Not Another Step! Economy of Movement and Pedestrian Choice Point Behavior in Shopping Malls

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ABSTRACT: People walk through the built environment in predictable ways. Choice movement of pedestrians at intersections in public places conforms to the principle of economy of movement or effort. To test this principle, pedestrians at two shopping malls were observed at three major intersections. Pedestrians navigated the intersections with the fewest number of steps. Choice point movement almost always avoided the crossover turning patterns that required more steps (i.e., turning left from the right-hand side of the corridor or turning right from the left-hand side). The findings support the argument that economy of movement explains much or most of the patterns of movement including right turning (when it does occur). These findings are consistent with a cost-benefit analysis of behavior: People attempt to reduce the cost (in this case, number of steps taken) in order to maximize the benefits of their behavior.

Keywords: *pedestrian circulation; pedestrian traffic patterns; choice point movement; movement in public places; behavior in shopping malls*

How people move through public spaces has important implications for users, architects, and other designers of public spaces. Pedestrian choice at intersections is one element of such movement that has received scrutiny across the years. One of the most frequently reported findings is a tendency for people to turn right at a choice point or intersection (Melton, 1935;

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Serrell, 1997; Underhill, 1999). Identification of empirical principles that influence this and similar behaviors are important to improve the design of the built environment.

Although some studies in museums, zoos, and aquaria have reported a strong tendency to turn right at a choice point, others have not. Bitgood (1995) reviewed the conflicting literature and concluded that the right-turn principle works only in the absence of other strong directional factors such as landmark attractors. We now believe that there is a little more to the story. That is, when right turning occurs, it involves the least amount of movement or effort.

The design of public spaces is critical in determining whether right turning (or any other behavioral tendency) occurs. The physical shape of the environment, its relationship to other spaces, and the presence of factors such as salient objects and direction signs must be considered. For example, in exhibit centers such as museums and zoos, there is a strong tendency for people to approach an attractive object. Whyte (1980) reported a similar phenomenon in city plazas. To overcome the economy of movement motivation, however, the perceived benefits of approaching an attractive object must outweigh the perceived cost of the effort.

According to the current hypothesis, right turning is an example of economy of movement because turning right, when it does occur, is motivated by taking the fewest number of steps. Consider Figure 1. When people come to an intersection with the traditional four-path, 90 degree angle on each arm of the intersection, they are generally on the right side of the path. The most economical choice is to turn right (Figure 1a) unless they desire to go straight (Figure 1b). On the other hand, if one approaches the intersection on the left-hand side of the path, it would be more economical to turn left (Figure 1d) or proceed straight ahead (Figure 1e). Because people tend to walk on the right, most pedestrians are on the right when they come to a choice point and consequently turn right. On the other hand, when people have a destination that requires a left turn, they move to the left of the path before reaching the intersection and then turn left—the most economical way to move. This explanation is simple and appears to account for empirical reports in the literature.

The tendency to walk on the right side of a path is a common finding (at least in the United States). The sociologist William Whyte (1980, 1988) has studied people's behavior in city plazas and on city streets. Whyte (1988), in his chapter on the "skilled pedestrian," summarized the pattern of walking on the right of city sidewalks:

> Pedestrians usually walk on the right. (Deranged people and oddballs are more likely to go left, against the flow.) (p. 57)

