

CHAPTER 5

SCALING RESIDENTIAL PREFERENCES: A METHODOLOGICAL NOTE

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SCALING RESIDENTIAL PREFERENCES: A METHODOLOGICAL NOTE

by

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1. *Introduction*

Studies of residential preference have been important in geography for many years, partly reflecting the continued interest in the scaling of cognitive images *per se* (Downs & Stea 1973, Gould 1975, Gould & White 1974, Lynch 1960), and partly as a component for the verification of wider theory (Johnston 1971 and 1972, Keeble 1976). Whether conceived at the urban, regional or national level, a common trait of many scaling methods has been the employment of ranked data and its subsequent manipulation using some form of principal components or factor analysis. Aside from certain methodological problems associated with the employment of principal components analysis in such contexts (e.g. see Johnston 1972), the interpretation of ranked data generates further problems reflecting the arbitrary imposition of an ordinal scale upon a judgemental process. The necessity to rank all choice alternatives ignores the fact that some respondents may be indifferent as to the alternatives through ignorance of the alternatives or because of genuine 'ties' in preference.

A related and more general point concerns the difficulties of implementing complicated questionnaire designs where the cognitive abilities of respondents are limited, e.g. as demonstrated by the studies of Gould & White (1974) and Gould (1975), which required very young schoolchildren to rank ninety-two British counties and seventy Swedish A-level regions, respectively. Re-

financed and intricate questionnaire design may also erode response rates, e.g. the high non-usable response rate experienced by Timmermans *et al.* (1982) in their recent application of the repertory grid methodology. Additionally, the cognitive abilities of most respondents cannot be expected to match those of the spatially articulate geography students used in some of the more demanding preference experiments (e.g. Louviere & Meyer 1976, Louviere & Henley 1977, Louviere 1979). Moreover, although the developing armoury of functional measurement methods and information integration theory approaches offer a valuable and theoretically consistent opportunity to evaluate interval scale subjective preferences in controlled laboratory experiments, the time constraint inherent in the administration of most operational survey designs demands a measurement method which is robust, reliable and easily administered.

A more intuitive, straightforward and easily implemented method of measuring residential preferences might consequently attempt to incorporate distinct preference and indifference zones within the scaling process. To this end, the present study utilizes a paired comparison procedure which allows for ties in the paired choices. Analysis of the data then employs the Rao-Kupper (1967) modification of the basic Bradley-Terry (1952) model for paired comparisons. The modified Bradley-Terry model postulates that the probabilities associated with the comparison of a choice alternative x with an alternative y are:

$$P(A_x - A_y) = \frac{\pi_x}{\pi_x + \theta\pi_y}, \quad (1)$$

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$$P(A_y \rightarrow A_x) = \frac{\pi_x}{\theta\pi_x + \pi_y}$$

$$P(A_x = A_y) = \frac{(\theta^2 - 1)\pi_x \pi_y}{(\pi_x + \theta\pi_y)(\theta\pi_x + \pi_y)}$$

where

$P(A_x \rightarrow A_y)$ = the probability of choosing alternative x in preference to alternative y

π_x = a preference parameter which indicates the worth of alternative x.

In this model, ties are incorporated by assuming the existence of a threshold parameter θ which reflects the respondent's inability to discriminate between two residential districts when a difference between the residential districts does in fact exist.

Estimation of the preference and indifference parameters in this model utilizes the weighted-least-squares logit-model approach (Beaver 1977) reviewed in Wrigley (1980). For each choice pair (x,y) the following logits are defined:

$$\bar{L}_{xy} = \ln \frac{f_{xy \cdot x}}{1 - f_{xy \cdot x}} \quad (2)$$

$$\bar{L}_{yx} = \ln \frac{f_{xy \cdot y}}{1 - f_{xy \cdot y}}$$

where $f_{xy \cdot x}$ is the observed proportion of respondents who choose x when queried about the pair (x,y). The resulting linear model in terms of the logarithms of the preference parameters (π_x) is:

$$E_A(\bar{L}_{xy}) = -\ln\theta + \ln\pi_x - \ln\pi_y = \psi + \beta_{xz} - \beta_{yz} \quad (3)$$

$$E_A(\bar{L}_{yx}) = -\ln\theta - \ln\pi_x + \ln\pi_y = \psi - \beta_{xz} + \beta_{yz}$$

