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Psychological response to helicopter noise at RAF Shawbury

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ABSTRACT

This paper describes an investigation into resident's psychological responses to helicopter noise around an RAF helicopter flying station.

Helicopter noise episodes were monitored for two weeks at 58 different locations in an area where helicopter flying training operations took place. Residents were interviewed, asked to complete a questionnaire and keep annoyance diaries. At the end of the survey period, residents were asked how annoyed they had been by helicopter noise over the past two weeks.

The results showed that most residents were not worried about accidents and felt that training should take place locally, but were equivocal over whether they felt that community concerns mattered and whether they could influence decisions made about training operations.

Only 10% of residents reported that they had been "very" or "extremely" annoyed by helicopter noise in the two-week monitoring period, and annoyance ratings did not correlate well with the LAeq, LCeq, LAmax, L10 or LAmax - L90 metrics. Overall there was a poor relationship between objective noise levels and subjective response.

Residents were more likely to report being "very" or "extremely" annoyed by an episode of helicopter noise if they were homeowners, "noise-sensitive", held a negative attitude towards the RAF or reported being annoyed by helicopter noise generally in the two-week period.

Overall, the survey demonstrated that the relationship between helicopter noise and reported annoyance is not straightforward, and that annoyance relates partly to individual differences and the impact of helicopter noise on daily living but apparently less to objective measured noise levels.

1. INTRODUCTION

A. RAF Shawbury

RAF Shawbury is the home of the RAF's helicopter flying training school. In the years leading up to this work (which took place in 1999-2000) there had been a history of increasing complaints from local residents concerning the station's flying activities in the area. A noise survey had been undertaken which demonstrated that the area did not trigger the RAF's Noise Insulation Grant Scheme. The RAF Centre of Aviation Medicine was tasked with conducting a new noise survey, which included an investigation into resident's psychological response to helicopter noise in the area. This paper describes this latter aspect of that work.

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B. Non-acoustic factors in noise annoyance

Acoustic properties which have been found to predict transportation noise annoyance include DNL/ Leq-type measures, loudness, duration of noise event, vibration, and the aversive quality of the noise[1, 2, 3]. The main effects of these properties are felt as activity interference (e.g. speech intelligibility) or as general annoyance. Variance in annoyance will also occur across types of noise source[4,5].

Attitudes[6,7], beliefs[8] and flight safety fears[9] may modify noise annoyance, although simple demographics do not reliably relate to annoyance in community studies[6].

Other individual differences which may modify noise annoyance include locus of control, or mastery[10, 11]. Noise sensitivity may be related to a general critical tendency in the individual rather than directly to noise exposure[12, 13]. Noise exposure itself may exacerbate pre-existing psychiatric disorder rather than cause it, and there may be perceptual differences between annoyed and non-annoyed people[14, 15].

Providing acoustic insulation, or lowering outdoor noise levels moderately, may not have a significant impact on self-reported noise annoyance[16]. Finally, annoyance may not lead directly to complaints from community residents, as these are thought to arise from unusual noise events rather than to the general noise environment[17].

The literature briefly described above influenced the design of the investigation into helicopter noise annoyance around RAF Shawbury.

2. METHOD

Noise monitoring was conducted for a two-week period at 58 different locations across the area where RAF Shawbury's flying training operations routinely took place.

At the start of the monitoring period, (usually) two or three residents living in properties near the monitoring sites (and selected on the basis of proximity of their homes to the sound monitoring equipment) were interviewed about their experiences of the flying operations in the area. They were also asked to complete a questionnaire which included the General Health Questionnaire – 12 item version (a short measure of state mental health), the Weinstein Noise Sensitivity Index[13] and a measure of Mastery[10] (which reflected the extent to which people considered that they had control of their physical and social environment).

The questionnaire also captured some demographic details collected with comparison to the 1991 Census in mind, and included four questions aimed at eliciting attitudes towards RAF Shawbury's activities in the area.

Residents were then asked to keep annoyance episode diaries throughout the monitoring period, the aim being to match episodes of annoyance from helicopter activities to acoustic events captured by the sound monitoring equipment. For each episode, residents were prompted to record the helicopter activity causing the annoyance, why it was a problem for them, and how annoying, intrusive and distressing they found the episode. They were also asked to record whether they made a complaint to RAF Shawbury.

At the end of the two-week period and as the noise monitoring equipment was removed, the diaries were collected and residents were asked a final question designed to measure global annoyance at helicopter noise during the past fortnight.

