Sociality, Tempo & Flow: Learning from Namibian Ride-sharing

Joseph Kasera
University of Namibia
Namibia
josephkasera@gmail.com

Jacki O'Neill
Microsoft
Bangalore, India
Jacki.oneill@microsoft.com

Nicola J Bidwell
University of Namibia **University of Pretoria**
Namibia South Africa
nic.bidwell@gmail.com

ABSTRACT
Ridesharing has become a hot topic in research and in the media, largely because of the recent rise of platforms like Lyft and Uber. Yet shared taxis and paratransit services have played central roles in many African countries' transport systems for years. We conducted an ethnographic study of shared taxis in Windhoek, Namibia, to understand how ridesharing is achieved in this setting, including the drivers' orientations, concerns and practices, and their consequences for their passengers. Our findings lead us to suggest designing a different sort of ridesharing system to support the drivers' agency and tempo, which enables drivers to locate customers in a more ad hoc way than established digital ridesharing platforms. This contributes to a growing body of research on designing for ridesharing.

Author Keywords
Workplace studies, ethnography, peer-to-peer platforms, P2P, paratransit, ridesharing, designing for agency

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI), H.5.3 Group and Organization Interfaces, Collaborative Computing, K.4.3 Organizational Impacts

INTRODUCTION
Ridesharing and paratransit services have been features of Africa's motor transportation for many years. Various semi-formal and informal arrangements provide affordable short and long distance rides where private and public transport is limited. These have emerged from local entrepreneurialism, and collaboration between passengers and between drivers and passengers. More recently, in the 'global north', there has been huge interest in so-called peer-to-peer (P2P) ridesharing systems, for profit (e.g. Uber, Lyft) or and non-profit (e.g. BlaBlaCar). Some of these systems are already deployed in, or scheduled for, Africa (e.g. Uber in Kenya, Nigeria, South Africa, Ghana, Uganda and Tanzania [14]). However, they tend to be designed to support aspects of transport ecosystems that are similar to those in the global north. Typically, services are designed for populations that can access smartphones and satellite navigation, and mapping and other location-based technologies. Further, they tend to privilege individualised transport preferences and practices, such as the most direct or convenient route to a single destination for a person or group.

In this paper we report exploratory studies of driving and using shared taxis in Windhoek, Namibia, to inform the design of technologies suited to a locally-invented transport system. Broader attention turned only recently to designing digital technology for informal or semi-formal transportation and, to date, Namibia's taxis mostly operate without technological mediation. Understanding practices in ridesharing systems that emerged in Africa can help the design of technologies suited to locally-sustainable, low-cost and accessible transportation, as well as extend the concepts that inform design more generally. Our study illustrates some of the ways that ridesharing in Namibia is a collective achievement, which can imbue new meanings in designing for, what has become variously known as, the 'peer', 'sharing', 'collaborative', or 'alternative' economy [4,22,33].

Often in African paratransit systems several, independent passengers share a ride along part of a route. In Windhoek, for instance, a driver picks-up and drops-off a succession of people at many different destinations. This significantly differs from more recently developed digital 'ridesharing' systems that use technology to link people wanting a ride somewhere to car owners willing to take them. Such digital systems focus on individual rides to one destination at a time; for example, the core service offered by Uber, an international for-profit franchise, facilitates linking passengers and drivers for a single point-to-point journey. Similarly, in most non-profit ride-sharing services the ride shared is between a driver and passengers wishing to go to the driver's destination or to places en route.

New technologies enable sharing transportation in new ways. Uber recently introduced UberPOOL so that strangers can share part of a ride. Each passenger's fare is lower and Uber argues that drivers have a steadier income because their idle times are less. However, driver-support websites, like UberPeople.net, blogs and media articles in the US (e.g. [28][17][6]) suggest drivers are, in fact, dissatisfied with UberPOOL and passengers avoid sharing with strangers. In addition to various potential issues associated with late passengers and "out of the way" pick-ups [6],

drivers claim UberPOOL incurs more costs (e.g. petrol, insurance, wear and tear), safety risks and effort, as drivers must constantly check their phone and change direction as people are added into rides or cancel en route [28]. Meanwhile, some passengers use UberPOOL to share only with people they know, or insist that drivers do not to pick-up many more passengers, and others are disappointed when there is another rider in the car. .

Practices and concerns around UberPOOL contrast with pratices and norms in Namibia's shared taxi system, where a shared ride emerges from the combined effort of passingers and drivers, not mediated by a 'Digital Middleman' [16] like Uber. It is timely, therefore, to study practices in countries that have long-standing, shared taxi systems. We do not suggest that designs suited to the Namibian context can automatically transfer to other cultures. Rather we suggest that proposing technologies suited to the markets in which existing ridesharing systems operate, based on deeply understanding their operation, can inspire designing for shared taxis elsewhere.

Many of the companies that created successful for-profit 'P2P ridesharing' systems adopt a certain business model that reflects US-dominated perspectives. In this model, a Digital Middleman [16] mediates between driver and customers, whose own roles in transactions are limited to requesting, accepting, rating and paying for rides. Uber's mediation has become contentious; for instance, while drivers make about the same from pooled and non-pooled rides, Uber profits more from UberPOOL and can penalize drivers who decline a second or third passenger [28]. Yet, alternative models are certainly possible. Our south-south research collaboration in informal transport sectors prompts us to believe that P2P systems can be used in different ways to respond to local practices. Our study of Ola use and non-use by auto-rickshaw drivers in India generated several ideas for designing technology to respond more sensitively to auto-rickshaw drivers' work practices; from a 'help me' button, to enable drivers to support one another, to visualization of the spatio-temporal landscape of rides, to inform 'where next' decisions in the hunt for passengers [1]. In this paper, we describe the practices of drivers, and potential and actual passengers that, together, achieve ridesharing and consider how technology may be designed to support and enhance these practices. This perspective leads us to propose a system to support ridesharing, which aligns more closely with the ethos of the original P2P movement because it doesn't involve a digital middleman.