The β and ψ parameters are produced directly from the weighted least-squares procedure, and the preference and indifference parameters (π_x and θ) are then recovered from these β and ψ parameters. For a full rationale, see Wrigley (1980). In this way, the scaling of residential preferences can be seen as part of the wider developments in categorical data analysis (Wrigley 1979, 1981, 1984) and as an illustration of the heightened awareness among quantitative

geographers and planners of the problems involved in the analysis of qualitative spatial data (e.g. the recent international symposium upon this subject held in Amsterdam, March 1983; see Nijkamp *et al.* 1984).

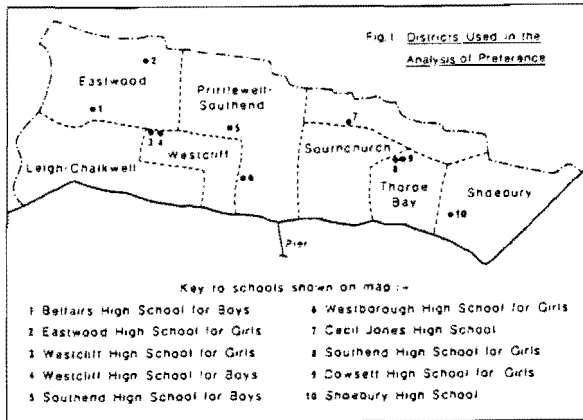
2. The preference survey

The study reported here concerns the intra-urban residential preferences of children attending ten secondary schools in Southend-on-Sea, England, using the modified Bradley-Terry paired comparison procedure described above. Prior to implementation of the main paired comparison sample design, it was first necessary to identify the choice set of residential districts. Provision was therefore made for a preliminary survey comprising two parts.

a) Using a free response questionnaire circulated to eighty-three respondents of different ages attending Southend High School for Boys (a grammar school with a wide catchment of pupils throughout Southend-on-Sea), the names of the most widely recognized districts within the Southend-on-Sea area were elicited. The mean number of districts identified was approximately eight, but subsequent analysis ignored lesser districts which were erratically mentioned and/or lay outside the Southend-on-Sea administrative boundary. Chi-squared analysis subsequently showed the seven most widely recognized districts (see Figure 1) to be identified with equal frequency by all age groups of respondents. The most frequently recognized 'landmarks and routeways' were also identified using this survey.

b) A sketch map was then prepared, depicting the most frequently mentioned landmarks and routeways identified in the first questionnaire. Using copies of this sketch map, twenty-eight sixth form geography students attending Southend High School for Boys were each asked to delimit as many of the seven most widely recognized districts as they felt able, and to locate on their copy of the sketch map the position of their home. It was assumed that this sample would have a fairly clear cognitive image of the town which could be efficiently translated into cartographic form. Drawing upon the methodology adopted by Lee (1976) the boundaries of each of the seven districts were superimposed upon master maps and the aggregate boundaries subjectively delimited as shown in Figure 1.

As the main focus of the study, some 2,800



children were each given a paired comparison questionnaire relating to these seven districts. Each child was asked to respond to the following broad stimulus:

Imagine that you left school a few years ago, and that you are now thinking about settling down in Southend. If you had the choice between living in (*district x*) or in (*district y*), which of the following statements would apply to you:

- I would rather live in (*district y*) than in (*district x*);
- I would rather live in (*district x*) than in (*district y*);
- Given the choice between the two, I wouldn't mind whether I lived in (*district y*) or in (*district x*) (i.e. I have no preference between the two).

