Finally, it is apparent that, at least in some respects, people were partially adapted to the conditions they encountered. This is illustrated by the fact that the respondents did not have a strong reaction to being in mere contact with others (in, for example, a train). Seven of the nine respondents that talked about contact were ‘not bothered by it’. Whilst contact would be avoided by choice, it was by no means intolerable.

‘Physical contact bothered me at first, but everybody’s in the same boat. It’s impersonal contact’. (Secretary aged 19.)

Again, rather resigned responses were given by eight of the respondents in talking of their journey to work as a whole. They indicated that they had ‘got used to it’ or had ‘become used to it’. On the other hand, it was also clear that the threshold of positive discomfort was frequently exceeded.

Discussion

Although the sample used was small, there was considerable homogeneity in the reactions obtained. This was probably due to the fact that all the respondents frequently experienced extreme conditions. Four important general points are implicit in the results obtained. Firstly, ‘discomfort’, has been used as a blanket term, but it is apparent that a whole host of discomforts are experienced. These range from the immediate pain of having one’s toe trodden on, through gross psychological reactions such as irritation to relatively subtle anti-social reactions. These responses did not occur in an all-or-none fashion. They appeared to be graded and though it was not possible to correlate them with the exact values of the situational parameters defining the context within which they occurred, they clearly did occur to an extent that depended on these values.

Secondly, it was seen that, for the moving pedestrian, discomfort was a function of delay and inter-personal interference. In the two environments observed specific occurrences of these effects were related to the overall pedestrian patterns that occurred in the space. In determining these patterns, the architectural attributes of the space are a main source of discomfort.

Thirdly, it was apparent that people were often responding to the cumulative experience of crowded conditions rather than to specific instances of discomfort which, in themselves, have been quickly forgotten. Even mildly uncomfortable conditions will, if experienced frequently, probably affect the quality of a person’s everyday life in a significant manner.

Finally, people were prepared to ‘pay’ to avoid congestion. This was indicated by a great variety of tactics used to minimize contact with extreme conditions. (An appropriate area for further research might be to find means of assessing the utility to the individual of being able to enjoy or avoid these conditions categorized as eliciting one or other type of comfort or discomfort. The utility of comfort could then be rationally related to the dissility associated with providing the relevant spatial, financial or other resources involved.)

Conclusion

In terms of overt pedestrian patterns there were a number of differences between the two environments observed. In the ticket hall, during the rush-hour, there are fairly continuous streams of people walking at a relatively fast pace along consistently used paths. Static groups occur very frequently at certain locations but rarely at others. The static groups have gross effects on flow. In the foyer a very large number of routes are traversed at a rather slow pace. Static groups occur in most parts of the space though certain locations are preferred to others. Though people get in one another’s way, bodily contact is rare. The role of information is marginal in the ticket hall during the rush-hour, but in the foyer it is consistently important.

Despite the differences just mentioned, there are a number of interesting similarities. In both locations waiting people prefer locations which are protected from flow and are good vantage points for seeing and being seen. Queues tend to follow main lines of flow and can interfere with movement in both the ticket hall and foyer, though this occurrence is relatively rare in the case of the latter. Finally, in peak conditions, the foyer, like the ticket hall, acted as a confluence and reservoir area as well as a service area.

It may be concluded that very similar categories of pattern occur in both spaces but the extent to which they obtain, and their general importance, differ considerably. Most of the effects described operate in a clear cut manner in the ticket hall whilst, with the exception of behaviour related to information requirements, they are manifested as somewhat less coherent tendencies in the foyer.

It is clear that whilst pedestrian effects in the ticket hall and foyer were similar in kind, design solutions related to these common patterns will be very different in the two cases. These solutions will depend not only upon a knowledge that certain effects are present, but also on the precise way in which they are manifested. Work such as that described can, nonetheless, be of value in suggesting the kind of problem that must be taken into account in movement spaces in general, whilst in some, cases it will be possible for specific design implications to be drawn. Further work might look at other types of environment and explore other areas of the scheme presented at the beginning of the paper. Such work, and work aimed at solving in a precise way specific problems that arise in particular environments, should in due course allow a great degree of systematization in discussing problems of movement space.

Finally, movement patterns are relevant to design only insofar as they are related to economic, experiential or similar criteria. Further relatively general work on comfort would appear to be particularly worthwhile since the critical stimuli eliciting a negative affective response were found to be common to a wide range of environments.

12 Direction-finding in large buildings

Gordon Best

Abstract: An experimental study is described which examines people’s patterns of behaviour on entry into a large public building and the reasons why people become lost.

Using one room in Manchester Town Hall, ‘lostness’, is defined as a deviation from the most direct route to that room from one of the main ten entrances. With this definition he recorded the paths to that room of 135 subjects. The results indicated that the length of the route and the number of changes of direction did not affect the likelihood of a subject
becoming 'lost'. The number of choices between different routes was the main variable affecting 'lostness'.

