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What Makes a Good Cargo Bike Route? Perspectives from Users and Planners

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ABSTRACT. Cargo bikes—bicycles made to carry both goods and people—are becoming increasingly common as an alternative to automobiles in urban areas. With a wider and heavier body, cargo bikes often face problems even in the presence of cycling infrastructure, thus limiting their possibilities of route choice. Infrastructure quality and the route choices of cyclists have been well studied, but often solely based on a quantitative approach, leading to tools such as BLOS (bicycle level of service). With various designs of cargo bikes being used for a wide range of purposes, the route choice of cargo bike users is difficult to generalize. This study combines quantitative and qualitative approaches in order to explore what is important for cargo bike users' route choice, and how this knowledge can be effectively used for planning. Our results suggest that while some general preferences exist, route choice involves complex dynamics that cannot be fully explained by quantitative measures alone: in addition to understanding "what" is important for cargo bike users, we need to understand "why" it is important. Furthermore, route choice is also influenced by the city context, making a study tailored to the local context essential.

Introduction

Citizens around the world are recognizing that the energy efficiency and spatial compactness of the bicycle provides a transportation

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solution for cities looking to improve the quality of their public space. At present, per capita vehicle use is 6,000–7,000 kilometers per year in Western and Northern Europe, and around 13,000 in the United States (Lewis 2020). In order to meet the European target for reduced greenhouse gas emissions from transportation, Europeans will need to cut auto travel by about 66 percent; Americans will need to reduce driving by nearly 90 percent (European Cyclists Federation 2011).

Many current urban trips include the need to carry more than the rider. Parents may need to take their young children to school or to the doctor. Cars and trucks currently carry groceries, equipment, and other goods in quantities that exceed what an ordinary bike can carry, even with luggage racks and a backpack on the rider.

For these uses, the "cargo bike" may be key to enabling the widespread use of active transportation and enable cyclists to carry larger loads, yet it is unclear if current bicycle infrastructure is designed to accommodate these larger vehicles. Maximizing the use of cargo bikes and reducing deliveries by heavy vehicles can pay dividends in terms of carbon emissions, air quality, safety of street users, and better use of urban space. Lightweight cargo bikes that can carry up to 250 kilograms are already used in various cities, and constitute a reliable, fast, and cheap way of delivering goods (Maes and Vanelslander 2012). However, there has been relatively little attention paid to the factors that make some routes much better than others for cargo bikes. Conscious consideration of these questions by transportation planners can promote more rapid growth of cargo bike transport.

In this article, we conduct interviews in two cities—Amsterdam and Stockholm—with cargo bike riders as well as planners to illuminate the factors that are particularly important for cargo bike use. The two cities have similarities in that urban cycling is a significant factor in local transportation, though the mode share of cycling in Amsterdam is much higher. There are also significant differences in topography, spatial layout, and weather. Therefore, these two cities offer useful comparisons and contrasts that may be valuable to planners and activists in other cities as well. While we do not know the total number of cargo bike users in these two cities, it is estimated that light electric freight vehicles can replace 10 to 15 percent of delivery-vehicle movements (Ploos van Amstel et al. 2018). For personal use, we already see about 2 percent of Amsterdam households owning a cargo bike, with families incorporating cargo bikes into their daily routine of transporting children and large amounts of groceries (Boterman 2018). Figure 1 shows two popular forms of personal cargo bikes found in Amsterdam.

It is expected that more than 80 percent of the population of Europe will live in urban areas by 2050, so cargo bikes are receiving an increasing amount of attention as an alternative means of urban mobility. A key advantage of cycling compared to motorized transport is that it allows for greater and more flexible route choices, thereby reducing travel distances to destinations (Manum and Nordstrom 2013). Cyclists can also minimize their exposure to air pollution by choosing an appropriate route (Hertel et al. 2008). While the route choices of cyclists and e-bike users have been extensively studied, no study has explored the route choices of cargo bike users (Plazier et al. 2017; Ton et al. 2017). The greater size and poorer maneuverability of cargo bikes, for instance, might result in cargo bike users avoiding narrow or

Figure 1
Examples of Cargo Bikes (Left: two-wheel model; Right: three-wheel model)

Source: Photographs by authors.

zigzagging routes that they would normally choose on a regular bike. Similarly, cargo bike users may be more inclined to avoid routes with steep gradients or excessively busy cycle paths.