Each child was provided with a basic outline sketch map in order to aid the identification of preferences. The children were selected from ten secondary schools (see Figure 1) within the Borough. Twenty-one paired permutations of the seven districts exist (see Table 1), and thus twenty-one variations of the basic questionnaire were circulated in approximately equal numbers to each school and to each of the four youngest age groups within each secondary school (some were also circulated to 16-17 year-old students if schools had a sixth form, but this only produced responses from a small and unreliable sample of 135 students). Each respondent was requested to consider just two residential districts framed within a single paired comparison question. In this way it was hoped: a) to restrict the context of the questionnaire to a simple choice situation which fell well within the comprehensive capabilities of all respondents; b) to pose the question in a manner which did not prescribe the nature of the response (the 'no preference' option serving to articulate indifference, uncertainty or inability to conceive a frame of reference to the

question: see Jansen (1982) for an overview of this problem); and c) to minimize the time required to administer the questionnaire. In this way it was possible to all but eliminate sample bias attributable to non-usable responses. The questionnaire also enabled the identification of age, home residence, school attended, tenure, and in some cases sex of respondents.

In all, 2,426 questionnaires were returned, a figure which accounts for some 17.8% of the children aged eleven to seventeen actually living in Southend-on-Sea. In order to illustrate the potential of the scaling process, the data were manipulated to identify how intra-urban residential preferences vary in accordance with a number of criteria, namely age, home residence, school and school type attended, and sex of respondents. An additional analysis of preference variation according to tenure is not reported here, because many respondents felt reluctant or were unable to reveal their parents' tenure.

3. Analysis of preference variation with age

Given that approximately equal proportions of responses were elicited from the four youngest age groups, it is possible to assess the type of sequential learning process and development of preference hierarchies in the spirit of Gould

Fig. 2 Year 1 Preference Profile

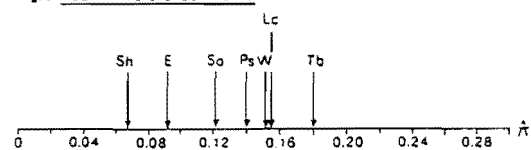


Fig. 3 Year 2 Preference Profile

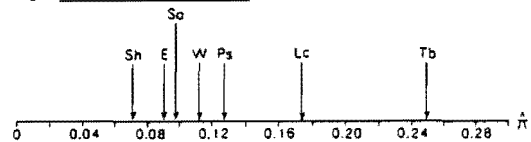


Fig. 4 Year 3 Preference Profile

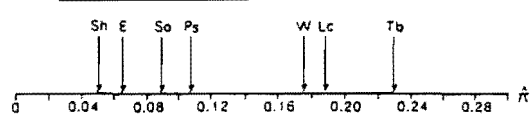
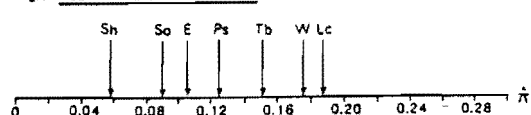


Fig. 5 Year 4 Preference Profile



Key to Figures 2-14 E - Eastwood Lc - Leigh-Chalkwell Ps - Prittlewell-Southend
Sh - Shoebury So - Southchurch Tb - Thorpe Bay W - Westcliff

(1975) and Gould & White (1974). To this end, preference parameters of the four age groups in the Southend-on-Sea study may each be plotted on a continuum of preferences as shown in Figures 2 to 5.

The significance of differences between these preference parameters can be ascertained by using straightforward test statistics (see Wrigley 1980, Andersen 1980, for details). Table 1 documents the significant differences associated with the Year 1 preference profile, which in conjunction with the estimated preference parameters ($\hat{\pi}$) shown in Figure 2 allows inferences about preference patterns to be made. In the case of Year 1, these inferences are that:

- a) the seven areas are not all viewed as equally desirable residential districts;
- b) Thorpe Bay ($\hat{\pi} = 0.188$) and Leigh-Chalkwell ($\hat{\pi} = 0.150$) are both preferred to Eastwood ($\hat{\pi} = 0.093$) and Shoebury ($\hat{\pi} = 0.066$) by significant margins of between 3:1 and 3:2;
- c) Southchurch ($\hat{\pi} = 0.120$), Westcliff ($\hat{\pi} = 0.147$) and Prittlewell-Southend ($\hat{\pi} = 0.137$) are all preferred to Shoebury ($\hat{\pi} = 0.066$) by a significant margin of approximately 2:1;
- d) preference differences within the group Thorpe Bay, Leigh-Chalkwell, Westcliff, Prittlewell-Southend and Southchurch are not significant;
- e) the preference difference between Eastwood and Shoebury is not significant.