The second part of the study employed the substitution of a new sign to guide visitors and indicated the next decision point on their route. A reduction in the number of lost subjects was observed. From the data a regression equation is derived which predicts from the number of route choice points the percentage of users that will become lost.

Editorial note
Because of illness, this paper was not presented at the conference. It is an edited version of an internal report, see Best [11.8].

Introduction
Little is known about the way in which people find their way through complex buildings. This study is an attempt to investigate the problem experimentally. The practical impetus for the study was supplied by the occupiers of two large buildings who reported that many of their users became lost.

The objectives of the study were:
To discover why people were becoming lost in these buildings and to correct the situation; and
To find out if people's direction-finding behaviour was systematically related to the physical environment they were moving through.

The building
The study was carried out in two buildings that make up the Manchester Corporation Town Hall. Together these buildings provided 450,000 sq ft (41,805 sq m) of floor area. As many as 9000 people use the buildings each day, entering by one of ten entrances and seeking one or more of 120 destinations.

The two buildings are very different in character, the original town hall being a six storey Victorian Gothic structure built in 1877 and the newer extension, an eight storey office block built in 1937. Because both buildings were concerned with the business of Manchester Corporation they were used as one complex, with heavy traffic moving between them. Internally they accommodated elaborate circulatory systems, including ten points of vertical movement and a number of 'dead end' corridors. Traffic between the two buildings was accommodated at street level and by central corridors connecting them at the third level.

Direction-finding routes
A destination was chosen for study, because it had a large number of users (approximately 100 per day), the users varied widely in their experience of the building, many users became lost on their way to the destination, and the routes used to get to the destination exhibited all the major characteristics of any route within the building. It was room M27 in the housing department.

Lostness
The feeling of 'lostness' varied widely from one town hall user to the next. Some people who were interviewed after spending nearly 30 minutes wandering around the buildings insisted that, at no point were they lost, others who appeared to find their way without trouble complained that they had felt 'lost' while doing so. For the purposes of experimentation it became necessary to define the state of 'lostness' in an operational way. The following definition was adopted.

Any person entering either building at any entrance and intending to go directly to M27 (the experimental destination) will get there most efficiently if he follows one of the experimental routes: a person that unintentionally deviates from one of those routes is direction-finding inefficiently and for the purposes of this study will be considered 'lost'.

From each of the town hall entrances the experimental route was the 'accepted and most direct' way of getting to room M27. In addition all of the signing in the buildings meant to direct users to room M27 was located along one of the routes and doormen (when asked) always directed people along these routes. Viewed in this light, a person's deviation from one of these routes could only be regarded as accidental and indeed inefficient.

By adopting this definition, the experimental problem became one of finding out which route a user had begun his trip on and then finding out if he had deviated from it.

Data collection
Interviews were carried out at the experimental destination to find out:
(i) Which entrance the user had entered by,
(ii) Whether or not he had intended to come directly to room M27,
(iii) Whether or not he had become lost – i.e. whether he had deviated from the experimental route,
(iv) And other questions about how much information the user had gained from signs and people and what experience the user had of the route and the building.

Model of the direction-finding process
The human direction-finder was seen as a possessor of a special class of information who elicited certain behaviour of experimental interest. The study was an attempt to relate the presence or absence of various sorts of information in a direction-finder's environment to the observed or inferred behaviour elicited.

Results of analysis of interviews
A hundred and thirty-five successful interviews were made at the entrance to room M27. The percentage of users lost on different routes was not significantly different from one to another. The choice of floor level on which to search for a destination is a direction-finding decision that accounts for 56% of the users that became lost. Over half the errors were due to mis-direction by other human beings.

Lostness and frequency of use
In general the more often a person used the town hall, the greater his success at direction-finding in it. The exception to this rule are those people who were using the building for the first or second time; their success at finding their way was as good as people who used the town hall two or three times a year. This result might be expected for it is likely that a person using a strange environment for the first time will be careful to get proper directions, while a person who has been there previously will think he 'remembers' where to go.
Choice points
People’s success at direction-finding is related (not significantly) with route length and the number of changes in route direction; in that the longer the route and the more changes in route direction the higher the proportion of direction-finders who become lost. The more people using the route, the more people become lost, possibly due to misdirection. The number of route choices also increases the amount of lostness. A choice point is a location where a user has to choose between two or more routes.

Observation of people’s direction finding behaviour revealed that the choice point within the buildings were points at which a user either sought further information on which to base a direction finding decision, or made an apparently expedient decision that was often incorrect.

<table>
<thead>
<tr>
<th>Observed correlation* with ‘lostness’</th>
<th>Probability of observed correlation by chance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route length changes in route</td>
<td>0.56</td>
</tr>
<tr>
<td>Number of direction changes</td>
<td>0.46</td>
</tr>
<tr>
<td>Total number of users</td>
<td>0.85</td>
</tr>
<tr>
<td>Choice points</td>
<td>0.93</td>
</tr>
<tr>
<td>Total choices</td>
<td>0.97</td>
</tr>
</tbody>
</table>

* Pearson product-moment coefficient.
These correlations are for the five experimental routes.

