

Measuring dose response relationships for environmental factors

Author

Brown, Alan

Published

1980

Conference Title

Seminar on Measuring Social Behaviour in Road Research

Version

Version of Record (VoR)

Rights statement

After all reasonable attempts to contact the copyright owner, this work was published in good faith in interests of the digital preservation of academic scholarship. Please contact copyright@griffith.edu.au with any questions or concerns.

Downloaded from

<http://hdl.handle.net/10072/397864>

Link to published version

<http://155.212.5.248/Presto/content/Detail.aspx?ctID=MjE1ZTI4YzctZjc1YS00MzQ4LTkyY2UtMDJmNTgxYjg2ZDA5&rID=NjcxOQ==&qrs=RmFsc2U=&q=YWlyIDlwN>

Griffith Research Online

<https://research-repository.griffith.edu.au>

Seminar on Measuring Social Behaviour in Road Research

SESSION III — PAPER 2

MEASURING DOSE-RESPONSE RELATIONSHIPS FOR ENVIRONMENTAL FACTORS

A.L. Brown, School of Australian Environmental Studies, Griffith University

MEASURING DOSE-RESPONSE RELATIONSHIPS
FOR ENVIRONMENTAL FACTORS

A.L. Brown, B.E., M.U.S., Ph.D., M.A.A.S., Lecturer, School of Australian Environmental Studies, Griffith University, Brisbane.

ABSTRACT

Using an investigation of the dose-response relationship for road traffic noise as an example, this paper examines some of the methodological issues involved in studies which attempt to relate human response to some aspects of the environment. It is intended to highlight some of the difficulties involved and to provide background to policy makers and practitioners who wish to apply the results of such studies. It is suggested that studies of an environmental factor in isolation may give misleading results unless that factor is shown to be of immediate concern to the respondents. The paper examines the difficulty in defining and measuring human response and suggests that frequency of official complaints is likely to be a very poor measure of community response. It shows that psychological and physical factors, independent of the environmental factor of interest, have an influence on the response to that environmental factor; and that this influence may be greater than that of the environmental 'dose'. This means that one is not able to predict an individual's response to a given dose, and instead must rely on predicting the pooled response of groups of people. It is suggested that the range and distribution of the initial data should be examined critically before attempting to apply any results from a study of a dose-response relationship. Finally, the concepts of habituation, suppression and mobility of affected people are introduced as areas requiring further investigation.

1. INTRODUCTION

The rational control of an environmental pollutant requires recognition of its adverse effects, measurement of the amount of pollutant in terms reflecting the amount of adverse effect, and the determination of levels of the pollutant which should not be exceeded if some goal of environmental quality is to be achieved. The first two requirements - recognition of the adverse effects of the pollutant and determination of a dose-response relationship - are proper areas of scientific enquiry. The latter requirement - the setting of goals - must remain part of the social-political process, though a clear statement of the dose-response relationship can ensure that the ramifications of selecting any particular goal are known.

In general, there has been little success in determining the dose-response relationship for environmental factors relevant to roadway planning (Lassiere 1976), though in the last decade and a half there has been considerable activity in examining this relationship for road traffic noise. This activity has resulted from recognition that noise from roadways can have a major impact on the well-being of people - particularly in urban areas - and can be subject to control by roadway, housing or planning authorities.

More than a dozen field studies of the dose-response relationship for traffic noise have been completed in various countries around the world. Included among these are two in Australia. The first, a study of community response to traffic noise near the South-East Freeway in Brisbane, has been reported in Brown and Law (1976 and 1978) and Brown (in press). The second, a survey of 818 people living along 19 roadways in Brisbane, Sydney and Melbourne, has been reported initially in Brown (1978). The latter will be referred to here as the BSM study. In common with all of the overseas studies, these studies required interviews with residents to ascertain the effects of traffic noise and the measurement of the road traffic noise levels to which residents were exposed. All studies attempted to relate the effects of road traffic noise to noise exposure. For example, one such study in the UK (Griffiths and Langdon 1968) led to the adoption there of an L_{10} (18 hour)* of 68 dB(A) as the noise level above which residents affected by increased noise from road traffic would be eligible for compensation under certain circumstances (Noise Insulation Regulations 1973).

It is not the intention of this paper to present the results of these studies of the dose-response relationship for road traffic noise. This has been adequately covered elsewhere. However, it is intended to examine parts of the methodology and analysis common to most of these studies, using the BSM study as an example throughout. The purpose, apart from highlighting some of the difficulties inherent in such investigations, is two-fold. Firstly, these difficulties are likely to be common across studies of human response to other environmental factors, and while little in this paper is new, a discussion of some of the problems illuminated in the BSM study could prove useful in other areas. Secondly, presenting some of the background to studies of the dose-response relationship for road traffic noise may help the practitioner be more sympathetic (and cautious) in the application of the findings of these studies.

* L_{10} (18 h) is the noise level exceeded for 10% of the 18 hour period from 0600 to 2400 hours.

2. TAKING THE ENVIRONMENTAL FACTOR OUT OF CONTEXT

There is always a danger in attempting to isolate one particular environmental factor in a social survey, in that, taken out of its context, it may assume disproportionate importance during the course of an interview. Its complex interactions with other factors will often not be understood, probably not even recorded. As an example of these complex interactions, Troy (1972) found that only 8% of the variance of residents' opinion of their neighbourhood could be explained by their assessment of the physical environment, and only 4% of the variance of this latter assessment by their attitude to noise.

To some extent, the context of the environmental factor of interest can be examined by masking the purpose of the questionnaire, at least in the initial stages. As an example, Fig 1 presents the results from an early unprompted question in the BSM questionnaire, where the purpose of the survey was still masked. This provided reasonable evidence of the ranking of different environmental factors and of the legitimacy of a specific investigation of the effects of noise from road traffic on the sample of people in the survey. The survey was initially presented to respondents as an attempt to ascertain what people thought of the area in which they lived. By contrast, if the questionnaire survey along the roadways in the BSM study had been concerned with air pollution, it is unlikely that an unmasked survey would have produced results with a similar degree of legitimacy.

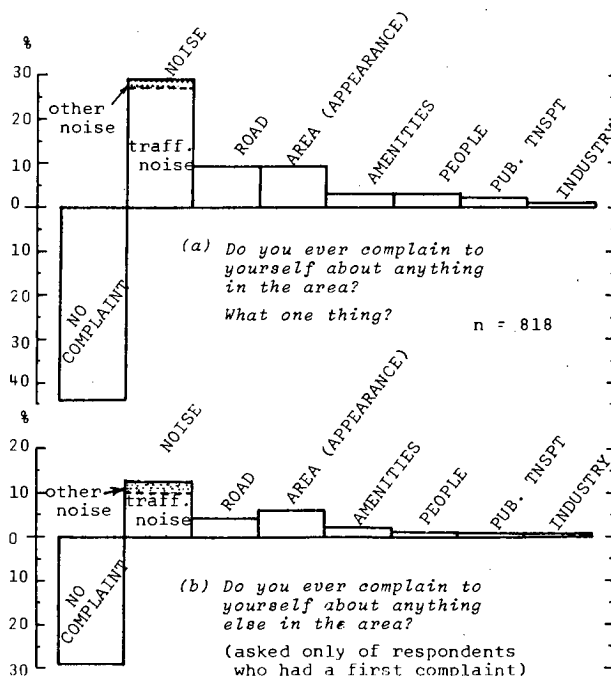


Fig 1 - Proportion of the BSM sample 'complaining' about aspects of their neighbourhood.

3. MEASURING RESPONSE

Are the responses to an environmental factor simple or complex?

The primary instrument used for measuring the effects of noise in the BSM study was a seven-point semantically labelled annoyance scale for the question: 'How much does traffic noise in the area annoy you?' However, traffic noise has other effects besides annoyance: communication interference, sleep interference, the shutting of windows, to name a few. In fact the BSM questionnaire yielded measures on fourteen variables concerning the effects of noise, each representing respondents' opinions about traffic noise and its effects, reported interference with activities, or respondents' actions regarding the noise. Even this list was not necessarily exhaustive.

What were the relationships between these noise-effect variables? Could 'noise-effects' be regarded as a single concept, or did these variables measure various aspects of noise interference? In particular, did a simple self-reported annoyance scale parsimoniously measure all the effects of noise? To examine these questions, noise-effect variables were subject to a principal component analysis, analysing across individuals. The plot of percentage of total variance accounted for by successive factors extracted is shown in Fig 2. This figure indicates the existence of only a single, general factor. While the first factor accounted for only 39% of total variance in the variables, no single additional factor accounted for a high proportion of the remaining variance. Further, factors after the first appeared to have no reasonable interpretation. Each of the variables loaded highly on the first factor, and the concept of 'noise-effects' as a single dimension can be accepted. In addition, the variable loading highest on the first factor was the self-rated annoyance scale. This result is in accord with McKenel (1970) who, in discussing the measurement of the effects of aircraft noise, commented that annoyance-scale responses have been shown to constitute a very robust general factor. Thus a simple self-rating by informants (i.e. How much are you annoyed?) provided a measure of noise-effects that was almost as reliable and valid as one obtained from a scale carefully constructed from answers to a series of questions. It should be noted that this fortunate result is quite unlikely to apply in other areas of attitude measurement, e.g. attitudes to severance caused by road construction. The relationship between annoyance and other effects of noise is further demonstrated in Fig 3.

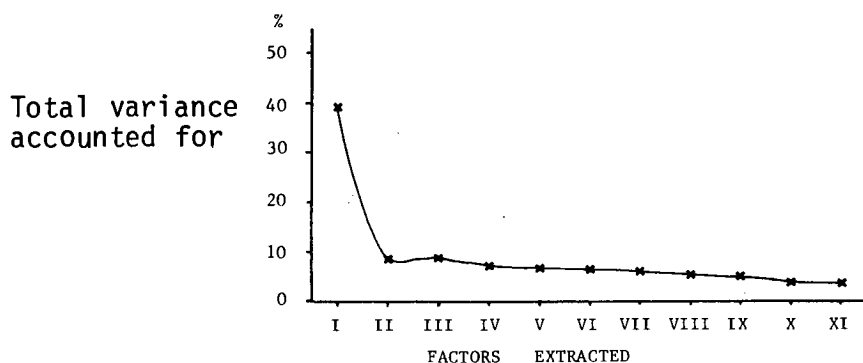


Fig 2 - Percentage of the total variance explained by successive factors in the principal component analysis of noise-effects.

