve speaker of the native language. This translator had not participated in any of the previous discussions.

Any mismatch between the original and the back-translated version of the questions was resolved by the native speakers sometimes using several rounds of translation/back-translation.

The text in all nine languages for the first question referring to the verbal response scale is shown below. It is obvious that different languages use different strategies to convey the exact meaning of the question. The English words that describe the negative feeling, bother/disturb/annoy, and their counterparts in the other languages, are shown in **bold.**

English: hinking about the last (..12 months or so..), when you are here at home, how much does noise from (..noise source..) **bother, disturb**, or **annoy** you; Extremely, Very, Moderately, Slightly or Not at all?

Dutch/Flemish:Wanneer u denkt aan de afgelopen (..12 maanden of zo..), in welke mate **stoort** of **hindert** het geluid van (..geluidbron..) u als u hier, bij u thuis bent; extreem, erg, tamelijk, een beetje of helemaal niet?

French: i vous pensez aux (..douze derniers mois..), quand vous êtes ici, chez vous, le bruit de (..source..) vous **gêne**-*t*-il: extrêmement, beaucoup, moyennement, légèrement, pas du tout?

German: enn Sie einmal an die letzten (..12 Monate..) hier bei Ihnen denken, wie stark haben Sie sich durch Lärm von (..Quelle..) insgesamt **gestört** oder **belästigt** gefühlt: Äuβerst, stark, mittelmäβig, etwas, oder überhaupt nicht?

Hungarian: ekintve az utóbbi (..idöszakot, 1 évet..) mennyire **zavarja** Önt a (..zajforrás..) zaja, amikor otthon tartózkodik: rettenetesen, nagyon, közepesen, kissé vagy egyáltalán nem.?

Japanese: Kako (..12 ka getsu kurai..) wo furikaette, anata wa jitaku de (..sôon gen wo ireru..) karano sôon de dono teido **nayamasareru**, aruiwa, **jamasareru**, **urusai to kanjiru** deshôka: hijôni, daibu, tashô, sorehodonai, mattakunai?

Norwegian:

Tenk etter på støysituasjonen de siste (..12 månedene..). Hvor **plaget** er du av støy fra (..støykilde..) når du er hjemme? Er du voldsomt plaget, mye plaget, ganske plaget, litt plaget, ikke plaget.?

Spanish: omando en consideracioHn los últimos (..12 meses..), indique Vd. en qué cuantía le **molesta** o **perturba** el ruido producido por (..indicar la fuente de ruido..) cuando se encuentra en su casa: extremadamente, muy, medianamente, ligeramente, absolutamente nada.

Turkish: aklaşık son (..12 ayı..) düşündüğünüzde, (..gürültü kaynağından..) gelen gürültü, burada evinizdeyken sizi ne kadar **rahatsız** etmektedir? Feci şekilde, çok, orta derecede, hafıfçe, hiç değil?

5. Verbal modifiers

The question referring to the verbal response scale also comprised a set of modifiers for naming the five response categories: extremely, very, moderately, slightly, and not at all annoyed. Initially these words were included in the translation process, but when the ICBEN team met to review the proposed wordings, there was a general agreement that neither dictionary translations nor expert judgment provided a sufficient basis to select verbal modifiers with good metric qualities for a single language or consistent meanings across different languages.

It was decided that the set of modifiers had to be constructed "from scratch" for each language following the same detailed procedure. The first step in this procedure was to create a list of 21 candidate response modifiers using the following six selection criteria:

- The phrase should be sufficiently short
- The phrase should be used in common speech
- The phrase should not mix positive and negative modifiers
- The phrase should be a real modifier and not an unmodified statement of the basic response
- The phrase should describe a feeling and not a behavioral reaction
- The phrase should not be the superlative form of an adverb

The selected words were presented to a group of respondents, 50 to 1000 people for each language, and they were given the task to choose the words for the end points of a subjective scale, and then find words for performing a successive subjective bisecting of this scale. They were also asked to do an intensity scoring placing each word on a 10 cm line that extended from "lowest degree of annoyance" to "highest degree of annoyance".

An analysis of the responses showed some important features that should be observed when doing similar tasks in the future.

- Some languages had many words describing the extremes but relatively few for describing the middle range of the subjective scale
- There were dialect differences both regarding intensity scores but also regarding the actual meaning of words
- In some languages there were significant age differences. Young and older people would have different word preferences

Differences among age groups indicate that the meaning of the modifiers may change over time. One should therefore consider updating of the modifiers for the verbal response scales at certain intervals. The ISO Technical Specification that described the procedure for assessing noise annoyance by means of social and socio-acoustic surveys was originally published in 2003 [10]. A Technical Specification can usually be considered the start of the development of a standard. However, ISO TS 15666 was revised in 2021, still having the status of a TS only. The revised version was amended with several items regarding the definition of high annoyance, but there was no recommendation for updating the verbal response scales.

Since the publication of the standardized questions in nine different languages in 2001 [5], the questions and response scale have been translated into eight other languages, and there is still work going on to expand this list. Table 1 lists verbal modifiers for 17 different languages that have been constructed according to the ICBEN recommendations [7].