Considerations of Figures 3-5 in conjunction with Table 1 allows inferences to be drawn in a similar way for Years 2 to 4.

In general terms, Figures 2-4 indicate an increasing spread of preferences among older age groups, while Table 1 further suggests improved differentiation among individual pairs as the age of the children increases. As such, the paired comparison method is seen to produce results which are both intuitively reasonable and which conform with the general evolution and sequential refinement of residential preferences discerned in Gould's (1975) classic Swedish national-level study. In that study, Gould concluded that mental maps of residential preference "crystallise out of a mental flux of indifference and uncertainty at an early age" (Gould 1975). However, as may be seen in Figure 5 and Table 1, the Southend study seems to exhibit a shift in the nature of this 'learning process' at Year 4 (age 14-15 years). At this point, although the proportion of the sample opting for the 'no preference' option further decreases relative to younger age groups, indicating continuing crystallization of preference at an individual level (a trend which continues in the much smaller and unreported Year 6 results), the range of the Year 4 group preference profile actually contracts.

It is unlikely, however, that this superficially counter-intuitive result mirrors any deficiency in

Table 1. *Age analysis: significant differences between district preference parameters.*

Choice pair	Year 1	Year 2	Year 3	Year 4
Eastwood vs. Shoebury	-	-	-	*
Eastwood vs. Southchurch	-	-	-	-
Eastwood vs. Thorpe Bay	**	**	**	*
Eastwood vs. Westcliff	-	-	**	*
Eastwood vs. Leigh-Chalkwell	*	**	**	**
Eastwood vs. Prittlewell-Southend	-	-	*	-
Shoebury vs. Southchurch	*	-	*	*
Shoebury vs. Thorpe Bay	**	**	**	**
Shoebury vs. Westcliff	**	-	**	**
Shoebury vs. Leigh-Chalkwell	**	**	**	**
Shoebury vs. Prittlewell-Southend	**	*	**	**
Southchurch vs. Thorpe Bay	-	**	**	*
Southchurch vs. Westcliff	-	-	**	**
Southchurch vs. Leigh-Chalkwell	-	*	**	**
Southchurch vs. Prittlewell-Southend	-	-	-	-
Thorpe Bay vs. Westcliff	-	**	-	-
Thorpe Bay vs. Leigh-Chalkwell	-	-	-	-
Thorpe Bay vs. Prittlewell-Southend	-	**	**	-
Westcliff vs. Leigh-Chalkwell	-	-	-	-
Westcliff vs. Prittlewell-Southend	-	-	*	-
Leigh-Chalkwell vs. Prittlewell-Southend	-	-	**	**

** Denotes significant difference in preference between districts at 0.01 level.

* Denotes significant difference in preference between districts at 0.05 level.

- Denotes non-significant difference in preference between districts.

the paired comparison procedure or even of the questionnaire design; rather, it might suggest that the basic differentiation of residential areas at the intra-urban scale is completed at a fairly early stage and that, subsequently, preferences may become more directly attributable to developing tastes and individual personalized information flows. This would consequently increase the number of conflicting preference structures within the older age groups, causing a decay in the overall group range.

4. Analysis of preference variation with home residence

The data was classified according to the seven home districts of the children (see Figure 1) and preference parameters obtained for each. The most outstanding result was the consistent preference in favour of the home area. This would seem to confirm the 'local dome of desirability' effect identified in Gould's studies. Figures 6 and 7 illustrate this feature in the preference profiles of children from Thorpe Bay and Westcliff.

5. Analysis of preference variation with school attended

Paralleling the 'local dome of desirability' effect for home residence, a similar effect was identi-

fied in relation to the school attended. When home residence was not held constant, most of the respondents from each of the ten schools participating in the study exhibited a strong or very strong preference for the area in which the school is situated. For example, Figure 8 illustrates this feature in the preference profile of children attending Belfairs High School.