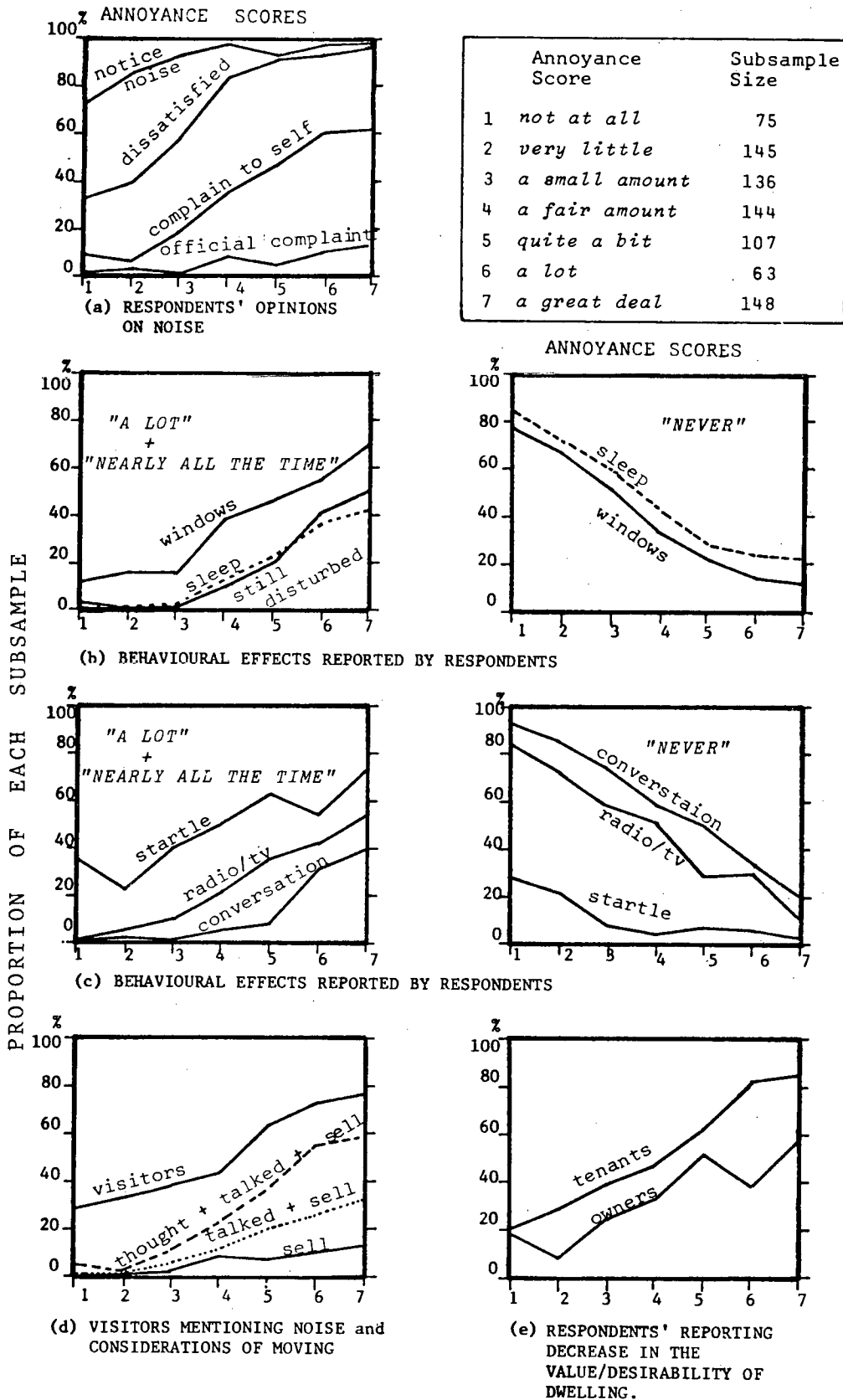


Fig 3 - Opinions and effects reported by BSM respondents grouped into subsamples of the same annoyance score. The noise annoyance scale and subsample sizes are shown in the top box.

In summary, individuals' self-rating of their annoyance could be regarded as a suitable and comprehensive measure of 'response' in investigating the dose-response relationship for the noise from road traffic.

3.1 OFFICIAL COMPLAINTS AS A MEASURE OF RESPONSE

Is the frequency of complaints to authorities such as local governments, police, etc. a good alternative measure of the response of the community to an environmental factor? It is highly likely, in the absence of specific surveys, that complaints might be the only measure of community response practitioners have available.

Results of the BSM study indicate that complaints are likely to be a very poor measure of response, at least for the response to road traffic noise. For each of the 19 BSM sites, the percentage of respondents at each site who reported having made an official complaint is shown in Fig 4 (5% is approximately 2 respondents). Frequency of complaints bore no relationship to the noise levels along the roadways (within each city, higher site numbers indicate higher noise levels). However, frequency of complaints was much higher along roadways where some form of community action had taken place with respect to the roadway, e.g. petitions, local meetings, etc. This suggests that complaint data is likely to be more a function of level of organisation in the community rather than of the noise 'dose'.

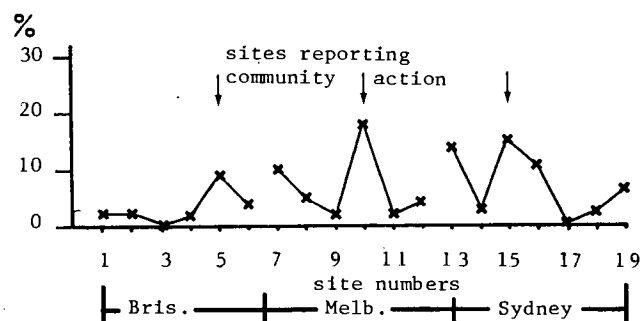


Fig 4 - Percentage of respondents at BSM sites who reported making an 'official' complaint about traffic noise.

4. INDIVIDUAL OR GROUP RESPONSE

While a dose-response relationship may exist for each individual, the relationship appears to be different across individuals, with different responses being recorded for the same noise exposure. This variation has been attributed to factors which intervene in the dose-response relationship; including both psychological factors pertaining to the individual and physical factors pertaining to the immediate environment. In any event, such variation has resulted in very low correlations being reported between the dose of road traffic noise and individual responses in all studies to date, including those reported by the author. This means that one is not able to predict an individual's response to a given noise exposure.

The predictable reaction on the part of researchers is to pool the responses of individuals exposed to the same noise dose. The dose-response relationship can then be examined using this group data. In this manner, most studies have been able to report relationships which would allow 'useful' prediction of group response to a given noise level. Schultz (1972) has categorically supported this pooling by his comment that in setting out to select a suitable rating scale for assessing community noise, for whatever application, no attempt should be made to predict individual response. Instead, one should be concerned with expressing, in physical terms, the magnitude of noise exposure affecting whole neighbourhoods. However, others have argued that the use of group response 'distorts reality' and that the consequences of this are harmful in that the susceptible sections of the population are not accounted for.

It seems inevitable that practitioners must resort to a noise-response relationship based on group data in any planning application. However, any such application must be tempered with the knowledge that the criterion level adopted indicates only the central tendency of human response and is certainly not the level below which no adverse human response will occur. For example, the UK criterion for compensation for noise (68 dB(A)) was based on median response for groups and is set such that one is reasonably confident (1 in 40 chance of being wrong) that half of the people exposed to that noise level will be less than moderately annoyed. The other half, of course, will be more than moderately annoyed. 'Moderate' has been determined arbitrarily by the researchers.

In addition to the likely problem of a criterion level set for *group response* being interpreted in practice as though it were set for *individual response*, it is not out of place here to comment that as soon as any such level is adopted there is a prevalent misconception that it can be used for design purposes as an *environmental standard*. For example, it is clear from the above that the adoption of the UK level of 68 dB(A) as a design goal for new urban areas is unlikely to result in a *desirable* acoustic environment.

Group response can be reported in different ways. The use of the median response for each group introduces no statistical difficulties into the analysis. However, the interpretation of a dose-response relationship based on medians is somewhat clumsy. Alternatively, group response can be expressed as the proportion of people in the group exceeding certain levels of annoyance, e.g. per cent highly annoyed. While these results can be interpreted more easily, there are problems in arbitrarily determining the breakpoints in the scale used to measure response. For example, Fig 5 shows the results of the BSM study in terms of median response, percent 'highly' annoyed, and percent 'moderately' or 'highly' annoyed - the latter two being based on arbitrary breakpoints of 5.5 and 3.5 on the 7 point annoyance scale. The use of terms such as 'moderately' and 'highly' is quite subjective, but can be given some credence if an attempt has been made to calibrate the simple scale of annoyance in terms of other, more tangible, effects of noise, e.g. window shutting, sleep or communication interference.

5. FACTORS INTERVENING IN THE DOSE-RESPONSE RELATIONSHIP

There are difficulties in defining a dose-response relationship where factors unrelated to the stimulus play a significant role in determining an individual's response. Such intervening factors contribute to the low correlations between dose and individual response.

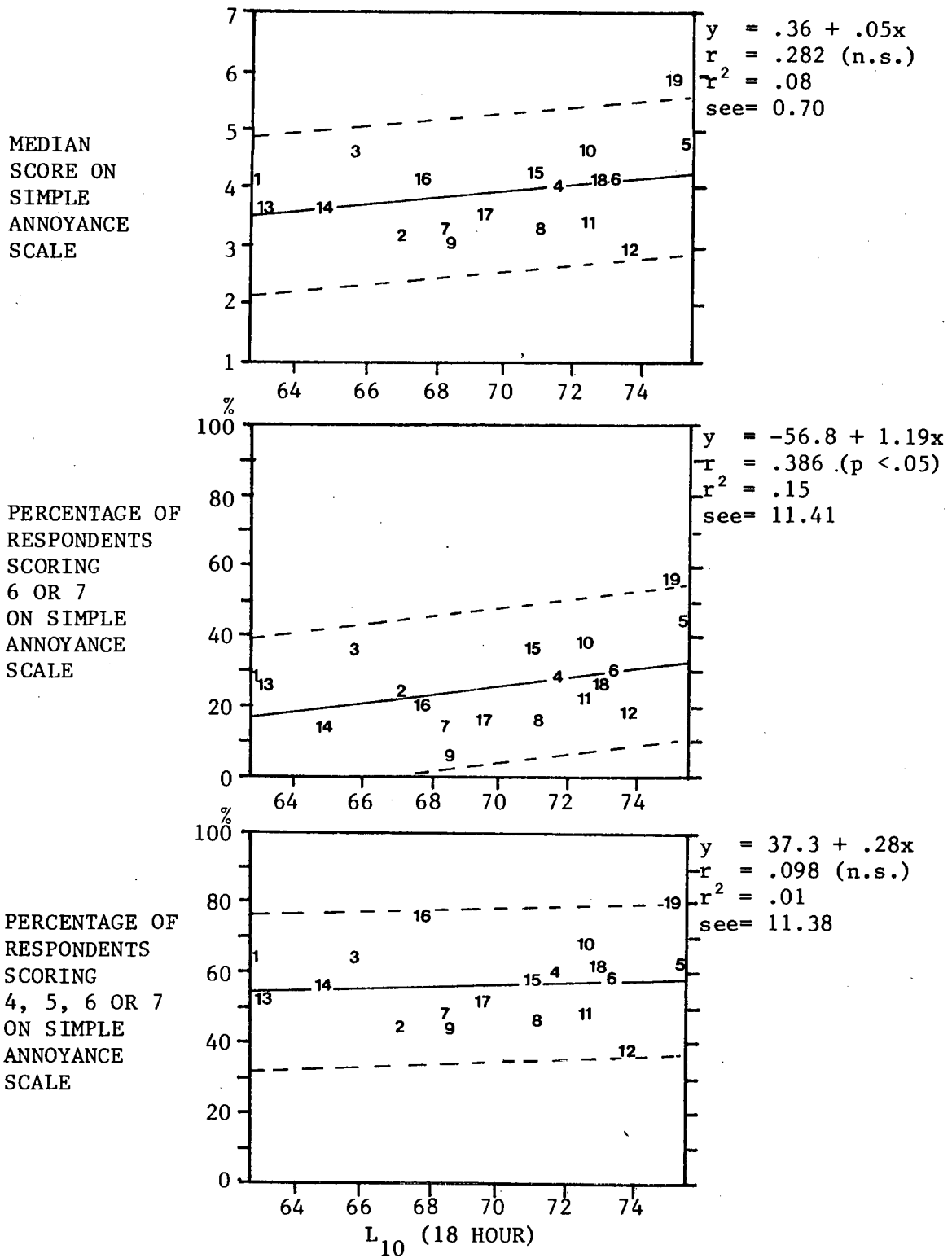


Fig 5 - The relationship of L_{10} (18 h) noise levels to different measures of group response for the 19 sites used in the BSM study.