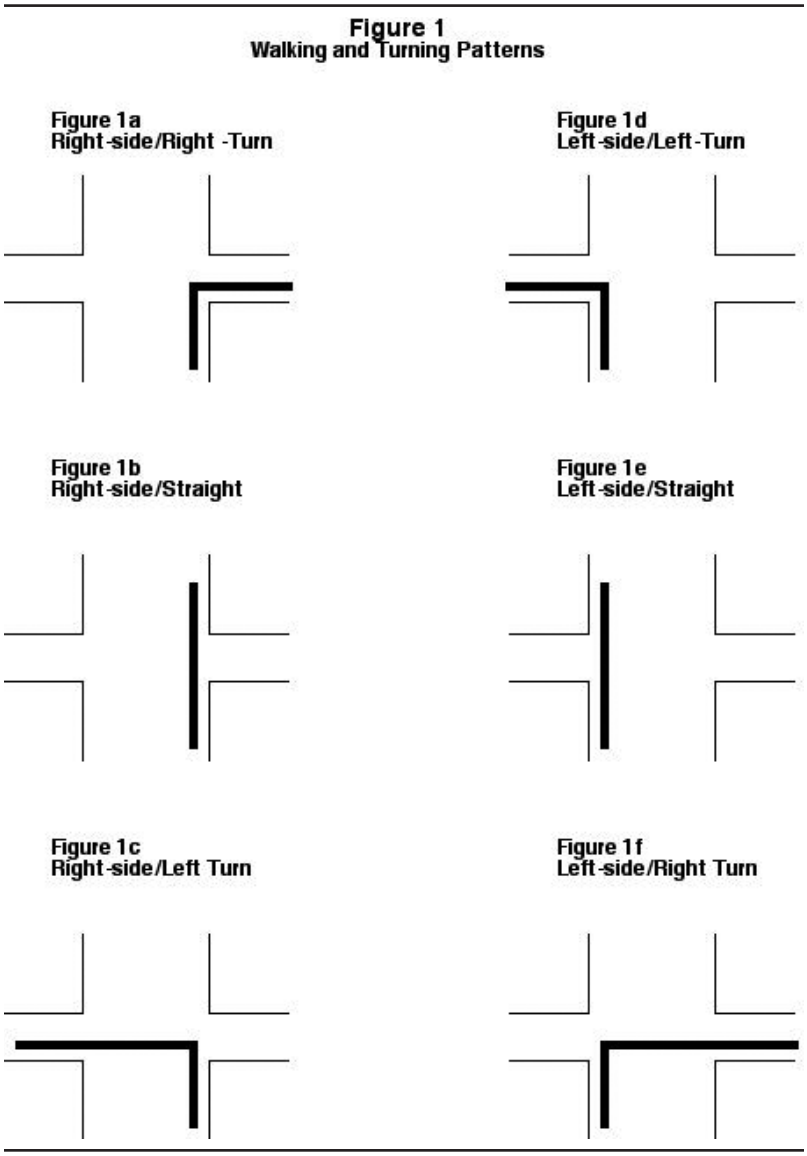

Figure 1 Walking and Turning Patterns

This description of New York City pedestrians, despite his tongue-in-cheek humor, also describes people's movement in many other public places. People tend to stay to the right as they walk. But, contrary to Whyte's (1988)

implication, those who walk on the left are not necessarily deranged or oddballs—they may have a left-turn destination.

If visitors enter a room or hall on the right side of the door, then turning right is the most economical response. However, if visitors enter along the left-hand wall, then turning left is the most economical response. The following literature appears consistent with this analysis.

Melton (1935) reported a preponderance of right-turning behavior in several art museum galleries. From 70% to 80% of visitors turned right as they entered the gallery. It is important to note that the entrance door was centered, so visitors had to turn right or left to view the artwork on the wall, and there were no objects in the middle of the gallery to pull the visitor toward the middle. Melton's data does not tell us if the left-turning visitors were on the left side of the path as they entered or if the right-turning visitors were on the right of the path. Given our proposed hypothesis of the economy of movement and effort, it would be instructive to know this information.

Melton (1935) also reported a strong tendency for visitors to exit at the first open door. It is not clear if the motivation for this behavior is also an example of economy of motion. It is possible that visitors perceive that it would be more economical to visually peruse the exhibit gallery (rather than approach each object) and then explore another gallery to see the entire museum.

Yoshioka (1942) observed a right-turn bias for one exhibition hall ("Hall of Man") but not for another ("Hall of Medicine") at the World's Fair in New York. This setting was considerably more complex than that of Melton. Each hall at the World's Fair had multiple entrances and exits. Yoshioka reported varying turning percentages for each entrance of these halls. He attributed the lack of right-turning dominance in the "Hall of Medicine" to attraction of exhibits near the entrance (salient object attraction). The "Hall of Man" did not have the four-path, 90 degree angle to each arm of the intersection (as shown in Figure 1) that was found in the "Hall of Medicine." In addition, exhibit displays seemed to be arranged so that they attracted visitors and drew them to the right.

Weiss & Boutourline (1963) also reported a right-turn bias in a museum setting as well as a tendency to circulate in a counterclockwise direction, depending on the design of exhibits and the design of the entire hall. These researchers recognized that the design of the space determined whether right turning occurred, although they did not venture an explanation for this behavior pattern.

Parsons and Loomis (1973) found that the right-turning principle did not hold in the pharmacy exhibition at the National Museum of History and Technology, probably because of the attraction of "landmark" exhibits. They reported that 60% did not turn right. This exhibition hall was also

considerably more complex than those studied by Melton (1935). In addition, these researchers found different traffic patterns when the museum was crowded. It is likely that fighting oncoming pedestrian traffic flow during crowded conditions is perceived as too much effort, thus encouraging a path of least resistance.