Southend's school system involves a number of single-sex schools and also maintains the dichotomy between grammar and secondary-modern type schools. A fortuitous spin-off of this is that results pertaining to controlled pairs of schools may be used to isolate three variables which might affect preference patterns. These variables are school type, sex of respondent, and spatial location of school.

First, Dowsett and Southend High Schools for Girls were compared, since the schools have adjacent locations (Fig. 1), are both single-sex schools, and service the same basic catchment area (although that of Dowsett is the smaller of the two). However, Southend High School for Girls is a selective-entrance (grammar type) school, whereas Dowsett has non-selective entrance. Comparison of the preference profiles (Figs. 9 and 10) obtained from these two schools with the preference parameter tests (Table 2) shows that although the selective-school children identify slightly more significant differences between areas, the order of preference is broadly similar, and five of the six significant differences identified by Dowsett children are the same as five of the eight significant differences identified by Southend High School for Girls. Presuming slight differences result from the different catchments, it appears in this case that school type is of little importance in the identification of residential preferences.

Secondly, Westcliff High School for Boys was compared with Westcliff High School for Girls, simply on grounds that the schools cater to opposite sexes of respondents. The schools have identical catchment areas, adjacent sites (Fig. 1), and are both selective-entrance (grammar type) schools. The relevant preference parameter tests (Table 2) show that eight of the twelve significant differences between areas identified by the girls' school are the same as eight of the twelve significant differences identified by Westcliff Boys' school. The preference profiles (Figs. 11 and 12) are therefore basically similar but differ in a few surprising aspects, notably the rating of Eastwood and Thorpe Bay. It appears, therefore, that sex of respondents cannot be completely disregarded in the scaling of aggregate preferen-

Fig. 6 Thorpe Bay Preference Profile

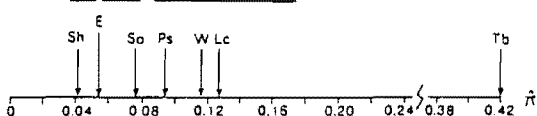


Fig. 7 Westcliff Preference Profile

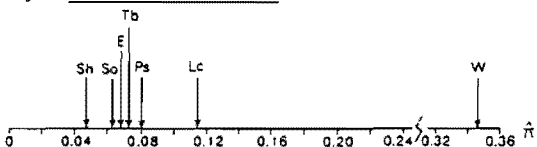


Fig. 8 Belfairs High School For Boys Preference Profile

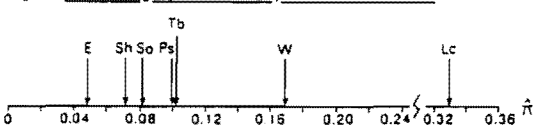


Fig. 9 Dowsett High School For Girls Preference Profile

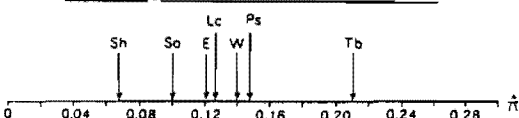


Fig. 10 Southend High School For Girls Preference Profile

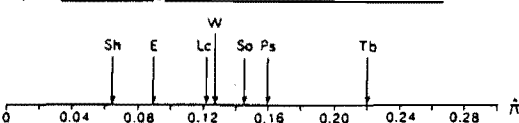


Fig. 11 Westcliff High School For Boys Preference Profile

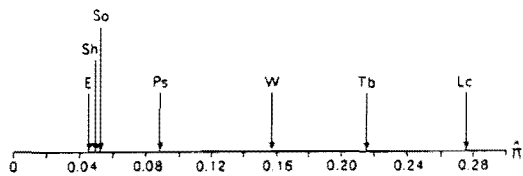


Fig. 12 Westcliff High School For Girls Preference Profile

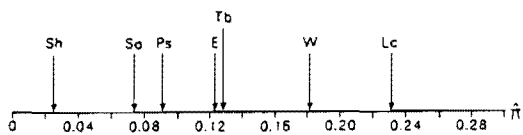


Fig. 13 Southend High School For Girls Preference Profile

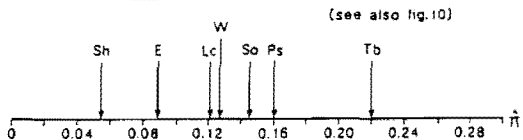
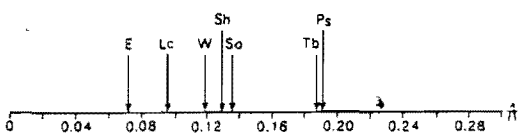


Fig. 14 Southend High School For Boys Preference Profile



ces, although without further evidence it appears that differences are minor and idiosyncratic when related to the overall preference hierarchy.