RELATED WORK

While companies that operate through P2P ridesharing apps seem to be radically changing taxi landscapes, the global transport market is very diverse. Many countries have vibrant informal transport systems that predate ridesharing apps. Rickshaws, auto-rickshaws, shared taxis, motorcycle taxis and informal bus systems operate in diverse ways and do not conform to categories often applied to transport in design, e.g. private motorized, non-motorized and public. By surveying transport experts around the world, Aguiléra *et al* [2] defined ten transport modes: rail public transport; road public transport; collective private services (shuttle premium services, vanpooling); conventional taxi; informal, on-demand motorized transport (moto-taxi, auto-rickshaw, minibus); automobile based services (ridesharing, carpooling); personal private vehicle; motorized two-wheelers; mechanized devices using human energy (bicycle, tricycle); and, walking. These categories differ in terms of the energy and technology used, speed, services offered and organization (e.g. private or public, individual or collective). Each instance of these diverse modes poses different challenges for operators, drivers and passengers, some of which can be ameliorated by technology. For instance, technology can enable passengers to navigate a complex informal transport system run by many small, independent operators [36] or connect passengers to moto-taxis in rural areas [11]. Thus, informal and semi-formal transport systems offer a rich design space.

Shared taxis generally operate in informal markets and are adapted to local contingencies, norms and rules. For instance, based on an ethnography in South Africa, Woolf and Joubert [37] explain that shared minibus taxis do not have formal stops or schedules, but their routes become tightly prescribed and profitable routes can be highly contested. Woolf and Joubert suggest that "*financial survival, frequency of routes travelled, time, passenger capacity and quantity of passengers become more important*", to minibus taxi drivers "*than traffic etiquette, hospitality, safety and rule of law*" [37].

There are few studies of informal/semi-formal shared taxi systems for the purposes of design, but there is plenty of research in the wider transportation sector. Thus, in the rest of our literature review we discuss technologies for taxis and ridesharing, and summarise some of the research that has ventured into technologies for informal transportation.

Technology for Taxis

Typically, technology design for taxis focuses on efficiently and effectively connecting drivers and customers, whether drivers pick-up passengers at ranks, on streets or only people who make a booking. Taxi operators in many countries, for example, use central dispatch systems to connect customers' requests, by phone, web- or phone-based apps, to local offices or call-centres that dispatch nearest available taxis [31,15].

The advent of P2P ridesharing apps changed taxi operation in some ways. Companies like Uber, Lyft, and Easy Taxi provide smartphone apps to more efficiently link customers and drivers. Customers can see available cars in their areas and send a request for a taxi, which is accepted by a driver who wants to take them. Although mainly studied in the US and Europe [13,21,30], these new services have been adopted, often along with local rivals (e.g. Ola [1]) in India Central and South America, the Middle East, and Africa.

The services tend to operate in something of a grey area of poorly regulated labour markets [7] in which operators do not identify as employers [30]. Uber, for instance, tends to court controversy wherever it goes. Local drivers in South Africa accused Uber of undercutting their profits [3] and avoiding tax [12], and Uber drivers in Kenya have protested against fare cuts [34]. Much of the research thus highlights concerns about the role of service providers, as digital middlemen, in manipulating the market-place for profit, unbound by employment law [1,30], and about the lack of transparency in the algorithms in the apps that match drivers and customers [1,21].

Research into Ridesharing

Beyond the specific implementations deployed by companies like Uber, research in the past decade has examined how best to support ridesharing using taxis or private vehicles. For example, Cheng *et al* [8] addressed 'the last mile problem' of getting people from transport hubs to their homes. Their proposed solution involves managing ridesharing requests, grouping people going in the same direction and connecting groups to taxis, minibuses or other empty vehicles. In effect, this creates a technologically mediated shared taxi system, although all passengers depart from the same hub at the same time unlike in Namibian shared taxis.

Karande *et al* [18] describe genetic algorithms that can help match a single driver to many passengers starting at different locations. They explain how modern GPS-enabled devices can enable drivers and passengers to instantaneously access real-time carpool service via an Intelligent carpool system, AICS. "*Several such start-up systems*", they write, "*have been developed to coordinate ride match communication between drivers and passengers in real time carpool settings*" [18]; however, their own design is for 'always-on', smartphone-endowed settings. In contrast, Miteche *et al* [23] designed a dynamic ridesharing system for people who 'hitchhike' or 'hike', in South Africa that includes an SMS-based implementation. Their app tried to mirror the existing informal processes in hitch hiking they observed.

Much of the design research in sharing private vehicles has considered systems that are based on phones and/or social network platforms. These studies tend to suggest that design must account for social relationships, since people are more likely to go out of their way for friends [35] and ridesharing networks may only partially overlap with existing local social networks [5].

Taking the route less travelled

The informal sector serves the majority of shared rides in many African cities. Yet most research into technologies for transportation focuses on the formal sector, and studies of transportation in Africa often depict informal markets as a problem (e.g. [20]). Research projects that aim to provide technological support for these existing, well-used transportation systems, must account for their dynamics and the complexities that emerge when multiple actors interact to create them. Responding to these has, in fact, resulted in some innovative applications that offer new opportunities for passengers, drivers and transport providers. For instance, there is no global information about Nairobi's semi-formal 'matatu' buses, because the network consists of many small, private actors. Matatus often have schedules and set routes, between designated stops, but passengers lack a map to help them navigate the system. Thus, Williams *et al* [36] created an integrated map of locations, routes and schedules by recording stops and times, on cell phones while travelling on matatus, and representing this data in Google maps by adapting the General Transit Feed Specification coding. Maps of local movement, such as mobility in Abidjan derived from call data [32], may also be used to optimize informal transit networks.

