Road Climbing: A Route Choice Heuristic

Michael S. Shum (mshum@nwu.edu)
Jeremy N. Bailenson (jnb@nwu.edu)
Steve I. Hwang (s-hwang@nwu.edu)
Layla R. Piland (l-piland@nwu.edu)
David H. Uttal (d-uttal@nwu.edu)
Department of Psychology; 2029 Sheridan Rd.
Evanston, IL 60208 USA

Abstract

Bailenson, Shum, and Uttal (1998) showed that when people are asked to select from potential routes on a map, their decision relied heavily on the initial attractiveness of the routes. Specifically, people preferred routes that were initially long and straight and headed in the general direction of the destination, even if that route was not the optimal (shortest) route. This paper extends this *road climbing* theory to route choice on maps of college campuses and to actual navigation around a college campus. Both experiments confirm that when given a choice among routes, people often resort to choosing the one that is most initially attractive. The road climbing model provides an explanation for both people's navigational decisions and also the path asymmetries that have been discovered by previous researchers studying route choice.

Introduction

When people are asked to make decisions or judgements, they often resort to use of mental shortcuts, or heuristics (Tversky & Kahneman, 1973). Use of heuristics minimizes cognitive effort and often leads to a satisfactory but non-optimal solution. Use of a heuristic may also result in peoples' judgements being *asymmetric*. For instance, people often make asymmetric judgments about spatial distance. Their distance estimates vary depending upon which location is viewed as the origin and which is viewed as the destination (McNamara & Diwadkar, 1997; Newcombe, Sandberg, & Lie, 1996; McNamara 1991; Holyoak & Mah, 1982; Sadalla, Burroughs, & Staplin, 1980).

Asymmetries can be found in the domain of route choice as well. *Path asymmetries* occur when subjects consistently choose a different route when traveling from point A to point B than they do when traveling in the opposite direction, from point B to point A. Path asymmetries have been demonstrated in people's route choices from memory (Stern & Leiser, 1988), from maps (Bailenson, Shum, & Uttal, 1998), and from decisions among identical paths during actual navigation (Christenfeld, 1995).

Bailenson, Shum, and Uttal (1998) proposed that these asymmetries arise from use of a heuristic that is similar to those employed during other forms of decision making. They labeled as *road climbing* the strategy wherein peoples' route choices are largely influenced by the initial attractiveness of potential routes. They showed that subjects consistently preferred routes that were initially long and straight and that headed in the general direction of the destination. These particular routes were preferred even when alternate routes (that were not as initially attractive) provided more optimal solutions. For example, subjects in their Experiment 1 chose road climbing routes over non-road climbing alternatives even in situations where the road climbing routes were 50 percent longer in length!

The road climbing theory provides an explanation for why asymmetric route choices occur. Path asymmetries result because the initial attractiveness of a route varies depending on which portion of the route is close to the origin. When origin and destination are switched, a route that was initially attractive one way may no longer be so; this is reflected in subjects' differential preferences.

In the current paper we attempt to further generalize the road climbing theory by demonstrating use of the strategy in more realistic settings. While previous research has shown asymmetries in actual navigation for identical options (Christenfeld, 1995), no studies have shown asymmetries when subjects actually traversed routes which possess different types of characteristics. Separate paths which are completely redundant (in terms of length, number of turns, angularity of turns, etc.) rarely occur in most urban systems.

We argue that path asymmetries occur because subjects disproportionally weigh the utilities of the initial portion of a route. In the current line of experiments, subjects navigated on routes which were chosen specifically for how attractive they were in terms of the road climbing theory. We predicted that those routes that more closely approximated a road climbing ideal would be the ones selected by subjects. In Experiment 1, we asked subjects to choose paths between two locations on actual maps of American college campuses. In Experiment 2, we observed subjects as they traveled between two points on the Northwestern University campus.