In order to address the lack of existing knowledge on the preferences of cargo bike users, we investigate the route choice preferences of cargo bike users, and consider how this knowledge can be effectively used in the planning process. Our main research question can be summarized as follows: How does infrastructure quality relate to the route choices of cargo bike users, and how can this knowledge be used to inform planning? Our article explores three subquestions:

1. What are the stated route choice preferences of cargo bike users?
2. How do these stated preferences relate to the actual route choices of cargo bike users?
3. How can this knowledge be used for planning?

Route Choice and Cycling Suitability Evaluation

The route choices of cyclists and the motivation behind them have been widely discussed in the field of transportation planning, as well as in other fields such as psychology (Ma et al. 2014; Stefansdottir 2014), sociology (Garrard et al. 2008), and engineering (Callister and Lowry 2013; Ehrgott et al. 2012; Priedhorsky et al. 2012). Route choice is often associated with the motivation for cycling; lack of route choice may result in reduced destination accessibility, possibly discouraging bicycle trips (Winters et al. 2010). Various attempts have been made to understand why cyclists choose certain routes, but there seems to be no agreement among researchers. Caulfield et al. (2012), and Suzuki et al. (2012), for instance, claim that directness and short travel times are the strongest motivation, but Krenn et al. (2014) found that the route that is actually used is 6 to 16 percent longer than the shortest possible route, based on research in various cities in the world.

While Koh and Wong (2013), Li et al. (2012), and Menghini et al. (2010) have focused on external factors such as the cycling environment, infrastructure, and legal system, Bernhoft and Carstensen (2008) examine user characteristics, and Garrard et al. (2008) consider trip purpose. Other studies combine both internal and external factors (Caulfield et al. 2012; Ehrgott et al. 2012; Krenn et al. 2014; Segadilha and Sanches 2014; Sener et al. 2009). Broach et al. (2012), for example, found that the purpose of the trip also matters in route choice and that commuter cyclists have a stronger preference for the shortness of the route than cyclists with non-utilitarian purposes.

Safety is another important aspect of route choice, and numerous studies have been conducted on this issue. Segadilha and Sanches (2014) argue that safety-related factors such as traffic speed, the number of heavy vehicles, and street lighting are the first priorities to cyclists. The presence of dedicated cycling facilities has been found to be important (de Sousa et al. 2014), as is the width of these facilities (Jensen 2007; Kang and Lee 2012). As might be expected, cyclists are found to prefer cycling facilities separated from car traffic (Caulfield et al. 2012; Hull and O'Holleran 2014). In Amsterdam, however, Ton et al. (2017) found that cyclists do not value separation as much. Other important factors to consider include traffic lights (Broach et al. 2012) and passing distances between cyclists and cars (Stewart and McHale 2014).

Comfort and the experience of cycling also play a role in route choice. Comfort is partially related to safety: relatively safer routes tend to be more comfortable, and relatively dangerous routes tend to be less comfortable. Congested spaces, intersections, and frequent turns all contribute to decreased comfort, since they require much more attention of cyclists, while a combination of continuous space and calm traffic with moderate complexity gives comfort to cyclists (Stefansdottir 2014). According to Koh and Wong (2013), cyclists prefer a route that is comfortable, close to roadways, with other cyclists and pedestrians, flat terrain, and good scenery. Road condition—including state of maintenance and surface material—is also a factor often discussed (Kroll and Sommer 1976). On-street parking facilities also affects cyclists' route choice (Sener et al. 2009; Winters and Teschke 2010). In addition to infrastructural elements, Liu et al. (2018) observe that the types of bicycle used and the carriage of people and cargo also affect the social, sensory, and spatial aspects of cycling experience.

How cyclists make trade-offs between route attributes is an important aspect to consider in route choice, since cyclists generally travel longer in order to avoid certain road attributes (Scarf and Grehan 2005; Tilahun et al. 2007). Cyclists have to accept trade-offs among various aspects of the route, and a holistic analysis needs to be done to understand this complex dynamic. Cyclists, for instance, are usually happy to take a moderate detour in return for a better environment for cycling (Broach et al. 2012).

