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Comparing Preferred-Safe Cycling Infrastructure Networks that Support Safety Perceptions of Cautious Versus Experienced Cyclists

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1 INTRODUCTION

Over the past decade, bicycle facility planning has become increasingly important for both urban and suburban communities as they seek to develop livable communities that reduce congestion, manage air quality or improve the quality of life. In fact, many metropolitan planning organizations are now developing bicycle and pedestrian masters plans in accordance with Federal Highway Administration's new requirements [1]. However, while these plans recognize the importance of providing safe and easy-to-use bicycling infrastructure, many communities struggle with how to provide safe infrastructure that is connected and continuous city-wide [2]. This network-level infrastructure challenge is further complicated by the fact that communities acknowledge that their cycling infrastructure needs to support both newer (and often more cautious) cyclists as well as more experienced cyclists. Much past work has shown that these groups perceive the safety of roadways and bicycling facilities differently [3, 4, 5], leaving many questions about how to best develop a city-wide cycling infrastructure network that meets the safety needs of different groups.

This research determines if a single cycling network can be developed that supports all types of users' safety perceptions or if multiple overlapping cycling networks are needed to support these different groups. Specifically, this work uses geographic information systems (GIS) to quantify cycling demand and two different levels of perceived cycling safety to generate (and compare) preferred-safe cycling route networks in an urban (Columbus, GA) and a suburban (Auburn, AL) area.

2 GIS-BASED PREFERRED-SAFE CYCLING INFRASTRUCTURE NETWORK METHODOLOGY

Four preferred-safe cycling infrastructure network maps were generated (cautious vs. experienced cyclists in urban vs. suburban areas). These maps were created using a method similar to travel demand modeling based on local GIS road network characteristics and land use data (detailed below) to characterize 1) the places cyclists seek to travel to/from and 2) the roadway routes that cyclists feel most safe cycling on.

First, community cycling movements were calculated, in the form of an origin-destination cycling trip matrix. This matrix, which describes the amount of cycling travel between every pair of census block groups in the region, is calculated using a gravity model of cycling demand and cycling attractiveness. Cycling demand from each block group is calculated based on household cycling trip data from the 2009 National Household Travel Survey (NHTS), seen in Table 1. Cycling attractiveness to each block group is calculated by weighting the

number of works in the census block group over the age of 16, collected from the 2010 American Community Survey.

Table 1: Production Cycling Trip Rates Table.

		Family	Non-Family
Age of Household Head	15-24	0.020	0.093
	25-34	0.047	0.082
	35-54	0.047	0.147
	55+	0.030	0.093

Second, the preferred-safe cycling roadway paths between every pair of block groups were identified. Rather than just shortest path or bicycle level of service (BLOS), these routes are identified based on how each group perceives the cycling safety of the current roadway or infrastructure and selects the one origin-destination route with the highest preferred-safety score (i.e. most perceived safe route). Preferred-safe scores are calculated for every route for cautious and experienced cyclists based on distance traveled, traffic volumes of roadways, separated cycling facilities available, space given for cyclists, number of travel lanes and speed of traffic (with relative weights for each characteristic). Each factor was weighted differently for cautious and experienced cyclists. For example, experience cyclists weighted travel distance as the most important, whereas cautious cyclists weighted separated facilities and space given for cyclists as most important. These characteristics were selected based on the existing literature, from a survey of cyclists and non-cyclists in Auburn, AL, and access to existing data. Final preferred-safe paths were identified in a route choice equation in ArcGIS network analyst.

Third, the final preferred-safe network map is generated, highlighting the road segments/ infrastructure components on which either cautious or experienced cyclists would be likely to travel. These segments are identified by joining the number of cyclists traveling between each pair of block groups (from Step 1) with each roadway segment that is part of the preferred-safe cycling route between that pair of block groups (from Step 2). The total number of cyclists for each segment is then summed for all the routes across every pair of block groups. Figure 1 demonstrates how network segments are scored higher (those circled in yellow) when more individuals use that same segment across three origin-destination pairs.

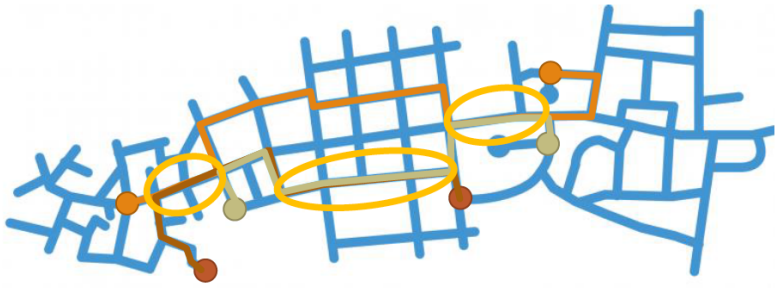

Figure 1: Standout Segments in the Preferred-Safe Network.

3 COMPARING PREFERRED NETWORKS IN URBAN AND SUBURBAN AREAS

Figure 2 demonstrates the preferred-safe routes for cautious cyclists in Columbus, GA. Colored segments represent those roadways or separated infrastructure pathways that support cautious cyclists' safety perceptions as they travel from one location to another. Overall, the colored segments highlight if cautious cyclists were to use the network, these are the places in which they would feel most safe traveling. The red segments represent those routes in which there is more demand on this segment for citywide travel, while the green segments

represent those locations where there is less demand. It is important to note that this network only shows where a cautious cyclist would most likely travel if he chose to cycle from one location to another; it is possible that the routes indicated may still surpass individuals' minimum perceived safety limits and the trip might not occur. While we are still formatting the final maps, we can conclude that there is more of a difference in the preferred-safe path network between cautious and experienced cyclists in urban areas than suburban areas. We believe this is due to the fact that urban areas have more parallel or alternate routes, where there are less options in suburban areas. Also, due to the fact that experienced cyclists' preferred-safe routes emphasized faster routes than cautious cyclists, both urban and suburban maps see main thoroughfare corridors used by experienced cyclists (but avoided by cautious cyclists). These results indicate that multiple infrastructure networks need to be considered to support different cyclists' perceptions of safety. Facilities that support all types of cyclist can be integrated on community peripheries (where there are fewer route options), but parallel "easy casual" and "express direct" routes can be separated and marked to support the needs of different cyclists.

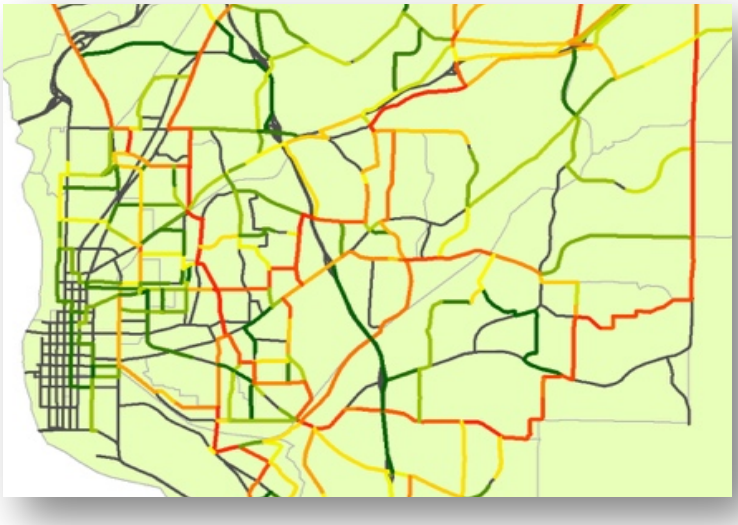

Figure 2: Preferred-Safe Routes for Cautious Cyclists in Columbus, GA.

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