Experiment 1: Campus Maps

In their Experiment 1, Bailenson, Shum, and Uttal (1998) created very artificial map stimuli that were designed to test specific aspects of the road climbing theory. In their attempt to use actual maps in Experiment 2, they did find evidence for road climbing on two college campus maps, but only on half the trials. Moreover, subjects in their Experiment 2 were required to only choose a path from A to B *or* B to A; thus, the asymmetries found in the experiment were between-subject. The goal in the current experiment is to extend these results by including a larger number of college campus maps (while imposing more stringent selection criteria), and also requiring subjects to choose routes in both directions. This way, any asymmetries we discover will be within-subject, a result that would clearly bolster the existence of path asymmetries in general, and the road climbing heuristic in particular.

Our predictions for Experiment 1, then, were as follows:

1. People's route choices would often be asymmetric. That is, they would select one route going from A to B, and a different one going from B to A.

2. The routes people will select will be those that are most initially attractive near the origin (i.e., the road climbing routes).

Method

Subjects The subjects were 32 students (19 females and 13 males; 30 right-handers and 2 left-handers) in a Northwestern University Introductory Psychology class who participated to earn partial experimental credit.

Materials and Design We gathered the stimuli by examining booklets of campus maps. We selected five different campus maps which met the following criteria:

1. There were two clear buildings which were joined by two or more distinct paths.

2. The paths were relatively stable; that is, once on a path there were not many opportunities to exit that specific path.

3. Two of the routes between the buildings had to serve as road climbing routes, one for each direction condition. In other words, one of the routes had to contain a long, straight segment near one of the buildings, while another route had to contain a long, straight segment near the other building.

The five campus maps selected were Clemson University, the University of Hartford, the University of Alabama, Adelphi University, and the University of Massachusetts at Amherst. Each subject saw a packet of twenty maps, organized into two blocks. In the first block, subjects saw all five experimental maps along with five filler maps. For the experimental maps, we denoted the origin with a sticker showing the letter "S", while we denoted the destination with the letter "F." The order of the fillers and the experimental maps was randomized. In the second block, subjects saw the same five experimental maps, however the origin and the destination buildings were reversed. For the filler maps, the origins and destinations were denoted with entirely separate buildings than in the first block in an attempt to hide the experimental goal from subjects. Maps in the second block appeared in the exact same order as maps in the first block.

Procedure Subjects participated in groups of twelve or less. They were instructed as follows:

> In the following experiment, you will see a series of maps of a town. Each map is on a separate page. Thick dark lines on the map represent roads on which you can travel; you will also see buildings and lakes on the maps. Your task for each map is to find a route between two buildings. The letter "S" appears on the building you must start from. Your destination is the building which is denoted with the letter "F." So your job is to find a path from "S" to "F." While you travel, you must stay on the streets (the thick, dark lines). Please begin on a street which emerges from the building indicated by "S." Please do not look back over maps that you have completed already.

After they completed the packet of maps, subjects received a post-experiment questionnaire where they had to indicate their age, gender, and handedness.

Results and Discussion

The dependent variable was the percentage of times subjects selected the predicted road climbing route as opposed to any other route available. Over all experimental trials, subjects selected the road climbing route 56% of the time. This differs significantly from 50%, $t(31)=3.16$, $p<.05$. Note that in this case selection by chance is *less* than 50%, as subjects were allowed to take any route that was available to them based on the configuration of the maps. The fact that we can predict to such a degree the route subjects will take out of numerous possibilities indicates that the road climbing model has efficacy beyond artificial maps like those used by Bailenson, Shum, and Uttal (1998).

Table 1 shows the route choices made by subjects on each of the five experimental maps. The percentages indicate the proportion of subjects who selected the road climbing route in that particular condition. Note that on each map, subjects were asked to go between two points on the map (i.e., points A & B), once with A as the origin and once with B as the origin. Direction on Table 1 indicates the general direction in which the route was heading: either North or East, or South or West. This arbitrary classification allows us to look at route preferences when origin and destination are switched.

Table 1: Percentage of road climbing route selections in Experiment 1.

