

## TEST-RETEST RELIABILITY OF PSYCHOLOGICAL SCALES (SENSITIVITY AND ATTITUDE) RELATED TO COMMUNITY REACTION TO NOISE

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### 1. INTRODUCTION

Socio-acoustic investigations examine the relationships between various measures of noise exposure and reaction (annoyance, dissatisfaction, disturbance) among residents. It is also common to examine a number features of the residents themselves (called modifier variables), which may affect their reaction. However, because of the generally correlational (or regression based) nature of the evidence provided, the implication of the name, that these variables do indeed modify reaction, should be treated with caution. Nonetheless, there is suggestive evidence for a causal relationship in some instances (eg, [1]).

In addition to the outcomes regarding exposure/reaction relationships and determination of acceptable levels of noise, socioacoustic studies often address theoretical issues regarding the underlying causal mechanisms of reaction and other potential outcomes of noise exposure [2-5]. The so-called modifier variables may be critical here in that they offer the possibility of explaining some of the variance in reaction not accounted for by noise exposure. In addition, these variables may offer information as to possible mechanisms of, and influences on, reaction. Modifier variables may also play a role in over-reaction to changes in noise exposure [6]. Finally, the modifier variables may also be important from a practical perspective. If they have a causal role in determining reaction, then the manipulation of these variables may be used to reduce reaction to noise [7].

The more accurate (reliable and valid) the measurement of the modifiers the better the chance of correctly addressing these issues. The statistical power for detecting relationships with various modifying factors is increased with more accurate measurement of the modifiers. In addition, knowledge of reliability is useful. Such knowledge allows calculation of real underlying correlations, via corrections for reliabilities of the measurement tools involved (see [8] for examples of such

calculations).

The ideal measure will be valid and reliable. While there are many types of validity, essentially validity refers to the extent to which the instrument actually measures what it is designed to measure. Reliability takes two distinct forms: stability (or test-retest reliability) and internal consistency. Internal consistency refers to the extent to which the measure consistently produces the same result from question to question within the one measurement session. In questionnaire research this is the extent to which two or more questions designed to measure the same construct provide answers consistent with each other. It thus measures the extent to which questions designed to tap the same variable actually do measure the same factor. Stability refers to the extent to which the measure will produce the same result on individuals over time. It thus refers to the reliability of the measure across a significant time span.

While stability of measurement of reaction has received some attention, stability of modifier variable measurement has remained neglected. Two prominent modifier variables are considered in the present study: attitude (toward the noise source) and noise sensitivity. In both cases, multiple questions are typically employed in the measurement of the constructs, and these modifiers show strong relationships with reaction even when noise exposure is controlled for [9-12].

Reliability of a survey scale is influenced profoundly by the number of questions combined to construct the scale, as well as the reliability of each of the questions [8, 13]. Thus, combining the answers to a number of questions on reaction to the noise produces a significantly more internally consistent scale than relying on one question alone. Awareness of this method for increasing reliability appears to be having an effect on socio-acoustic surveys which recently have commonly employed several questions to construct a scale of reaction [14-18].

The second advantage of employing a number of related questions to compose a composite scale of reaction is that this allows calculation of the internal consistency (measured by Chronbach alpha) of the scale.

The present study employed multiple questions to measure both noise sensitivity and attitude to the noise source. Internal consistency and test-retest reliability (stability) were assessed.

## 2. METHODS

### Site

The present study was conducted around Sydney (Kingsford-Smith) Airport. The airport is located approximately 20 minutes drive from the centre of a city of 3.5 million inhabitants.

The airport configuration consisted of 2 runways (one North-South, and one East- West) prior to the introduction of a third runway parallel and slightly to the east of the North-South runway, in late 1994. The present study occurred before these changes were in operation at the Airport.

### **Subjects and Sample Selection**

From a survey of 1015 residents a subset was randomly selected to be retested. Of these subjects 97 completed the same questionnaires a second time. Subjects were 60 females and 37 males.

Residences were selected from random start points chosen on the basis of noise levels and location relative to Sydney Kingsford Smith Airport to produce a 2x2 design. Current noise level was either "high" or "low". Future noise level was either projected to change (up or down, depending on current level) or projected to remain unchanged, due to flight-path changes with the opening of the third runway. The four areas thus produced ("high stays high", "low goes high", "high goes low", "low stays low") were approximately equally represented in the sample.

Within each residence one respondent was selected using the last birthday technique, without replacement.