Shettel (1976), in his evaluation of "Man in His Environment" at the Field Museum of Natural History, provided a detailed analysis of visitor movements in the exhibition. He reported that 73% of visitors entered on the right side of the "Sphere of Life" and most stayed on that side, failing to view exhibits on the left side. One-sided viewing is a common observation in museum exhibitions and is also explained by economy of movement.

Taylor (1986) reported predominately right-hand turns and counterclockwise flow at the Steinhart Aquarium in San Francisco. Although Taylor did not report it, analysis of the floor plan of the aquarium suggests that it was designed so that turning right was the most economical move. That is, fewer steps were required to turn right if the visitor is walking on the right side of the path. The first intersection in the aquarium was a "T," with the choice of turning right or left (there was no option to go straight). Taylor also reported that visitors were reluctant to backtrack to see all of the exhibits (another example of economy of movement).

Deans, Martin, Neon, Nuesa, and O'Reilly (1987) reported a study at the Reid Park Zoo in which visitors were asked to retrace (on paper) their circulation route through the zoo. The most common circulation pattern involved turning right and circulating counterclockwise on the periphery of the zoo, essentially making a circle, but not using paths that connect one part of the outer circle with another. Of the 43% who followed the perimeter path, 78% of these visitors turned right. Because following the perimeter path exclusively (rather than using connecting paths as well) would save a large number of steps, this behavior can be interpreted as an application of economy of movement.

Bitgood, Hines, Hamberger, and Ford (1992) did not observe a majority of visitors turning right in any of several exhibitions in a changing exhibit gallery at the Anniston Museum of Natural History. Although the circulation patterns of the visitor changed from one exhibition to another, there was no strong tendency to turn right or to circulate in a counterclockwise direction. For two of the exhibitions (bird illustrations and dinosaurs), more than 70% remained on the left-hand wall after they entered. In the Edgerton exhibition, 60% stayed along the left wall; for the "Faces of Destiny" exhibition, 56% stayed along the left wall. In only one exhibition did fewer than 50% of visitors walk along this wall. In no case did more than 33% turn right. The architectural characteristics of the exhibit hall and the layout of exhibit displays

seemed to dictate the direction of traffic flow. The most important architectural characteristic of this gallery was the fact that visitors entered along the left wall. In addition, it is important to note that there was only one entrance and exit. Visitors left by the same door as they entered.

Underhill (1999) argued that right turning is the major pattern in retail stores and discussed the importance of this factor for retail design. However, he did not offer specific, quantitative reports of his data. He also did not indicate that the pattern might be influenced by the design of the space. A detailed quantitative analysis of movement in retail settings would be helpful.

The above review provides considerable indirect support for the economy of movement hypothesis. However, to date, no study has examined choice point behavior as it relates to whether the pedestrian is walking on the right or left side of the pathway prior to the choice behavior. Given our economy of movement principle, it is necessary to examine both choice behavior and the side of the pathway in which movement occurs.

To provide a direct test of the hypothesis that pedestrian choice-point behavior at intersections is motivated by economy of movement, we observed people's turning behavior as a function of right- or left-sided walking at two small shopping malls in northeast Alabama. Both malls contained several anchor stores (Sears, JCPenney, etc.) and several intersecting corridors.

METHOD

Shopping Mall 1, after a recent $40 million expansion, claims to contain 720,000 square feet of leasable area, making it the 14th largest in Alabama. It has three anchor stores: Dillards, JCPenney, and Sears. Shopping Mall 2 includes 489,312 square feet of retail, with four anchor stores: Belk, JCPenney, McRae?s, and Sears. Observations were recorded in one of the main intersections in Mall 1 and in two of the intersections in Mall 2.

The intersections selected for recording were of the type shown in Figure 1 and were selected because there was a large traffic flow and a significant number of destinations for each direction. From a single direction, six possible traffic patterns were examined to account for the combinations of walking on the right or left side of the path and turning right or left or continuing straight ahead. Thus, a right-side/right-turn pattern (Figure 1a) would signify an individual who was walking on the right side and turned right. A right-side/left-turn (Figure 1c) pattern signifies walking on the right side and turning left.

The floor plan of Mall 1 can be described as an inverted T shape or cross. The intersection studied was located between JCPenney and Sears along one

corridor and the main entrance and Dillards along the single arm of the T. In Mall 2, two intersections were studied. One was located between Sears and McRae?s along one corridor and the movie theaters and Belk along the shorter arms. The other intersection was on the same corridor, at the opposite end of the mall, close to Sears. Both malls contained seating benches in the intersection. In addition, Mall 2 had a water fountain in the center of one of the intersections (the site of Samples 3, 4, and 5).

