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Consumer Spatial Choice Strategies: A Comparative Study of Some Alternative Behavioural Spatial Shopping Models

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Abstract: The purpose of this paper is to outline a conceptual model of consumer spatial decision making and choice behaviour and to investigate the use of various combination rules of consumer's evaluations of attributes of shopping centres to predict spatial choice behaviour.

The research findings indicate that the linear combination rules perform as well as the multiplicative rules and that both types of rules perform quite acceptably. The paper concludes by discussing some implications for future research on spatial decision making and choice.

Introduction

Following the seminal work of GOLLEDGE, RUSHTON and CLARK (1966), WOLPERT (1965), GOULD (1963) and others (7, 12, 13, 14, 15, 16, 17, 53, 65), a growing body of literature has emerged in geography, dealing with the spatial decision-making of individuals. The specific aim of much of this work is to conceptualize and/or to model the spatial behaviour of individuals *per se*, that is the behaviour of individuals which is independent of the particular spatial structure of the study area under investigation. The ultimate objective of this tradition then is to develop a consistent theoretical framework and a set of measurement models which can be considered as valuable alternatives to the gravity and entropy-maximizing approaches in understanding the spatial behaviour of individuals and/or in providing applied theory and methodology to certain problems in urban and regional planning.

The revealed preference (11, 25, 27, 47, 48, 49, 50, 51, 52, 61), functional measurement (1, 2, 29, 30, 31, 32, 33, 34, 36, 38), conjoint measurement (24, 26, 46, 54) and portfolio theoretical approaches (56) can be considered as alternative ways toward achieving this end, each with its own advantages and drawbacks. The important thing, however, is that these approaches all have in common the fact that the spatial decision-making of an individual is assumed to be related to his evaluation of a set of spatial stimuli on a number of relevant attributes. These attributes may be thought of as the dimensions which are relevant to the class of stimuli being evaluated. For example, in the case of shopping behaviour, the relevant attributes of shopping centres may be, amongst others, the number of retail outlets and the number of parking lots, whereas in the case of residential choice behaviour, the relevant attributes of the residential zones may be, amongst others, the location of the zone in relation to that of jobs, shopping centres, and the number of rooms in the houses.

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Given the evaluation of an individual of each relevant attribute of the stimuli, the problem is then to combine these separate evaluations into an overall judgement, and to relate this to the observed behaviour of the individual. Several combination rules are possible, and the main problem a researcher is confronted with is to decide, on both theoretical and empirical grounds, which combination rule is best for modelling the specific behaviour he is dealing with. Therefore, a major point of research should be to determine under what circumstances a particular combination rule is most useful or, formulated in a different manner, which combination rule describes best the decision-making involved in conducting a particular activity.

The purpose of the present paper is threefold: (1) to present a conceptual framework for spatial choice strategies of consumers, (2) to identify a set of attributes of shopping centres which are assumed to be related to observed spatial choice behaviour and (3) to compare several combination rules with respect to their ability of predicting real-world consumer choice behaviour. The remainder of this paper strictly follows this three-fold purpose. The paper concludes by discussing the implications of the results of the study for future research in the field of spatial shopping behaviour.

A Conceptual Framework

General Outline

Consider a spatially distributed population of N different individuals, located at fixed points in space, such as their place of residence. These N different individuals are partially organized as households and, therefore, only some of these N individuals are frequently engaged in shopping. Assume these individuals constitute the basic decision-making units in our problem. For the purchasing of goods, assume there exists a constant set of k shopping centres or shopping opportunities $S = \{S_1, \dots, S_k\}$. These shopping centres are in fixed locations. Consequently, the distance separation between an individual consumer and a shopping centre varies considerably over these shopping centres. Furthermore, assume that the shopping centres have a number of attributes $A = \{A_1, \dots, A_k\}$ which influence

the decision-making of the individual consumer. The general problem is to model the spatial choice strategy of consumers in mathematical terms. It is suggested that three kinds of factors are relevant to this decision problem (see also 28):

1. the factors by which the choice set is constrained;
2. a *combination rule* by which the separate evaluations of the attributes of the shopping centres are integrated into an overall judgement;
3. a *choice rule* by which the evaluative component of the decision problem is linked with observed behaviour in space.