3. RESULTS AND DISCUSSION

A. Noise monitoring

The full results of the noise monitoring aspect of this study are reported elsewhere[18], but in summary the monitoring found daytime LAeq to range between 48 to 62 dB (LAmax 78 to 102 dB), and nighttime LAeq to fall between 37 to 47 dB (LAmax 65 to 84 dB).

B. Diarists

A response rate of 88.2% was achieved for the diary study. At the end of the study period 172 diaries had been collected, of which 161 usable diaries were entered for analysis. Of these, over one-third (38.5%) were returned with no recorded annoyance episodes. In the remainder, the number of episodes recorded ranged from 1 to 26 per diary, with a mean of 5.5 episodes.

The demographic measures captured in the pre-diary questionnaires were compared to 1991 Census data for the locality. As a group the diarists were older, more likely to be retired and home-based than others in the local area. Because of this, the diarists were likely to be exposed to helicopter noise more than the local population by virtue of being more likely to be home during normal flying hours.

In other respects, the pre-diary questionnaire found that the responses of diarists to questions about noise sensitivity in general, mastery and general state mental health were the same as those which could be expected from the general population.

C. Attitudes towards RAF Shawbury's activities

Four items in the pre-diary questionnaires assessed the diarists' attitudes towards RAF Shawbury's flying activities. See Figure 1. (below) for details. When the four questions were combined to form a scale, the score correlated weakly and negatively with the measure of noise sensitivity used. This indicated that for the diarist group, greater noise sensitivity tended to be associated with a more negative attitude towards military helicopter activity.

D. Global annoyance

At the end of the monitoring period, each diarist was asked "Thinking about the past two weeks, how annoyed have you been by helicopter noise, here at home?". Just over 50% of diarists reported that they had not been annoyed by helicopter activity during the monitoring period, 10% reporting being very or extremely annoyed. This would suggest that severe noise annoyance may be experienced by a minority of a community, suggesting that individual differences may play a role in reported noise annoyance.

E. Relationship between activities and annoyance issues

Table 1 (below) shows the most commonly reported activities and noise annoyance issues within the diaries. Further inspection revealed that there were statistically significant relationships between the observed activities, and the reasons why diarists found them to be problematic. See Table 2 (below) for details. This may offer a partial explanation why attempts to link noise directly to annoyance are often unreliable, as they may not take into account the activity represented by the noise level.

F. Noise episodes

Diarists were asked to record any episodes of particularly annoying, intrusive, distressing or nuisance helicopter activity, or any about which they might consider complaining. They also recorded the time and duration of the activity. 525 episodes were recorded and matched to events captured by the monitoring equipment, and ranged from less than one minute to 13 hours long, with a mean of 2 hours 8 minutes. See Table 3 (below) for acoustic characteristics of the episodes.

Further analysis of the results suggested that recording of annoyance during "short" (3 minutes or below, the average duration of a single overflight) episodes was related to startle issues, while annoyance during longer episodes related to less extreme but more persistent activity.

Again, this would suggest that any attempt to directly link noise and annoyance may be confounded by systematic differences in the reasons why people find various aspects of helicopter noise to be annoying at the time in question.

G. Annoyance severity across activities and issues

Helicopter activities, as recorded by the diarists, and annoyance issues, were analysed by their reported annoyance ratings[b]. See Table 4 (below). The highest annoyance ratings were associated with the less frequently observed activities or issues reported by diarists. For example, "fear of accidents" was linked to the highest annoyance issue ratings, but was only recorded in 3.6% of episodes; similarly, observing training with underslung loads led to the highest activity annoyance levels but was only recorded in 4.8% of episodes.

H. Relationships between acoustic data and diarist ratings

Analysis showed that helicopter noise events which resulted in a diary entry followed a similar pattern to the general helicopter noise levels recorded during the survey; that is, diary entries were not reserved for the noisiest events. This might suggest an interaction with what the diarists were doing at the time of the event, impacting on the annoyance judgment.

I. Relationship between LAeq and global annoyance

Analysis showed that the areas where monitoring revealed the highest noise LAeq16H(0700-2300) (as used in the RAF Noise Insulation Grant Scheme) were not necessarily those with the highest reported annoyance due to helicopter noise, as expressed either by global judgments or by the number of episodes of annoyance recorded in diaries. Generally, there was a poor correlation between noise and subjective annoyance. Analysis showed a weak positive correlation between individual global annoyance judgments and daytime LAeq, but no such correlation was found for the nighttime LAeq.