The current hypothesis suggests that economic turning combinations (i.e., fewest number of steps) include the following: (1) from the right side of the corridor and making a right turn, (2) from the right side of the corridor and continuing straight ahead, (3) from the left side of the corridor and making a left turn (Figure 1d), and (4) from the left side of the corridor and continuing straight ahead. The two patterns not economical in terms of number of total steps involved crossing over from one side to the other are turning from the right side of the corridor and making a left turn (Figure 1c) and turning from the left side of the corridor and making a right turn (Figure 1f).

All samples were of pedestrian traffic coming from one direction. A group was selected as it passed an imaginary line on the floor approximately 20 feet before it reached the intersection. If visitors were moving from one side of the corridor to the other across these 20 feet, they were counted as walking on the latter side as long as the move was complete before they reached the intersection (as measured by the end of the last retail store). Once the group passed, the pattern was coded as one of the six possible in Figure 1. Once a group was recorded, the next group to pass the imaginary line was selected, until a minimum of 100 groups had been recorded.

Between 100 and 105 groups were observed for each of the five samples (see Table 1). Sample 1 was collected in Mall 1 and comprised 100 groups approaching from the south, where JCPenney was located. Sample 2 was collected in Mall 2 with pedestrians approaching from the west (Sears). Samples 3, 4, and 5 were all taken in Mall 2. Sample 3 included 105 pedestrian groups approaching from the west (McRae?s) and Samples 4 and 5 included 100 and 103 groups, respectively, approach from the east (Sears). Samples 4 and 5 were collected independently and during the same time period to serve as a reliability check for the recording procedure.

RESULTS AND DISCUSSION

Table 2 summarizes the pedestrian traffic flow at intersections for the five samples in the two malls. Note that because the sample sizes were between

TABLE 1
Samples of Pedestrians, Locations, and Direction of Flow

Sample	N	*Location*	*Intersection*	*Direction of Flow*
1	100	Mall 1	Between Sears and JCPenney	From the south
2	100	Mall 2	Between Sears and McRae's	From the south
3	105	Mall 2	Between Belk and cinema	From the east
4	100	Mall 2	Between Belk and cinema	From the west
5	103	Mall 2	Between Belk and cinema	From the west

NOTE: Samples 4 and 5 served as a reliability check.

TABLE 2
Choice Point Behavior for Each Sample at Mall Intersections

Pattern	*Sample 1*	*Sample 2*	*Sample 3*	*Sample 4*	*Sample 5*
Right side to right turn	52	58	30	17	19
Right side to straight ahead	34	27	60	30	33
Right side to left turn	2	0	1	6	2
Left side to left turn	11	10	9	18	22
Left side to straight ahead	1	5	5	28	27
Left side to right turn	0	0	0	1	0
Total	100	100	105	100	103

100 and 105 groups, the frequency approximates percentages. Thus, 52 groups turning right from the right side of the corridor represent 52% of the observed groups.

ECONOMY OF MOVEMENT

In all samples, pedestrians almost always chose the path that required the fewest number of steps. In Sample 1, 86% of the right-side walkers turned right or continued straight. All 12 left-side groups turned left or continued straight ahead. As Table 2 reveals, other samples showed a similar pattern of economy of steps. Only rarely did pedestrians cross over at the intersection (i.e., turn from the right side of the corridor to the left side or from the left side of the corridor to the right side). Crossover frequencies were 2, 0, 7, 2, and 1, for each of the five samples, respectively. Frequently, pedestrians were observed crossing to the other side of the corridor before reaching the intersection and then turning left, if they had moved to the left side, or right, if they had moved to the right side of the corridor.

RIGHT-SIDE WALKING

For three of the four locations, the numbers of right-side groups were 85, 88, and 91. However, for Samples 4 and 5 (both were independent measures of pedestrians from the west or from the direction of Sears), only 53 and 54 right-side groups were observed. This lower rate of right-side walkers may have been because of a simulation ride on the right side of the fountain which, if walking straight through the intersection, made walking to the right involve a greater distance than did walking to the left (another example of saving steps). Another possible factor was presence of an anchor store (Belk) on the left side of the corridor.

RIGHT TURNING

For two intersections (one in each mall), more than one half of the visitors turned right (52% and 58%, respectively). However, only 30 of the groups turned right for Sample 3, and 17 and 19 turned right for Samples 4 and 5, respectively. Obviously, turning right is not a consistent pattern of choice point behavior at intersections. Note that pedestrians walking on the left side of the corridor almost never turned right. Only one group out of 508 observations actually turned right from the left corridor.