The factors which constrain the choice set show that not all shopping centres are considered for patronage by an individual consumer. It is assumed that two factors are important in this respect. Firstly, we assume that the number of shopping centres entering the decision problem of an individual consumer is constrained by the consumer's information field (see also 22, 43, 44, 55, 57). Hence, shopping opportunities located outside the information field of an individual consumer – the shopping opportunities he is unfamiliar with – are not evaluated for patronage. Secondly, we assume that the choice set of an individual consumer is constrained by the idea of his "reasonable travel time", reflecting his willingness to travel in order to purchase a particular item. That is, we assume that the distance separation between an individual consumer and a shopping opportunity is not a disutility variable, and that a more realistic postulate of spatial consumer behaviour is that of spatial indifference (see also 58). Therefore, within a constrained spatial range, the shopping opportunities are evaluated only in terms of their attraction attributes.

The combination rule constitutes the core of our conceptual framework. Therefore, we will discuss this point separately.

The choice rule, the third factor in our framework, may be deterministic or probabilistic. A deterministic choice rule states that a consumer will always choose the shopping alternative which scores best on the subjective evaluative function. A probabilistic choice rule, however, states that spatial be-

haviour is some function of the overall judgement of a consumer.

Consequently, a consumer might also choose a shopping alternative for which his overall judgement is not best, relative to his overall judgement of the other shopping opportunities in his choice set.

Combination Rules

The overall judgement of an individual consumer has two interlocking components: (1) his evaluation of the attributes of the shopping opportunities, and (2) his subjective relative importance of these attributes. In the literature, several rules of combining these components into an overall judgement have been suggested. Research findings in transportation planning (35, 37, 39, 41, 59, 60), management science (e.g. 42), marketing (3, 4, 5, 20, 40, 45, 63, 64), clinical judgement (18, 19) and related fields (e.g. 8, 10), suggest that the linear and the multiplicative combination rules are most promising when studying the decision-making of individuals. Four combination rules may be identified:

1. Unweighted linear — compensatory model: $E_i = \sum_j e_j$
2. Weighted linear — compensatory model: $E_i = \sum_j w_j e_j$
3. Unweighted multiplicative model: $E_i = \pi_j e_j$
4. Weighted multiplicative model: $E_i = \pi_j e_j^{w_j}$

where: E_i = the overall evaluation or judgement assigned to shopping alternative i ;

e_j = a separate evaluation of the j th attribute of a shopping alternative;

w_j = the subjective weight assigned to the j th attribute of a shopping alternative.

Essentially, the compensatory models assume that low values on one attribute of a shopping alternative can be compensated by high values on another attribute. It is assumed that an individual's judgement of any shopping alternative in a choice situation is a function

of his separate evaluations of the attributes of the alternative and the subjective importance weights assigned to these attributes. The weighted linear—compensatory model assumes that the individual constructs the weighting function which reflects the degree of salience of the attributes. Therefore, the magnitude of compensation depends on some cognitively constructed weighting function. By contrast, the unweighted linear—compensatory model is stimulus-centred. It assumes that the magnitude of compensation is held among the attributes themselves.

Models 3 and 4 are multiplicative models. These models postulate that if any of the separate evaluations of the attributes of the shopping alternatives is close to zero, the overall judgement of the shopping alternative is also very low. For example, if a consumer has a low valuation for the parking facilities in a particular shopping centre, his overall judgement for this centre will also be low, no matter what his valuation is for its other attributes, such as the number of retail outlets and the ease of movement within the centre. The weighted and unweighted multiplicative models differ in the same manner as the weighted and unweighted linear compensatory models. That is, the weighted multiplicative model assumes that the consumer constructs cognitively some weighting function whereas the unweighted multiplicative model does not have explicitly constructed importance weights.

A major disadvantage of the linear models is that the relative contribution of a separate evaluation of one of the attributes of a shopping alternative is dependent upon the number of separate evaluations included in the model. Therefore, the prediction of the model partially depends on the construct validity of the model, thus leading to interesting and important methodological issues in the formulation of multi-attribute spatial choice models. Clearly, this suggests that the multiplicative models might give more realistic descriptions of real-world consumer spatial choice strategies.

Method

To test the predictive ability of the foregoing models, data were collected from individuals

responsible for shopping. Each subject evaluated the shopping centres within his "reasonable travel time" distance on a number of relevant attributes. They also evaluated the relative importance of these attributes. Finally, they provided data on the frequency of patronizing these shopping centres for the purchase of various durable and non-durable goods. The collection of the data involved the following decisions.

The data for the study were collected through personal interviews with 771 households in the region of Kempenland, the Netherlands, during June, 1978. The respondents were asked to evaluate the shopping centres within their "reasonable travel time" distance on the eleven attributes given in Table 1.

Valuations were made on a nine-point rating scale, ranging from "extremely low" to "excellent". It was assumed that these values constituted an interval scale.