Over the last decades, various methods and measures have been developed in order to holistically understand the route choices of cyclists. One such measure is the concept of *level of service* (LOS). With its origins in the field of civil engineering, LOS aims to measure the quality of infrastructure and can be defined as a "qualitative measure that needs to reflect user perceptions of the quality of service, comfort and convenience" (Zhang and Prevedouros 2011). LOS was originally developed in the United States as a tool to analyze the quality of roads for automobiles, but it has since been modified and applied to other modes of transportation (Hull and O'Holleran 2014). LOS for automobiles is too narrowly focused and fails in evaluating road quality for cyclists, and therefore bicycle level of service (BLOS) was created (Huff and Liggett 2014). BLOS can be defined as "the level of satisfaction that a bicyclist would experience while riding on a bicycle road" (Kang and Lee 2012). In practice, however, BLOS indicators rely on a number of simplifications and assumptions that tend to fail to reflect the actual preferences of cyclists (Callister and Lowry 2013). Many BLOS studies consider bicycles as equal to vehicles (Asadi-Shekari et al. 2013). The studies do not take into account potential varieties in bicycle types. Lack of validation of BLOS leads to questionable results, and the inability to accommodate various types of bicycles reduces the power of this indicator. At the same time, attempts to include personalized preferences and take into account the changing environments surrounding cycling infrastructure can be resource intensive and time consuming (Huff and Liggett 2014). BLOS or similar types of approaches are often used for route prediction, but they usually take into account only time and distance. Incorporating personal preferences would make the prediction more accurate (Priedhorsky et al. 2012). In this study, we seek to provide a first step in this direction by exploring cargo bike users' route choice preferences.

Research Design

Our study takes the form of a comparative case study focusing on two cities with different cycling contexts: Amsterdam and Stockholm. With the only possible exception of Copenhagen, Amsterdam is known as the world's leading cycling city, with a high level of cycling usage and extensive provision of cycling infrastructure rarely seen elsewhere (Nello-Deakin and Nikolaeva 2020). Cycling in Amsterdam does not involve many geographic constraints in terms of route options, since the city is flat and there are not many topographical barriers. Stockholm, on the contrary, is a city where route options are often significantly limited by water and varying terrain. The number of cyclists in Stockholm has risen rapidly during the last decade, and there exist a sufficient number of existing cargo bike users in Stockholm to enable a study of this topic. Nevertheless, Stockholm's cycling infrastructure and culture are by no means as well developed as in Amsterdam. In addition, Stockholm has more extreme weather, being much colder and snowier than Amsterdam in the winter. By studying the two cities, we are able to compare a mature cycling city and a developing cycling city with slightly different geographical and climatic contexts. This allows us to explore the extent to which the route choices and preferences of cargo bike users are common to both cities and therefore generalizable (at least to a certain degree), or, on the contrary, specific to each city.

Overall Preferences

In order to answer our first subquestion about the stated route choice preferences of cargo bike users, we conducted an online survey. We decided to focus on stated preferences rather than observed preferences (such as traffic volume of cyclists) because cyclists only start using a route if its condition is perceived as safe and comfortable; as a consequence, observed route choices may not necessarily reflect cyclists' true preferences (Ma et al. 2014). Anyone who used a cargo bike (defined as any type of bicycle that is larger than a normal bicycle) in each city was able to participate. The survey link was distributed during approximately six weeks in each city. The survey consisted of two parts. The first part involved the usage of cargo bikes: type, trip purpose, and frequency. The second part asked questions about route choice preferences. Route choice preferences were investigated quantitatively, and the importance of each infrastructure element was surveyed with a 10-point Likert scale. (See Table 1.) At the end of the survey, several open-ended questions were included to allow for more flexible answers. These questions focused on infrastructure issues that people face while using a cargo bike, and were included both to expand the scope of this survey as well as to identify relevant issues for the subsequent interviews. (See the subsection below on the dynamics of actual route choice.)

Table 1

Variables in the Study (# = number)

Variable	Abbreviation
Type of infrastructure	Type
Width of cycling space	Width
Smoothness of road surface	Smoothness
Straightness	Straightness
Absence of vehicle parking	No parking
Traffic volume (car)	# Cars
Traffic volume (heavy vehicle)	# Heavy vehicles
Traffic volume (bicycle)	# Bicycles
Traffic volume (pedestrian)	# Pedestrians
Speed limit	Speed limit
Number of traffic lights	# Traffic lights
Intersection design	Intersection
Brightness	Brightness
Upward steepness	Steepness

Survey variables were selected based on previous studies, and refined based on the local context in each city.