	Direction		
Map	N/E	S/W	Mean
Clemson	85	41	63
Hartford	48	53	51
Alabama	33	83	58
Adelphi	60	33	47
Amherst	56	66	61

As an example, we include a schematized version of one of the campus maps (University of Massachusetts at Amherst) in Figure 1. This version differs from the actual map that subjects saw in that it is simplified to include only the pertinent road climbing paths and the origin and destination buildings. The routes in question concern the loop existing between two buildings, one at the intersection of Commonwealth Ave. and Massachusetts

Ave. (point A) and one at the intersection of Governor's Drive and N. Pleasant St. (point B). Subjects in the experiment were asked to find a route between points A and B, half the time with A as the origin and half the time with B as the origin. Notice in Figure 1 that there are two potential road climbing routes between A and B, the first involving Commonwealth Ave. and Governor's Drive (route 1; approximately 20.96 cm in length), and the other involving N. Pleasant St. and Massachusetts Ave (route 2; 22.71 cm). The question of which route would be predicted by the road climbing model depends on whether A or B is the origin. It is important to note that in the actual maps that subjects saw their were other possible routes to take between the two buildings. However, we only include the routes which satisfied the road climbing constraints; these also tended to be the routes that subjects took.

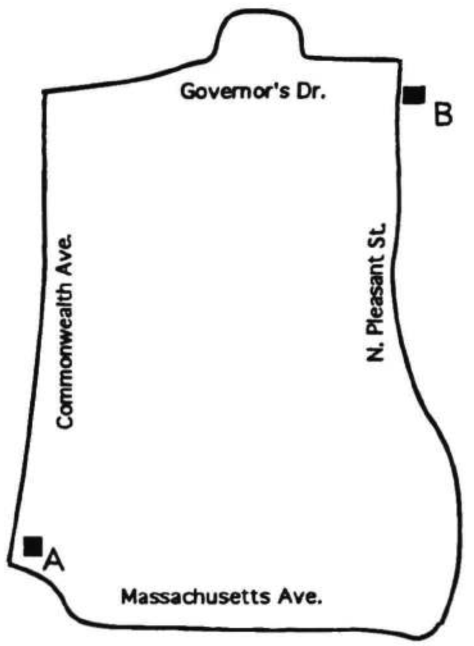

Figure 1: Schematized version of Amherst map used in Experiment 1.

When heading from point A to B, route 1 provides a more initially attractive route as per the road climbing model: Commonwealth Ave. is long and straight and heads in the general direction (North) of the destination. On the other hand, route 2 is less attractive because the initial heading is South, which is in the *opposing* direction of the destination. These intuitions were confirmed by the data, in that subjects heading from A to B selected route 1 over route 2 by a two-to-one margin (66 vs. 34). When heading from point B to A, the attractiveness of the potential routes switch. Route 2 becomes the preferred route because it is initially long and straight and heads South, in the general direction of the destination. Route 1, on the other hand, heads West for a bit and then enters a turn where subjects have to go North, in the opposing direction of the destination. In this case, subjects selected route 2 over route 1 (56 vs. 44). Overall, subjects selected the predicted road climbing route 61 of the time for this particular map.

On the Amherst map, both routes were similar in length. However the road climbing effect is particularly striking when we examine maps on which there was a choice between a clear-cut "optimal" route versus an alternative that was more initially attractive. In two cases (Clemson & Alabama), there was a single route that was overwhelmingly preferred by subjects in either direction. However, the proportion of subjects who chose the less optimal alternative varied significantly as a function of which direction the subject was traveling in, as per the road climbing model.

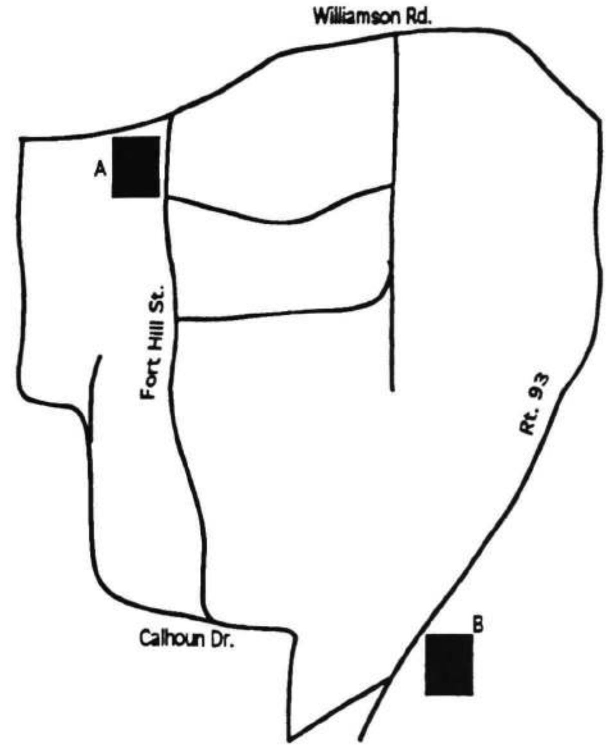

Figure 2: Schematized version of Clemson map used in Experiment 1.