Table 1. List of attributes

-
1.	Parking facilities
2.	Hindrance of traffic
3.	Distances between shops
4.	Availability of specialty shops
5.	Availability of superstores
6.	Prices of the goods
7.	Quality of the goods
8.	Choice range in goods
9.	Quality of service
10.	Window display
11.	Number of shops
-

The attributes of the shopping centres which were evaluated were obtained from an initial extensive list, developed from individual interviews in a pilot study, and a limited examination of the existing geographical literature on the consumer cognitive dimensions of shopping centres and related developments (6, 9, 21, 23, 62). The reduced set of attributes, included in the models, was established on the basis of the degree in overlap in meaning among the attributes selected, the frequency with which each attribute was mentioned in the pilot study, and whether the attribute was relevant in a planning context. The list of attributes, given in Table 1, is assumed to represent those attributes which affect most the consumer's spatial choice behaviour.

The next set of related operational decisions concerned the measurement of the importance weights a consumer assigns to the selected set of attributes of the shopping centres. These operational decisions were structured by the necessity that the measurements of the subjective importance weights constitute a ratio scale. In addition, it was thought to be necessary that the measurements of the subjective importance weights should resemble as closely as possible the decision-making of consumers in real-world situations. That is, the measurements of the weights should encompass elements of trade-off. Therefore, the usually-employed dissimilarity scales were considered inappropriate.

Given the rather extensive number of attributes, the alternative of the constant sum scale was also considered to be inappropriate, since the respondents would probably have the greatest difficulty in discriminating between the attributes. Hence, a pairwise comparison design, with one constant attribute as a reference item, was employed. Respondents were asked to allocate 10 points to the two attributes in correspondence with the importance they assigned to the first attribute as compared with the reference attribute. For example, if a respondent considered the first attribute four times as important as the reference attribute, the respondent was asked to allocate respectively 8 and 2 points; if the attributes were considered equally important, the allocation was 5:5, and so on. Data were gathered in this manner for three replications. The three reference attributes were chosen in such a way that the whole spectrum of importance was covered, that is, the first reference item had turned out to be of relatively high importance in the pilot study, the second reference attribute of median importance, and the third reference attribute of relatively low importance. In order to minimize response bias, the replications were separated from each other by sets of questions about totally different subjects.

The respondents had little difficulty in evaluating the relative importance of the attributes. A disadvantage of the procedure, however, is the discontinuity in the ratios of the importances, leading to inherent variability in the ultimate vector of relative importance

scores of the respondents. This vector was determined first by transforming the data from the three replications to correspond to the same scale range. Next, the reliability of the data was tested by calculating the correlations between the scales. These correlations are given in Fig. 1.

Given the inherent variability of the data, the results were satisfactory. However, Fig. 1 shows that the data for some respondents were very unreliable. Therefore, respondents with low correlations between their individual scales were eliminated and not included in the final analysis. The ultimate vector of relative importance scores for the remaining respondents was calculated as the geometric means of the relative importance scores in the three replications. This whole procedure was repeated twice, once for shopping for durable goods, and once for non-durable goods.

Finally, the preference ordering of the shopping alternatives for each respondent was determined from the frequencies of their visits. It was assumed that the most frequently visited shopping alternative was the most preferred.

Results

In order to assess the predictive ability of the four combination rules for the obtained

data, the proportion of correct predictions was determined. It was assumed that the relationship between overall judgement and overt spatial choice was a deterministic one. Hence, it was assumed that a consumer chose the shopping alternative within his reasonable travel time conception which scored best on a particular combination rule. The analysis was employed twice, once for shopping for durable goods, and once for non-durable goods. The procedure, therefore, yielded eight predictions.

To determine the predictive effectiveness of the four combination rules, it was necessary first to compute the objective relative weights for the attributes. Since it is impossible to provide all individual weights here, Table 2 reveals the average weights and the standard deviations for the selected attributes of the shopping centres. Table 2 shows that parking facilities, number of superstores and speciality shops, hindrance of traffic, price, quality of goods, and choice range are the most important attributes to the consumers in the sample. Table 2 also reveals that the average weights do not differ significantly between shopping for durable goods and shopping for non-durable goods. Only the average weight of the attribute "service" seems to be relatively more important in the case of shopping for durable goods. Its average weight rises from 1.08 to 1.19.

Figure 1. Distribution of respondents based on the product-moment correlations between their scales.

