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THE INFLUENCE OF ACTIVITY DISTURBANCE ON REACTION THE SYDNEY AIRPORT HEALTH STUDY

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ABSTRACT

Noise-induced activity disturbances may promote negative reactions to noise. The relationship of noise sensitivity to reaction may in turn reflect greater activity disturbance amongst noise sensitive individuals, or a greater impact of activity disturbance on reaction amongst these individuals. The present community survey around Sydney Airport (N=1,015) assessed noise-induced disturbance of several activities (e.g. conversation, relaxing, entertaining), reaction to noise (annoyance and general reaction-dissatisfaction, affectedness), and noise sensitivity. Activity disturbance correlated positively and significantly with reaction and noise sensitivity. Reaction was significantly predicted by activity disturbance and noise sensitivity in regression analyses. Sensitivity correlated positively and significantly with the difference between reaction and activity disturbance. These results are consistent with the view that activity disturbance contributes to reaction. Further, the contribution is greater amongst noise sensitive individuals, who also demonstrate greater activity disturbance.

1 - INTRODUCTION

Noise-induced activity disturbances may promote negative reactions to noise (annoyance, disturbance, dissatisfaction). Several community studies have demonstrated that more negative reaction to noise is associated with greater noise-induced activity disturbance and performance deficits [1,2,3,4,5,6,7,8,9]. For example, annoyance has demonstrated associations with interference with activities such as conversation, mental concentration, recreation and rest [10,11,12,13]. In the laboratory, annoyance with simulated traffic noise at 85 dB LAeq was associated with the perceived influence of noise on performance and performance efficiency [14].

Interference with speech may be particularly important because of the role of speech in communication and recreational activities (e.g. watching TV: see [15]). Holmberg et al. [16] found that annoyance with occupational noise was greater for individuals performing tasks involving verbal communication than for individuals involved in other tasks [see also 17]. Widmann [18] found that annoyance increases linearly with reduction of the speech to (traffic) noise ratio. Further, the greatest reduction in annoyance with aircraft noise is achieved when energy is removed from frequency bands which produce maximum masking of speech [4].

There is also evidence for an association between sleep disturbance and reaction [19]. In a community study around Australian airports [10] 26.7% of seriously affected respondents (in terms of general reaction) nominated sleep disturbance as the activity disturbance they would most like to eliminate (despite night-time curfews), compared to only 19.1% of all respondents.

Activity disturbance may be influenced by noise-sensitivity. For example, highly noise-sensitive subjects have been found to perform significantly more poorly in deep mental processing tasks under noisy conditions (for example, difficult mental arithmetic) than less noise-sensitive subjects [14], [20].

Noise-sensitivity has also appears to influence reaction. Fields' [21] meta-analysis concluded that all 14 relevant studies which met the criteria for quality supported the hypothesis that a general sensitivity to noise increases annoyance. Job's [22,23] review of correlations between sensitivity and reaction, between sensitivity and noise, and between reaction and noise suggests that there is a relationship between sensitivity and reaction which cannot be explained entirely by noise exposure, although the direction of causality in this relationship is ambiguous. The moderating influence of sensitivity on reaction is also supported by findings of studies conducted subsequent to these reviews [e.g. 24,25,26], [20].
Taken together, these findings suggest that the relationship of noise-sensitivity to reaction may reflect, at least in part, greater activity disturbance amongst noise-sensitive individuals. Alternatively, the same level of activity disturbance may have a greater impact on reaction amongst noise-sensitive individuals. The present community survey around Sydney Airport investigated these issues.

2 - METHODS

2.1 - Subjects and sample selection

Subjects were 523 female and 482 male residents of areas selected on the basis of location relative to Sydney (Kingsford Smith) Airport to produce a 2×2 design; noise exposure prior to runway reconfiguration (when the present data were collected) was "high" or "low", and noise exposure was projected to change (decrease or increase, respectively) or to remain unchanged, due to reconfiguration. The four areas thus produced- "high to high" (H-H), "high to low" (H-L), "low to low" (L-L), "low to high" (L-H)- were approximately equally represented in the main sample (N=1012). Each area comprised several census districts.
From a random starting point within each census district, every 7th residence along a predetermined path was approached, and one respondent selected within each household using the "last birthday" technique, without replacement.