Passengers who depend on shared informal transport are more likely to be in populations that cannot access high bandwidth solutions or smartphones, thus design must also account for constraints on technology use. Figueira *et al* [11] developed an SMS-based system to connect passengers and goods in remote areas of Uganda with 'boda-boda', or 'moto-taxis', without needing GPS. Meanwhile, Ouoba and Bissyande [27] proposed an SMS-based system to provide near real-time information on bus schedules, by embedding stripped down mobile phones in bus stops and buses to communicate the location of a bus along the route.

Windhoek's informal shared taxi system, described in this paper, is a traditional form of ridesharing that, we believe, brings a new perspective to the design of P2P ridesharing systems. Specifically, as the next sections outline, ridesharing is a collaborative achievement, amongst drivers and potential and actual passengers, that has its own rhythms shaped by, and adapted to, local contingencies.

CONTEXT OF THE STUDIES

Shared taxis dominate public transport in Windhoek, where 87% of low-income earners cannot afford to own cars. Windhoek's bus service was expanded in 2016 with new vehicles. However, during our data collection, 80% of the service's 79 buses were older than 20 years and buses were overcrowded and infrequent; operating only at the start and end of the day, Monday to Saturday, between to central Windhoek, or 'town', Katutura, and other suburbs; and, at the end of weekdays from the city's three universities. Thus, with the proliferation of cell phones amongst low-income population there has been recent interest in designing to support the Namibia's shared taxi system.

Shared Taxis in Windhoek

There are over 6,000 officially registered taxis serving the city's 323,000 population. In January 2015 an estimated 41%, 75%, 100% of work, education and leisure trips, respectively, in Windhoek used taxis [24]. People on low-incomes spend 24% of their earnings on mobility [24]. Shared taxis are at least 60% more costly to passengers than buses, but much cheaper than 'private' taxis, which are booked by phone for specific point-to-point trips. The taxi

system includes 295 official 'ranks' around Windhoek [25] but drivers can pick-up and drop-off passengers along the road, and do not have pre-defined routes. Taxis do not have meters and rides cost N$10 per person to go to a rank [25], N$20 to go to a location that is not a rank, a '2x Taxi', and N$20 after dark. Most taxi users live in Katutura and Khomasdal [25] 8Km and 5Km, respectively, northwest of 'town'. The areas were created when the South African colonial administration relocated 'Coloureds' to Khomasdal and 'Blacks', of various tribal and language groups, to Katutura (the Otjiherero word for "the place where we do not want to live"), during Apartheid. These areas are now vibrant centres of their own but, 25 years after liberation, racial and economic demographics broadly persist.

Passengers hail shared taxis, recognised by the large letters of a unique 4-digit identifier painted on the side doors and back window, by holding out their hand or approaching taxis parked at ranks. While a ride does not require pre-booking it is rarely along the most direct route. Vehicles carry four passengers and drivers keep their seats in use by picking-up a new passenger as soon as possible after one leaves. Drivers with empty seats often try to obtain passengers by slowing down for people standing by the roadside, beeping their horns as they drive along or searching by 'circling' an area. Thus, although a passenger who gets into a taxi first may be the first to arrive at their destination, it can be difficult to estimate how long a ride might take. None-the-less passengers rarely wait as long as they might in shared mini-buses in many African cities, which often collect a full load before departing from a rank or terminus.

Technology Design Impulses

There has been increased interest in designing mobile applications to support shared taxis in Namibia. In 2014, Author-1 designed a Real-time Passenger Management System (RPMS) based on his experience of riding taxis [19]. Implemented on a personal computer and cell phones, RPMS aimed to assist central taxi operators to manage supply and demand. It tackled the taxi dispatch problem by using real-time scheduling to match drivers/vehicles to customers waiting at different locations who send SMS and Internet-based requests. RPMS also provided functionality for operators to record fares charged and receive passengers' feedback on driver service and safety. In this way, RPMS resembles central dispatch, and could enable Namibian operators to operate as digital middlemen similar to companies like Uber. However, Namibia's taxi system is composed of drivers who work independently as well as drivers contracted by operators. Thus, we sought to produce more insights about drivers' everyday working practices to inform the design and deployment of low-cost, useable technology suited to shared taxis.

We worked with researchers based in India, who had extensive experience in ethnography of work practices and were studying the practices of auto-rickshaw drivers and their use, and non-use, of Ola [1]. Namibians' positive response to the RPMS concept, which we presented at the nation's annual science festival in June 2015, also motivated us to use the topic of shared-transport in teaching under-graduate computing. The topic enabled exposing 3rd year students in a research methodology course to international expertise. India-based collaborators introduced their methods and insights about auto-rickshaws to the students over Skype. For the rest of semester teams of 4 - 5 students explored a research problem in their practical classes related to digital systems to support shared transport in Namibia.

In September other computing students competed in the #GoTaxiNam hackathon. The competition, run by Namibia Business Innovation Institute and Bank of Windhoek Holdings Ltd, aimed to stimulate creativity in innovating a payment business model and prototype to beneficially transform the cash-based payments that taxis currently use. The challenge required a sustainable, commercially-viable, cash-free model, and a prototype to enable payment through feature and smart phones. Prototypes had to enhance the control environment for taxi-drivers and owners; make it easy for customers to pay, and drivers to accept and acknowledge payment; reward good, and discourage poor, driving: promote market uptake for taxi-owners, drivers and customers; and, offer a "user friendly" and simple, "total experience".