For the dose-response relationship for road traffic noise, two factors have consistently been reported as significant predictors of individual response : viz, a person's susceptibility to noise annoyance and a person's opinion of the neighbourhood as a place to live. Noise annoyance increases with increasing susceptibility (a psychological attribute invariant with noise exposure) and with decreasing opinion of the neighbourhood. In the BSM study, the importance of these factors was confirmed, and two additional factors - location of activities within the dwelling (i.e. in rooms near the roadway or in rooms away from the roadway) and housing type (high-set house, low-set house or terrace/unit) were also significant predictors. While bearing in mind the instability of regression weights, the following give some idea of the relative influence of these intervening factors on individual response to noise. For a given noise exposure, individuals with low and high susceptibility scores differed by roughly 2.5 points on the 7 point annoyance scale; with poor and high opinion of the neighbourhood, by roughly 1.5 points; with different activity locations by roughly 1 point; and with different housing type, by roughly 0.5 points.

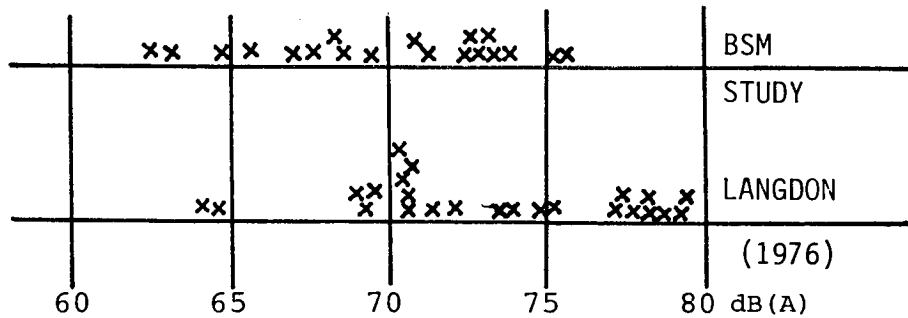
The difficulty for the practitioner is how, if at all, to take account of these intervening variables. It could be argued that their incorporation into planning is necessary if the goal of such planning is to set maximum limits to the response (annoyance) rather than to the dose (noise). However, this author believes that environmental criteria should be applied to the location, rather than to people at that location for the simple reason that, even in the short term, the turnover of dwelling occupants is quite high. Thus intervening factors which are person-specific, susceptibility and opinion of the neighbourhood, are not constant at a location, and even if they could be obtained by survey, have little validity for long term planning. Other intervening factors related to the dwelling structure are more tractable, but as the reliability of these in predicting annoyance is yet to be tested, these too should be ignored for planning purposes. It is suggested that while intervening factors are of little use in planning, practitioners should be sensitive to the effects that they may have on individual response.

6. RANGE AND DISTRIBUTION OF THE DOSE

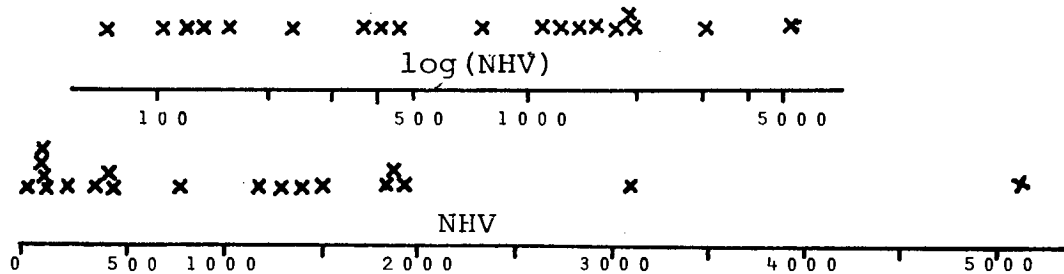
Very few surveys are unrestricted in terms of resources, and in a study of response to an environmental factor this usually means a restriction in the number of sample sites, with two resultant undesirable effects. Firstly, the range of the dose may be restricted. Secondly, the distribution of sample sites across the range of the dose may be unsuitable for correlation analysis. In field studies of environmental factors this problem is often compounded in that the magnitude of the dose at sites selected for the study can only, at best, be estimated during the design of the experiment, and the final range and distribution is often largely fortuitous.

Fig 6(a) demonstrates different ranges and distribution of noise levels used in two studies of the dose response relationship for road traffic noise. The BSM study included no sites with noise levels higher than 75 dB(A) (no noisier roadways fronting residential properties could be located in Brisbane, Sydney or Melbourne) and the Langdon study had few sites below 70 dB(A). Other studies could also be indicated with quite different ranges and distributions. These differences have had little attention in the literature. Most studies rely on finding the best linear relationship between dose and response and report the correlation coefficient from this linear analysis. What happens, in effect, is that each study defines its own noise-

response relationship as the best fitting linear relationship across the (usually limited) range of noise levels encountered in the study. If the dose-response relationship for road traffic noise is, in fact, linear across the complete range of levels of interest, this presents no difficulty. However, if the relationship is curvilinear, then the restriction of range in each study becomes significant, with the linear relationship reported from each study merely indicating a chord of the curvilinear relationship over the restricted range. While the curvilinear relationship in this case is conjectural, the important point is that one should examine the range of the noise-levels reported in such studies, and not rely merely on the reported correlation coefficients.



(a) L_{10} (18hour)



(b) Number of heavy vehicles, BSM Study.

Fig 6 - Range and distribution of some 'dose' variables.

An allied problem is the extrapolation of the observed linear relationship beyond the range of the data. It is interesting to note, in this context, that Langdon's data was used to confirm the suitability of the 68 dB(A) L_{10} (18 h) criterion level in the UK. While 68 dB(A) does not lie outside the range of his data, the paucity of sites with levels less than 70 dB(A) gives some cause for concern.

Not only the range, but also the distribution, of the noise levels should be examined. There are pressures on a researcher to report the maximum correlation coefficient that can be extracted from the data, but an example of how the distribution of the dose can influence the magnitude of the correlation coefficient is shown in Fig 6(b). In the BSM study, the highest correlation coefficient reported was that between the number of heavy vehicles using the roadway (NHV)* and annoyance scores ($r = 0.72$). However,

* NHV can be regarded as a proxy acoustic dose by considering it as an indicator of number of 'noisy' events.

the high positive skewness of this variable has noticeably inflated the correlation coefficient, i.e. the two high values of NHV have had undue influence. However, the log transform of the dose ($\log(\text{NHV})$) had a near uniform distribution and its correlation with annoyance can be accepted at face value ($r = 0.52$). Blind acceptance of a researcher's reported correlation coefficient, without examination of the distribution of the variables, is to be discouraged.

7. HABITUATION, SUPPRESSION AND MOBILITY

Finally, there are several other questions which should be raised in any study of a dose-response relationship - though as yet they have had little quantitative investigation, or even recognition. They include habituation, suppression, and the mobility of susceptible fractions of the exposed population. Using noise from traffic as an example, *habituation* is the phenomenon which imputes that response to a given noise exposure decreases over time. It is evidenced by statements such as 'but you get used to it', although two minor studies have failed to measure any such phenomenon. *Suppression* is another mechanism which may affect the dose-response relationship. It is suggested that people may be affected to a greater extent than indicated by their self-reported annoyance. Given that many respondents in the BSM study commented on the inevitability of the continuation of high traffic noise levels at their dwelling, it is not unreasonable to speculate that they may invoke some defence mechanism which lowers their expectations of their acoustic environment. It is suggested that these respondents may be surprised at how much the noise had affected them if for some reason the noise was eliminated.

Finally, in areas exposed to higher noise levels it is possible that the annoyance-susceptible fraction of the population may be more *mobile* than other fractions. Over time, this results in lower levels of community annoyance. The BSM study clearly indicated the mechanism by which noise-susceptible residents could be removed from areas of high noise level, though this cannot be verified without time-series data.

It is suggested that these speculative phenomena should be kept in mind when examining or planning any study of a dose-response relationship, especially if some change in the dose has occurred, e.g. the opening of a new roadway.

8. CONCLUSION

Field studies of dose-response relationships for environmental factors are likely to be time consuming and relatively expensive because gathering data on human response is generally labour-intensive. For this reason a certain amount of reliance will have to be placed on studies from overseas countries in the formulation of a criterion level for adoption in Australia. Hopefully, this paper may encourage critical examination of the data used in such studies so that debate about which criterion level to adopt will be based on an understanding of what that level means in terms of human response; rather than on some vague notion that an environmental factor becomes 'unacceptable' at some specified level.

In addition this paper has highlighted some of the methodological issues which should be confronted in future studies.

BIBLIOGRAPHY

- ABELSON, P. (1977). The impact of environmental factors on relative house prices. Bureau of Transport Economics Occasional Paper No. 7. (AGPS: Canberra.)
- (1979). *Cost Benefit Analysis and Environmental Problems*. (Saxon House: London.)
- ADLER, A. and BEN-AKIVA, M. (1979). A theoretical and empirical model of trip chaining behaviour. *Transp. Res. B* 13B(3), pp. 243-58.
- ANDERSON, N.H. (1962). Application of an additive model to impression formation. *Science* 138, pp. 817-18.
- (1970). Functional measurement and psychophysical judgement. *Psychol. Rev.* 77, pp. 153-70.
- (1974). Information integration theory: a brief survey. In D.H. Krantz, R.C. Atkinson, R.D. Luce, and P. Suppes (Eds.) 'Contemporary Developments in Mathematical Psychology.' (W.H. Freeman: San Francisco).
- (1976). How functional measurement can yield validated interval scales of mental quantities. *J. Appl. Psychol.* 61, pp. 677-92.
- (1979). Algebraic rules in psychological measurement. *Am. Scientist* 67, pp. 555-63.
- ANSCOMBE, F.J. and TUKEY, J.W. (1954). The criticism of transformation. Paper presented before the Am. Stat. Assoc. and Biometric Soc., Montreal (mimeo).
- ARMSTRONG, J.G. (1979a). Advocacy and objectivity in science. *Manage. Sci.* 25(5), pp. 423-28, May.
- (1979b). Unintelligible research and academic prestige: further adventures of Dr. Fox. Unpub. Paper presented at 1979 (May) TIMS/ORSA Conf., New Orleans, La.
- ATHANASIOU, R. and YOSHIOKA, G.A. (1973). The spatial character of friendship formation. *Environ. Behav.* 5, pp. 43-66.
- AUSTRALIAN INSTITUTE OF URBAN STUDIES (1979). Staggered work hours and peak hour congestion in Melbourne. (AIUS: Canberra.)
- AUSTRALIAN TRANSPORT ADVISORY COUNCIL (1978). Transport and energy overview. (AGPS: Canberra.)
- BANISTER, D.J. (1978). Decision-making, habit formation and a heuristic modal split model based on these concepts. *Transportation* 7, pp. 5-18.
- BANNISTER, H. and OGBORN, K. (1978). Rising petrol prices, residential markets and employment markets in urban areas. Paper presented to the 3rd Annu. Meet. Regional Science Assoc. (Australia and New Zealand Section), Monash Univ., Melbourne, December.
- BEGGS, J.J. (1976). Some empirical findings on the relationship between residential density and accessibility to job opportunities. Proc. 8th ARRB conf. 8(6), Session 32, pp. 7-15.