2.2 - Materials

A structured interview (based on previous socioacoustic surveys [13], [27] and pilot results) assessed a range of variables including activity disturbance, reactions to noise, and noise-sensitivity. Participants also filled out several self-completion questionnaires.
Subjects were asked to indicate whether local aircraft noise disturbs or interferes with 12 activities (e.g. conversation, watching TV, relaxing, household activities, entertaining).
Two questions assessed general reaction to aircraft noise: (i) "Would you please... estimate how much you personally, are affected overall by aircraft noise?"; (ii) "How dissatisfied are you with aircraft noise in this neighbourhood? Please... estimate how much dissatisfaction you feel overall." Subjects responded using a card depicting a thermometer marked with numbers from 1 to 10 with an associated 5-point verbal scale (2="a little", 5="moderate", 7="a lot", 10="much"). A general reaction index was computed from these scores, employing weighting from factor analysis.
Noise sensitivity was assessed by having subjects rate their annoyance with 12 noise situations (e.g. a pneumatic drill or jackhammer is operating nearby, someone rustles paper at the movies, you hear the sound of a door slamming) using a card depicting a thermometer marked with numbers from 0 to 10 and an associated verbal scale ("none", "a little", "moderate", "a lot", "very much"). Factor analysis revealed a factor relating to loud noises, and another relating to quiet noises. Thus, the corresponding two sensitivity indices were computed.

2.3 - Procedure

Before the changes to the configuration of Sydney Airport, a letter was sent to every selected residence announcing the investigation. Second, trained interviewers door-knocked at selected residences and asked to speak to the person over 18 living at the residence who had last had a birthday. When a suitable individual agreed to participate, the structured interview was conducted in the home and questionnaires were completed by the subject while the interviewer waited.

3 - RESULTS

General reaction was regressed on activity disturbance and the two sensitivity indices, within each noise area, employing a stepwise entry criterion of alpha=.05. Activity disturbance entered at the first step in each area (H-H: $F_{1,218}=148.25$, $p<.001$; H-L: $F_{1,222}=178.44$, $p<.001$; L-L: $F_{1,153}=76.75$, $p<.001$; L-H: $F_{1,191}=192.45$, $p<.001$). Sensitivity to loud noises entered at the second step in H-H (increased multiple r from.636 to.647), H-L (increased multiple r from.668 to.682), and L-L (increased multiple r from.578 to .593). Sensitivity to quiet noises did not enter any regression equations.

	H-H	H-L	L-L	L-H
AD with GR	.627** (240)	.666** (235)	.589** (166)	.704** (202)
AD with SQUI	.200** (233)	.029 (229)	.230* (163)	.006 (196)
AD with SLOU	.241** (224)	.156* (224)	.258* (159)	.037 (195)
GR with SQUI	.295** (242)	.151* (245)	.310** (240)	.099 (250)
GR with SLOU	.306** (235)	.274** (240)	.314** (236)	.214* (249)
(AD – GR) with SQUI	.031 (224)	-.065 (229)	.018 (162)	-.046 (196)
(AD – GR) with SLOU	-.010 (233)	-.069 (224)	.039 (158)	-.072 (195)

Table 1: Correlation of activity disturbance (AD) with general reaction (GR), & of sensitivity to quiet and loud noises (SQUI & SLOU) with AD, with GR, and with AD minus GR, for high noise areas expecting noise to remain the same (H-H) or to decrease (H-L), & low noise areas expecting noise to remain the same (L-L) or to increase (L-H).

4 - DISCUSSION

Activity disturbance demonstrated high, significant, positive correlations with reaction in high and low noise areas. These results replicate earlier findings in relation to annoyance. Results are reported here for the psychometrically superior measure, general reaction [28,29], however we observed the same pattern of results for annoyance measures.

We observed lower, less consistent, significant positive correlations of activity disturbance and reaction with sensitivity to both loud and quiet noises. These relationships appeared to be stronger in areas expecting no changes to noise level (although this impression was not assessed statistically), perhaps because responses in these areas are over-determined by expectations.

Of course it is possible that activity disturbance and reaction are not distinct. For example, people may answer the activity disturbance questions by considering their reaction in general, or vice versa. More basic research is required to resolve such issues.

Reaction was significantly predicted by activity disturbance and noise-sensitivity in regression analyses. In all noise areas, activity disturbance entered first, suggesting a stronger influence on reaction that noise sensitivity. Nonetheless, sensitivity to loud (but not quiet) noises added significantly to the prediction afforded by activity disturbance in 3 noise areas.

The difference between reaction and activity disturbance did not correlate significantly with sensitivity. These results are consistent with the view that activity disturbance, which is greater amongst noise-sensitive compared to non-noise-sensitive individuals, contributes to reaction. However, the contribution appears to be no greater amongst noise-sensitive individuals. Thus, these results support the claim that noise sensitivity influences activity disturbance which in turn influences reaction, rather than the claim that noise sensitivity modifies the influence of activity disturbance on reaction.

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