METHODS

We present qualitative data from an exploratory study of shared taxis in Windhoek mainly collected by Author-1 and supplemented by data from smaller studies conducted by two student groups. Author-1's data consists of observations of taxi rides and semi-structured interviews of drivers, and the students' data consists of oral questionnaires of taxi drivers and other students.

Author-1 started recording ethnographic observations on taxi drivers' practices during his normal daily trips to and from his home in Katutura to work at the university, shopping and occasional social activities. Katutura is the home of the majority of the taxi-using population of Windhoek and, as our data suggests, the university is a major destination. Observations were recorded for a total of 23 different rides in different taxis on 18 days, including details of the actions and interactions of taxi drivers and other people (e.g. passengers, other road users etc.) as Author-1 organised, undertook and paid for his trips. He interacted with taxi-drivers in English, the language they used to him. When conversation did not interfere with the driver's business or road safety, he asked questions about the practices and situations he observed.

Author-1 also interviewed another four individual drivers for about 45 minutes each. Interviews included specific directed and open-ended questions covering: demographics; taxi and driving experience; details of work hours and income expectancy; structure of work day; constraints and preferences in planning routes and picking-up passengers; volumes of passengers etc. Although we recompensed driv-

ers for their time, equivalent to what they would have earned while working, recruiting was difficult. More participants worked for themselves than an operator, which suggests that it might be harder for someone who reports to a company to take time to be interviewed; and, further, our results indicate that drivers prefer to maintain a tempo in their working day to ensure profit. A further 22 taxi-drivers were interviewed by, or answered the oral questionnaires of, two groups of 3rd year students. For ethical reasons we asked students to interact only with participants who they already knew well.

We transcribed interviews and observations and Authors- 2 and 3 derived recurrent themes in these transcripts and from students' questionnaires. Generally, our themes reflect the reappearance of similar or related observations or statements in interviews or questionnaires. Here, we present the themes that most influenced our design proposal.

PARTICIPANTS & THEIR VEHICLES

Taxi driving in Windhoek is often a younger man's job. All participants were male and less than 35 years old, which everyday observation suggests is representative. Drivers tended to indicate that taxi driving was a job for now, not forever, saying "*If I get a better job, then I will see*". Of the 26 drivers interviewed, 18 had driven taxis for between 1 and 5 years and five for between 5 and 10 years. Only two participants had driven taxis for 10 or more years and one for less than a year.

Most drivers in our study spoke English and at least one other language, and three of the four drivers that Author-1 interviewed spoke at least three languages. Drivers' education varied. Two of Author-1's interviewees reached Grade 10, two had matriculated high school and two had also taken short courses after leaving school. However, four of ten participants in one set of the students' short interviews mentioned that text-literacy or education amongst drivers might impede use of a design that the students proposed. Drivers often said financial circumstances were a reason for being unable to continue education.

In our interviews, the vehicles registered as taxis were 5-20 years old. Half were owned by the drivers participating in interviews and half by other people, including family members, to whom the drivers paid 30% of their net income.

TIME IS MONEY

Taxi driving is typically considered lucrative in Namibia, where jobs are scarce and often low paid, and drivers confirmed that they were motivated by earning an adequate income. TM, for instance, who started taxi driving 10-years ago said:

"At that time my salary was N$800 a month, which compared with this, taxi, I could get N$2,000. These days you can get not a very good income, but its better, because most jobs don't pay as much. Even when I was driving trucks I could end up with N$5,400 or $N6,000. But compared with taxis you can get even better, nice, $8 - 10,000."

After fuel, most participants' average daily income is N$250 (approximately US$15), but varies across the month. Participants might earn N$600 at month's end, when they are busiest, especially between 25th and 3rd when government employees are paid. However, they can earn only N$100 a day, after petrol, from 5th to 19th when least busy. As described below, all the drivers mentioned being motivated by the sociability of the job by meeting people, providing a service, etc.). However, they primarily organize their work to achieve the high turnover of fares and minimal outgoings (e.g. fuel use, fines) necessary to deliver this income. Indeed, drivers estimated that they took between 40 and 200 (median 70) passengers a day, but also noted their estimates were rough as they focused on income earned rather than counting passengers.

Drivers said their busiest months are when the schools are open, students are writing exams and during November and early December, when many people travel for their holidays and there is less competition from other taxi drivers. On busy days, like at the end of the month, drivers might not break much, instead focusing all their efforts on earning as much as they can. On quiet days, they reported working longer hours, well past 18:00 or 19:00 when their workday would end if they had made "*nice money*".

Finding passengers

Drivers have various methods for keeping all their seats in use as much as possible during their working day. Author-1's interviewees start to pick-up customers as soon as they get in their taxis in the morning, and this structures their routes in the first part of the day. For some, the first passengers are neighbours, while other drivers must '*work around the street'* looking "*until you get the starting person*".

Drivers also aim to fill seats by waiting at ranks and unofficial pick-up/drop-off spots. For instance, two drivers in interviews started their day by driving to a popular rank that is slightly west of Katutura on the same side as they live. Although drivers can choose which routes they will drive when and where to stop, they are constrained by the need to find enough passengers to make a reasonable income. They must, therefore, learn about and follow the flow of passengers – the bulk of whom have specific trajectories at certain times of day. From 05:00 to 06:00 most customers go to town from Katutura, Khomasdal and suburbs slightly north or west of town; and, from 15:00 onwards most customers go from town to the suburbs. As GK explained about the morning flow:

"*Because a lot of people are working in town and I have to take them to town and few of them are coming from town to go to Katutura, but not the same amount as I take from Katutura to town*".

However, congestion often accompanies heavy flows and sitting in traffic reduces drivers' earning power. TM, for instance, said that he does not like driving to town during the morning peak "*because you know town is also queues,*

very long queues, four people you can stand for 1-hour". Hence TM pursues and accepts only customers going to school and work in Katutura, Khomasdal and Northern Industrial area during the morning rush. Drivers, therefore, use their local knowledge and make judgments in negotiating the various local conditions to maximise income.