The survey was conducted online in order to facilitate participation. The survey link was distributed both online and in person. In the former case, dissemination took place through social media, cargo bike shops, businesses using cargo bikes, and bike-related organizations. For the surveys carried out in person, intercept surveys were carried out on streets with large numbers of cyclists, as well as schools where many parents pick up their children by cargo bike. In total, we collected 206 valid responses in Stockholm and 121 in Amsterdam.

The results of the survey were analyzed with SPSS. General route choice preferences were analyzed using the questions based on the Likert scale. The importance of each variable was ranked using measurements of central tendency (mean, median) and rates of high-score answers (those who selected “8” or higher out of 10 alternatives from 1 to 10). Our intention in combining these three measurement methods was to reduce the potential bias resulting from relying on a single method of summarizing Likert scores.

Dynamics of Actual Route Choice

In order to answer our second subquestion, cargo bike users were interviewed. Our aim was to better understand the main trade-offs faced by cargo bike users when making route choices. Interviewees were selected from the survey respondents based on their willingness to participate in an interview. The interview took the form of a semi-structured interview where the topics were standardized, but the phrasing of each question depended on the context of each interviewee’s cargo bike usage.

The interview included four main topics, which are summarized in Table 2. Each interviewee was asked to submit route information prior to the interview; subsequently, the road condition along each route was checked by the interviewer either by cycling the route or by observing the route virtually through Google Street View. Seven cargo bike users were interviewed in Stockholm and four in Amsterdam, with a mixture of different types of cargo bikes and usage purposes.

Table 2

Questions Cargo Bike Users Were Asked

Topic	Question
Usage information	When do you use a cargo bike, and for what purpose?
	What kind of cargo bike do you use?
Route information	Which route do you take? (asked prior to the interview)
	Why do you take this route?
	What do you like and dislike about this route?
	Does the route differ sometimes? When and why?
	Are there road segments you try to avoid?
Normal bike—cargo bike difference	Do you also use a normal bike?
	Do you choose a different route?
	What kinds of difficulties do you face even with a normal bike?
	What are the problems specific to your cargo bike?
Application of preferences	Which road segments in the city are best/worst for your cargo bike (as examples)?
	Why are they good/bad?
Other	What are other important aspects of your route choice?

Knowledge Transfer to Planning

For our third subquestion, we interviewed city planners working on cycling policy and/or traffic infrastructure issues in order to explore how the knowledge acquired in the surveys and the interviews might be translatable to practice. Two planners in Stockholm and one in Amsterdam were interviewed; interviews were semi-structured, and the details of the questions were tailored to the expertise of each planner.

As shown in Table 3, the interview consisted of four parts. The first part of the interview was an exercise designed to provide a starting point for a discussion on the topic of route choice. Prior to the interview, each planner was asked to guess the route taken by one of the cargo bike users interviewed in the previous research phase, based on the start/end points of the trip on a map. Subsequently, planners were asked about the reasoning behind their guess; this was followed by the revelation of the actual route taken by the cargo bike user, leading to a discussion of potential issues on the route. The second part of the

Table 3

Interview Topics and Questions (City Planners)

Topic	Question
Case study	Based on the start/end points indicated in the map, which route do you think the cargo bike user takes?
	Why do you think this route is chosen?
	What kind of problems do you think the cargo bike user may face on this route?
	How surprising were the reasons behind the route choice?
Planning procedure	What is the process of planning for bicycles like?
	How are roads evaluated?
	What are the criteria of evaluation?
BLOS	Do you think BLOS is useful for bicycle planning in Stockholm/Amsterdam?
Reflection	Do you think map making is useful for planning?
	What kind of difficulties does map making involve?
	What kind of planning for cargo bikes do you think works best?

interview focused on the process of infrastructure planning for bikes, with the aim of understanding how it is evaluated in each city. The idea of BLOS was then introduced in the third part, and the quantitative results of the survey with cargo bike users were presented and discussed with planners. The last part of the interview consisted of a global reflection of the three previous parts, leading to a discussion of potentials and limitations of trying to evaluate the quality of road segments using a quantitative approach.

