Women on wheels: Gender and cycling in Solo, Indonesia

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This paper explores the question of how to promote cycling among women who face disproportionate mobility and accessibility barriers in rapidly urbanizing contexts by analyzing empirical findings from a multi-method research study based in Solo, Indonesia. Building on and applying a combination of critical gender, geography, and development perspectives, it focuses on the perceptions, attitudes, and behaviors of women residing in low-income neighbourhoods with little access to public transportation networks in Solo as an 'indicator species for bike-friendly cities'. Based on research and analytic findings, the paper further contemplates alternative policy and planning approaches to promoting cycling in more gender-inclusive and responsive terms.

Introduction

Many cities in Southeast Asia face acute urban challenges related to proliferating car and motorcycle ownership, including severe levels of traffic congestion, vehicular air pollution, and road traffic crashes and injuries, along with sprawling patterns of car-centric land use development. While income and wealth expansion have shifted car ownership from a luxury commodity to a common feature of middle class life, motorcycle ownership has become even more widespread across different income groups. Yet motorization patterns can also reinforce class and gender disparities in urban mobility and accessibility (Disko, 2008; Tran & Schlyter, 2010). Low-income households, women, children, the elderly, and people with disabilities are less likely to have access to automobiles and motorcycles, and are more likely to rely on public transportation and walking. As a result, they disproportionately suffer declines in public transit services and the quality of the urban built environment that often accompany mass motorization. Within low income households, women can experience limits on their mobility options through a combination of their class status, which limits access to cars or motorcycles, and gender status, which deprioritizes their mobility needs relative to their male counterparts.[1]

Where transport has long been a keystone of international and urban development practice, the recent emphasis on sustainability has renewed attention on alternatives to motorization, including public transport, walking, and cycling (Bannister, 2008; Cervero, 1998). Few modes of urban transportation are as environmentally sustainable, inexpensive, flexible, or healthy as the bicycle. Not only does cycling offer greater speed, spatial reach and coverage than walking, but bicycles are also as strong on the convenience factor as private vehicles that offer point-to-point travel. This can be

especially appealing to women, many of whom forego the use of mass transit systems out of safety and security concerns, but also travel outside of central commuter corridors and peak hours, while combining multiple stops and destinations as a result of their household and caretaking responsibilities. In addition to addressing uneven mobility and accessibility to opportunities, services, and amenities across population groups, promoting cycling among women appears pivotal to preempting motorization and promoting modal shifts away from private motorized vehicles in keeping with sustainable transport and urban development goals. Yet, even in contexts where women have less access to automobiles and motorcycles, and must rely more heavily on public transportation and walking, cycling tends to be more popular among men and undertaken for exercise and leisure rather than utility purposes such as daily commuting or running errands.

This paper explores the question of how to promote cycling among women who face disproportionate mobility and accessibility barriers in rapidly urbanizing contexts by analysing empirical findings from a multi-method research study based in Solo, Indonesia. Building on and applying a combination of critical gender, geography, and development perspectives, it focuses on the perceptions, attitudes, and behaviors of women residing in low-income neighbourhoods with little access to public transportation networks in Solo as an 'indicator species for bike-friendly cities'. Based on research and analytic findings, we further contemplate alternative planning approaches for promoting cycling in more gender-inclusive and responsive terms. In what follows, we review the literature on gender and cycling before briefly describing the case of Solo and our research design and methodology. The main section of the paper analyses research findings and is followed by a concluding discussion of policy implications.

