WAYFINDING IN THE HOSPITAL ENVIRONMENT: THE IMPACT OF VARIOUS FLOOR NUMBERING ALTERNATIVES*

JANET REIZENSTEIN CARPMAN

MYRON A. GRANT

DEBORAH A. SIMMONS

University of Michigan

ABSTRACT

Finding one's way around a large, complex building like a hospital is a difficult task at best. Add in the stress that most hospital patients and visitors experience and the task becomes even more arduous. A decision as basic as how floors are numbered can have important ramifications on orientation and wayfinding. A study was designed to discover which of several feasible floor numbering schemes would be most comprehensible to hospital patients (both inpatients and outpatients), visitors (inpatient visitors and outpatient companions), and staff. Patients and visitors were asked to complete a simple wayfinding task as well as to rate each of the floor numbering alternatives for preference; staff rated the alteratives in terms of their overall desirability. The results showed that one option (Sub 1, Sub 2) was interpreted correctly most often and was highly preferred by the patients and visitors interviewed. Conversely, staff members preferred numbering the floors 1, 2. The divergence in preferences and its relationship to wayfinding is discussed.

Finding one's way in an unfamiliar environment can be a trying experience. The importance of being able to orient oneself, locate oneself in space, and know where to go next is fundamental [1, 2]. There is also considerable evidence to support the notion that spatial disorientation can be disruptive to the individual [3]; evidence has been presented by Best to suggest that an unsuccessful

wayfinding experience in of itself can induce stress [4]. Additionally, the lack of orientation reduces an individual's sense of control, ultimately resulting in being lost. If the individual is already under stress, such as in a hospital environment, the unsuccessful wayfinding experience can be even more overwhelming.

In more complicated environments, such as hospitals where levels of stress are already high, each element in the overall design (i.e., signage, color scheme, floor numbering) can play an important role in aiding wayfinding and thus reducing stress. From the user's point of view, being able to find the right floor may be as important as finding his or her way on a particular floor. Best found that mistakes in floor choice constituted the greatest number of wayfinding errors for those trying to locate a particular destination within a town hall [5]. Likewise, Devlin found that in an elderly population, getting off on the wrong floor was a common and frustrating experience [6].

Recognizing that the numbering of hospital floors is likely to be an important factor in the ease with which people find their way around a medical facility, a study was conducted to examine the relative advantages and disadvantages of various floor numbering options. The study was designed in order to discover which of several feasible floor numbering alternatives would be most comprehensible to hospital patients (both inpatients and outpatients), visitors (inpatient visitors as well as outpatient companions), and staff.

THE PROBLEM

The construction of a new adult general hospital by the University of Michigan made the question of adoption of an effective floor numbering system particularly timely. As designed, the new hospital (see Figure 1) will have two floors below the main entry level, one of which continues into the new ambulatory care facility (a separate building sharing a common wall). Both the floor directly below the main entry level of the hospital and the next floor down will house a variety of units (e.g., respiratory therapy, emergency, diagnostic radiology) which will serve as common patient and visitor destinations. Given this spatial arrangement, the task was to develop a floor numbering scheme that would be legible. Since floor numbers would have to be abbreviated to fit on elevator buttons, no more than four characters were used for any of the options. The five options tested were: A, B; B1, B2; Sub 1, Sub 2; 1, 2; and LL1, LL2 (see Figure 2).