Results and Analysis

Survey Results: Overall Preferences

In Table 4 (Stockholm) and Table 5 (Amsterdam), we report survey responses regarding the importance of each element in shaping the route choices of cargo bike users. The relative importance of each

Table 4

Ranking of Overall Preferences in Stockholm

(*N*=206)	Mean	Rank	Median	Rank	% High score (8-10)	Rank
# Heavy vehicles	7.65	1	8	1	65.5	1
No parking	7.24	2	8	1	51.9	4
Type	7.20	3	8	1	59.2	2
# Cars	7.09	4	8	1	52.4	3
Smoothness	6.87	5	7	2	45.1	5
Width	6.82	6	7	2	44.7	6
Intersection	6.19	7	7	2	33.5	8
# Pedestrians	5.92	8	6	3	31.1	9
# Traffic lights	5.84	9	6	3	34.5	7
Straightness	5.82	10	6	3	29.6	10
Brightness	5.64	11	6	3	28.6	11
Steepness	5.26	12	5	4	23.8	13
Speed limit	5.17	13	5	4	24.8	12
# Bicycles	4.82	14	5	4	13.6	14

element is ranked based on mean, median, and percentage of high score answers.

Regardless of the method used, there is considerable overlap in the most important elements for each city, even though there are differences in the exact ranking. The traffic volume of heavy vehicles is the most important element in both cities. These results suggest that the method used here (Likert scale) can produce informative results in terms of which elements have high importance without a detailed consideration of statistical operations, even though it may not enable us to ascertain their precise order of importance.

In both cities, the type of infrastructure, smoothness, traffic volume of cars, and traffic volume of heavy vehicles are among the five most important elements. The existence of car parking in Stockholm and number of traffic lights in Amsterdam are considered important in that city, but are ranked low in the other city. All other elements have similar ranking in both cities, and significant differences between the two cities can be observed only for these two elements.

Tables 4 and 5 show preferences on the type of infrastructure, which was measured with a Likert scale with five alternatives from very favorable to very unfavorable: "1" represents "very favorable" and "5" represents "very unfavorable." The result supports the well-known finding that cyclists value physical separation of cycling space from automobiles (Caulfield et al. 2012; Hull and O'Holleran 2014) and that the higher the level of separation is, the more cyclists tend to prefer it.

Cargo Bike User Interviews

Seven people were interviewed in Stockholm. Reasons mentioned for choosing a specific route included time, distance, scenery, safety, and infrastructure. Many of the interviewees were still not happy with their chosen route, mainly complaining about car traffic and infrastructure quality. While car traffic was mentioned as a safety issue by parents carrying children, many interviewees also pointed out that, with a cargo bike that is larger than a normal bike, it is often impossible to overtake cars waiting in traffic, forcing cargo bike users to stay behind cars. Several people stated that bike paths with physical separation can be a problem or an obstacle for a wide cargo bike with high

Table 5
Ranking of Overall Preferences in Amsterdam

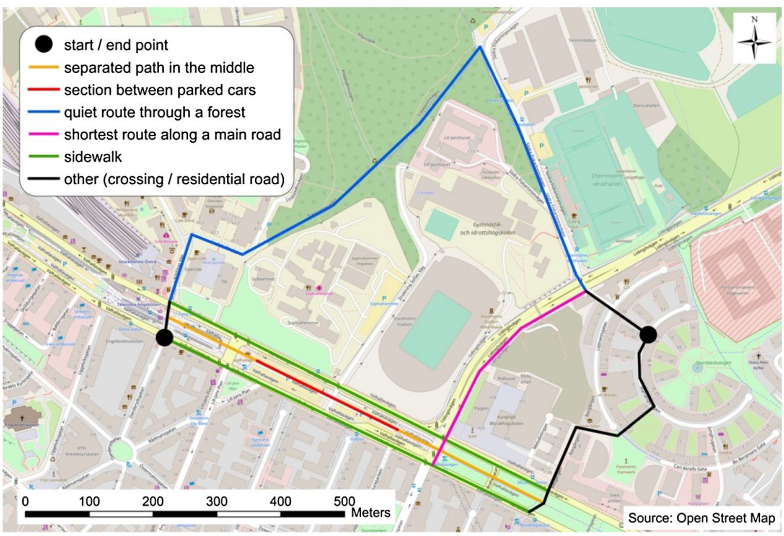
(*N* = 121)	Mean	Rank	Median	Rank	% High score (8-10)	Rank
# Heavy vehicles	7.38	1	8	1	56.2	1
Smoothness	7.08	2	8	1	51.2	2
# Cars	6.79	3	7	2	47	4
# Traffic lights	6.66	4	8	1	50.4	3
Type	6.64	5	7	2	46.3	5
Width	6.52	6	7	2	40.5	6
Intersection	6.45	7	7	2	38.9	7
Brightness	5.98	8	6	3	33.9	10
Steepness	5.94	9	6	3	37.1	8
No parking	5.83	10	6	3	34.7	9
# Bicycles	5.23	11	6	3	13.2	14
# Pedestrians	5.16	12	5	4	19	12
Speed limit	5.14	13	5	4	28.1	11
Straightness	4.84	14	5	4	16.6	13