Doorkeepers’ descriptions of choice locations played a central role in determining whether a user found his way successfully. In all cases doorkeepers instructed users by describing physical characteristics of a choice location so that the user could recognize it when he came to them.

However signs rarely displayed descriptive information of this kind. An experiment was carried out to test the effect of a geographically descriptive signing system within the town hall, the hypothesis being tested was: a direction-finder’s behaviour is systematically related to the physical environment he is moving through because the number of decisions he must make is a function of the ‘choice value’ of his route, i.e., the number of yes/no decisions required.

The probability of a correct decision is increased if the physical nature of each succeeding route choice is known to the direction finders and can be recognized upon arrival.

Route descriptive signing system experiment
The experiment consisted of designing a new sign and testing its effect on people’s behaviour at a particular chosen point on a particular route.

The sign contained a symbol to relate the direction finder to the signing system: Housing a symbol that would select the appropriate direction finding response without delay, i.e., an arrow a symbol that would allow a direction finder to anticipate his next decision point and therefore recognize it upon arrival i.e., the words ‘To Lift hall’.

This sign was located so that if the new sign was effective the proportion of errors on this route should approach the same level as those from another route which started at the lift hall and shared the route from that position. The route the sign was installed on, we shall call the test route. We shall compare the percentage of users lost with the control route that entered at the lift hall. Before the sign was installed, the test route users were the least successful at route finding (40% lost). The control route users were more successful (17% lost).

The only altered factor is the sign, so any significant change in the route finding success on the test route could reasonably be attributed to the presence of the experimental sign.

From the data collected before the experiment a regression equation was written predicting percentage lost from the number of route choice points.

\[ Y = 8.8X - 7.26 \]

\[ Y = \% \text{ of users lost along a route} \]
\[ X = \text{the number of route choice points} \]

Test route has six choice points = 45.6% lost.

Stability statistics found no significant differences between the figures of lostness before and after the experiment, on other routes.

With the new sign in place the figure of 19% lost for the test route was that predicted for the situation when the first three choice points were ‘eliminated’ by the sign and was similar to that for the control route (17% lost).

Route uncertainty
The route uncertainty associated with direction finding is indicative of the amount of information a person must process in order to travel its length. Each route choice situation where a yes/no decision is required might then be assigned a ‘bit’ value and its uncertainty assessed in this way. For example a direction-finder passing through a 2-choice situation would have to process one bit of information, a 3-choice situation would require 1.58 bits and so on. A value of route uncertainty is obtained by examining each point along a route and assessing the chances of a direction finder making a correct choice at that point. Thus, if a choice point contains two choices the direction finder has a 0.5 chance of choosing correctly. By multiplying successive choice probabilities together a total value P for the route uncertainty can be obtained.

A regression equation predicts the percentage lost from the route uncertainty.

\[ Y = 9.74X - 12.4 \]

\[ X = \text{Route uncertainty} \]
\[ Y = \% \text{ lostness for the route} \]
Correlation of these predicted values with those derived from the data gave $r = 0.97$. However, this information theory model assumes that a user who did not know where he was going was as likely to make one choice as any other at a given choice point. A direct implication of this highly predictive model is that even though choice locations within a building may vary significantly in their physical nature, direction-finders perform as if they are all the same. This finding is of some interest because a number of hypotheses exist which imply that people make use of various "cues" when moving through buildings and other physical settings: the implication is that people relate their behaviour, or sense of direction, to symbols or cues in their surroundings and in this way are guided along certain paths.

A model of the direction-finding process has thus been founded on the assumption that all choice situations within a building are equally likely to evoke a direction-finding response: interestingly the model fits the empirical data describing people's direction-finding behaviour. This study suggests that an understanding of general architectural cues is not particularly relevant to the solution of direction-finding problems.

**Practical direction-finding problems**

By identifying the number of people presently using each route, it is possible to assess the magnitude of the direction-finding problems, by working out the Uncertainty Value of the route it is possible to predict the total number of people likely to become lost under each set of conditions, if no additional signing is provided. Also by knowing the amount of uncertainty of each route it is possible to predict the amount of sign information to eliminate the lostness generated by the route.

By dealing with the more important destinations of a building in this manner it is possible to predict the savings that would result from a re-allocation of the buildings functions. These potential savings could then be compared with the cost of making the building alterations. It would then be possible to choose whether to provide a signing system for the existing layout or to re-allocate the major destinations, thereby eliminating the need for much of the signing. These same principles have obvious application to the design of new buildings where direction-finding is considered a significant problem.

It would be interesting to see if urban traffic congestion were in anyway related to the degree of uncertainty with a city street pattern. It may well be that where pattern uncertainty is high (where many choices exist for getting from A to B) traffic would be evenly distributed and less congested than in areas where the choice of route is largely contained by one-way streets and other restrictions. It is possible that traffic congestion results as much from the uncertainty associated with a street pattern, as from the capacity or geometry of that pattern. We have always thought of the design of urban traffic systems as a problem of physical design; this could be another example of an apparently physical problem being solved in a non-physical way.