After finding one or two passengers drivers often spend some minutes trying to fill the remaining seats before driving to passengers' destinations. As they are less likely to find passengers once on the road to town, drivers circle around in places, such as suburbs, for a few minutes or set off using a longer route. At ranks or pick-up/drop-off spots drivers try to gather three or four customers all going to the same or close-by destinations. At the university, where many students leave at the same time, drivers hustle to fill their cars, by approaching students to ask them about their destinations.

Drivers choose to accept customers based on whether routes to requested destinations are compatible with existing passengers' routes, and enable keeping seats filled and a high turnover of passengers. Author-1 was turned down four times in six different afternoon journeys to Katutura, from the university or town, before securing a ride. It is likely the drivers considered that it was not a good time for them to gain passengers in Katutura at the end of Author-1's ride.

Whilst drivers are keen, and make some effort, to fill their empty seats, it is not always possible. In an interview one said: "*Sometimes you won't get four people or three, but you just keep your routine"*. Once, when a driver was unable to secure more passengers, because there were few people standing by the road, he asked if he could take Author-1 directly to his final destination for twice the price. Thus, as well as expected passenger volumes, drivers must balance income with fuel consumption as passengers pay the same amount for most trips between locations about 7Km apart.

Impact on passengers

Just as drivers must seek passengers, passengers must also seek a driver willing to go in their direction. This requires passengers to have local knowledge to determine where to stand on the roadside or which rank or pick-up/drop-off spot to walk to at a particular time in order to get a taxi heading in their intended direction. Author-1, who usually left home in Katutura just before 07:00, was rarely able to immediately hail a ride along the roadside because taxis drive to town earlier in the morning or after morning peak-hours. He was turned down six times in 13 journeys from home in the morning, when he requested 'town' to drivers who asked him where he was going. Often, after several minutes assessing taxi traffic, he walked a short distance to a place where he knew more taxis would stop or pass.

Passengers cannot always go directly to their final destination because they travel in a shared vehicle and drivers choose routes. Instead they may have to take a route or break the journey according to drivers' favoured drop-offs or stopping points. This extends the passenger's journey time. For instance, typically Author-1 broke his regular 13km journey between Katutura and the university into two stages: first a taxi from Katutura to the KFC pick-up/drop-off in town, and then another from KFC to the university. He was only able to get a taxi to take him all the way from Katutura to the university twice, at quieter times when drivers are short of business, and the journey time was considerably less.

Not Being Robbed or Fined

Drivers' said they did not discriminate in obtaining customers them because they are primarily oriented to get fares and balance destinations with fuel use. Yet, most assessed potential passengers for security risks based on the time, number, destination, appearance and gender. One said:

"*You can see this one, maybe is a tschape, tsotsi or toto [thief or gangster]. He doesn't look nice. This guys, this person. Then you will know and you will avoid him. Even if they offer you a lot of money, and you will say no, its ok, rather pick someone else. Sometime dress. Sometimes they can dress nice. Just to see, you can check him in the face*".

Another said did not pick-up more than one man at night "*because during the night guys are very dangerous*", and recounted an attack by totsis:

"I came with them from town, until to their location they tell me, when we reach where they tell me, they start asking me money. It's me who is supposed to ask the money. But they ask me where is the money you work? They take all my money and my other cell phone and then they run away. They point me with knife."

Drivers are also concerned about receiving fines and some felt traffic officials impeded their work. The drivers we interviewed were regularly stopped by traffic officials but had rarely been fined. One driver had recently paid N$3,500 in fines, but two said that they had been stopped more than 50 times and received only one ticket each, and another said he had never had a ticket.

"*The [police] are everywhere, because even if you want to take a short-cut which is illegal, and those are dangerous, I will just not do it because I will get a fine. Traffic cops are waiting. You will take the shortcut and get a fine for $1,500*."

Most drivers interviewed said they have "*no problem with traffic cops and just continued their job when they were nearby and obeyed road laws*". Some, however, said traffic officials patrolling near illegal pick-up/drop-off spots slowed their business. Indeed, Author-1 observed two drivers being ticketed at one place and that some drivers were nervous near illegal pick-up/drop-off spots because they did not have the correct documents (driving license and taxi registration).

Being Paid

Since drivers try to maintain an uninterrupted pace in delivering and replenishing passengers, passengers usually pay during the ride before the taxi stops or they disembark. Sometimes a passenger pokes the driver before handing over the fare and sometimes the customer in the front seat mediates transactions so the driver does not divert his attention from the road:

"*No I don't turn around, because you might have to go out of the way. I give it to the next passenger who is seated me, so he can give the change to the next passenger.*"

With flat, not metered, fares, payments often proceed swiftly. When passengers get in at the same rank, they tend to pay at the same time, regardless of their destination. This can help manage change if a passenger has a larger note. It became easier to produce change in 2014 when the basic fare became N$10, Namibia's lowest denomination note. Drivers said that they got change by driving to filling stations or when buying food. Author-1 observed one driver ask passengers while on the move if they had '*big money*' (e.g. N$100, N$200) and then, when a passenger said "*yes*", stop at a small market to get change. A driver we interviewed noted that when he started in the morning he had only N$40 or N$50 and needed to run around for change if a customer told him that they had a large note only when they reached their destination. All drivers interviewed were adamant that they took only cash and would take nothing 'in kind' and all drivers said no customer had tried to use ewallet, FNB bank's mobile payment service that allows sending money to anyone with a Namibian cellphone number. One driver said that sometimes passengers who did not have cash asked to be taken to an ATM, and offered their cell-phone as security whilst they made the withdrawal.