STUDY PROCEDURE

Sixty randomly sampled patients and visitors (15 inpatients, 15 outpatients, 15 inpatient visitors, and 15 outpatient companions) at the University of Michigan Hospitals were interviewed during November, 1982. Inpatients were randomly sampled by hospital room and bed number. Approximately half the inpatient visitors were sampled in hospital waiting rooms and half in patient
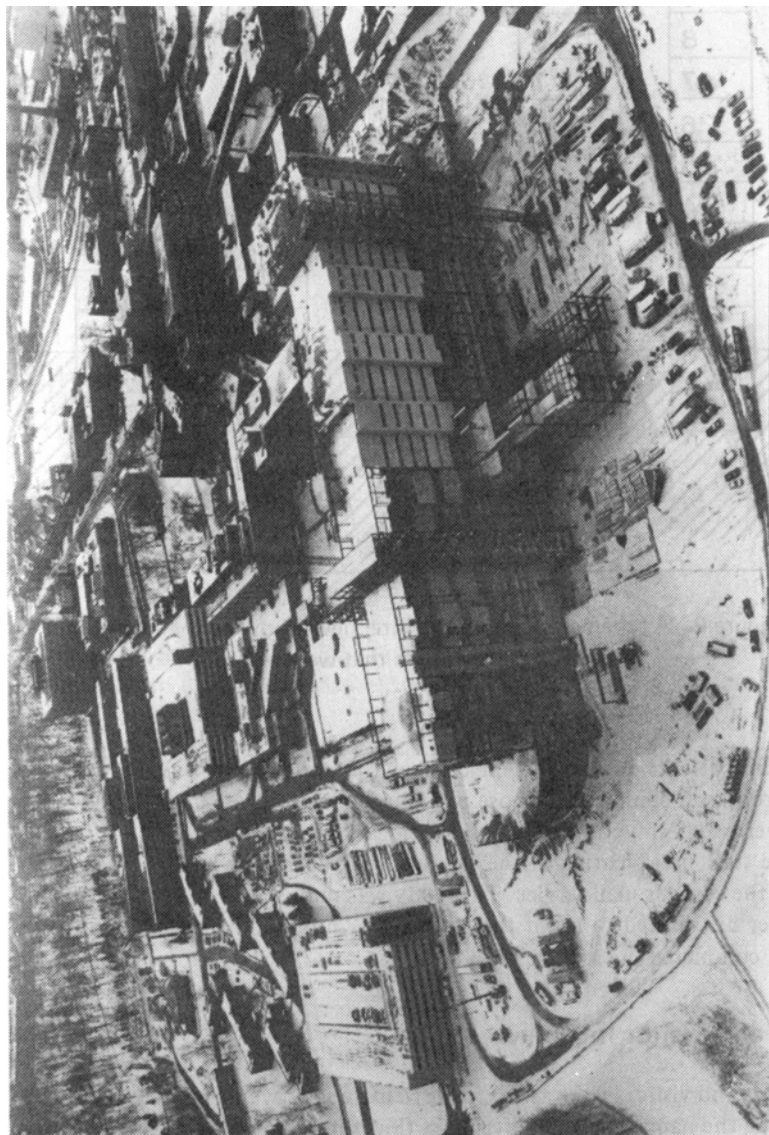
Figure 1. An aerial view of the Adult General Hospital portion of the University of Michigan Hospitals, as it was being constructed in the winter of 1983.

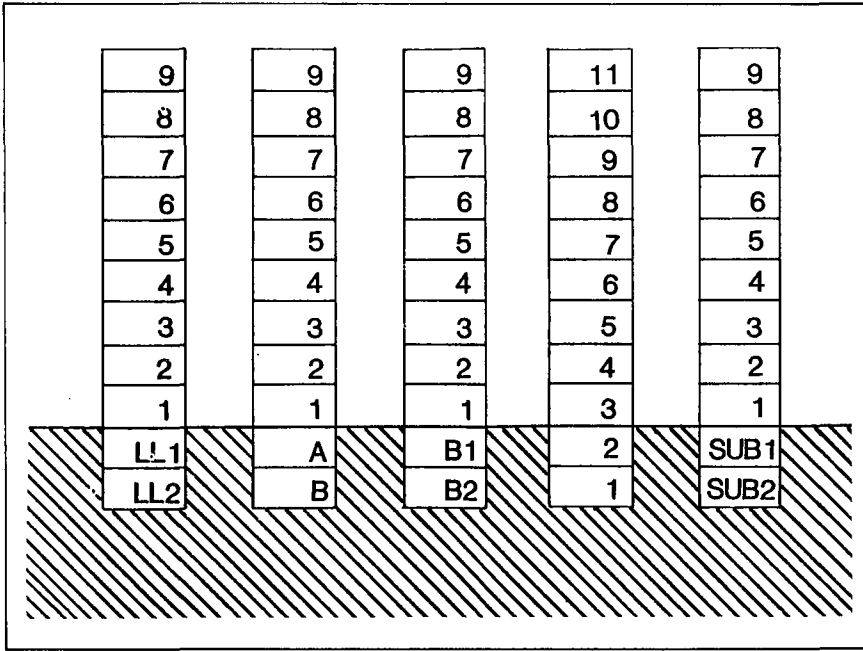| 9		9		9		11		9
8		8		8		10		8
7		7		7		9		7
6		6		6		8		6
5		5		5		7		5
4		4		4		6		4
3		3		3		5		3
2		2		2		4		2
1		1		1		3		1
LL1		A		B1		2		SUB1
LL2		B		B2		1		SUB2