J. Non-acoustic factors affecting annoyance judgments

Correlation analyses of the noise levels and annoyance judgments either globally or within episodes did not yield any strong, reliable relationships which could be used to predict the community response. A comparison of the diaries with and without recorded annoyance episodes was then performed to look for other factors which might help to explain the community response.

It was found that there was no statistically significant difference in overall nighttime LAeq exposure levels between diarists who did and did not record annoyance episodes, but overall daytime LAeq values showed a statistically significant difference with a slightly higher mean LAeq for those who made diary entries (54.6 dB versus 53.2 dB).

It was found that homeowners (including those with mortgaged properties) were significantly more likely to make diary entries that those living in rented properties.

In terms of personal characteristics, those who did choose to record annoyance episodes were found to score more highly on the measure of noise sensitivity used, than those who did not. This group of

[b] The diarists recorded four measures of negative feelings: annoyance, intrusion, distress and nuisance. As all four were found to be highly interrelated, the annoyance measure was deemed to provide an adequate single measure of community response and so is the one generally reported here. In the scale used, 1 = not at all annoyed, 5 = extremely annoyed.

people tended to have a more negative attitude towards the RAF activities in the local area. There was also a significant difference in global annoyance judgments, with those using the diary declaring more annoyance over the monitoring period, as might be expected.

There were no significant differences between those who recorded and those who did not record episodes in terms of age, length of residence in the current location, number of dependant children, general mental health status or mastery scores.

In summary, from the comparison of episode annoyance, activities/ issues and noise levels, it appears that the subjective annoyance judgments within episodes may have been somewhat dependent upon the type of activity and its differential impact on individuals, rather than solely on the objective noise levels alone.

K. Complaints and activities/ annoyance issues

It was notable that only 10 of the annoyance episodes recorded by the diarists resulted in a complaint to RAF Shawbury. These tended to reflect unusual or extreme events, rather than solely to the reported annoyance rating, this being in line with findings in the literature.

L. Diarists' comments

The episode diaries encouraged diarists to comment on each episode. The general themes emerging from these comments were as listed below.

- Helicopters are a part of the local environment (and so not annoying to those diarists)
- A perception that no account is taken of community annoyance
- A feeling that diarists could not escape from the helicopter noise
- The diarists had to take action to cope with the noise, such as close windows
- A specific impact of the noise, such as waking a child or disturbing livestock
- Fears over flight safety/ fear an accident might happen
- A belief that the survey was "fixed" to show the flying school in a positive light

4. CONCLUSIONS

This work demonstrated that the relationship between helicopter noise and reported noise annoyance in local communities may not be a straightforward one.

It would appear that subjective reports of noise annoyance relate only partly to the objectively recorded noise levels. Other factors, including the nature of the helicopter activity, why it was experienced as annoying at the time it occurred, individual differences within the population and home ownership status, appear to be critical in understanding the relationship between noise and subjective response in community populations.

It is suggested that any future work on the link between objective helicopter noise levels and subjective community response should attempt to investigate the non-acoustic and psychological issues likely to mediate the relationship.

It is also suggested that non-acoustic issues and interventions should be considered when devising strategies to reduce the impact of helicopter noise on local communities, in addition to acoustic ones.

Finally, consideration should be given to the full range of issues reflected in subjective response to helicopter noise, and in particular acknowledge that it is possible that the umbrella term "annoyance" may mask a range of distinct issues worthy of being addressed individually.