volumes of bike traffic; accordingly, some cargo bike users preferred bike lanes without a hard separation. Unclarity as to where to cycle, infrastructure inconsistencies, rough surfaces, hills, and bicycle traffic were also mentioned as obstacles encountered when moving around by cargo bike.

In some cases, there were also conflicting preferences in terms of infrastructure types and traffic lights. One section of Fleminggatan (a main street in the city) has a bus lane that is shared with bicycles. One respondent mentioned it as an example of the worst road segment because carrying children on a cargo bike while sharing a road with buses is scary, but another interviewee called it the best segment because there is a lot of space thanks to the bus lane. Another conflict of opinion was observed in relation to the "green wave"—a coordinated set of traffic lights designed to allow cyclists to bike through consecutive intersections without stopping. For one interviewee whose cargo bike does not have a motor, the speed of green wave was too fast, while it was mentioned in a positive light by another interviewee who uses a cargo bike with a motor.

As an example of route choice in Stockholm, Figure 2 displays the route choice of a father who carries his children from home to school on a trailer attached to a road bike. Even though the total distance is only about 1 km, there are several route options. The blue route goes through woods and is comfortable to bike on, but it is longer, and he takes this route only when he has enough time. The orange line represents a cycling path in the middle of a main road (Valhallavägen), which is almost completely separated from car traffic with grass and

Figure 2
Example: A Route Choice in Stockholm



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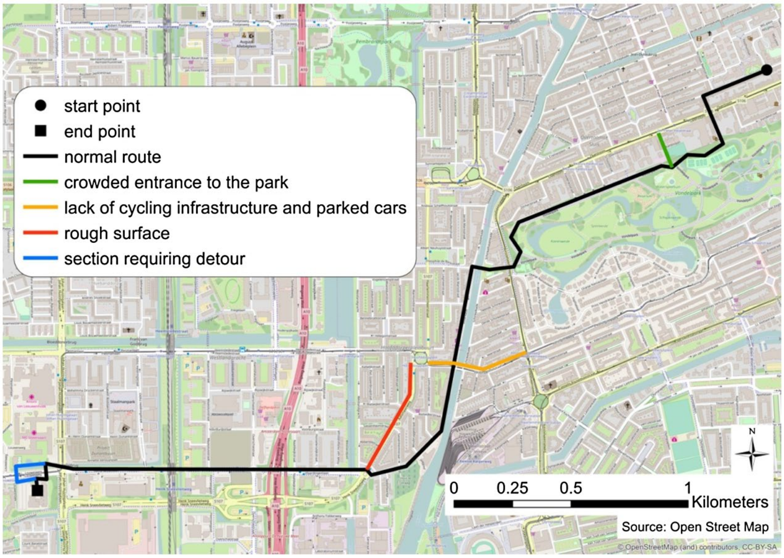
trees on both sides. However, one section of this route (marked in red) also functions as a parking area for cars, forcing cyclists to go through the middle of parked cars. In the evening when visibility is low, he tries to avoid the route while transporting children. The pink route is a bike path along a main road and is the shortest option of all, but the road has a lot of traffic and is not pleasant to cycle along, so he only uses this route when he is in a hurry. Another option is to use sidewalks, indicated with green. This is technically illegal and can take longer when there are pedestrians, but is a safe option without the need to make a long detour. Whether he uses the sidewalk on the northern side or southern side of the road depends on the timing of traffic lights.