Drivers risk not being paid or paid sufficiently. One morning Author-1 observed a passenger confess he did not have money to pay for his trip as he had forgotten his wallet. The driver was upset, politely told the passenger to get out and tried different tactics to get another customer. In interviews drivers noted that sometimes people don't want to pay enough money when dropped home or '*deeply inside of the location they are going*'. One said:

"*You just get what the customer is giving you. Even though she know or he know that you are supposed to pay $20. You don't know, you are new to going that direction, you just get that $10*"

A risk of not being paid is a reason why drivers are cautious about the promise of stable income for pre-booking a regular ride. For instance, TM explained when Author-1 asked if he would take him every day to town in the morning:

"... it depends on the person, not with all of the guys. You can talk nice-nice that you will give me the $700 [per month] but at the end of the month it will be a problem. 'I am having what-what-what, a wedding, let me give you 10."

TEMPO & PACE

The tempo experienced by customers in hailing, waiting and riding in a taxi is determined by the drivers' aim of high turnover for minimum fuel consumption and responses to constraints in various ways. Drivers time their work and breaks to fit passenger availability. Often they work for 2 to 4- hours, before breaking once or twice after 09:00 "*when its quiet*", then return to their taxis from 15:00 onwards, when schools close and work ends.

In securing a taxi, especially during busy times, passengers experience a high tempo. Drivers rarely spend time negotiating but are committed once they agree to take a passenger. On the roadside drivers rapidly decide to accept a passenger or simply say 'no' or nothing at all before moving on. Drivers hustle customers approaching a busy rank or pick-up/drop-off spots. For instance, 3-4 drivers will scramble for prospective passengers walking through the university campus gates, each calling out a destination, such as 'town', and mentioning that they only need one passenger in order to proceed. Drivers move up to 100m or so from their taxis looking for customers at ranks, but park with their hazard lights on and engines running at illegal pick-up/drop-off spots, looking out for traffic officials as well as customers. They move briskly, to hurriedly coordinate more passengers and hasten customers into their taxi. Drivers cease their harried engagement if a potential customer's and their own touted destination do not match, and swiftly move onto other potential customers.

Once in a taxi a passenger experiences different tempos depending upon whether the all seats are full. Sometimes customers are guided to a taxi that requires more passengers or is blocked behind other taxis. Thus, after all the jostling, and despite drivers' reassurances that "*we are going now now*", they must sit and wait for 5 to 15 minutes while their taxi is filled or for the taxi blocking theirs to leave. Once on the move, with all seats filled, passengers can experience a high tempo again. There is a widely held perception that taxis drive dangerously fast, meanwhile Namibians often say that their time-management practices contribute to risky driving: they set-off for scheduled appointments too late and try to catch-up time on the road. Half of the ten students, of around 20-years old, in students' interviews said they sometimes felt scared in taxis and two said they felt scared during every ride, and Author-1 observed speeds in taxis that made him feel unsafe. This is similar to findings in South Africa that the need to earn money can override road safety concerns [37]. However, speed is sometimes tempered by congestion and drivers often complained about traffic queues.

INDEPENDENCE, COLLABORATION & COMPETITION

Our data indicates that independence is important to drivers. Yet, as described next, it also provided many different examples of coordination cooperation and, occasionally competition, amongst drivers and passengers to collaboratively achieve ride sharing.

Independence

Nearly half of fourteen participants owned their taxis and drivers in long interviews indicated that owning a taxi was a goal for those who did not. Saving for a taxi can take many years, 15-years in the case of GK who now owns his taxi. Drivers without their own vehicles often have a 'contract' with the owner whereby they take ownership of the vehicle after a paying the owner 30% of their income for some agreed duration. Such contracts mean drivers handle the car as their own, as GK explained: "*you really care for it. But if you be paid, aa-aa [no]. I don't think it will be the same as if you do the contract.*". In discussing whether they would consider driving for a private, pre-booked taxi-company, drivers mentioned impacts on income. TM, a more experienced driver who now owns his own taxi, said: "*But working for someone is a problem. My money will be less. I will just get a share, let's say 30% what-what*".

Drivers appreciate their independence and being able to drive where they want, whether it's their own or someone else's car. In interviews, a seasoned driver said that his work satisfaction came from being on his own, and another mentioned flexibility in his hours, even though he rarely takes breaks: "*One good thing is like, I don't have time to start, even if I wake up late I am going to start anytime*". Drivers said that they did not have regular hours and their days varied across the week. During their breaks they might go home to eat, take a shower, bathe or sleep or buy food and park under a tree to rest. While earning was important, drivers also structured their day according to their priorities and preferences (similar to the auto rickshaw drivers in [1]. In short interviews about a student group's design proposal, one driver noted a disadvantage of tracking taxis was that:

"*Owners will always know where we are, for example when we are resting or use the car for our personal purposes or let me say not for work*".

Such unease can impact technology adoption and workers concerns about the consequences of introducing new technology on their working life should be taken seriously in designing any technology for them. Consider, for instance, concerns around the negative effects of increased tracking have also been reported in a study of London bus drivers who were resistant to the surveillance imposed by the tracking devices which were integral to the new technology [29].