- BEN-AKIVA, M.E. (1975). Structure of passenger travel demand models. *Transp. Res. Rec.* 526, pp. 26-42.
- BETTMAN, J.R., CAPON, N. and LUTZ, R.J. (1975). Cognitive algebra in multi-attribute models. *J. Market. Res.* 12, pp. 151-64.
- BLACKORBY, J., PRIMONT, R. and RUSSELL, R. (1978). *Separability, Duality, and Functional Form.* (Academic Press: New York.)
- BODILY, S.E. (1980). Life risk analysis. *Op. Res.* 28(1), pp. 156-75.
- BOHM, P. (1971). An approach to the problem of estimating demand for public goods. *Swedish J. Econ.* 73(1), pp. 94-105.
- BOULDING, K. (1969). Economics as a moral science. *Am. Econ. Rev.* 59(1), pp. 1-12.
- BOURGIN, C. and GODARD, X. (1979). Structural and thresholds effects in the use of transportation modes. Resource paper for 4th Int. Conf. on Behavioural Travel Modelling, Eibsee, West Germany.
- BOWYER, D.P. (1978). Monitoring transport management schemes: Victoria Road (Sydney) case study. Australian Road Research Board. Internal Report, AIR 287-2.
- (1979). Measuring and assessing the effects of transport management schemes. Inst. Eng. Aust., Transp. Conf., pp. 154-59.
- and LOCK, J.B. (1978). Mode choice modelling and prediction: the Tasman Bridge case study. Australian Road Research Board. Internal Report, AIR 289-6.
- BOX, G.E.P. and COX, D.E. (1964). An analysis of transformations. *J. Royal Stat. Soc. B* 26, pp. 211-43.
- and TIDWELL, P.L. (1962). Transformation of the independent variables. *Technometric* 4, pp. 531-50.
- BRAND, D., ATTANUCCI, J., MORRIS, H. and KALAUSKAS, C. (1978). Southeast Expressway reserved lane for buses and carpools. Paper to 57th Meet. Transp. Res. Board. Washington, D.C.
- BREHMER, B. (1969). Cognitive dependence on additive and configural cue-criterion relations. *Am. J. Psychol.* 82, pp. 490-503.
- (1971). Subjects' ability to use functional rules. *Psychonomic Sc.* 24, pp. 259-60.
- BROOME, J. (1979). Trying to value a life - a reply. *J. Public Econ.* 12, pp. 259-62.
- BROWN, A.L. (1978). Traffic noise annoyance along urban roadways: report on a survey in Brisbane, Sydney and Melbourne. Australian Road Research Board. Internal Report, AIR 206-6.
- (1979). Annoyance caused by road traffic noise. Ph. D. Thesis, Univ. Queensland.

- BROWN, A.L. (1980). The noise-response relationship near a freeway. Proc. Xth ARRB Conf. 10(5), pp. 144-53.
- and LAW, H.G. (1976). Effects of traffic noise: South-East Freeway, Brisbane. Proc. 8th ARRB Conf., 8(6), Session 33, pp. 8-30.
- (1978). South-East Freeway (Brisbane) noise annoyance study: report on the survey. Australian Road Research Board. Research Report, ARR No. 82.
- BROWN, G.R. (1972). Analysis of user preferences for system characteristics to cause modal split. *Highw. Res. Rec.* 417, pp. 25-36.
- BROWN, H.P. (1977). Attitudinal measures in models of mode choice. Forum Papers. 3rd Aust. Transp. Res. Forum.
- BROWN, I.D. (1979). Can ergonomics improve primary safety in road transport systems? *Ergonomics* 22(2), pp. 109-16.
- BRYANT, J. (1975). Traffic noise and the community. Australian Road Research Board. Research Report, ARR No. 23.
- BUCHANAN, J.M. and FAITH, R. (1978). Trying again to value a life. *J. Public Econ.* 42, pp. 245-48.
- BUREAU OF TRANSPORT ECONOMICS (BTE). (1975). *Brisbane Airport: Economic Evaluation of Alternative Development Strategies.* (AGPS: Canberra.)
- (1980-forthcoming). *Urban Air Pollution: The Role of Vehicle Emissions.*
- BURG, A. (1972). Characteristics of drivers. In T.W. Forbes, (Ed.) *Human Factors in Highway Traffic Safety Research.* (Wiley-Interscience: New York.)
- BURNETT, K.P. (1976). Travel time cognition and its theoretical and policy implications. Paper presented at Meet. Assoc. Am. Geographers.
- and HANSON, S. (1979). Modelling travel as complex human behaviour. PTRC Summer Annu. Meet., Univ. Warwick, England.
- BURNS, L.D. and GOLOB, T.F. (1976). The role of accessibility in basic transportation choice behaviour. *Transportation* 5(2), pp. 175-98.
- CALDER, B. (1977). Focus groups and the nature of qualitative marketing research. *J. Market. Res.* XIV, (August), pp. 353-64.
- CAMKIN, H.L. (1978). Recent experiments and experiences with bus priority measures in Sydney. Paper to Inst. Eng., Aust., Symp. on Road Based Public Transport, Melbourne.
- CAMPBELL, B.J. (1973). Problems in the attempt to define and predict who will be the 'accident repeater'. Paper presented at the First Int. Conf. on Driver Behaviour, October 8-12, Zurich.
- CAMPBELL, D. (1977). Qualitative knowing in action research: *J. Social Issues.*

- CARROLL, J.D. and CHANG, J.J. (1970). Analysis of individual differences in multidimensional scaling via an N-way generalisation of 'Eckart-Young' decomposition. *Psychometrika* 35, pp. 238-319.
- CARTERETTE, E.C. and FRIEDMAN, M.P. (Eds.) (1974). *Handbook on Perception Vol. 11: Psycho-physical Judgement and Measurement*. (Academic Press: New York.)
- CILLE, F.P. and FREEMAN, P.N.W. (1977). Estimated road accident costs in South Africa, updated (1977). Rep. RT/8/77, Nat. Inst. for Transp. and Road Research, Pretoria, South Africa (30 p.).
- COASE, R. (1960). The problem of social cost. *J. Law Econ.* 3, pp. 1-44.
- COMMONWEALTH BUREAU OF ROADS (CBR). (1973). *Evaluation of Roadwork - Principles and Procedures - Bureau Paper 19*. (CBR: Melbourne.)
- CONNOR, W.S. and ZELEN, M. (1959). Fractional factorial experimental designs for factors at three levels. Nat. Bur. Standards, Appl. Math. Series No. 54.
- CONROY, M. (1978). Accessibility and the evaluation of land use/transport plans. Proc. 9th ARRB Conf. 9(6), pp. 19-35.
- COUNTRY ROADS BOARD OF VICTORIA (1979a). Union Road, Surrey Hills Study - Summary Report.
- (1979b). Eastern Freeway Corridor, Traffic Studies.
- and THE MELBOURNE METROPOLITAN BOARD OF WORKS (1978). Outer Ring Study: Diamond Creek to Ringwood: Technical Report - The Community.
- COURTNEY, T.D. (1975). The changing role of the CBD within the metropolitan retail structure of Hobart. Unpub. M.A. Thesis, Dept. Geography, Univ. Tasmania.
- CRESSWELL, W.L. and FROGGATT, P. (1963). *The Causation of Bus Driver Accidents: An Epidemiological Study*. (Oxford University Press: London.)
- CURRY, D.J. and LOUVIERE, J.J. (1980). The aggregate effects of induced consumer information processing. *J. Market. Res.* forthcoming.
- DAGANZO, C.F., BOUTHELIER, F. and SHEFFI, Y. (1977). Multinomial probit and qualitative choice: A computationally efficient algorithm. *Transp. Sc.* 11, pp. 338-58.
- DALY, A.J. and ZACHARY, S. (1978). Improved multiple choice models. In D.A. Hensher and Q. Dalvi (Eds.). 'Determinants of Travel Choice.' (Saxon House: London.)
- DALY, N.J. (1977). Photochemical pollution in Australian airsheds. Bureau Transp. Econ. Occasional Paper No. 6.
- DASGUPTA, A.K. and PEARCE, D.W. (1972). *Cost Benefit Analysis: Theory and Practice* (McMillan: London.)
- DAVIDSON, K.B. (1973). Relationships between land-use and accessibility. Greater London Council. Dept. Plan. and Transp. Res. Memo. No. 378.
- DAWES, R.M. (1971). A case study of graduate admissions: applications of three principles of human decision making. *Am. Psychol.* 26, pp. 180-88.

DAWES, R.M. and CORRIGAN, B. (1974). Linear models in decision making. *Psychol. Bull.* 81, pp. 95-106.

DAWSON, R.F.F. (1967). Cost of road accidents in Great Britain. Road Research Lab., (U.K.) RRL Lab. Rep. LR 79.

————— (1971). Cost of road accidents in Great Britain. Trans. Road Res. Lab., (U.K.) TRRL Lab. Rep. LR 369.

DELFT, A. van and NIJKAMP, P. (1976). A multi-objective decision model for regional development, environmental quality control and industrial land use. Paper of Regional Sc. Assoc. 33, pp. 35-57.

DEPARTMENT OF TRANSPORT AND HIGHWAYS DEPARTMENT, SOUTH AUSTRALIA (1979). Evaluation of the bus lanes on North East Road.

DIX, M.C. (1979). Structuring our understanding of travel choices: The use of psychometric and social research techniques. Resource paper for 4th Int. Conf. on Behavioural Travel Modelling, Eibsee, West Germany.

DOBSON, R. (1979). Market segmentation: A tool for transport decision-making. In D.A. Hensher and P.R. Stopher (Eds.) 'Behavioural Travel Modelling,' pp. 219-51. (Croom Helm: London.)

————— and TISCHER, M.L. (1977). Comparative analysis of determinants of modal choices by central business district workers. *Transp. Res. Rec.* 649, pp. 7-14.

DORFMAN, R. (1975). The technical basis for decision making. In E.T. Haefele (ed.) 'The Governance of Common Property Resources.'

DOWNS, A. (1970). Uncompensated non-construction costs which urban highways and urban renewal impose upon residential households. In J. Margolis (Ed), 'The Analysis of Public Output'. (NBER: New York).

DUNPHY, R.T. (1973). Transit accessibility as a determinant of auto-mobile ownership. *Highw. Res. Rec.* 472, pp. 63-71.

EHRENBERG, A. (1975). *Data Reduction. Analysing and Interpreting Statistical Data.* (John Wiley and Sons: London.), p. 364.

EINHORN, H.J. (1970). The use of nonlinear, noncompensatory models in decision making. *Psychol. Bull.* 73, pp. 221-30.

————— (1971). Use of nonlinear, noncompensatory models as a function of task and amount of information. *Organisational Beh. Human Performance* 6, pp. 1-27.

ELLIOTT, B.J. (1980). Drink driving publicity - An analysis of possible strategies. Unpub. Paper. 1st Pan Pacific Conf. on Drugs and Alcohol March 3, Canberra.

EPSTEIN, S. (1978). Transcript of Special Program on the Policies of Cancer on 'Broadban' 28/11/1978. (Australian Broadcasting Commission.)