Thirdly, the effect of geographical location combined with the effect of sex was assessed by comparing Southend High School for Girls with Southend High School for Boys. The schools have similar catchments, are both selective-entrance (grammar type) schools, but have different locations and pupils of different sex. The relevant preference parameter tests (Table 2) show that in this case only three of eight significant differences identified by the girls' school are the same as three of five significant differences identified by the boys. This represents only a broad similarity between the two profiles (Figs. 13 and 14), indicating that location effects strongly compound the minor sex effects previously noted. In particular, both areas exhibit strong preferences for the district in which the school is located.

Taken together, these analyses of preference variation according to school attended illustrate how the paired comparison procedure may be used to successfully generate preference profiles which comply with broad *a priori* expectations. Thus, in this limited case study, location of school attended affects residential preferences

Table 2. Analysis by school attended: significant differences between district preference parameters.

	Belfairs High School for Boys	Southend High School for Girls	Dowsett School for Girls	Westcliff High School for Boys	Westcliff High School for Girls	Southend High School for Boys
Eastwood vs. Shoebury	-	-	-	-	**	-
Eastwood vs. Southchurch	-	-	-	-	-	*
Eastwood vs. Thorpe Bay	*	**	-	**	-	**
Eastwood vs. Westcliff	**	-	-	**	-	-
Eastwood vs. Leigh-Chalkwell	**	-	-	**	*	-
Eastwood vs. Prittlewell-Southend	*	*	-	-	-	**
Shoebury vs. Southchurch	-	**	-	-	**	-
Shoebury vs. Thorpe Bay	-	**	**	**	**	-
Shoebury vs. Westcliff	**	*	*	**	**	-
Shoebury vs. Leigh-Chalkwell	**	*	*	**	**	-
Shoebury vs. Prittlewell-Southend	-	**	**	-	**	-
Southchurch vs. Thorpe Bay	-	-	*	**	-	-
Southchurch vs. Westcliff	*	-	-	**	**	-
Southchurch vs. Leigh-Chalkwell	**	-	-	**	**	-
Southchurch vs. Prittlewell-Southend	-	-	-	-	-	-
Thorpe Bay vs. Westcliff	-	-	-	-	-	-
Thorpe Bay vs. Leigh-Chalkwell	**	*	*	-	*	*
Thorpe Bay vs. Prittlewell-Southend	-	-	-	**	-	-
Westcliff vs. Leigh-Chalkwell	*	-	-	-	-	-
Westcliff vs. Prittlewell-Southend	*	-	-	*	**	-
Leigh-Chalkwell vs. Prittlewell-Southend	**	-	-	**	**	**

** Significant difference in preference between districts at 0.01 level.

* Significant difference in preference between districts at 0.05 level.

- Non-significant difference in preference between districts.

quite strongly, while sex and school type have less pronounced effects, being important only in accounting for occasional minor differences detected in preference ordering and the degree of differentiation between areas.

6. A comparison of techniques

As suggested in Section (2) above, an important advantage of the paired comparison procedure lies in the ease and readiness with which a simple question can be interpreted by respondents of variable intellectual capacity. This benefit is compounded if, as in the present study, or in many cases involving 'on-board' (endogenously stratified) sampling used by transport planners, there is only a limited time available for the administration of the questionnaire.