Sociability & Collaboration amongst Drivers & Riders

Unlike Woolf and Joubert's observations in South Africa [37], sociability is often integral to a taxi ride in Namibia. All drivers who agreed to participate in interviews mentioned that they liked communicating, dealing with customers or providing a service. Our observations suggested often drivers, who speak several languages, are sensitive to passengers' home/tribal language; for instance, using English if they realise that their language differs. Often sociability has intrinsic value: "*its very fun meeting different people*" and some drivers reported that meeting new people and going to new places contributed to job satisfaction. Drivers reported that sociability was part of their job: "*If you are working with people, you must talk to them*", and that they talked "*Just to make them [customers] feel comfortable"*. They indicated sociability was two-way, "*… they ask me how is your day. Then we discuss my day*", for instance, and:

"*Sometimes you can meet a person first time. First time even in a taxi and that person can open himself up, can start to talk his conversations, even secrets, ask advice also*"

Sometimes conversation is about building business, "*Talking provides good service, people may ask for me in the future*". Our observations suggest drivers referred to, or tried to, build relationships when soliciting passengers. For instance, in competing for customers outside the university drivers often said to Author-3 "*you are my sister/mother*" or "*I know your house*." However, as one driver explained, relationships might mean a customer occassionally phones for a ride when they are stuck but it's not regular "*because people can take any taxi these days, any taxi."*

Some drivers indicated pride in their service, such as GK: "*I like to take people to their work, I don't like people to get late. And I enjoy it*." Certainly, we observed several drivers politely asking passengers to give them 2 minutes to get other passengers. However, during other trips Author-1 observed drivers and passengers who did not talk, and some drivers did not thank him when he paid them.

Conversation is also part of collaboratively achieving a shared taxi ride. Drivers and passengers effectively work together to get to, or close to, their destinations and balance their personal needs with others sharing a taxi to enable a efficient ride. They also collaborate to organise payments, as described above. Drivers balance providing a service to passengers with their own intentions to keep moving and earning. Similarly, passengers balance personal needs with those of the other independent riders in the taxi to achieve a smooth ride for all. For example, a passenger amicably agreed, when asked by a driver, to disembark because congestion prevented the taxi from proceeding to his destination.

Cooperation & Competition between Drivers

One driver alluded, in an interview, to a protocol where drivers waiting at a rank would give a customer to a driver who was short of only one: "*If you have 3 customers already, then you are saying that you must give him one*." This is another example in which drivers orient to provide a smooth taxi service and benefits both drivers who have a nearly full car and the passengers already waiting in that car. Sometimes we observed a 'work together' attitude between apparently familiar drivers who would get customers for each other and inform others of the traffic status, such as dodging traffic officials. Drivers in our interviews said that it was only other taxi drivers who gave way to them on the roads, such as permitting them to turn right. They also said

they might tell another driver they pass that there are customers at a particular rank or pick-up point, though they rarely phoned or SMS'ed other drivers because the driver might be too far away. However, coordination between drivers is limited and drivers tended to say: "*We don't work together, we are just driving, he is having his own plan."*

In interviews drivers said that they did not compete for passengers, but we often observed jostling and mild contests for passengers between drivers parked at ranks or unofficial hotspots. One said:

"*Sometimes you can force a bit … but not very much… you can try to force 'come-here, come-here, ddd come-here', but not very much. If you see they are going ... you leave - just check for someone else*."

Coordination amongst Passengers

Passengers may compete or coordinate for seats. We observed a group of people all say their destinations at the same time, when a driver slowed, and then scramble a little for seats when the driver accepted a destination. Author-1 also experienced someone run to share his taxi on hearing him state the same destination as their own, and another time a man convinced a driver, with a passenger already in his taxi, to take both Author-1 and him to a central drop-off.

Nine of ten students interviewed, who used taxis on average twice a day, were positive about a student design proposal of an internet application to enable passengers to rate taxi drivers by the service received. Eight said they would use it and four said that it would enable passengers to be selective, or "*choose which taxi is the best when it comes to service it provides*". Two said such a rating system would improve improve passenger safety and two noted it might promote a change in drivers' attitudes "*because this will alert all the taxi drivers about their driving and how their services are depending on the passengers by rating them*".

Competition between Taxi Drivers & Other Road Users

There are common perceptions in Namibia that taxis are dangerous and their drivers are antagonistic, but we rarely observed hostility when riding in taxis. Once, while waiting in a taxi for a final passenger, Author-1 observed a quarrel at a pick-up point, because a taxi driver claimed another driver had parked too closely to his taxi. Some taxi drivers said bus drivers and 'courier guys' were equally bad drivers and that they had paid for damages when private cars had bumped them. Some drivers interviewed, however, agreed with perceptions that taxi drivers drove too fast or poorly: "*Some of them, I really don't know how they do driving. They are driving in their own way*."

USING TECHNOLOGY

Drivers varied in their technology literacy and interest. In Author-1's interviews drivers said they owned phones of 1 to 5 years old. Most were smartphones and Samsung models were common. Three drivers mentioned using their phones for Facebook, and using some combination of email, WhatsApp, Twitter and the internet, especially to download music and local and international news. One driver said that between 09:00 and 12:00 he logged into Facebook, WhatsApp and Internet and another said, like many Namibians, he used Facebook but not the internet.

Two drivers interviewed used Google maps "*to familiarise with locations*" or find a destination when the customer did not know. Some said drivers have GPS, however, most are already familiar with Windhoek and technology to support work was generally limited. Drivers often played music or listened to talk radio or news, sometimes selected music specifically for the passengers when waiting at ranks, and told Author-1 in interviews that they listened with or without passengers. Some drivers said that customers called them, and we occasionally observed drivers using their phones to call or text while driving. Using a cell-phone while driving is illegal and drivers in interviews said they would get heavily fined and that they sometimes used Bluetooth to connect their phone to the radio, or used a headset, although we did not observe this happening. None-the-less, drivers seem aware that technology will introduce changes to taxis in the future, for instance, "*GPS would improve locating*" and:

"*Maybe you are on the internet and they can give you the correct, the area it's congested. And you know the route, and we can avoid also and take shortcuts*"

DISCUSSION

New ridesharing apps have created a buzz in the global north, yet ridesharing is a long established practice in Namibia, and elsewhere in Africa, where it is not usually technologically-mediated. Instead passengers and drivers have evolved practices to create an effective, low cost local transport system. Drivers earn a reasonable wage through practices that maximise passenger turnover and minimise outgoings (e.g. fuel, fines). They keep their seats filled as much as possible by seeking and hustling for passengers or soliciting passengers in motion; take payment on the move, not at the end of each passengers' ride; and get change or cash from ATMs at convenient points on the way.