- EVERETT, P.B., HAYWARD, S.C. and MEYERS, A.W. (1974). Effects of a token reinforcement procedure on bus ridership. *J. Appl. Behav. Anal.* 7, pp. 1-9.
- EVERETT, P.B., DESLAURIERS, B.L., NEWSOM, T. and ANDERSON, V.B. (1978). The differential effect of two free ride dissemination procedures on bus ridership. *Transp. Res.* 1, pp. 1-6.
- EYSENCK, H. (1975). Who needs a random sample? *Bull. British Psychol. Soc.* 28, pp. 195-98.
- FAIGIN, B.M. (1976). Societal costs of motor vehicle accidents. Rep. DOT-HS 802 119, U.S. Dept. Transp., Washington D.C., U.S.A. (35 pp.).
- FECHNER, G. (1960). *Elements of Psychophysics*. (Translated by H.E. Adler). (Holt: New York.)
- FEDERAL HIGHWAY ADMINISTRATION (1973). Methodology for evaluation of the environmental consequences of alternative national highway investment programs. (FHWA: Washington.)
- FERREIRA, J. and SLESIN, L. (1976). Observation on the social impact of large accidents. Tech. Rep. 122, Operations Research Centre, Mass. Inst. Technol., U.S.A.
- FESTINGER, L. (1957). *A Theory of Cognitive Dissonance*. (Stanford University Press: Stanford.)
- *et al.* (1950). *Social Pressures in Informal Groups: A Study of Human Factors in Housing*. (Stanford Uni. Press: Stanford.)
- FISHBEIN, M. and AJZEN, I. (1975). *Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research*. (Addison: Wesley.)
- FLAMBOI, E.E. and LEE, S.N. (1972). Short term benefits from field accident studies. Paper presented at the Proc. of the 16th Conf. Assoc. for Auto. Med. pp. 14-27. (Soc. Automotive Eng. Inc.: New York.)
- FLOWERDEW, A.D. and HAMMOND, A. (1973). City roads and the environment. *Regional Studies* 7, pp. 123-36.
- FOERSTER, J.F. (1979). Non-linear perceptual and choice functions: Evidence and implications for analysis of travel behaviour. Resource paper for 4th Int. Conf. on Behavioural Travel Modelling, Eibsee, West Germany.
- FOX, J.C., GOOD, M.C. and JOUBERT, P.N. (1979). Collisions with utility poles. Rep. No. CR1, Dept. Mech. Eng., Univ. Melbourne.
- FREEDMAN, K. and ROTHMAN, J. (1979). The 'Slob' campaign: an experimental approach to drink-driving mass media communication. Traffic Accid. Res. Unit. Dept. Motor Transport, N.S.W. September.
- FREEMAN, A.M. (1978). Decision making on chemicals with economic/environmental trade-offs. Report to OECD Environment Directorate 24/4/78.
- FRIED, M.A., HAVENS, J.J. and THALL, M.T. (1977). Travel behaviour - A synthesised theory. Final Rep., Project 8-14, NCHRP.

FUSS, M., McFADDEN, D. and MUNDLAK, (1978). A survey of functional forms in the economic analysis of production. *In* M. Fuss and D. McFadden. (Eds). 'Production Economics.' (North Holland: Amsterdam.)

GALLAGHER, F.D. (1976). A note on evaluating road safety policy. Rep. DGT 157. Director General of Transp., Western Australia (23 pp.)

GAUDRY, M.J.I. and DAGENAIS, M.G. (1979). The dogit model. *Transp. Res.* B13(2), pp. 105-12.

GAUDRY, M. and WILLS, M. (1978). Estimating the functional form of travel-demand models. *Transp. Res.* 12, pp. 257-89.

GEORGESCU-ROEGEN, N. (1936). The pure theory of consumer's behaviour *Q. J. Econ.* 1.

GLAZER, L.J. and CRAIN, J. (1979). San Bernadino freeway express busway: evaluation of mixed-mode operations. Paper to 58th Annu. Mett. Transp. Res. Board, Washington, D.C.

GOLDSTEIN, L.G. (1972). Youthful drivers as a special safety problem. *Accid. Anal. Prev.* 4, pp. 153-89.

GOLOB, T.F. (1973). Resource paper on attitudinal models. Highw. Res. Board Spec. Rep. 143, pp. 130-45.

————— and DOBSON, R. (1974). Assessment of preferences and perceptions toward attributes of transportation alternatives. Transp. Res. Board Spec. Rep. 149, pp. 58-81.

GOLOB, T.F., HOROWITZ, A.D. and WACHS, M. (1979). Attitude-behaviour relationships in travel demand modelling. *In* D.A. Hensher and P.R. Stopher (Eds.) 'Behavioural Travel Modelling.' pp. 739-57. (Croom Helm: London.)

GOLOB, T.F. and RICHARDSON, A.J. (1980). Non-compensatory and discontinuous constructs in travel behaviour models. *In* P.R. Stopher, A.H. Meyburg and W. Brog (Eds.) 'New Horizons in Travel Behaviour Research.' (Lexington Books: Lexington, Massachusetts.)

GOODWIN, P.B. (1973). On the evaluation of human life in accident studies. *Accid. Anal. Prev.* 5(3), pp. 287-93.

————— (1977). Habit and hysteresis in mode choice. *Urban Studies* 14, pp. 95-98.

GOULD, P. (1977). Changing mental maps: childhood to adulthood. *Ekistics* 43, pp. 111-19.

GREEN, P.E. and SRINIVASAN, V. (1978). Conjoint analysis in consumer research: issues and outlook. *J. Consumer Res.* 5, pp. 103-23.

GREEN, P.E. and WIND, Y. (1972). Hinsdale, Illinois. Dryden Press.

GREEN, P.E., CARMONE, F.J. and WIND, Y. (1972). Subjective evaluation models and conjoint measurement. *Behav. Sci.* 17, pp. 288-99.

- GREEN, P.E. and DEVITA, M.T. (1975). An interaction model of consumer utility. *J. Consumer Res.* 2, pp. 146-53.
- GREGORY, D.R. (1979). Traumatic neurosis. *Am. Assoc. Autom. Med.*, pp. 21-23.
- GRIFFITHS, I.D. and LANGDON, F.J. (1968). Subjective response to road traffic noise. *J. Sound Vib.* 8(1), pp. 16-32.
- GÜTTMAN, J.M. (1975). Implicit assumptions and choices among estimates of the value of time. *Transp. Res. Rec.* 534, pp. 63-68.
- HAEFNER, L.E. (1978). Benefit cost evaluation of an intra regional air service in the bay area on a technology assessment of transportation system investments. (NTIS: N78-28988).
- HAHN, G.J. and SHAPIRO, S.S. (1966). A catalog and computer program for the design and analysis of orthogonal symmetric and asymmetric fractional factorial experiments. Tech. Rep. Schenectady, New York: General Electric Res. and Development Center, Info. Sciences Lab., No. 66-C-165.
- HAKKINEN, S. (1979). Traffic accidents and professional driver characteristics: a follow-up study. *Accid. Anal. Prev.* 11, pp. 7-18.
- HALLAM, C. (1977). Evaluation of transit lanes. Traffic Auth. N.S.W. Report.
- HAMMOND, K.R. (1966). Probabilistic functionalism: Egon Brunswick's integration of the history, theory, and method of psychology. In K.R. Hammond, (Ed.) 'The Psychology of Egon Brunswick.' (Holt, Rinehart, and Winston: New York.)
- _____ and SUMMERS, D.A. (1972). Cognitive control. *Psychol. Rev.* 79, pp. 58-67.
- HAMMOND, K.R., STEWART, T.R., BREHMER, B. and STEINMANN, D.O. (1975). Social judgement theory. In M.F. Kaplan and S. Schwartz (Eds.) 'Human Judgement and Decision Processes.' (Academic Press: New York), pp. 271-312.
- HAMMOND, K.R., HURSCH, C.J. and TODD, F.J. (1964). Analysing the components of clinical inference. *Psychol. Rev.* 71, pp. 438-56.
- HANSEN, W.G. (1959). How accessibility shapes land-use. *J. Am. Inst. Plan.* 25, pp. 73-76.
- HANSON, S. (1974). On assessing individual's attitudes towards potential travel destinations: a research strategy. Proc. Transp. Res. Forum, pp. 363-70.
- HARRIS, W., MACKIE, R.R. and others (1972). *A Study of the Relationships Among Fatigue, Hours of Service and Safety of Operations of Truck and Bus Drivers.* (Bur. Motor Carrier Safety, Fed. Highw. Admin., U.S. Dept. Transp: Washington, D.C.)

- HARSHMAN, R.A. (1970). Foundation of the PARAFAC procedure: Models and conditions for an elementary multi-modal factor analysis. Working Papers. In *Phonetics* No. 16, Univ. California: Los Angeles.
- LADEFOGED, P. and GOLDSTEIN, L. (1977). Factor analysis of tongue shapes. *J. Acous. Soc.* 62(3), pp. 693-707.
- HARTGEN, D.T. (1974). A dynamic model of travel mode switching behavior. *Transportation* 3, pp. 45-58.
- (1979). Applications of the behavioural sciences to transportation. PTRC Summer Annu.Meet., Univ. Warwick.
- HARVEY, D. (1973). *Social Justice and the City*. (Edward Arnold: London.)
- HEGGIE, I.G. (ed.) (1976). *Modal Choice and the Value of Time*. (Oxford University Press: Oxford.)
- (1978). Behavioural dimensions of travel choice. In D.A. Hensher and Q. Dalvi (Eds.) 'Determinants of Travel Choice.' (Saxon House: Westmead.)
- and JONES, P.M. (1978). Defining domains for models of travel demand. *Transportation* 7(2), pp. 119-35.
- HENSHER, D.A. (1976). Market segmentation as a mechanism in allowing for variability in traveller behaviour. *Transportation* 5(3), pp. 257-84.
- (1977). Re-opening of the Tasman Bridge: the effect on mode and route of travel for east-west travel. Macquarie Univ., School of Econ. and Financial Studies, Res. Paper No. 144.
- (1977). Some comments on identification of magnitude of travel cost and travel time. Macquarie Univ. School of Econ. and Financial Studies. Res. Paper No. 145.
- (1978). A review of individual choice modelling. Report to Aust. Dept of Environment, Housing and Community Development.
- and DALVI, Q. (Eds.) (1978). *Determinants of Travel Choice*. (Saxon House: Westmead.)
- HENSHER, D.A. and JOHNSON, L.W. (1979). External structure of variables in individual choice models of travel demand. *Int. J. Transp. Econ.* 6(2), pp. 51-62.
- (1980a). Behavioural response and functional form. Seminar on 'Measuring Social Behaviour in Road Research'. Proc., pp. 73-83.
- (1980b). *Applied Discrete Choice Modelling*. (Croom Helm: London.)
- HENSHER, D.A. and LOUVIERE, J.J. (1979). Behavioural intentions as predictors of very specific behaviour. *Transportation* 8, pp. 167-82.

- HENSHER, D.A. and McLEOD, P.B. (1977). Towards an integrated approach to the identification and evaluation of the transport determinants of travel choice. *Transp. Res.* 11, pp. 77-93.
- HENSHER, D.A. and STOPHER, P.R. (Eds.) (1979). *Behavioural Travel Modelling*. (Croom Helm: London.)
- HERBERT, D.C. and CORBEN, C.W. (1977). Fairfield on-scene study of collisions - First quarterly report October to December 1976. Traffic Accid. Res. Unit, Rep. No. 3/77, Dept. Motor Transp., N.S.W.
- HERBERT, D.C. and HUMPHREYS, M. (1978). Fairfield on-scene study of collisions - Second quarterly report January to March 1977. Traffic Accid. Res. Unit, Rep. No. 5/78, Dept Motor Transp., N.S.W.
- HERBERT, G. (1975). Project Evaluation: The State of the Art. Country Roads Board (Vic) Tech. Rep. No. 61.
- HILGARD, E.R. and LOFTUS, E.F. (1979). Effective interrogation of the eyewitness. *Int. J. Clinical Experimental Hypnosis*. XXVII(4), pp. 342-57.
- HIRSHLEIGER, J. (1975). The economic approach to risk benefit analysis. Proc. Conf. on Risk-Benefit Methodology and Application, California Univ. Sch. Eng. and App. Sc. (NTIS: PB-261920).
- HJALTE, K., LINGRED, K. and STAHL, I. (1977). *Environmental Policy and Welfare Economics*. (Cambridge University Press: London.)
- HOLDSWORTH, J.H. (1973). Residential disruption costs in urban areas. (Commonwealth Bureau of Roads: Melbourne.)
- HOLLAND, E.P. and WATSON, P.L. (1977). Measuring the impacts of Singapore's area license scheme. Proc. Third World Conf. Transp. Res., Rotterdam, April. (Martinus Nijhoff: The Hague.)
- HOROWITZ, J. (1980a). Specification error in probabilities discrete choice models. App.C of D.A. Hensher and L.W. Johnson. 'Applied Discrete Choice Modelling Development' (Croom Helm: London.)
- (1980b). Sources of error and uncertainty in behavioural travel demand models. In W. Brog, A.H. Meyburg and P.R. Stopher. (Eds.) 'Recent Advances in Behavioural Travel Research.' (Lexington Books: Lexington.)
- HOWARD, B.V., YOUNG, M.F. and ELLIS, J.P. (1979). Appraisal of the existing traffic accident data collection and recording system - South Australia. Rep. CR6, Offic of Road Safe., Dept Transp. Melbourne.
- HOWARD, R.A. (1979). *Life and Death Decision Analysis*. (Stanford University, U.S.A.) (145p.)
- JANIS, I.L. and HOVLAND, C.I. (1959). An overview of persuasability research. In C.I. Hovland and I.L. Janis (Eds.) 'Personality and Persuasability.' (Yale University Press.)
- JARVIS, J.R. (1977). Accident reporting and analysis: research needs. Australian Road Research Board. Internal Report, AIR 000-84.