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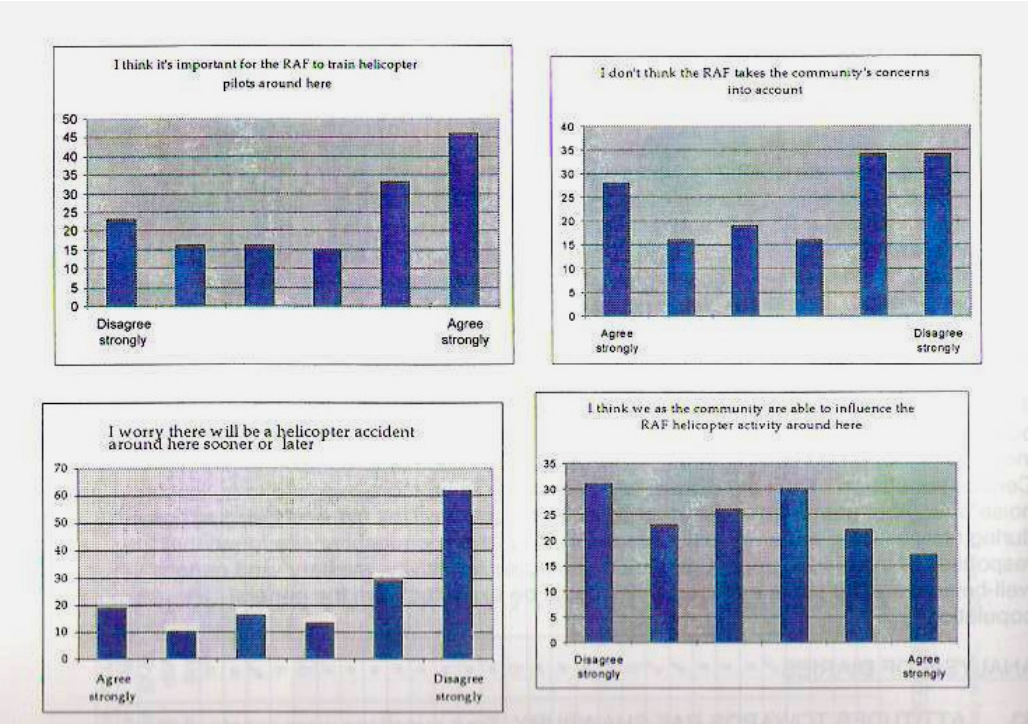

Figure 1: Attitudes towards local helicopter activity

Table 1: Issues and activities recorded in episode diaries

Issue	% of episodes including issue
Noise very loud	67.0
Quiet of countryside spoiled	61.1
Too close to (own) house	43.0
Privacy infringed	35.0
Speech interference/ related	33.0
No warning of the activity	13.0
Vibration (indoors)	11.4
Sleep disturbance	6.1
"Avoid" contravened	5.0
Animals and livestock disturbed	4.4
Fear of accidents	3.6
Child upset by noise	0.2

Activity	% of episodes including issue
Direct overflight	56.2
High number of overflights	39.4
Low flying	33.1
Circling	14.1
Flying near to other properties/ village	11.4
Formation flying	8.4
Hovering	6.9
USLs	4.8
Constant droning noise in background	3.0

Table 2: Relationships between activities and annoyance issues

Observed activity	Associated annoyance issues	Chi-square	Degrees of freedom	p
Direct overflight	The noise it made was very loud	15.76	1	<0.001
	The helicopter was too close to my property	23.63	1	<0.001
	I felt vibration/ the building was shaken	9.43	1	<0.01
	Animals and livestock were disturbed	4.63	1	<0.05
	The noise stopped me from speaking or listening to the TV/ radio	7.13	1	<0.01
	The helicopter appeared to fly into an "avoid"	4.64	1	<0.05
	I had no warning of the activity	4.82	1	<0.05
High number of overflights	The noise it made was very loud	4.75	1	<0.05
	The noise stopped me from speaking or listening to the TV/ radio	6.48	1	<0.05
	I had no warning of the activity	25.85	1	<0.001
	I felt my privacy was infringed	11.41	1	<0.001
	The quiet of the countryside was spoiled	21.35	1	<0.001
Low flying	The noise it made was very loud	27.91	1	<0.001
	I was concerned that an accident would happen	18.46	1	<0.001
	The helicopter was too close to my property	44.67	1	<0.005
	I felt vibration/ the building was shaken	19.07	1	<0.001
	Animals and livestock were disturbed	8.21	1	<0.005
	I felt my privacy was infringed	5.14	1	<0.05
Hovering	The noise it made was very loud	4.45	1	<0.05
	I was concerned that an accident would happen	18.71	1	<0.005
	The helicopter was too close to my property	6.68	1	<0.01
	I felt vibration/ the building was shaken	34.60	1	<0.001
	Animals and livestock were disturbed	29.14	1	<0.001
	The helicopter appeared to fly into an "avoid"	6.48	1	<0.05
	I felt my privacy was infringed	6.99	1	<0.01
Under-slung loads	I was concerned that an accident would happen	5.23	1	<0.05
	I felt vibration/ the building was shaken	7.03	1	<0.05
	The noise stopped me from speaking or listening to the TV/ radio	6.19	1	<0.05
Circling	I was concerned that an accident would happen	8.33	1	<0.005
	The helicopter was too close to my property	20.69	1	<0.001
	I felt vibration/ the building was shaken	4.67	1	<0.005
	*I had no warning of the activity	4.44	1	<0.05
	I felt my privacy was infringed	13.36	1	<0.001
Formation flying	-	-	-	-
Flying near to properties/ village	The noise it made was very loud	11.26	1	<0.001
	*I felt vibration/ the building was shaken	8.80	1	<0.005
	The helicopter appeared to fly into an "avoid"	6.40	1	<0.05
	I felt my privacy was infringed	11.59	1	<0.01
Constant droning noise in background	I was concerned that an accident would happen	21.47	1	<0.001
	I had no warning of the activity	35.57	1	<0.001
	I felt my privacy was infringed	19.74	1	<0.001
	The quiet of the countryside was spoiled	7.21	1	<0.01