The next step in the analysis involved the examination of the predictive power of the four combination rules. Table 3 summarizes the results. The entries in this table present the actual proportion of correct predictions for each combination rule, respectively for shopping for non-durable goods and for shopping for durable goods. Table 3 shows that the predictive effectiveness of the four combination rules is basically the same. The proportion of correct predictions is not really dependent upon the combination rule used to relate the evaluation of individuals to their spatial behaviour in a real-world situation. In addition, it is evident that the predictive power of the four combination rules is better in the case of shopping for durable goods than for shopping for non-durable goods.

Given these results, the present study does not permit firm conclusions on the structure of consumer choice strategies. However, a number of possible interpretations may be set up from these results. Each interpretation clearly involves implications and directions for future research in the field of spatial consumer choice behaviour. Firstly, the attributes selected may be too numerous or not relevant in the context of a consumer's discrimination between alternative shopping opportunities. This suggests that further research on restricted sets of attributes will be needed. Another possibility is to use alternative combination rules, such as the non-compensatory combination rules (conjunctive, disjunctive, lexicographic models, etc.). Secondly, the treatment of the distance variable may be incorrect. It

Table 2. Average weights and standard deviation for attributes

Attribute	Average weight		Standard deviation	
	Non-durable goods	Durable goods	Non-durable goods	Durable goods
Parking facilities	1.45	1.43	1.81	1.75
Hindrance of traffic	1.78	1.77	4.70	4.82
Distances between shops	0.73	0.76	0.31	0.35
Speciality shops	1.39	1.37	1.23	1.18
Superstores	1.44	1.42	1.41	1.38
Prices	2.93	2.90	1.92	1.91
Quality of goods	3.59	3.61	2.23	2.23
Choice range in goods	2.27	2.25	1.43	1.36
Service	1.08	1.19	0.60	0.79
Window display	0.66	0.68	0.49	0.56
Number of shops	1.01	1.04	0.62	0.80
Travel distance	1.08	1.11	0.76	0.80

Table 3. Proportion of correct predictions

Combination rule	Non-durable goods		Durable goods	
	Proportion	Absolute	Proportion	Absolute
1	.60	330	.78	211
2	.60	329	.77	210
3	.59	325	.78	212
4	.60	329	.77	210

might be relevant to consider the case where distance enters the decision-making model explicitly as still another attribute of the shopping centres. In this way, it becomes possible to consider the trade-off between the distance variable and the attractiveness variables. This might partially explain the relatively low proportion of correct predictions in the case of shopping behaviour for non-durable goods. Although the overall judgement of a consumer of the major shopping centres is higher than his overall judgement of a minor shopping centre, he might not patronize one of the major shopping centres if the minor shopping centre is located closer.

Finally, we have considered the decision to choose a particular shopping centre as an isolated and stable act at one particular point in time. Clearly, however, shopping is a recurrent activity involving specific decision-relevant dimensions at specific points in time: for example, the decision to choose a particular shopping centre will be influenced by the specific needs at that time, the possible combination of the purchase of goods, and constraints in behaviour such as available time and availability of a car. Therefore, it might be useful to generalize the approach and develop models which include such dimensions, and which consider explicitly shopping decision-making from a time perspective.

Conclusions

The basic objective of this article was to present a conceptual framework for the decision-making of an individual in a spatial shopping context, and to test four alternative combination rules as shopping strategies on the basis of this framework. The results of this study indicate that the approach presented was satisfactory in terms of its overall predictive effectiveness. However, it was not possible to derive firm conclusions about the relevance of the four shopping strategies in different shopping contexts, i.e. shopping for durable and shopping for non-durable goods. It became clear that the four combination rules generated basically the same proportion of correct predictions of spatial choice behaviour of consumers. A number of possible explanations for this result have been given. Still another clue is provided by DAWES and CORRIGAN (1974) [8] who have argued

that linear models work well in situations where the predictor variables have conditionally monotone relationships to the dependent variable, where there is measurement error in both dependent and independent variables, and deviations from optimal weighting do not make any practical difference. Since, in this case, these conditions are satisfied, it is not surprising that the linear models perform as well as the multiplicative models.

In comparing the predictive power of the four combination rules for durable goods-shopping with that of the four combination rules for non-durable goods-shopping, the results of this study indicate that the combination rules might be more relevant in the case of shopping for durable goods than for non-durable goods. The proportion of correct predictions in the case of shopping for durable goods was evidently higher compared with those for non-durable goods. Given these results, it is evident that more research on the decision-making of consumers will be needed if we wish to understand more fully the determinants and the basic principles of consumer spatial choice behaviour.

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