Technology might benefit shared taxis in various ways, such as #GoTaxiNam Hackathon's cashless payment proposition [26], as well as connecting drivers and riders. Our fieldwork could inspire multiple design directions for facilitating connections. For example, rideshare-like mechanisms that bring customers together to fill a taxi might enable them to reach their destinations easily, without having to break their journey, spend time looking for taxis, or sitting in a taxi waiting for it to be filled. However such a solution do not seem to fit with the tempo and pace of a driver's day because just one late passenger would delay the whole ride. That is, such a solution does not account for crucial aspects of how drivers organise their work. A more appropriate design, like the alternative we propose next, would account for the pace and practices of driving.

Designing for the Drivers

Our preliminary insights suggest a P2P system that responds to both drivers' constraints and loose collaboration amongst drivers and passengers. Like Uber, Author-1's RPMS [19] focused on a central controller and passenger convenience. However, drivers in our interviews worked independently, thus, our design proposal does not involve a digital middleman [16] and distributes control in ways that are more aligned with the original P2P movement. We suggest that a system to improve services to passengers is best designed by considering drivers as independent peers oriented towards efficiently finding people to fill seats ad hoc, as they do at hotspots, ranks and by cruising the streets. Our design focuses on drivers' agency and the dynamics of finding passengers, not pre-booking. Drivers in Windhoek, as elsewhere [15], note that they appreciate the freedom to schedule their itineraries and select destinations and passengers. Indeed, elsewhere drivers often prefer their regular taxi dispatch systems to Uber's or Lyft's apps because they let them see, and choose between, incoming requests [21].

Our design requires only taxi drivers to have smartphones, internet access and GPS as most drivers interviewed had these. A driver with available seats enters, into the system, the location to which he is driving and the number of seats currently unfilled. As his journey to that location unfolds he enters when a seat is filled or becomes available. The system automatically updates the driver's location, using GPS data from his phone, and prompts him to update the location to which he is driving when he arrives at the one he last input.

Our design proposal has options for passengers whether or not their phones can access the internet, since smartphone and internet-use are not ubiquitous amongst Windhoek's taxi users. Passengers send an SMS or use WhatsApp to input their 1) location within the next 3-minutes, and 2) their required destination. The system responds to passengers with a list of the IDs of available taxis that are both within 300m of the passenger's location and have entered destinations within 1Km of the passenger's destination.

Drivers seeking a 'starting person' can also use the data entered by passengers to determine where there are many people looking for taxis in approximately real-time. We did not generate data on whether passengers plan trips ahead of undertaking them but local travel practices suggest lateness might be common with pre-bookings and incompatible with drivers' tempo. We suggest alerts and destination requests would be spoken as drivers sought to avoid fines, and in interviews mentioned Bluetooth and headphones.

We propose the system will support customers' experience compatible with movement practices. First, passengers would reach to their final location more directly as drivers would not have to circle to find passengers. Second, the system would smooth the tempo of taxi experiences by reducing the frenzied touting at ranks and time spent searching for taxis or waiting while a taxi fills-up or circles. Possible extensions of the P2P system might also enable passengers to feedback on the quality of rides, as the students' idea for an online rating system was well received.

Versions of *'Sharing'*

Designing systems to support different ridesharing practices and cultures throughout the world can extend the range of meanings associated with sharing rides. Attention to ridesharing platforms, so far, tends to focus on the impact of start-ups in the US, Europe (e.g. Uber, Lyft [21,30,13]) and India (e.g. Ola [1]). Most services focus on matching passengers to drivers in single trips and 'ridesharing' is a somewhat disingenuous term as it is merely a new version of traditional private hire taxi services. The meaning of sharing for some non-profit services (e.g. BlaBlaCar) is more literal, since a driver going somewhere anyway shares seats that, otherwise, would be free, to passengers without charge or for a contribution to fuel costs. In many African countries shared taxis fall into neither category. Like for UberPOOL, independent passengers share rides with others but the service generates profit. As we have illustrated here, however, technology design must account for the particular contingencies of these types of journey.

Interestingly, commercial 'P2P ridesharing' platforms have enabled launching shared taxis in countries where they did not previously exist. So far, however, such systems differ from the ridesharing we report. For example, some evidence suggests that rather than being a collaborative achievement, drivers and customers are dissatisfied when rides are shared, even though the customers chose the pooling option [14]). It will be interesting to examine in future how this new form of taxi sharing contrasts with African varieties that have been honed over time to produce a workable service for drivers and riders alike.

Attending to the details of long-established practices of sharing can, as we have shown, produce a radically different design perspective for technologies. Our proposal to support ridesharing does not rely on a digital middleman's intervention, but instead accounts for drivers' and passengers' collaborative achievement. The Ubers and Olas of this world tend to prioritise passenger convenience [1,30,13]. In contrast our proposal aims to enhance local knowledge, such as about passenger flows and where to find taxis, and maintain tempo and flow, without eroding the independence of drivers or passengers. Accounting for specific sharing practices, thus, extends the meanings available to designing technologies to connect people. While we focus on designing for transportation markets, we also envisage that identifying meanings imbued in local practices can have wider applicability, such as designing systems to support a range of independent workers and small businesses in informal markets, such as day labour [9,10]. Our experience also suggests that the meanings available to inform design are enriched by research collaborations between sites in the 'Global South', where there may be very different practices and contingencies in response to similar constraints.

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