- JOHN PATERSON URBAN SYSTEMS PTY. LTD. (1972). Review of the cost of road accidents in relation to road safety. Prepared for the Comm. Dept Shipping and Transp. (50 p.)
- JOHNSON, L.W. (1978). Estimation of a general class of demand functions for meat in Australia. *J. Market. Agr. Econ.* 46(2), pp. 128-37.
- (1979). An introduction to generalised functional form and random coefficients in transport modelling. *Environ. Plan. A* 11, pp. 1029-37.
- JOHNSON, R.M. (1974). Tradeoff analysis of consumer values. *J. Market. Res.* 11, pp. 121-27.
- JONES, P.M. (1979). New approaches to understanding travel behaviour: the human activity approach. In D.A. Hensher and P.R. Stopher (Eds.) 'Behavioural Travel Modelling.' pp. 56-80. (Croom Helm: London.)
- JONES-LEE, M.W. (1976). *The Value of Life: An Economic Analysis.* (Martin Robertson: London.)
- (1979). Trying to value a life: why Broome does not sweep clean. *J. Public Econ.* 12, pp. 249-56.
- JORESKOG, K.G. (1973). A general methods for estimating a linear structural equation system. In A.S. Goldberger and O.D. Duncan (Eds.) 'Structural Equation Models in the Social Sciences.' pp. 85-112. (Seminar Press: New York.)
- and SORBOM, D. (1978). *LISREL Users Guide.* (National Educational Resources, Inc.: Chicago.)
- JUAS, B.N. and MATTSSON, B. (1978). Valuation of personal injuries: a comparison of explicit and implicit values. Rep. 3-78, Univ. Karlstad, Sweden (63 p.)
- JUNGER, P.D. (1979). The inapplicability of cost-benefit analysis to environmental problems. *Ekistics* 46(276), pp. 184-94.
- KAHNEMAN, D. and TVERSKY, A. (1979). Prospect theory: An analysis for decision under risk. *Econometrica* (In press.)
- KEENEY, R.L. and RAIFFA, H. (1976). *Decisions with Multiple Objectives: Preferences and Value Tradeoffs.* (John Wiley and Sons: New York.)
- KEMP, R.N., NEILSON, I.D., STAUGHTON, G.C. and WILKINS, H.A. (1972). A preliminary report on an on-the-spot survey of accidents. Transp Road Res. Lab. (U.K.) TRRL Lab. Rep. LR 434.
- KENNEDY, J.K. (1957). *Profiles in Courage.* (Cardinal: New York.)
- KILMARTIN, L.A. and THORNS, D.C. (1977). Urban social problems and prospects. *Aust. N.Z. J. Sociol.* 13.(1).

- KING, R.J. (1978a). Social impact of transport related changes : a classification of residential areas. Australian Road Research Board. Internal Report, AIR 268-1.
- (1978b). Accessibility and behaviour : initial case studies. Australian Road Research Board. Internal Report, AIR 268-2.
- (1979). Accessibility and behaviour in twenty areas of Melbourne. Australian Road Research Board. Internal Report, AIR 268-3.
- KLEIN, D. (1972). Social aspects of exposure to highway crash. *Human Factors* 18(3), pp. 211-20.
- KOENIG, G. (1977). Les indicateurs d'accessibilités dans les stades urbaines: de la théorie à la pratique. *Revue Generale des Routes*, July. (English translation available).
- KRANTZ, D.H., LUCE, R.D., SUPPES, P. and TREVSKY, A. (1971). *Foundations of Measurement*. (Academic Press: New York) 1.
- KRANTZ, D.H. and TVERSKY, A. (1971). Conjoint measurement analysis of composition rules in psychology. *Psychol. Rev.* 78, pp. 151-69.
- KRISHNAN, K.A. (1977). Incorporating the concept of minimum perceivable differences in the logit model. *Manage. Sci.* 23(11), pp. 1224-33.
- KRUSKAL, J.B. and WISH, M. (1978). *Multidimensional Scaling*. (Sage Publications: London.)
- KRUTILLA, J.V. (1979). Economics and the environment: A time for taking stock. Environmental Economics: Papers Presented at the Nat. Conf., May 1978, (AGPS: Canberra.)
- and FISHER, A.C. (1975). *The Economics of Natural Environments*. (John Hopkins: Washington.)
- LANCASTER, K.J. (1966). A new approach to consumer theory. *J. Polit. Econ.* 74, pp. 132-57.
- LANE, J.E. (1976). A review of environmental evaluation techniques. Australian Road Research Board. Internal Report, AIR 1022-1.
- LANGDON, F.J. (1976). Noise nuisance caused by road traffic in residential areas: Part 1. *J. Sound Vibration* 47(2), pp. 243-63.
- LANSING, J.B. and HENDRICKS, G. (1967). How people perceive the cost of the journey to work. *High. Res. Rec.* 197, pp.44-55.
- LASSIERE, A. (1976). The environmental evaluation of transport plans. U.K. Dept. of the Environ. Res. Rep. 8.
- LAYARD, P.G. and WALTERS, A.A. (1978). *Micro-economics Theory*. (McGraw-Hill: New York.)

LEE, T.R. (1978). The Tasman Bridge collapse and its effects on metropolitan Hobart: Social disruption and patterns of adjustment on the Eastern Shore. Occasional Paper No. 2, Dept Geog., Univ. Tasmania.

————— and WOOD, L.J. (1978). The Tasman Bridge collapse and its effects on metropolitan Hobart: Background and methodology of a research report. Occasional Paper No. 1, Dept Geog., Univ. Tasmania.

————— (1980). The city in an era of restricted car usage: some potential responses and adjustments to restricted car usage. *Forthcoming in Geoforum*.

————— Forthcoming. *Adjustment in the Urban System: The Reactions of a City to Restricted Use of the Car*. (Pergamon Press: London.)

LEISCH, P.W. and SINDEN, J.A. (1976). Market failure or utility success in land use analysis. Paper presented to 20th Annu. Conf. Aust. Agricu. Econ. Soc.

LENNTORP, B. (1976). Paths in space-time environments: a time-geographic study of movement possibilities of individuals. Lund Studies in Geography B 44, Gleerup, Lund.

LERMAN, S.R. (1975). A disaggregate behavioural model of the urban mobility decisions. Mass. Inst. Technol., Internal Rep. 75-5.

————— and LOURVIERE, J.J. (1979). On the identification of the functional form of the utility expression in travel choice models. *Transp. Res. Rec.* No. 673, pp. 75-85.

LEVIN, I.P. (1979a). Application of attitude measurement and attitudinal modelling techniques in transportation research. Resource paper for 4th Int. Conf. Behavioural Travel Modelling, 1-7 July, Eibsee, F.R. Germany.

————— (1979b). The development of attitudinal modelling approaches in transport research. In D.A. Hensher and P.R. Stopher (eds.) 'Behavioural Travel Modelling.' pp. 758-81. (Croom Helm: London.)

————— LOUVIERE, J.J., MEYER, R.J. and HENLEY, D.H. (1979). Perceived versus actual modal travel times and costs for the work trip. Technical Rep. #120, Inst. Urban and Regional Research, Univ. Iowa.

LICHFIELD, N. (1971). Cost-benefit analysis in planning: A critique of the Roskill Commission. *Regional Studies* 5, pp. 157-83.

LINDGREN, H.C. and BYRNE, D. (1971). *Psychology: An Introduction to a Behavioural Science*. (Wiley: New York.)

LINNEROOTH, J. (1978a). Re-evaluating the value of life: theoretical considerations. IIASA, Laxenburg, Austria (43 p.)

————— (1978b). Re-evaluating the value of life: Practical considerations. IIASA, Laxenburg, Austria (35 p.)

LOCK, J.B. and GELLING, M.J. (1976a). Effect on traffic patterns of the collapse of the Tasman Bridge. Proc. 8th ARRB Conf. 8(5), Session 20, pp. 42-52.

————— (1976b). The Tasman Bridge disaster - before and after. *Aust. Rd Res.* 6(2), pp. 9-16.

LOUVIERE, J.J. (1978). Psychological measurement of travel attributes. In D.A. Hensher and M.Q. Dalvi (Eds.) 'Determinants of Travel Choice.' (Teakfield, Farnborough (Saxon House Studies): London.)

————— (1980a). On the identification of the functional form of the utility expression and its relationship to discrete choice. Appendix B In D.A. Hensher and L. Johnson (Eds.) 'Applied Discrete Choice Modelling.' (Croom Helm: London.)

————— (1980b). A conceptual and analytical framework for the analysis of travel choice. In K.P. Burnett (Ed.) 'Economic Geography: Special Edition on Spatial Choice, Spatial Constraints, and Spatial Behavior.' forthcoming.

————— (1980c). Psychological contributions to understanding individual traveller behavior. In K.P. Burnett and J.J. Louviere (Eds.) 'Transportation Geography.' (V.H. Winston and Son: New York.) forthcoming.

————— (1980d). Applications of principles of experimental design to modelling and prediction of judgement and choice: a functional measurement approach. Seminar on Measuring Social Behaviour in Road Research. Proc., pp. 61-72.

————— (1980e). Psychological contribution to understanding individual travel behaviour. In P. Burnett and J.J. Louviere (Eds.) 'Transportation geography'. (V.H. Winston: New York.) forthcoming.

————— BEAVERS, L.L., NORMAN, K.L. and STETZER, F. (1973). Theory, methodology, and findings in mode choice behavior. Working Paper, Inst. Urban and Regional Res., Univ. Iowa, No. 11.

LOUVIERE, J.J. and HENSHER, D.A. (1980). On the design of experiments to model choice behavior: a leisure travel destination choice example. In preparation, March.

LOUVIERE, J.J. and KOCUR, G. (1979). Analysis of user costs and service tradeoffs in transit and paratransit services. UMTA/TSC Project Evaluation Series, Final Report. Prepared by Cambridge Systematics, Inc.

LOUVIERE, J.J. and LEVIN, I.P. (1978). Functional measurement applied to consumer spatial and travel behavior. *Advances in Consumer Research.*

LOUVIERE, J.J. and MEYER, R.J. (1979). Behavioural analysis of destination choice: theory and empirical evidence. Tech. Rep. #112, Inst. Urban and Regional Res., Univ. Iowa.