Figure 2. A schematic used in the interviews showing the five floor numbering alternatives that were tested.

rooms. Outpatients and outpatient companions were sampled from hospital waiting rooms in clinic areas. Those participants interviewed in hospital waiting rooms were randomly sampled by seating location.

Those staff participating in the study filled out a survey and returned it through the campus mail service. The study was published as part of a hospital newsletter distributed to all of the staff. Three-hundred-fifty staff members returned completed questionnaires.

Patient and Visitor Interview

Patients and visitors were asked to participate in a twenty-minute interview concerning the naming and numbering of floors in the new hospital. Participants were asked a series of questions concerning: 1) the clarity of various options in relation to a simple wayfinding task, 2) their rating of each option regarding its overall desirability, 3) their choice of the "best" and "worst" options, and finally, 4) their preferred name for the entry floor.

Staff Survey

The staff survey covered questions concerning: 1) how many times in the past week participants had been asked to give directions, 2) their rating of each option regarding its overall desirability and, 3) their choice of the "best" and "worst" options.

RESULTS

Patient and Visitor Responses

Clarity of the floor numbering options in relation to a wayfinding task—The participants were shown a simple drawing of the cross section of a generic building, showing two floors below grade and five floors above grade (Figure 3). Each participant was asked to locate a series of floors on the drawing (e.g., If you were told your appointment was on floor B2, where on this drawing would you expect to find it?)
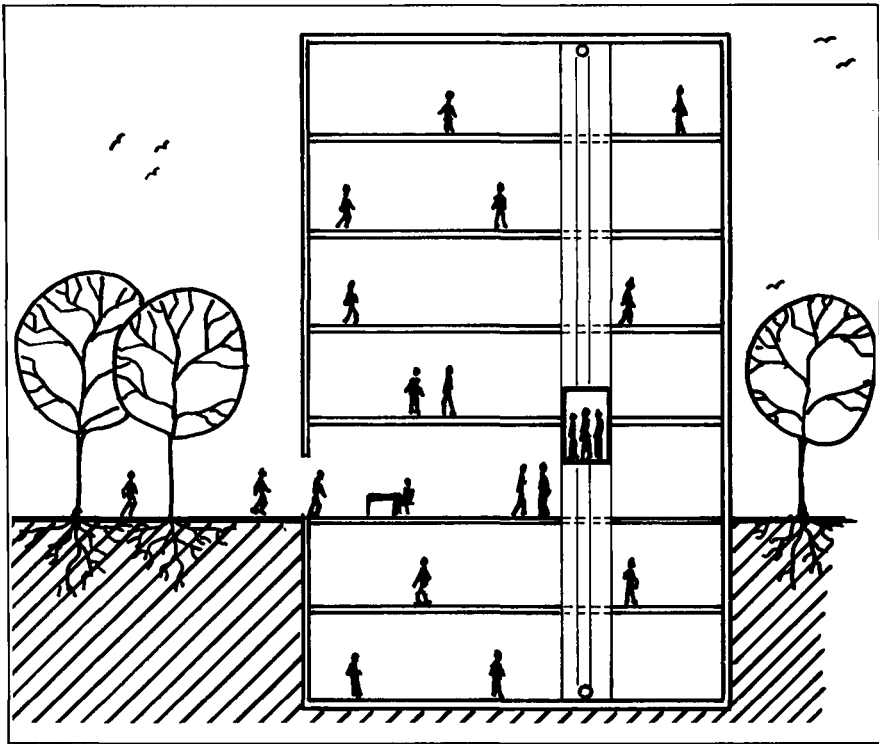

Figure 3. The cross section of a generic building, showing two floors below grade and five floors above grade level.