Notes:

1. * Indicates that activity does not relate to an issue as expected by Chi-square test.

2. All other associations did not reach statistical significance at the $p<0.05$ level.

Table 3: Acoustic characteristics by helicopter activity or annoyance issue, all episodes

Activity/ annoyance issue	% of all episodes	Mean/ Standard Deviation								
		L_{Aeq}	L_{Ceq}	SEL	L_{Amax}	L_{10}	L_{Ceq} - L_{Aeq}	L_{Aeq} - L_{90}	L_{Amax} - L_{90}	Number of events during episode
Direct overflight	56.2	56.8 8.8	65.0 11.9	85.1 15.3	71.0 12.2	51.7 16.1	7.8 4.8	14.3 9.9	28.1 11.6	7.6 9.9
High number of overflights	39.4	54.8 7.6	62.8 12.1	88.3 16.6	72.6 12.2	50.3 14.2	7.1 3.9	14.5 10.0	32.1 10.2	10.7 11.5
Low flying	33.1	58.1 9.0	66.9 12.2	83.0 17.1	69.9 13.1	51.4 19.7	8.2 4.4	15.6 10.0	26.7 12.6	7.3 10.8
Circling	14.1	55.1 10.2	64.8 16.3	79.7 22.4	65.6 15.8	43.6 19.7	8.6 6.1	16.5 14.1	25.5 13.8	8.6 11.2
Flying near to other properties/ village	11.4	57.9 6.4	64.8 7.3	86.2 11.0	72.9 6.4	60.6 7.5	6.7 2.0	13.5 6.6	28.9 8.1	4.4 5.6
Formation flying	8.4	55.0 8.1	62.4 9.3	89.4 10.2	73.1 8.4	56.3 8.9	6.8 2.0	10.6 5.9	29.0 9.0	9.0 9.8
Hovering	6.8	59.4 7.1	71.6 15.7	79.8 24.9	68.1 16.5	48.6 22.6	9.6 6.1	19.7 14.4	28.5 12.5	12.7 17.1
USLs	4.8	60.2 5.8	72.4 13.5	85.5 20.1	72.3 15.3	52.8 21.4	9.8 5.6	15.8 13.5	28.4 10.3	9.1 8.5
Constant droning noise in background	3.0	56.7 4.4	62.8 4.3	97.2 6.3	75.8 5.6	56.7 3.7	6.1 2.7	14.6 6.7	34.0 7.3	10.3 5.3
Noise very loud	67.0	57.0 8.7	64.6 11.5	85.6 14.5	72.1 10.6	53.9 14.8	7.2 3.5	13.8 3.5	28.7 11.2	7.4 10.7
Quiet of countryside spoiled	61.1	56.4 8.5	64.9 12.2	86.3 14.9	70.4 12.4	51.7 17.1	7.6 4.2	13.8 9.8	27.6 11.2	7.9 9.8
Too close to (own) house	43.0	57.0 9.0	65.3 12.7	83.6 17.9	70.4 13.0	51.9 17.4	7.7 4.6	14.6 10.0	28.0 11.6	7.9 11.2
Privacy infringed	35.0	56.9 9.0	64.6 12.3	87.1 14.9	72.2 11.2	54.4 14.3	7.1 3.5	13.2 9.3	28.6 10.1	8.0 10.4
Speech interference / related	33.0	56.6 9.6	64.0 11.7	87.4 13.9	70.3 13.0	51.7 16.4	7.7 4.7	14.3 9.1	27.5 13.2	8.0 11.2
No warning of the activity	13.0	58.0 8.4	65.4 9.0	95.7 9.1	77.6 8.2	57.9 9.8	7.4 1.9	13.2 6.7	33.5 9.8	11.5 7.8
Vibration (indoors)	11.4	57.4 7.8	64.5 9.6	85.4 13.0	72.2 8.4	56.1 13.0	6.9 2.7	12.9 6.6	27.2 10.0	8.1 11.7
Sleep disturbance	6.1	52.4 8.8	58.0 10.1	83.7 12.3	70.1 11.9	52.5 7.7	5.7 2.3	13.7 5.8	31.4 10.4	5.0 6.3
"Avoid" contravened	5.0	56.8 8.8	63.7 9.7	84.3 12.1	70.6 8.4	57.8 8.9	7.0 1.8	13.1 6.6	26.9 10.1	6.9 9.5
Animals and livestock disturbed	4.4	57.9 5.8	64.7 7.4	84.0 12.6	74.2 12.4	53.4 13.0	7.4 3.6	16.5 6.7	32.5 11.9	11.1 20.3
Fear of accidents	3.6	53.8 8.7	60.3 10.0	88.8 5.2	71.7 7.7	54.7 10.5	6.5 1.6	8.6 5.9	27.4 7.8	8.1 8.1
Child upset by noise	0.2	No data								