### **Materials**

First, subjects responded to a structured interview based on previous socioacoustic survey questionnaires [16, 19] and revised on the basis of the results, and interviewer feedback, from a pilot study. The interview assessed demographic variables, reactions and sensitivity to noise, attitudes to the noise source, disturbance due to aircraft noise, and aspects of physical and mental health. Two questions assessed general reaction to the 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 indicated their subjective reactions using an "opinion thermometer"- a card depicting a thermometer marked with numbers from 1 to 10 and an associated verbal scale ("none", "a little", "moderate", "a lot", very much").

Noise sensitivity was measured by 11 different noise situations for which respondents rated their annoyance on the opinion thermometer described above. The noise situations varied from being woken by a barking dog, to someone talking while you are watching TV, to having conversation interrupted by traffic noise.

Attitude to the noise source was also assessed by 11 items. Respondents rated their agreement (5 point scale from strongly agree to strongly disagree) with statements such as "The government is not doing enough to stop noise pollution", and "Sydney airport is of value to this neighbourhood". Appropriate questions were rescaled so that larger scores indicated more negative attitude.

After being interviewed subjects also completed two personality questionnaires.

### **Procedure**

Interviews were conducted by trained interviewers at subjects' homes. First, a letter was sent to every selected residence announcing the investigation. Second, 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. Up to 5 calls back were made to contact the

residence and interview the selected resident. The structured interview was conducted and questionnaires given to the subject to complete while the interviewer waited. The second interview was conducted with 97 of the same residents, after a period ranging from 6-12 weeks. It employed the same basic procedures except that an incentive payment was offered. Alpha was set at .05 for all statistical tests.

### 3. RESULTS AND DISCUSSION

In support of the veracity of the test-retest study conducted, the general measure of reaction (extent to which the resident is affected by the noise) was highly reliable with a test-retest correlation of 0.85 [20].

#### **Noise Sensitivity**

The overall sensitivity measure was reliable. The 11 individual sensitivity questions all produced statistically significant test-retest correlations (range: 0.38 to 0.54) except one situation (rustle of papers at the movies was not reliable:  $r = 0.22$ ). The most reliable individual situations were hearing someone using electric power tools ( $r = 0.54$ ), an unanswered telephone ( $r = 0.52$ ), neighbours' radio or TV playing loudly ( $r = 0.50$ ), and conversation being interrupted by traffic noise ( $r = 0.49$ ). The overall scale of sensitivity produced by the addition of all the relevant items achieved a reasonable but not high stability (test-retest reliability) of 0.59.

In terms of internal consistency, the Chronbach alpha of 0.86 indicates strong internal reliability.

#### **Attitude towards the Noise Source**

The overall attitude measure was similarly reliable with all 11 items resulting in statistically significant test-retest correlations (range: 0.33 to 0.70). The least reliable item was: "There are better alternative than using planes" ( $r = 0.33$ ), while the most reliable items were: "The airport should be shifted to a less populated location, regardless of inconvenience" ( $r = 0.70$ ) and "Sydney airport is of value to this neighbourhood" ( $r = 0.61$ ). The overall scale of attitude produced by the addition of all the relevant items achieved a test-retest reliability of 0.67.

The combined attitude scale resulted in a Chronbach alpha of 0.75, indicating sound reliability on this construct.

These results indicate that measurement of attitude to the noise source is stable across time. The measurement of noise sensitivity (using a method in common use) is somewhat stable but may be in need of improvement in this regard. However, these estimates of stability may be underestimates because of the possibility that respondents' awareness of noise and attitudes towards relevant authorities may have been influenced by the considerable media attention to impending changes to Sydney Airport. Real and unusual changes to these characteristics may have been induced in the respondents. Thus, it can be concluded that the stabilities of these scales are at least 0.59 and 0.67, and probably somewhat higher.

In both cases scales constructed from the combination of the questions achieved sound internal consistency. It is also common to find that such measures of sensitivity and of attitude each produced more than one consistent underlying factor when subjected to factor analysis [e.g., 14, 19, 21]. The present study followed this trend, with two underlying factors of sensitivity and three factors of attitude. As a guide to the reliabilities achieved by such scales, the two scales of sensitivity each achieved good internal consistency (6 item scale:  $\alpha = 0.80$ ; 5 item scale:  $\alpha = 0.76$ ).

Overall, these results indicate that both noise sensitivity and attitude to the noise source can be measured with reasonable reliability.

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