Literature review

Much of the existing literature on gender and cycling focalizes and explains travel patterns between men and women based on quantitative research methods applied to North American, European, and Australian contexts (McClintock, 2002; Garrard *et al.*, 2008; Pucher & Buehler, 2008; Emond *et al.*, 2009; Krizek *et al.*, 2009; Association of Pedestrian and Bicycle Professionals, 2011; Aldred *et al.*, 2016). Women are generally found to have less access to private motorized vehicles, rely more heavily on public transportation and walking, and make more chained trips, comprising multiple destinations at shorter distances and non-standard times for varying purposes (Gossen & Purvis, 2005; Krizek *et al.*, 2005; Kunieda & Gauthier, 2007; Emond *et al.*, 2009). Common explanatory factors for lower rates of cycling among women include: (i) labour market positions, (ii) household roles and responsibilities, (iii) life stages, (iv) gender-based perceptions and valorization of safety and risk, (v) cultural norms, (vi) physical barriers such as urban spatial structures which segregate housing from other land uses, (vii) weather and topographical conditions and (viii) lacking public transportation systems (McGuckin & Nakamoto, 2005; Kunieda & Gauthier, 2007; Garrard *et al.*, 2008; Krizek *et al.*, 2009; Lusk *et al.*, 2014). Though still an emerging area of research, studies of women in developing countries find pronounced mobility challenges related to lower levels of income, tenuous social and legal statuses, strained infrastructural conditions resulting from rapid urbanization (including lacking public transportation options), cultural and religious norms, and threats of harassment and violence in public spaces (Astrop, 1996; Peters, 2013; Rosenbloom & Plessis-Fraissard, 2010; Tran & Schlyter, 2010).

In framing the problem of gender and sustainable mobility, the feminist geographer Susan Hanson (Hanson, 2010) warns of valorizing masculinity as a desirable benchmark, especially in light of findings that women travel shorter distances, make less use of the car, make more use of public transit and conduct more of their travel on foot in many parts of the world. While elevating the importance of the equity dimension of sustainability alongside the environmental and economic, she cautions against over-problematizing the fact that women's mobility is less than men's and instead calls for further research disentangling when and where women's mobility levels are imposed or chosen, how much agency is involved, and whether low mobility metrics, necessarily translate into lost opportunities. This entails generating more in-depth, context-specific, place-based multi-method studies of how gender shapes mobility in all its complexity. While gender can be understood as an identity, a set of roles, and lived experience embedded within households, communities and cultures; neighbourhoods, regions and larger societies as well as urban built environments and institutional structures—mobility—likewise, assumes multiple dimensions including distance and time travelled, mode of travel, linkages among trips and reasons for travel. Further, contemplating policies to promote sustainable mobility requires a better understanding of how people alter their mobility practices in response to changing conditions.

That sustainable transport policies in rapidly developing regions like Southeast Asia are shaped by international development agencies and practices, which can perpetuate economic development and modernization aims in ways that are permeated by masculine norms and reinforce gender inequality, calls for another layer of critical development analysis—in addition to gender and geography (Cornwall & Molyneux, 2006; Tran & Schlyter, 2010; Roberts & Soederberg, 2012; Thynell, 2016). Over the past two decades, international development institutions like the World Bank and Asian Development Bank have incorporated inclusive gender policies in making urban infrastructure investments in transport, education, health, and other sectors and combating poverty. In mainstreaming gender issues in the transport sector, such development banks often emphasize the importance of expanding women's earning potential and their access to market goods and services, as a strategic means to facilitate economic and social development more broadly (See Thynell, 2016: 78 for overview). In turn, critical gender and development scholars have problematized the narrow economism of equating women's empowerment with workforce participation and consumerism as well as uneven, gendered expectations for women's higher earnings to necessarily translate into household improvements and investments in children's education (Thynell, 2016).

Bringing together such critical gender, geography, and development perspectives helps clarify a series of conceptual tensions and research questions related to gender and cycling in rapidly urbanizing contexts. First, when lower levels of mobility among women in developing countries are attributed to deficient income and infrastructure development as well as traditional cultural, religious, and social norms restricting women's behavior, development and modernization can appear the logical solution. Yet in rapidly urbanizing regions such as Southeast Asia, many cities and regions have achieved unprecedented levels of economic growth, urban infrastructure development and democratization reforms only to find declining rates of cycling among women. Is this still a matter of lacking development and modernization or might there be other factors at play? A related question arises from the mainstreaming of gender issues in the transport sector for improved economic outcomes by international development agencies and practitioners. Flipping the above logic, whereby modernization and