As can be seen in Table 1, there was a considerable amount of variation among the options in terms of the percent of correct and incorrect responses. With 53 percent of the participants correctly locating both Sub 1 and Sub 2, this option represents the floor numbering scheme that generated the highest degree of accuracy and generally seemed to be the most clearly understood. The floor numbering alternatives with the next highest degree of accuracy in terms of clearly defining a particular floor, were B1, B2 (37% and 38% correct respectively) and LL1, LL2 (30% and 44% correct respectively). It should be pointed out, though, that for both sets of options, B1, B2 and LL1, LL2, the participants chose a floor below grade level (i.e., in the right direction) approximately half the time.

For the floor numbering alternatives 1, 2 and A, B, the participants located the correct floor far less often. Interestingly though, the participants located these floors in a consistent pattern even though this pattern did not match the "correct" responses conventionally used by the designers. Consequently, while only 30 percent identified floor 1 as the lowest level, 47 percent located it at the entry level. Likewise, only 19 percent identified floor 2 as the second lowest level; most of the participants (72%) thought floor 2 would be found one floor above the entry level.

The floor numbering option A, B produced the greatest number of inaccurate responses. Only 3 percent of the participants identified floor A as being located one floor below grade; more often, 69 percent of the time, it was thought to be

Table 1. Percentage of Correct and Incorrect Responses:
Simple Wayfinding Task

Floor Numbering Option	Percentage of Correct and Incorrect Responses	
	Correct Response Percent	Incorrect Response Percent
B1	37	63
B2	38	62
Sub 1	53	47
Sub 2	53	47
LL1	30	70
LL2	44	56
1	30	70
2	19	81
A	3	97
B	10	90

N = 30 (each participant was only asked to locate 5 of the possible 10 alternatives)

the entry level floor. Floor B was located on the lowest level (correct response) 10 percent of the time, one floor below grade 43 percent of the time, and one floor above grade 30 percent of the time.

Patient and visitor preference for floor numbering schemes—The participants were also asked to rate (on a scale of 1 to 5) each of the floor numbering alternatives in terms of how good or bad of a possibility it was. As can be seen in Table 2, the floor numbering option B1, B2 was the most highly preferred, significantly more preferred than 1, 2; LL1, LL2; and A, B. These three least preferred alternatives (1, 2; LL1, LL2; and A, B) were not found to be significantly different from one another.

Interestingly, when the two measures are compared, an example of convergent validity emerges. The preference findings are relatively consistent with the results of the wayfinding task. The alternatives B1, B2 and Sub 1, Sub 2 were both more preferred and more likely to generate correct responses during the wayfinding task. Likewise, the least preferred option A, B generated the greatest number of incorrect responses.

Patient and visitor choice of "best" and "worst" option—A second method of measuring the participants' preference for the various floor numbering options was attempted. Participants were asked to select which of the five alternatives was "best" and which was "worst." As can be seen in Table 3, this measure of preference provides a less than clear picture on which to base a design solution. With the exception of the A, B floor numbering option, the participants seemed to be fairly evenly divided among the other four schemes in terms of "best" solution.

LL1, LL2 was found to be the "worst" solution by 37 percent of the participants, followed by A, B (29%) and 1, 2 (22.6%). The smaller percentage

Table 2. Preference Ratings for the Floor Numbering Options:
Patient and Visitor Responses

Floor Numbering Option	Mean Score
B1/B2	3.48
Sub 1/Sub 2	3.27
1/2	2.90
LL1/LL2	2.65
A/B	2.53

Items connected by brackets are not significantly different in terms of mean rating (significance level = .02). A standard *t*-test was used to determine statistical differences.
   N = 62

Table 3. Percent Time Best and Worst Options Were Selected:
Patient and Visitor Responses

Floor Numbering Option	Best Option Percent	Worst Option Percent
B1/B2	29.0	3.2
Sub 1/Sub 2	19.4	8.1
LL1/LL2	22.6	37.1
1/2	25.8	22.6
A/B	3.2	29.0
N = 62		

of participants choosing B1, B2 and Sub 1, Sub 2 as the "worst" options is consistent with the preference rating results discussed previously. Although asking which alternatives were "best" and "worst" provided no clear solution, the results were generally consistent with previous findings.