LOUVIERE, J.J. and NORMAN, K.L. (1977). Applications of information processing theory to the analysis of urban travel demand. *Environ. Behav.*

LOUVIERE, J.J., OSTRESH, L.M., HENLEY, D. and MEYER, R.J. (1976). Travel demand segmentation: Some theoretical considerations related to behavioral modeling. In P.R. Stopher and A.H. Meyburg (Eds.) 'Behavioral Travel Demand Models.' (Lexington Books: Lexington, Massachusetts.)

LOUVIERE, J.J. and WILSON, E.M. (1978). Predicting consumer response in travel analysis. *Transp. Plan. Technol.* 4, pp. 1-9.

LOUVIERE, J.J., WILSON, E.M. and PICCOLO, M. (1979). Application of psychological measurement and modelling to behavioural travel-demand analysis. In D.A. Hensher and P.R. Stopher (Eds.) 'Behavioural Travel Modelling.' pp.713-38. (Croom Helm: London.)

LUCAROTTI, P.S.K. (1977). Car availability - the fundamental modal split. *Transp. Plan. Technol.* 3(4), pp. 203-13.

LUCE, R.D. (1959). *Individual Choice Behavior.* (John Wiley and Sons: New York.)

————— and GALANTER, E. (1963). Discrimination. In R.D. Luce, R.B. Bush and E. Galanter (Eds.) 'Handbook of Mathematical Psychology.' (Wiley: New York.)

MCDONALD, R.P. (1979). A simple comprehensive model for the analysis of covariance structures: Some remarks on applications. Mimeo.

————— (1978). A simple comprehensive model for the analysis of covariance structures. *British J. Mathe. Stat. Psychol.* 31, pp. 59-72.

McFADDEN, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka (Ed.) 'Frontiers in Econometrics.' (Academic Press: New York.)

————— (1978). Modelling the choice of residential location. In A. Karlqvist, L. Lundqvist, F. Snickars and J.W. Weibull (Eds.) 'Spatial Interaction Theory and Planning Models.' (North-Holland; Amsterdam.)

McGLASHAN, N.D. (1978). The Tasman Bridge collapse and its effects on metropolitan Hobart: Medical facilities in a divided city. Occasional Paper No. 3, Dept Geog., Univ. Tasmania.

MCGUIRE, F.L. (1976). Personality factors in highway accidents. *Human Factors* 8(5), pp. 433-42.

MCGUIRE, W.J. (1969). The nature of attitudes and attitude change. In G. Lindzey and E. Aronson (Eds.) 'The Handbook of Social Psychology' 2nd ed. Vol. 3 (Addison-Wesley.)

McKENNEL, A.C. (1970). Noise complaints and community action. In J.D. Chalupnik (Ed.) 'Transportation Noises.' (Univ. of Washington: Seattle.)

McKENZIE, H.P. and RICHARDSON, A.J. (1978). Mode and route changing associated with the Spit Road Transit lane. Fourth Aust. Transp. Res. Forum, pp. 517-48.

- McLEAN, A.J. (1973). A review of in-depth studies in relation to road safety. Rep. No. NR/22. Aust. Dept Transport: Canberra.
- (1974). The development of an in-depth study of accidents in metropolitan Adelaide. In 'Road Accident Information Seminar, Canberra.' pp. 170-82.
- and ROBINSON, G.K. (1979). *Adelaide in-depth accident study 1975-1979. Part 1: An overview.* Road Accident Research Unit, Univ. Adelaide.
- McMILLAN, R.K. and ASSAEL, H. (1968). National survey of transportation attitudes and behavior: Phase 1, Summary report. Nat. Co-op. Highw. Res. Program Rep. No. 49, Transp. Res. Board, Washington D.C.
- MAIER, N. (1960). Maier's law, *Am. Psycholo.* 15, pp. 208-12.
- MALECKI, A.M. (1978). Perceived and actual costs of operating cars. *Transportation*, 7, pp. 403-15.
- MALER, K. (1974). *Environmental Economics: A Theoretical Inquiry.* (John Hopkins University Press: Baltimore.)
- MANSKI, C.F. (1977). The structure of random utility models. *Theory and Decisions* 8, pp. 229-54.
- and McFADDEN, D. (Eds.) (1980). *Structural Issues in Discrete Choice Models: With Econometric Applications.* (M.I.T. Press: Cambridge, Mass.)
- MARLAND, R.E. (1972). The role of a professional society for traffic medicine. Paper presented at the Proc. of the 16th Conf. of the AAAM, pp. 1-4. (Soc. Auto. Eng., Inc.: New York.)
- MARSHALL, A. (1962). *Principles of Economics.* (McMillan: London.)
- MEYER, R.J. (1979). A behavioural model of choice set formation in destination choice. Ph.D. Thesis, Univ. Iowa.
- LEVIN, I.P. and LOUVIERE, J.J. (1979). Functional analysis of mode choice. *Transp. Res. Rec.* No. 673, pp. 1-7.
- (1980). Issues in modelling travel behaviors in simulated choice environments: a review. In K.P. Burnett (Ed.) 'Economic Geography: Special Edition on Spatial Choice, Spatial Constraints, and Spatial Behavior.' forthcoming.
- MILLER, G.A. (1956). The magic number seven, plus or minus two: some limits to our capacity for processing information. *Psycholo. Rev.* 63, pp. 81-97.
- MINISTRY FOR CONSERVATION (1979). Who prepares an environment effects statement?
- MISHAN, E. (1971). *Cost-benefit Analysis.* (Allen and Unwin: London.)

MITROFF, I. (1972). The myth of objectivity or why science needs a new psychology of science. *Manage. Sci.* 18, pp. B613-B618.

MOONEY, G. (1978). Human life and suffering. In D. Pearce (Ed.) 'The Valuation of Social Cost.' (Allen and Unwin: London.)

MORRIS, J.M. and DUMBLE, P. (1980). Accessibility, perception and travel behaviour. Proceedings pp 137-49. Seminar on Measuring Social Behaviour in Road Research.

————— and WIGAN, M.R. (1979). Accessibility indicators for transport planning. *Transp. Res. A*, 13A, pp. 91-109.

MORRIS, R.F. (1978). Victoria road transit lane. An assessment of performance. Rep. to the Traffic Authority of New South Wales. Int. Department of Main Road Report.

————— and DOBINSON, K.W. (1979). 'Transit' - the soft traffic restraint option. *Inst. Eng., Aust. Transp., Conf.* pp. 10-14.

MOSELEY, E.B. (1963). Loss of a loved person. In 'Research on Fatal Highway Collisions Papers 1962-1963.' No. 163, pp. 79-82.

NATIONAL ASSOCIATION OF AUSTRALIAN STATE ROAD AUTHORITIES (1978). *Environmental Factors within Project Evaluation: A Review of Current Techniques.* (NAASRA: Sydney.)

NAATANEN, R. and SUMMALA, H. (1976). *Road User Behaviour and Traffic Accidents.* (North-Holland: Amsterdam.)

NASH, C., PEARCE, N. and STANLEY, J. (1975). An evaluation of cost-benefit analysis criteria. *Scottish J. Political Econ.* 22(2), pp. 121-34.

NATH, S.K. (1969). *A Reappraisal of Welfare Economics.* (Longman Group: London.)

NICOLAIDIS, G.C. (1977). Psychometric techniques in transportation planning: two examples. *Environ. Behav.* 9(4), pp. 459-86.

NIE, N.H., HULL, C.H., JENKINS, J.G., STIENBRENNER, H. and BENT, D.H. (1975). *Statistical Package for the Social Sciences.* (McGraw Hill: Sydney.)

NIJKAMP, P. (1977). *Theory and Application of Environmental Economics.* (North Holland Publishing Company: Amsterdam.)

NOISE INSULATION REGULATIONS (1973). S.I. 1973/1363, HMSO.

NUFTULIN, D., WARE, J. Jr. and DONNELLY, F. (1973). The Doctor Fox lecture: A paradigm of educational seduction. *J. Medical Educ.* 48, pp. 630-35.

O'FARRELL, P.N. and MARKHAM, J. (1974). Commuter perceptions of public transport work journeys. *Environ. Plan. A* 6, pp. 79-100.

O'MALLEY, B.W. (1975). Work schedule changes to reduce peak transportation demands. In 'Better Use of Existing Transportation Facilities.' *Transp. Res. Board, Special Report 153*, pp. 166-82.

OTWAY, H.J. and FISHBEIN, M. (1976). The determinants of attitude formation: an application to nuclear power. Rep. IIASA-RM-76-35, IIASA, Laxenburg, Austria.

P.G. PAK-POY AND ASSOCIATES and PRETTY, R.L. (1976). Bus priority treatments for Brisbane. Rep. to Metro. Transit Auth.

PATTON, T. and CLARK, N. (1970). Towards an accessibility model for residential development. In N. Clark (Ed.) 'Analysis of Urban Development.' Proc. Tewkesbury Symp. Special Rep. No. 5, Transport Section, Univ. Melbourne, pp. 266-88.

PEARCE, D. (1977). Justifiable government intervention in preserving the quality of life. In Wingo and Evans (Eds.) 'Public Economics and the Quality of Life.' (John Hopkins.)

PERRINE, M., WALLER, J. and HARRIS, L. (1971). Alcohol and highway safety: Behavioural and medical aspects. NHTSA Tech. Rep., DOT, U.S. Dept Transp.

PIRIE, G.H. (1979). Measuring accessibility : a review and proposal. *Environ. Plan. A* 11(3), pp. 299-312.

PORRIT, D. and BORDOW, S. (1976). Some implications on an experimental trial of crisis intervention with road trauma in-patients. *Aust. J. Alcohol Drug Dependence* 3(4), pp. 136-39.

PORTNEY, P.R. (1975). Voting, cost-benefit analysis and water pollution policy. In Peskin and Seskin (Eds.) 'Cost-benefit Analysis and Water Pollution Policy.' (Urban Institute: Washington.)

RACHMAN, S.J. (1973). The effects of psychological treatment. In H.J. Eysenck (Ed.) 'Handbook of Abnormal Psychology'. (Pitman Publication.)

RECKER, W.W. and GOLOB, T.F. (1976). An attitudinal modal choice model. *Transp. Res.* 10, pp. 299-310.

————— (1979). A non-compensatory model of transportation behavior based on sequential consideration of attributes. *Transp. Res.* B13(4), pp. 269-80.

REDD, W.H., PORTERFIELD, A.L. and ANDERSON, B.L. (1979). *Behaviour Modification*. (Random House: New York.)

REYNOLDS, F. and JOHNSON, D. (1978). Validity of focus group findings. *J. Advertising Res.* pp. 18, 3, 21-24.

RHOADS, S.E. (1978). Economists and policy analysis. *Pub. Admin. Rev.* Mar-April.