RELIABILITY CHECK

A comparison of Samples 4 and 5 suggest a very similar pattern of traffic flow by independent observers obtained during the same interval of time. For example, right-side/right-turn frequencies were 17 and 19, respectively. Because the groups selected by each observer were obtained independently, the high level of agreement between observers suggests that the samples represent the actual traffic flow rather than being contaminated by selection bias.

GENERAL DISCUSSION

The results of this study combined with the literature suggest that economy of movement is a powerful empirical principle in understanding how pedestrians move through their environment. Unlike previous studies of choice point movement, the current study associated the choice at intersections with side of pathway before the choice. This method allowed more valid assessment of the economy of movement principle.

Although this study used naturalistic observation rather than experimental manipulation, the methodology incorporated systematic replication across settings (four different intersections at two shopping malls) and a reliability check. Thus, both reliability and threats to validity were addressed. If the economy principle is not invoked, it is difficult to explain why pedestrians almost never turned from the right side of the corridor to the left or from the left side of the corridor to the right. Two alternative explanations (destination and crowding) are unlikely, given the pattern of results.

First, it is difficult to argue that the pedestrian's destination determined the patterns, because a higher number of crossover movements from one side of the corridor to the opposite arm of the intersection would have occurred in at least some of the samples. Pedestrians were observed moving to the opposite side of the corridor before reaching the intersection if their destination required a crossover pattern of turning, thus minimizing the extra steps at the intersection itself. Clearly, people anticipated and avoided the extra steps necessary to cross over by moving to the other side of the pathway before reaching the intersection.

A second explanation that might be considered for these findings is crowding. It is reasonable to hypothesize that the extra effort of confronting oncoming crowds would discourage these crossover patterns. However, if this were true, there should be a different pattern under crowded conditions than under uncrowded conditions. This was not the case. In fact, the mall intersections were not crowded enough to make a crossover turn difficult.

Economy of movement can be viewed as a way people minimize the cost or workload (time and effort) of their behavior. Minimizing effort often maximizes the benefits of an experience. For example, in museums, saving steps is likely to postpone the onset of museum fatigue and to allow a more valuable experience. In this light, economy of effort is a corollary of a cost-benefit model of behavior in which the costs (time and effort) are divided into the benefits (value of the experience). If such an analysis is valid, there is an important implication when costs are divided into benefits: Choice behavior will be more strongly influenced by the costs than by the benefits. This outcome can be seen by comparing two possible outcomes: holding cost constant and varying benefits versus holding benefits constant and varying costs (see Fig. 2). As shown in this graph, behavioral outcomes are improved much more dramatically when the costs are reduced than when the benefits are increased. Applying this to exhibition centers, visitors will read more labels when the cost is small (few words) than when the benefits are increased (more interesting content).

Too often, architects and other designers of public spaces such as museum exhibitions fail to recognize the economy of movement principle and

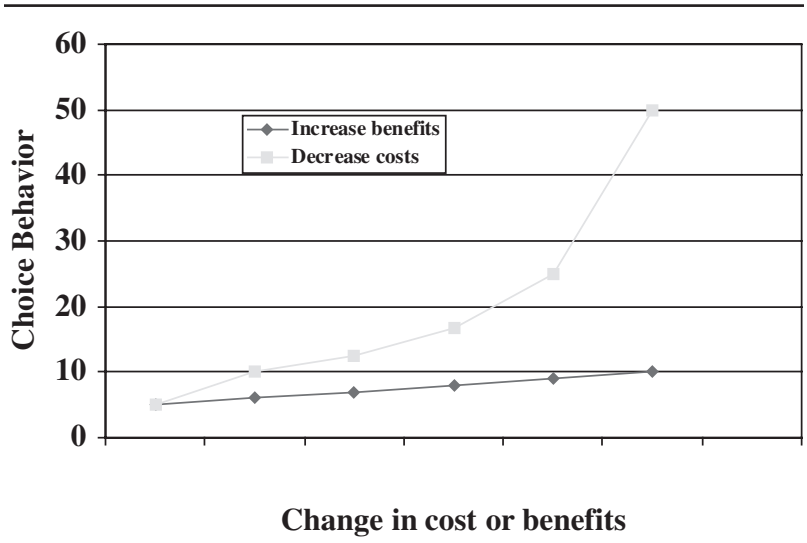

Figure 2: Increase Benefits or Decrease Costs

consequently design spaces that function poorly. For example, it is not unusual to find museum exhibits that require backtracking to view all the objects or to find direction signs that attempt to force visitors to violate the economy principle.

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