Naming of the entry level–Finally, patients and visitors were asked what name they would give to the entry level floor. Over 50 percent of the respondents said they would call this the "Main" floor. Nineteen percent said they would call it the "ground" floor while 11 percent would call it the "lobby," 6.5 percent would name it floor "3," and a small percentage (between 2 and 3%) would call it "one," "entrance," "main lobby," "admitting," or "G1."

Staff Responses to the Questionnaire

While patients and visitors may have particular wayfinding needs because of their unfamiliarity with the hospital environment, the staff who must move about the hospital efficiently on a continuing basis may display somewhat different needs. Consequently, staff responses to the various floor numbering alternatives were also elicited.

Staff preferences for floor numbering options–Those staff members responding to the survey were asked to rate (on a 1 to 5 scale) each of the five floor numbering options in terms of its overall desirability. As can be seen in Table 4, numbering the lower most floors 1, 2 was the more preferred alternative, significantly more preferred than any of the other options. Likewise, the alternative of labeling the two lowest floors A, B was significantly less preferred than any other option. Interestingly, even though numbering the floors 1, 2 was given a significantly higher rating, with a mean of 2.98 on the preference scale, it was considered only a satisfactory alternative. That is, from the staff's point of view, none of the alternatives was particularly well liked.

Table 4. Preference Ratings for the Floor Numbering
Options: Staff Responses

Floor Numbering Option	Mean Score
1/2	2.98
LL1/LL2	2.69 ⎤
Sub 1/Sub 2	2.50 ⎬
B1/B2	2.43 ⎦
A/B	2.15

Items connected by brackets are not significantly
different in terms of mean rating (significance level = .05).
A standard t-test was used to determine statistical
differences.
N = 333

Table 5. Percent Time Best and Worst Option
Were Selected: Staff Responses

Floor Numbering Option	Best Option Percent	Worst Option Percent
B1/B2	11.0	4.9
Sub 1/Sub 2	17.3	22.2
1/2	37.0	21.9
LL1/LL2	26.3	20.1
A/B	8.4	31.0

N = 335

Staff choice of "best" and "worst" option—Just as in the patient/visitor
interview, the staff were asked to select an overall "best" and "worst" option.
The results of the choice of a "best" option (Table 5) are consistent with the
preference ratings described above. Numbering the two lowest floors 1, 2 was
considered "best" 37.0 percent of the time, followed by LL1, LL2 (26.3%);
Sub 1, Sub 2 (17.3%); B1, B2 (11.0%); and A, B (8.4%).

However, the selection of a "worst" alternative was less clear. The option of
labeling the lower two floors A, B was considered "worst" by 31.0 percent of
the participants. Interestingly, the options of numbering the floors 1, 2; LL1,
LL2; and Sub 1, Sub 2 were considered "worst" 21.9 percent, 20.1 percent, and
22.2 percent of the time respectively; B1, B2 was considered "worst" by only
4.9 percent of the participants.

Comparing the ratings of "best" and "worst" provides an interesting design dilemma. Although 37.0 percent thought numbering the floors 1, 2 was "best," 21.9 percent thought it was "worst." From a design decision point of view, one would expect an alternative that was clearly "better" to be selected as such by the participants. However, one must worry if a similarly high percentage also selects it as the "worst" alternative.

Comparing Patient/Visitor and Staff Responses

Although the staff are aware of wayfinding problems in the hospital (78% reported giving directions 3 or more times in the previous week), their perception of an ideal floor numbering scheme was not necessarily similar to that of the patients and visitors. As can be seen in Table 6, the preference ratings of the staff as compared to those of the patients/visitors for the various alternatives are quite different. Of the five alternatives, similar, non-statistically significant different ratings were given to only LL1, LL2 and 1, 2. Otherwise, the staff ratings for B1, B2; Sub 1, Sub 2; and A, B were found to be significantly lower than the patient/visitor ratings of these alternatives. That the staff tended to give lower overall ratings to the alternatives provides some insight into these differences. Consequently, even though the staff rated A, B significantly lower than the patients and visitors, in both groups A, B was the least preferred of the alternatives. On the other hand, while the patients/visitors considered B1, B2 and Sub 1, Sub 2 to be the more highly preferred alternatives, the staff rated both of these alternatives below 1, 2 and LL1, LL2.