6. Definition of high annoyance

The ICBEN recommendation defined high annoyance as a response comprising either one of the two upper categories of the verbal scale, or the three upper response categories of the numerical scale. This definition, however, was omitted in the ISO Technical Specification, which had no advise on how to score the responses. As a result, studies that refer to ISO TS 15666 have been

Table 1
Recommended modifiers for 5-point verbal annoyance response scale.

	1	2	3	4	5
English	not at all	slightly	moderately	very	extremely
Dutch	helemaal niet	een beetje	tamelijk	erg	extreem
French	pas du tout	légèrement	moyennement	beaucoup	extrémement
German	überhaupt nicht	etwas	mittelmäβig	stark	äuβerst
Hungarian	eqyáltalánnem	kissé	közepesen	naqyon	rettenetetesen
Japanese	mattakunai	sorehodonai	tashô	daibu	hijôni
Norwegian	ikke	litt	ganske	mye	voldsomt
Spanish	absolutamente nada	ligeramente	medianamente	muy	extremadamente
Turkish	hiç değil	hafifçe	orta derecede	çok	şekilde
Polish	wcale nie	mało	średnio	bardzo	skrajnie
Danish	slet ikke	lettere	moderat	kraftigt	ekstermt
Portuguese - Brazilian	nada	algo	medianamente	muito	extremamente
Romanian	absolut deloc	putin	nici mult, nici putin	mult	extrem
Chinese	yi dian ye bu	yi dian dian	zhong deng	fei chang	ji du
Simplified	一点也不	一点点	中等	非常	极度
Traditional	一點也不	一點點	中等	非常	極度
Korean	junhyia	jogum	jebupp	meu	umchungnage
Vietnamese	hoan toan khong on	on mot phan nao	khong qua on	on nhieu	cuc on
Thai	ไม่รบกวน/ ไม่ทำให้รำคาญเลย	รบกวนเล็กน้อย/ ทำให้รำคาญเล็กน้อย	รบกวนพอสมควร/ ทำให้รำคาญพอสมควร	รบกวนอย่างมาก/ ทำให้รำคาญอย่างมาก	รบกวนอย่างมากที่สุด/ ทำให้รำคาญอย่างมากที่สุด

using various definitions of high annoyance, see for instance [13] *inter alia*.

This issue was discussed during the 2021-revision of the Technical Specification, and the original ICBEN definition of high annoyance was therefore included in the revised document.

7. Other lessons learned

The ICBEN Team recommended two standardized survey questions. When the responses to those questions are analyzed, the outcome is whether or not a respondent is *highly annoyed*. However, the definition of *highly annoyed* for the two responses varies, meaning that you may get two different values for *highly annoyed* for the same noise situation.

The working group commissioned to revise ISO TS 15666 conducted a review of 240 research papers that cited the TS [2]. They found that only a few of them had actually used both of the recommended reference questions, and survey results could be presented as *percentage highly annoyed* without specification on how this value was derived. Therefore, results from a survey using the verbal scale could sometimes be directly compared with results based on a numerical scale, and results based on either of the two scales could be combined to yield more general exposure–response functions.

To avoid this confusion the newly revised version of ISO TS 15666 specifies that survey results should be presented as *percentage highly annoyed* with a subscript indicating the relevant response scale: $\%HA_V$ and $\%HA_N$ for results derived from a verbal or a numerical scale respectively. The revised document also provides a method for transforming the verbal response so it may be directly compared with a numerical response [10]. Gjestland and Morinaga [6] have analyzed 43 surveys where both response scales have been used to validate this transformation procedure Brink et al. [1] have expanded the transformation concept further and shown how a numerical response can be transformed to a verbal one.

8. Concluding remarks

The ICBEN recommendations for conducting community noise surveys were launched 20 years ago, and according to Researchgate.net the journal article by Fields et al. [5] in which they were presented has received 582 citations to date. In addition, a number of authors have cited the corresponding ISO Technical Specification directly. This goes to show that the recommendations have had a great impact on these kinds of studies. Results from annoyance surveys from across the world, conducted according to these recommendations, can now be meaningfully compared, and thanks to the attempted standardization, robust general exposure–response functions for various types of community noises have been establish.

Both the ICBEN document and the ISO Technical Specification recommend the use of two standardized questions, so the annoyance is being assessed using both a verbal and a numerical scale. A review of papers citing these documents, however, shows that a majority of the surveys have been conducted using only one response scale. For the next revision of the TS one may consider suggesting the use of both scales to be optional. The transformation procedures for inter-scale comparisons should compensate for missing information.

The title of ISO TS 15666 is "Assessment of noise annoyance by means of social and socio-acoustic surveys". However, the literature search reveals that the described methods, and especially the response scales are being used for a number of other purposes such as assessment of a wide range of attributes other than annoyance, for instance room and building acoustic parameters, noise sensitivity, sleep, loudness and other sound quality parameters, etc. So, the methodology has been applied to both field and laboratory experiments. The recommendations state typically a one-year or a six-month reference period, but in the literature, there are examples of assessment time periods down to a few seconds. One may consider expanding the TS or develop a new one specifically aimed at acoustic response scales.

Most languages are quite dynamic, and the meaning of words and phrases may change over time. The current list of verbal modifiers should therefore be updated at given intervals.

Data availability

No data was used for the research described in the article.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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