In Amsterdam, four cargo bike users were interviewed. In three of the four interviews, the intensity of motorized traffic and the frequency of traffic lights were mentioned as the main reasons for selecting the chosen route. Interviewees noted that being unable to move quickly and make sharp turns gives cargo bike users less opportunity to move around cars in case the road is shared, and thereby diminishes their comfort when cycling on a main road. Three interviewees also mentioned the difficulties created by the blockage of roads, whether on a bike path or a shared road, by construction and by motor vehicles, especially delivery trucks. One interviewee also noted that he cannot overtake bike taxis, which are significantly wider than normal bikes. Poles at the entrance of a bike path to prevent cars from entering were also mentioned as irritating, even it is generally still possible to pass with a cargo bike through the poles. Speed bumps and rough surfaces were also noted as problematic for carrying fragile cargo. All in all, however, interviewees generally appreciated the cycling infrastructure of Amsterdam and considered that most of the city is accessible by a cargo bike. Many of the problems they faced, such as the presence of traffic lights, tourists, and confusing intersections, are not necessarily attributable to the usage of cargo bikes as opposed to normal bikes.

An example of a route in Amsterdam is shown in Figure 3. This cyclist uses a traditional large cargo bike with three wheels. The black line indicates the route taken, and the colored lines are the segments he tries to avoid. The green segment is the official route to the park

Figure 3
Example: A Route Choice in Amsterdam



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for bicycles, but because there are many pedestrians, traveling on this segment with his large cargo bike is difficult and instead he uses a path officially made for pedestrians. The orange segment has no dedicated cycling infrastructure, and has many cars parked on the road. The red section has a separated bicycle path, but the surface is not smooth due to tree roots, and he prefers not to use this route especially with fragile cargo. The last part of his trip requires him to stay on the right side of the road and make two left turns, as indicated in blue, but he prefers to avoid the detour and stay on the left side, as the traffic volume of bicycles is low and is usually not a problem.

City Planner Interviews

Two planners in Stockholm and one planner in Amsterdam were interviewed. In Stockholm, we used the route shown in Figure 2 for discussion, and in Amsterdam we used Figure 3.

In both Stockholm interviews, planners found it difficult to guess the route taken by the cyclist because there were several options and some parts of the routes involved usage of private roads or illegal usage of roads, such as cycling on the sidewalk. The main problem faced by the cargo bike user along that route—that the segment of a bike path also used for car parking is not comfortable to cycle on, especially in the evening—was only spotted by the interviewees after the interviewer hinted at this issue. This exercise worked as a lesson that all kinds of bicycles need to be considered in the planning process. Road evaluation for cyclists in Stockholm is done based on several factors, such as traffic volume of bicycles, category of roads (commuting route, main route, local route), and safety of cyclists. However, safety is difficult to measure, and there is no clear-cut way to holistically evaluate roads. Maps are actively used in the planning process in Stockholm, and the idea of BLOS was favored by both planners interviewed as a straightforward way to evaluate roads and provide information for planning. While both agreed that map making is useful in planning, they pointed out technical difficulties such as coordination with other departments and making changes to existing maps.

The interview in Amsterdam used the route shown in Figure 3 as a basis for the discussion. While the western side of the route was not familiar to the city planner interviewed, the route and the reasoning behind it were not surprising to him. He considered route choice of a cargo bike less complex than that of a normal bike because the cyclist is likely to avoid smaller roads due to its larger size. In Amsterdam, evaluation of roads involves the width of the cycle paths, with a goal of a certain percentage of roads being equipped with a wide (more than 2.5 meters) cycling space; in addition, the speed of cycling is also monitored. There are also surveys about the level of satisfaction for cycling, with both general and specific questions. The interviewee called cyclists “pedestrians with wheels,” and because the usage of bicycles in the Netherlands is different from that in other countries, he did not think BLOS would be useful at all in the Netherlands. He also pointed out that even if a BLOS map can be made, the map can lose its meaning because combining different criteria makes it difficult to see what the map is about. A large part of infrastructure improvement in Amsterdam depends on public opinions through complaints and suggestions, and the city takes a more qualitative approach to improve infrastructure.

Conclusion

In this research, a survey was used to explore the stated route choice preferences of cargo bike users in Stockholm and Amsterdam. In both cities, four of the five most important infrastructure elements guiding route choice were the same: type of infrastructure, width of cycling space, traffic volume of heavy vehicles, and traffic volume of cars. The survey suggests that the traffic volume of heavy vehicles is the most important factor guiding the route preferences of cargo bike users. According to the subsequent interviews with cargo bike users, the reasons behind this finding are somewhat different in the two cities. In Stockholm, people often raised concerns about the safety of cycling alongside heavy vehicles; in Amsterdam, on the contrary, interviewees often mentioned the difficulty of passing large parked vehicles. Streets in Amsterdam are much narrower than those in Stockholm, and cargo bike users need to take into account the possibility of getting stuck around parked vehicles.