For the patients and visitors, the floor numbering alternatives Sub 1, Sub 2 and B1, B2 represented relatively clearly defined destinations—they were fairly successful in locating these floors and tended to prefer them. However, while wayfinding may have been an important criteria in deciding on a floor numbering scheme for the staff, the image projected by the option was also

Table 6. Comparison of Staff and Patients/Visitors Preferences
for Floor Numbering Options

Floor Numbering Option	Patients/ Visitors N = 62	Staff N = 338	T-Score	Significance
B1/B2	3.48	2.43	5.8140	**
Sub 1/Sub 2	3.27	2.50	3.8438	**
1/2	2.90	2.98	− .3202	
LL1/LL2	2.65	2.69	− .1998	
A/B	2.53	2.15	2.2072	*

* significant at the .05 level
** significant at the .0001 level

considered. Many of the staff reported that any alternative that suggested that the floors were in the basement (i.e., B1, B2 and Sub 1, Sub 2) produced a bad image. They felt that it might be demoralizing to the staff and they feared that patients would not want to be treated in a basement.

It is useful to note that the floor numbering scheme in the existing hospital is to give floors below grade designations such as 1, 2, 3.

Discussion and Recommendations

The ultimate purpose of this study was to determine the most appropriate floor numbering scheme for the new University of Michigan Adult General Hospital. Realizing the role a floor numbering scheme may play in successfully being able to find one's way within the hospital, patients and visitors were asked to complete a simple wayfinding task as well as to indicate their preference for various alternatives. From the results of these interviews, the option that was interpreted correctly most often as well as being highly preferred by patients and visitors was Sub 1, Sub 2.

From a wayfinding perspective, Sub 1, Sub 2 gives the user a clear point of reference and a clear distance to travel. To most people, "Sub" designated something that might be found below and Sub 1 meant one floor below entry, while Sub 2 meant two floors below entry. None of the other alternatives provided as clear a point of reference. With A, B and B1, B2 the users did not know which was closest to the ground; with LL1, LL2 the participants found it difficult to interpret "LL," and with 1, 2 there was confusion about where floor counting began—at the lowest level or at the entry floor.

The results are somewhat clouded when the patient/visitor responses are compared with staff responses. For the most part, staff members surveyed preferred numbering the floors 1, 2. However, this preference seems to be influenced by the concern that other floor numbering alternatives (i.e., B1, B2 and Sub 1, Sub 2) project a poor image. Some staff expressed a concern that in naming the floors B1, B2 or Sub 1, Sub 2, the lower two floors would be thought of as being in the basement. The ability of a floor numbering scheme to project an image is particularly interesting if not directly related to wayfinding concerns. However, in selecting an alternative that seems to best meet the wayfinding needs of the patients and visitors (i.e., Sub 1, Sub 2), some methods of moderating the "basement" image of the space must also be addressed by the designers.

REFERENCES

1. S. Kaplan, Adaptation, Structure, and Knowledge, in *Environmental Knowing: Theories, Research and Methods*, Gary T. Moore and Reginald G. Golledge (eds.), Dowden, Hutchinson, and Ross, Inc., Pennsylvania, 1976.

2. K. Lynch, *The Image of the City*, MIT Press, Cambridge, Massachusetts, 1960.
3. G. D. Weisman, Way-Finding and Architectural Legibility: Design Considerations in Housing Environments for the Elderly, in *Housing for the Elderly: Satisfaction and Preferences*, V. Regnier and J. Pyncos (eds.), Garland Publishing Inc., New York, 1982.
4. G. A. Best, Direction-Finding in Large Buildings, in *Architectural Psychology: Proceedings of the Conference at Dalandhui, University of Strathclyde*, D. Canter (ed.), Royal Institute of British Architects, 1969.
5. _____, Direction-Finding in Large Buildings, Msc thesis, University of Manchester, 1967.
6. A. Devlin, Housing for the Elderly—Cognitive Considerations, *Environment and Behavior, 12*:4, 1980.

Direct reprint requests to:

Janet Reizenstein Carpman
University of Michigan
Office of Hospital Planning, Research
    and Development
Box 50, North Ingalls Building
Ann Arbor, MI 48109