During the data collection phase of the Southend study, the opportunity arose to administer a more conventional and time-consuming ranking experiment to 92 respondents of Southend High School for Boys. This experiment was performed after the paired comparison experiment had been completed and required respondents to rank all nine residential districts. (Leigh-Chalkwell and Prittlewell-Southend were split into their four constituent districts for purposes of this analysis.) As in the Gould studies, respondents were not allowed to assign equal ranks to two or more alternatives, meaning in effect that each respondent was required to maintain consistent preference transitivity for the equivalent of 36 paired comparisons. In total, therefore, the 92 respondents (32 in Year 1, 23 in Year 2 and 37 in Year 4) scaled the equivalent of $(92 \times 36 =)$ 3312 paired comparisons and generated a far greater volume of data than the responses to a single paired comparison question by each of the 2,426 respondents of the full sample.

However, Figures 15-17 clearly show that this benefit accrues entirely at the expense of consistency: the equivalent amount of paired comparison information derived from a ranking study and manipulated using a principal components program singularly fails to identify any consistent group preferences (as scaled using the eigenvalues) between ages, even though the preference signal (λ) value increases with age of respondents in a manner consistent with the results of the Gould study. The internal inconsistencies within the (single school) Southend High School for Boys ranking study and principal components analysis (Figs. 15-17) are poor when compared with the consistency of preference transitivity obtained for the entire South-

end paired comparison results (Figs. 2-5). Additionally, numerous practical problems of comprehension were encountered in the administration of the ranking questionnaire to younger respondents, and the hitherto insignificant problem of non-usable responses became a more important factor.

7. Discussion

The preceding residential preference study was designed in the hope that two methodological problems commonly encountered in the scaling of environmental preferences might be confronted, namely that:

- 1) the arbitrary imposition of an ordinal or higher-order measurement scale upon a judgemental process may fail to adequately represent the relative utilities of a set of choice alternatives, and
- 2) complex survey designs may not be practicable in some real world situations because of the variable capabilities of respondents and/or the importance of the time constraint which is inherent in the administration of many social survey designs (especially in 'on-board' sampling).

It has been our contention (and the results described in Section (6) would seem to support this) that the use of paired comparison procedures may in some circumstances facilitate more

Principal Components Analysis Results

Fig. 15 YEAR 1

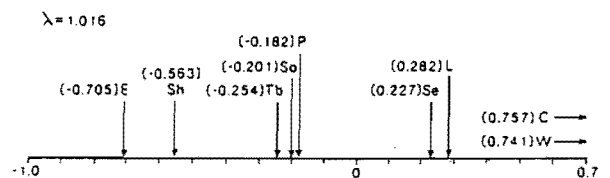


Fig. 16 YEAR 2

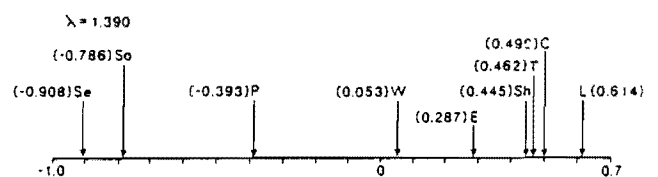
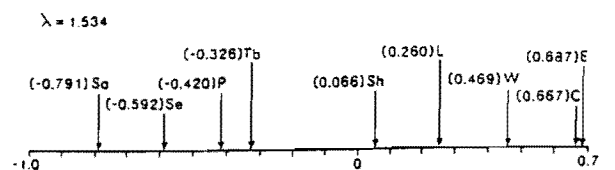


Fig. 17 YEAR 4



Key to Figures 15-17. C - Chalkwell E - Eastwood L - Leigh P - Prittlewell Sh - Shoebu
So - Southchurch Se - Southend Tb - Thorpe Bay W - Westchill

natural and accurate scaling of environmental images than the more restrictive and taxing ranking procedures previously employed by Gould, among others. They may also be gainfully incorporated into a variety of contemporary sample designs. It should, of course, be recognized that this study makes no attempt to avoid many of the other valid criticisms of studies of this type, in particular those relating to the difficulties of questioning immature respondents. In this case, children could not be wholly expected to come to terms with the idea of 'settling down' in Southend-on-Sea, as required by the main questionnaire. Nevertheless, Gould's (1975) sentiment that

until we are prepared to attempt the measurement task, our knowledge and insights will remain at the speculative 'discussion paper' level. . .

has continued relevance in this subject area. Accurate and meaningful scaling techniques,

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