development brings increased cycling among women, in this case, improvements in mobility and access are expected to deliver higher workforce participation and earnings for women and material gains for households. Whether this necessarily occurs or gives way to alternative, unanticipated outcomes and effects remains to be seen. Hence we respond to the call of feminist geographers to resist simple problematizations of women's lesser mobility, by instead inquiring what we can learn from the current barriers and challenges, preferences and behaviors, and strategies of women cyclists among low income, transit-underserved populations. Based on an in-depth, context-specific, and place-based investigation in Solo, Indonesia, this paper seeks to explore such gaps in knowledge by reporting and analysing empirical findings on barriers and challenges for women cyclists, their mobility preferences and behaviors, and strategies for navigating and negotiating their mobility. It additionally ponders normative questions of how to alternatively approach the task of creating more inclusive and responsive cycling infrastructure and policies—in substantive, processual, and epistemic terms.

Case description

Solo is a medium-sized city in Central Java, Indonesia with a local population of 510,000 (that more than doubles during the day) and a polycentric, dispersed spatial structure that hosts a variety of manufacturing, craft production, trade, and service enterprises. Like many rapidly urbanizing regions of the Global South, it faces increasing motorization and accompanying congestion, pollution, and infrastructural challenges. In particular, motorcycle ownership has quickly escalated over the past decade, more than doubling between 2009 and 2013 to nearly 424,000, thanks in part to the availability of low cost imports, financing mechanisms, and national fuel subsidies (Guerra, 2017). With nearly one vehicle per person in the city, Solo has rapidly become a motorcycle city, focusing most of its transportation planning efforts on improving conditions for such faster vehicles. While motorcycles provide a relatively fast, flexible, and inexpensive mode of transportation in Solo, they have also contributed to traffic congestion and vehicular air pollution, reduced access of city streets and public spaces by pedestrians and cyclists, diminished public transportation usage and perpetuated sprawling land use development. The historically neighbourhood-scale built environment largely remains mixed-use, compact, and dense, especially compared to North American urban contexts. However, newer urban development projects, particularly those in the city center, tend to be larger in scale and car-oriented. Moreover, sprawled, leap-frog residential and industrial developments, with few amenities and transit connection, are multiplying on the urban fringes.

   At the same time, Solo claims a longstanding reputation as a national cultural center and has recently gained international attention for its model of progressive urban governance (Bunnell et al., 2017; Bunnell et al., 2013; Fahmi et al., 2016; Morrell et al., 2011; Phelps et al., 2014; Song, 2016; Taylor & Song, 2016). Since 2005, the city's long-term development plan has explicitly aimed to nurture a people-centered creative economy—more immediate policy embodiments including micro-economic and cooperative development, street trader management, and revitalization of traditional markets. Though Solo is no longer the walking and cycling city that it once was,[2] its 28 km of "slow lanes", separating bikes from motorized vehicles on key corridors in the city center, are the country's longest (though motorcyclists and street vendors have overtaken their use). Since 2010, the city government transforms its main thoroughfare,

Jalan Slamet Riyadi, into a public space for walking, cycling, badminton, aerobics, community gatherings, musical performances, and street food sampling for 'Solo Car Free Day'. As part of the 'Bike to School' campaign, the City partnered with pro-cycling groups to offer a bike clinic and race for middle and high school students (2015) and K-12 bike safety education (2016). Further working with school administrators and the police, it banned motorcycle use among minors (under age 17) commuting to school.

Yet for all these infrastructure investments and measures to promote active transport, a 2015 traffic count on the city's two main roads revealed cycling to account for a mere 1 per cent of mode share, compared to 67 per cent for motorcycles, 21 per cent for cars, and 11 per cent for public transportation (Guerra, 2017). The two roads do not represent the city at large, but the stark contrast between the city government's especially active efforts to promote cycling in the central area and low rates of cycling there begs the question, "why?" This is particularly the case among women, who account for close to half of the population in Solo. Bicycling has been around since the Dutch colonial era and Solonese women historically cycled at comparable rates to their male counterparts, as the city's batik workshops and plastic, tobacco, and textile factories sponsored pro-cycling policies (e.g. bicycle bonuses, parking facilities) for the largely female workforce (Kota Kita, 2015). Over time, deindustrialization and motorization have diminished bike use in the city, at especially pronounced rates among women, who have shifted to other forms of employment, though it could be argued that their lesser access to automobiles and motorcycles should promote higher bike use.