Cycling planning has long emphasized the need for physical separation of cycling space from motor vehicles (Caulfield et al. 2012; Hull and O'Holleran 2014). While our survey results support this assumption, our interviews reveal that some cargo bike users prefer to share a bus lane with buses because of its greater width. The difficulty of being flexible with a cargo bike—which is potentially more difficult to maneuver in relatively narrow, physically separated cycling paths—is an important aspect that needs to be considered before automatically advocating the physical separation of cycling space. As our findings suggest, a large enough road width is a key element for the convenience and safety for users of wide cargo bikes.

Our interviews also revealed that route choice of cargo bike users is a complex process that involves many considerations that cannot be easily quantified using measures such as BLOS. Even though quantification of infrastructure quality is possible to some degree, there are factors that remain difficult to measure and factor into a route choice model, such as pleasantness, darkness, the time that the cyclist has available, the timing of traffic lights, and the direction of travel, as can be seen in the examples of route choice. Despite the goal of tools such as BLOS, namely, generalizing route choice preferences or cycling suitability, our results suggest that there is no simple way of generalizing preferences: despite sharing some characteristics, the route choice preferences of cargo bike users are not universal, but depend on a multitude of individual and place-specific factors. As the planner in Amsterdam stated about cyclists in Amsterdam, this is particularly true for cargo bike users, who are perhaps even more varied than "regular" cyclists in terms of their bicycle types, cycling styles, and purposes.

These results suggest that planning of cycling infrastructure for cargo bikes requires a study tailored to the local context, preferably combining a quantitative approach that allows us to understand "what" cargo bike users want, with a qualitative approach that allows us to understand "why" they want it. Whether it is possible to provide infrastructure that is favored by all cargo bike users is difficult to say, considering the varying individual cyclist's preferences. However, one can conclude that it is necessary to consider the local context and adjust the methods to optimize the analyses and avoid misinterpretation of the results. The extent to which this statement is applicable to normal bikes cannot be judged directly from this study, but it suggests that varying preferences of cyclists make it difficult for planners to provide infrastructure that is favored by everyone. With the complexity and varying preferences of route choice for cargo bikes, an attempt to improve the cycling environment for normal bicycles could be counter-productive for cargo bikes, and additional considerations should be made for the safety and comfort of cargo bike users. With the appearance on the streets of more and more innovative unconventional types of bicycles and other vehicles using cycling infrastructure, there is an increasing need for inclusive planning of cycling infrastructure. The proposed planning strategy of focusing on both "what" and "why" can be beneficial not only for cargo bikes but also for a wider range of cycling infrastructure users.

Limitations and Discussion

Our method of selection for survey participants may have potentially resulted in biased results in terms of some infrastructure preferences. In Stockholm, many of the participants were targeted along streets with a high volume of bicycles, i.e., main roads. This may have resulted in the overrepresentation of those who prefer to cycle on main roads, which tend to have particular infrastructure qualities such as separated bike paths and high traffic volume of cyclists. Most interview recruiting took place during commuting hours, and therefore people who only cycle during off-peak hours may have been underrepresented. In Amsterdam, much of the participant collection was done at primary schools due to high usage of cargo bikes among parents with young children, leading to a potential bias in terms of trip purpose.

The research did not include a systematic comparison between cargo bikes and normal bikes, and the extent to which the route choice preferences observed in this research are determined by the usage of cargo bikes specifically is unknown. Even though differences between normal bikes and cargo bikes were explored in the interviews, including normal bikes in the survey could have provided an objectively comparative result. Such data, we suggest, could be collected in future studies. One of the planners interviewed in Stockholm noted that this is precisely the kind of research that the city needs to conduct because planners do not know what cargo bike users want. Knowledge of differences between normal bikes and cargo bikes might then be applied to the planning process, which currently is focused mostly on normal bikes, even in Amsterdam, where usage of cargo bikes is very common. Since more and more types of unconventional bikes are appearing these days, taking into account the different preferences and requirements of different kinds of bicycles is likely to become an issue of growing importance for city planners worldwide.

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