To illustrate this difference we present as another example a schematized version of the Clemson map in Figure 2. Notice that between points A and B, there are a number of possible routes. The two we were primarily interested in were Fort Hill St.-Calhoun Dr. (route 1), and Williamson Rd.-Rte. 93 (route 2). Route 1 is the more optimal alternative as it is 20 shorter than route 2 (7.47 cm vs. 8.89 cm). It is also the road climbing route when traveling from building A to building B. On the other hand, route 2, although longer, is more initially attractive when traveling from B to A since Cahlhoun Dr. initially heads away from the destination. This distinction was reflected in the results. Although, route 1 was chosen almost 70% of the time overall, it was chosen 85% of the time when it was the road climbing route from point A to B, and only 54% of the time when it was not the road climbing route (from B to A). Likewise, route 2 was chosen less than 25% of the time overall, 41% when it was the road climbing route and only 12% of the time when it was not[1].

Experiment 1 shows that subjects make asymmetric route choices when navigating on campus maps. Furthermore, these asymmetries appear to stem from the use of the road climbing heuristic. In Experiment 2, we generalize the results to navigation in the real world by observing travelers' route choices on the Northwestern University campus.

Experiment 2: The Real World

Christenfeld (1995) found in naturalistic observation that when given choices between three identical routes, subjects tended to pick the one that had the turn *latest* along the route. In a sense, Christenfeld's finding conforms to the road climbing model, which states that subjects prefer to travel long and straight initially, and defer turns or changes until later in the route. The goal of Experiment 2 was to see if this finding would hold up for routes that were not "identical" (in Christenfeld's sense), in that routes typically vary in length and other features. In particular, we chose as the observation piece a section of the Northwestern campus in which there were two main potential routes. Each varied in initial attractiveness depending on which of two locations was viewed as the origin; in addition, the routes varied in length (see below). In terms of distance, then, one route was a more "optimal" choice than the other.

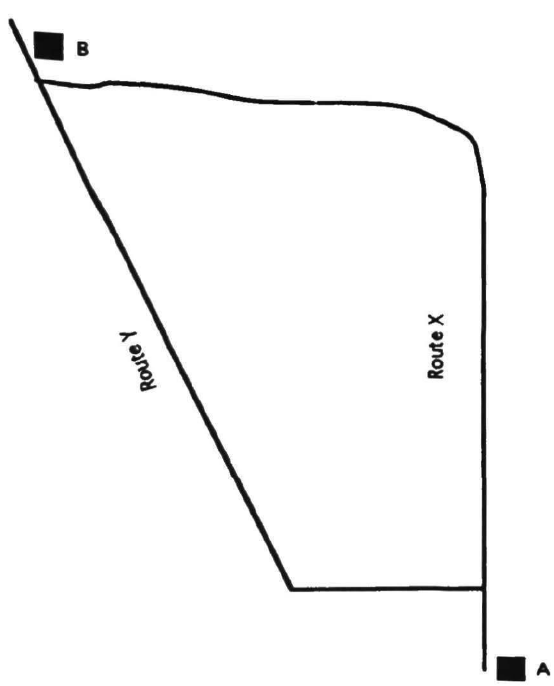

Figure 3: Representation of the Northwestern routes used in Experiment 2.

[1]The percentage of times subjects selected route A (70%) and route B (25%) do not add to 100% because subjects selected routes that were neither A nor B about 5% of the time.

Our predictions were similar to those in Experiment 1:

1. People's preferences for any particular route will be dependent on the direction on which they are traveling. In other words, we should find asymmetric path choices between subjects traveling one way, and subjects traveling the other.
2. These asymmetries will reflect bias toward road climbing routes, those that are initially attractive near the origin.