- RICHARDSON, A.J. (1978). Development in transport systems management evaluation. Working Paper 78/13, Dept Civ. Eng., Monash Univ., Melbourne, Australia.
- (1980a). Search models and choice set generation. Int. Conf. on Research and Applications of Disaggregate Travel Demand Models. Univ. Leeds, England.
- (1980b). Behavioural considerations in transport modelling. Seminar on Measuring Social Behaviour in Road Research. Proc. pp 15-27.
- and YOUNG, W. (1979). A measure of linked-trip accessibility. Dept Civ. Eng. Working Paper 79/15, Monash Univ., Melbourne, Australia.
- RITCHIE, S.G., YOUNG, W. and OGDEN, K.W. (1980). Analysis and appraisal of freight generation characteristics - part 4: preliminary analysis of location characteristics. Australian Road Research Board. Internal Report, AIR 302-4.
- ROMANOS, M.C. (1978). Energy price effects on metropolitan structure and form. *Environ. Plan. A* 10, pp. 93-104.
- RYAN, G.A. (1978). *Report of the Road Accident Research Unit*. Health Comm. of Victoria.
- SCHAEFFER, K.H. and SCLAR, E. (1975). *Access For All: Transportation and Urban Growth*. (Penguin Books: Harmondsworth.)
- SCHULTZ, T.J. (1972). Community noise ratings. Applied Acoustics Supp. No. 1. (Applied Science Publishers: Barking.)
- SEARLES, B. (1978a). Further assessment of Victoria Road transit lane. NRMA (N.S.W.) Rep., March.
- (1978b). The morning transit lane from Balgowlah to Neutral Bay: report on long term trends and re-evaluation of initial performance. NRMA (N.S.W.) Rep., October.
- (1978c). A study of uncoded accidents in Sydney. M. Eng. Sci: Thesis. Univ. New South Wales.
- SEGAL, L. and CLARKE, N. (1979). Techniques for placing dollar values on environmental damage. Proc. Workshop on Measuring Environmental Damage Costs. Dept. Science and Environment: Canberra.
- SEGAL, M.D. (1970). The in-depth approach to collision investigations. *Traffic Safety* 70(8), pp. 22, 23, 38, 39.
- SHINAR, D. (1978). *Psychology on the Road: The Human Factor in Traffic Safety*. (John Wiley and Sons: New York.)

SIMON, H.A. (1955). A behavioral model of rational choice. *Q. J. Econ.* 69, pp. 99-118.

————— (1978). Satisficing and the one right way. *In* S. Kaplan and R. Kaplan (Eds.) 'Humanscapes: Environments for People.' pp. 127-31. (Duxbury Press: Belmont, California.)

SIMS, A.G. and DOBINSON, K.W. (1979). SCAT. The Sydney co-ordinated adaptive traffic system, philosophy and benefits. Paper to Int. Symp. on Traffic Control Systems, Berkeley, Califo. U.S.A.

SINCLAIR, A. (1978). Public participation in transport planning (in Australia). Occasional Paper 20, Bureau of Transp. Econ.

SKINNER, B.F. (1973). *Beyond Freedom and Dignity*. (Penguin Books Limited.)

SLOVIC, P. and LICHTENSTEIN, S. (1971). Comparison of Bayesian and regression approaches to the study of information processing in judgement. *Organisational Behav. and Human Performance* 6, pp. 649-744.

SLOVIC, P., FISHHOFF, B. and LICHTENSTEIN, S. (1977). Behavioral decision theory. *Annu. Rev. Psych.*

SNYDER, C.W., JR. and LAW, H.G. (1979). Three-mode common factor analysis: Procedure and computer programs. *Multivariate Behav. Res.* 14, pp. 435-41.

————— (1980). Three-mode models for road research. Paper presented at Seminar on Measuring Social Behaviour in Road Research. ARRB.

————— and PAMMENT, P.R. (1979). Calculation of Tucker's three-mode common factor analysis. *Behav. Res. Methods and Instrumentation* 11(6), pp. 609-11.

SPITZER, J.J. (1978). A Monte Carlo investigation of the Box-Cox transformation in small samples. *J. Am. Stat. Assoc.* 73, pp. 488-95.

STANLEY, J., HOGG, T.M. and DELANEY, P. (1973). The theory of benefit and cost measurement, with reference to residential disruption costs of urban road improvements. *Aust. Rd. Res.* 5(2), pp. 23-35.

STEVENS, S.S. (1966). A metric for the social consensus. *Science* 151, pp. 530-41.

STOPHER, P.A. (1969). A probabilistic model of travel choice for the journey to work. *Highw. Res. Rec.* 283, pp. 57-65.

————— (1979). Preference models and destination choice. Paper presented to PTRC Summer Annu. Meet., Transp. Models Session M1, 9-12 July 1979, Univ. Warwick, U.K.

————— and MEYBURG, A.H. (Eds.) (1976). *Behavioural Travel-Demand Models*. (Lexington Books: Massachusetts.)

TAKANE, Y., YOUNG, F.W. and deLEEUW, J. (1977). Nonmetric individual differences multidimensional scaling: An alternating least square method with optimal scaling features. *Psychometrika* 42, pp. 7-67.

TALVITIE, A. (1979). Inaccurate or incomplete data as a source of uncertainty in econometric or attitudinal models of travel behaviour. Resource paper for 4th Int. Conf. on Behavioural Travel Modelling, 1-7 July 1979, Eibsee, F.R. Germany.

TARDIFF, T.J. (1977). Causal inferences involving transportation attitudes and behavior. *Transp. Res.* 11, pp. 397-404.

————— (1979). Attitudinal market segmentation for transit design, marketing and policy analysis. Presented at 58th Annu. Meet. Transp. Res. Board. Washington, D.C.

THOM, A. (1979). Measuring the epidemiological parameters of environmental health hazards. Proc. Environmental Damage Costs Workshop, Dept of Science and Environment, Canberra.

THOMAS, S. (1978). The valuation of accident cost savings. *J. Transp. Econ. Policy* XII(3), pp. 330-32.

TISCHER, M.L. and PHILLIPS, R.V. (1979). The relationship between transportation perceptions and behavior over time. *Transportation* 8, pp. 21-36.

TORGERSON, W.S. (1958). *Theory and Methods of Scaling*. (Wiley: New York.)

TRAIN, K. and McFADDEN, D. (1978). The goods/leisure trade off and disaggregate work trip mode choice models. *Transp. Res.* 12(3), pp. 349-53.

TRAVERS MORGAN R. (1974). Environmental evaluation: The cost-benefit approach. Technical Rep. No. 1 to Urban Motorways Committee.

TROY, P.N. (1972). Environmental quality in four Melbourne suburbs. Urban Research Unit Monograph, Research School of Social Sciences, Australian Nat. Univ.

————— and BUTLIN, N.G. (1971). *The Cost of Collisions*. (Cheshire: Melbourne.)

TRUONG, T.P. and HENSHER, D.A. (1980). The goods/leisure trade off and disaggregate mode choice models. (Draft paper). School of Economic and Financial Studies, Macquarie Univ.

TUCKER, L.R. (1966). Some mathematical notes on three-mode factor analysis. *Psychometrika* 31, pp. 279-311.

————— (1972). Relations between multidimensional scaling and three-mode factor analysis. *Psychometrika* 37, pp. 3-27.

TUKEY, J.W. (1957). On the comparative anatomy of transformations. *Ann. Math. Stat.* 28, pp. 602-32.

TVERSKY, A. (1972). Elimination by aspects: A theory of choice. *Psycholo. Rev.* 79(4), pp. 281-99.

- ULPH, A. and REYNOLDS, I. (1979). The use of travel cost to evaluate recreation benefits. *Environmental Economics: Papers Presented at the Nat. Conf. May 1978.* (AGPS: Canberra.)
- UNDERWOOD, R.T. (1979). New urban roads - a case for keeping future options open. *Inst. Eng., Aust., Transp. Conf.*, pp. 142-46.
- UNITED KINGDOM. DEPARTMENT OF TRANSPORT (1977a). Road accident costs 1975, 1976, January 1977. *Highway Econ. Note 1.* (11p.)
- (1977b). Report of the Advisory Committee on Trunk Road Assessment. (HMSO: London.)
- UNITED STATES. WHITE HOUSE OFFICE OF SCIENCE AND TECHNOLOGY (1972). Cumulative regulatory effects on the costs of automotive transportation. U.S. Government Printing Office, Washington, D.C., U.S.A.
- URBAN MOTORWAYS PROJECT TEAM (1973). Report of the Urban Motorways Project Team to the Urban Motorways Committee. Dept Environment. (HMSO: London.)
- VOORHEES, A.M. and PARTNERS (1979). Bus lane study for Johnston Street. Report to MMTB, TRB and CRB.
- WALKER, L. and BECKENHAM, S. (1979). Air pollution damage costs: a literature review. *Proc. Environmental Damage Costs Workshop.* Dept. of Science and Environment, Canberra.
- WEIBULL, J.W. (1976). An axiomatic approach to the measurement of accessibility. *Regional Sci. Urban Econ.* 6, pp. 357-79.
- (1980). On the numerical measurement of accessibility. *Environ. Plan. A* 12(1), pp. 53-68.
- WEISBROD, B.A. (1964). Collective consumption services of individual consumption goods. *Q. J. Econ.* 18, pp. 471-77.
- WICKER, A.W. (1969). Attitudes vs. actions. *J. Social Issues* 25, pp. 41-78.
- WILDAYSKY, A. (1966). The political economy of efficiency: cost benefit analysis, systems and program budgeting. *Public Admin. Rev.* XXVI (4).
- WILKIE, W.L. and PESSEMIER, E.A. (1973). Issues in marketing's use of multi-attribute models. *J. Market Res.* 10, pp. 428-41.
- WILLIAMS, A. (1978). A note on trying to value a life. *J. Public Econ.* 12, pp. 257-58.
- WILLIAMS, H.C.W.L. (1977). On the formation of travel demand models and economic evaluation measures of user benefit. *Environ. Plan A* 9, pp. 285-344.
- and ORTUZAR, J.D. (1979). Behavioural travel theories model specification and the response error problem. PTRC Summer Annu. Meet., Univ. Warwick, England.

- WINETT, R.A. and NEITZEL, M.T. (1975). Behavioural ecology: Contingency management of consumer energy use. *Am. J. Community Psychol.* 3, pp. 123-33.
- WINKLER, R.C., COLLETT, J. and SYME, G.J. (1979). Domestic resource consumption: Behavioural analysis of electricity and water consumption. Proc. 2nd Aust. Behaviour Modification Conf., Adelaide.
- WOOD, L.J. (1978). The Tasman Bridge collapse and its effects on metropolitan Hobart: Shopping patterns of Eastern Shore residents. Occasional Paper No. 4, Dept Geog., Univ. Tasmania.
- and LEE, T.R. (1979). The Tasman Bridge collapse and its effects on metropolitan Hobart: Distruption of journey-to-work patterns. Occasional Paper No. 5, Dept Geog., Univ. Tasmania.
- YELLOTT, J.J. (1977). The relationship between Luce's choice axiom, Thurstone's theory of comparative judgement and the double exponential distribution. *J. Math. Psychol.* 13, pp. 109-44.
- YOUNG, W. (1979). Modelling residential location choice: a review of some results. Proc. 5th Aust. Transp. Res. Forum, pp. 371-93, Sydney.
- (1980 α). Perceived aspects of location. Seminar on Measuring Social Behaviour in Road Research. Proc., pp 151-73.
- (1980 b). Coding details and initial analysis of a residential location choice study. Australian Road Research Board - Draft Report.
- and RICHARDSON, A.J. (1979). Residential area location preference. *Transp. Res. Rec.* 707, pp. 39-47.
- (1980). Residential location preference models: compensatory and non-compensatory approaches. PTRC Summer Annu. Meet. Warwick.
- YOUNG, W., MORRIS, J.M. and OGDEN, K.W. (1978). Developing and administering a home interview survey. Australian Road Research Board. Internal Report, AIR 301-1.
- YOUNG, W., RICHARDSON, A.J. and OGDEN, K.W. (1978). A model of residential location choice using utility theory. Proc. 9th ARRB Conference, 9(5), pp. 131-42.
- YOUNG, W., RITCHIE, S.G. and OGDEN, K.W. (1980). Factors influencing freight facility location preference. *Transp. Res. Rec.* (in press).
- ZAREMBKA, P. (1974). Transformation of variables in econometrics. In P. Zarembka (Ed.) 'Frontiers in Econometrics'. (Academic Press: New York.), pp. 81-104.