Table 4: Annoyance ratings by helicopter activity or annoyance issue, all episodes

Activity/ annoyance issue	% of all episodes	Indoors during episode (%)	Mean annoyance / Standard deviation	Mean intrusion / Standard deviation	Mean distress / Standard deviation	Mean nuisance / Standard deviation	Complaint made? (%)
Direct overflight	56.2	53.6	3.5 1.2	3.5 1.2	2.6 1.3	3.5 1.3	6.4
High number of overflights	39.4	47.3	3.6 1.1	3.6 1.1	2.7 1.3	3.6 1.1	1.4
Low flying	33.1	61.5	3.6 1.2	3.8 1.1	2.8 1.4	3.7 1.2	2.9
Circling	14.1	55.4	3.8 1.2	3.8 1.1	3.1 1.5	3.7 1.2	4.1
Flying near to other properties/ village	11.4	55.0	3.0 1.0	3.1 0.9	2.1 0.9	3.1 1.2	15.0
Formation flying	8.4	45.5	3.5 1.3	3.7 1.3	2.5 1.4	3.5 1.4	2.3
Hovering	6.8	66.7	4.1 1.1	4.4 0.8	3.6 1.3	4.3 0.9	5.6
USLs	4.8	44.0	4.1 0.9	3.9 1.0	3.4 1.3	3.9 1.0	8.0
Constant droning noise in background	3.0	56.3	3.9 0.8	3.9 1.0	3.4 1.0	3.9 0.9	0
Noise very loud	67.0	52.8	3.6 1.2	3.7 1.2	2.6 1.3	3.6 1..2	4.3
Quiet of countryside spoiled	61.1	47.4	3.6 1.1	3.6 1.1	2.7 1.3	3.5 1.2	5.0
Too close to (own) house	43.0	57.1	3.8 1.0	3.9 1.0	3.0 1.2	3.8 1.1	4.4
Privacy infringed	35.0	44.6	3.9 1.0	4.0 1.0	3.2 1.2	4.0 1.0	8.2
Speech interference / related	33.0	52.6	3.7 1.1	3.8 1.0	2.8 1.4	3.7 1.2	6.9
No warning of the activity	13.0	50.0	3.7 1.0	3.9 1.0	3.1 1.2	3.9 1.2	1.5
Vibration (indoors)	11.4	65.0	3.7 1.3	4.0 1.2	3.2 1.5	3.8 1.2	1.7
Sleep disturbance	6.1	90.6	3.9 0.9	3.8 0.9	3.1 1.0	3.9 0.8	6.3
"Avoid" contravened	5.0	65.4	3.8 1.0	3.9 0.9	3.2 1.2	3.6 0.9	19.2
Animals and livestock disturbed	4.4	47.8	3.4 1.3	4.0 1.3	2.5 1.2	4.0 1.3	13.0
Fear of accidents	3.6	52.6	4.4 1.0	4.4 0.9	4.0 1.3	4.3 1.1	0
Child upset by noise	0.2	No data					