Method

Subjects We observed 185 (76 males, 109 females) people on the Northwestern campus as they traveled between two points.

Procedure Figure 3 shows the two points and the paths that connect them.

Notice that when point A is the origin and point B is the destination, route X is a better road climbing choice than route Y since it satisfies the requirements of being long and straight initially, and it heads in the general direction of point B. Route Y, on the other hand, contains a turn early in the route which is visible from point A. When origin and destination are switched, however, route Y becomes the more attractive route; whereas route Y is long and straight initially, route X contains an early turn (also visible from point B). Thus, road climbing principles predict that subjects should be more likely to take route X when A is the origin, and route Y when B is the origin.

In order for a traveler to qualify as a subject, he or she had to pass through both points A and B. Furthermore, travelers who didn't stay on marked paths did not qualify as subjects. Multiple travelers who were clearly moving in a group were counted as a single subject. The data were collected in two separate hour and a half sessions, each session occurring on a different day at a different time.

Results and Discussion

Table 2 shows the number of subjects who chose either route X or route Y in the two direction conditions. First, there was a clear preference overall for route Y over route X (86% vs. 14%) over all trials across both directions. However, note that when B was the origin, route X was chosen only 6% of the time, while when A was the origin, route X was chosen 22% of the time. This asymmetry was significantly different from chance, $\chi^2(1)=10.29$, $p<.05$.

Table 2: Route choice by subjects in Experiment 2.

	Route Choice	
Origin	X	Y
A	21	75
B	5	85

Interestingly, considering just length, route Y is a better choice than route X, as it is over 12% shorter (97.61 m vs. 108.81 m). That almost a quarter of the subjects heading from A to B chose route X evidences that people do not always choose the optimal solution; rather, their decisions may be based on use of a strategy such as road climbing.

Because this experiment involved observing behavior in a naturalistic setting, we were unable to control for a number of factors that may have affected subjects' choices, such as subjects' familiarity with the routes, general condition of the paths, the slope of the routes, etc.; the fact that we were able to find an observable bias suggests that road climbing may be a fairly robust phenomenon when navigating in the actual world.

General Discussion

In the current line of studies we further demonstrated road climbing during route choice. Subjects showed asymmetric choice behavior as a consequence of attending disproportionately to the initial segment of a route. In Experiment 1, we found evidence for asymmetric road climbing from subjects who chose routes on university campus maps from around the United States. In Experiment 2, we observed subjects as they traversed along paths on the Northwestern University campus. Subjects exhibited road climbing and asymmetric route choices during actual navigation in the real world.

The road climbing strategy seems to fall under the class of heuristics in which subjects are disproportionately biased toward the initial portion of stimuli. In different domains, this bias has usually resulted in findings that have come under the rubric of *primacy effects*. For instance, memory is best for words at the beginning of a list (Murdock, 1962) and initial information in an argument greatly influences how later claims in the argument are interpreted (Pennington & Hastie, 1986). Primacy effects have also been found in perceptual domains, for example, in the perception of pitch (Williams, 1975).

The road climbing heuristic appears to be the spatial analog of these effects: when choosing a route, subjects are biased in their decision toward ones which are the most initially attractive. This differential attendance to the initial portion of routes may be heightened when subjects are made to focus on routes not as a whole, but in parts. For example, Bailenson, Shum, and Uttal (1998) showed that when maps were regionalized (i.e., broken up with boundaries), subjects were more likely to make road climbing choices. They explained this effect by proposing that regionalization causes subjects to process the maps on an incremental region-by-region basis. Thus, the initial region (containing the origin) receives even more attention than it would normally since it is separated form other regions.

The findings in the current paper confirm that subjects make road climbing choices on actual maps and in the actual world. Both of these demonstrations are greater in complexity than the simple artificial maps used in previous studies. It may be the case that when subjects make these sorts of decisions they are imposing some kind of their own regionalization. It has been found that subjects automatically regionalize spatial layouts such as maps (Downs, Liben, & Daggs, 1988; McNamara, 1986). In effect, this implicit regionalization may cause subjects' choices to adhere to the road climbing model.

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