Cultural-ideological and political factors have also shaped gendered dimensions of mobility. Among Indonesia's topographically and socio-culturally diverse regions, Central Java counts among the most liberal and Solo has long been a bastion of social and political movements for independence, democracy, and human rights. Yet, as a majority Muslim society, Indonesia as a whole has also been impacted by the growing popularity and political influence of the conservative and fundamentalist factions of the Islamic movement. Since the late 1990s and early 2000s, the Islamic movement has steadily expelled liberal Muslim intellectuals and grassroot activists from its ranks and thinned its alliance with the democratization movement. At the national level, fundamentalist leaders have derailed efforts at gender reform (i.e. ban on polygamy, equal inheritance rights, anti-domestic violence bill), while advancing Shari'a local and provincial codes focused on women's dress, movement in public space, and behaviour (Brenner, 2011) in more Muslim-dominated, conservative regions of the country. Notwithstanding this highly charged cultural-ideological and political climate, increasing numbers of Indonesian women have entered the workforce as gender norms have shifted with ongoing modernization, economic development, and democratization. Still, even among young and educated urban middle-class Indonesians, gender-based roles in the form of male head of households and primary female responsibility of childrearing and housework remain pervasive (Utomo, 2016).

Research design and methodology

This paper reports and analyses findings from the 'Women on Wheels' research project, aimed at better understanding the mobility needs, barriers, and concerns of women in Solo, Indonesia, in part, to inform policies and programs for promoting cycling and sustainable transport more generally. The research was designed as a multi-method study, comprising Focus Group Discussions (FGDs), individual interviews, field observations,

and surveys in addition to secondary research, and carried out between August 2015 and August 2016. The project was undertaken in partnership between the local Indonesian NGO Yayasan Kota Kita (YKK), Swedish non-profit organization Living Cities and university-based researchers from the United States. The team selected Solo as a 'crucial case study' (Eckstein, 1975; McKeown, 1999; George & Bennett, 2005) based on secondary research and field observations indicating that the city's relatively short travel distances (related to the city's polycentric, dispersed spatial structure) and flat topography, record of progressive urban policies and historic vitality of civic life as well as civil society were conducive to higher cycling rates among women. Preliminary FGDs and interviews with different groups of female cyclists in Solo confirmed higher rates of cycling among lower income women residing in areas underserved by public transportation networks, as well as those working in factories located on the urban periphery. Project partners consequently decided to focus on the perceptions, attitudes, and behaviors of this group, reasoning that women who either bicycled currently, or were likely to benefit from cycling, were best positioned to illuminate existing needs, barriers and opportunities associated with cycling.

In purpose and design, 'Women on Wheels' was an applied—rather than purely academic—research project. It grew out of a shared commitment among partner organizations and researchers around promoting empowerment and inclusion of citizens in decision-making and planning of their communities and cities. It purposively sampled lower-income women residing in areas underserved by public transportation networks in an effort to elevate and meaningfully incorporate the mobility needs and experiences of underrepresented and underserved groups in addressing policy and planning gaps. Viewed from traditional models of knowledge creation and pedagogy that impose boundaries and vertical hierarchies among academic disciplines or between the academy and society in the name of 'detached objectivity' or 'rigor', the underlying epistemological and methodological approach risk partiality, micro-orientation, and overlooking historical and systemic factors. Alternatively, constructivist perspectives within history and philosophy of science find all human knowledge to be conditional, subjective, and partial as well as power-laden, political, and strategic in its production (Kuhn, 1962; Barnes, 1977; Foucault, 1990). Sharing this view, the 'Women on Wheels' project privileges the situated experiences and knowledge of those on the margins of transport policy, public infrastructure investment, and urban land use development to identify existing gaps, tensions, and opportunities. Where some of our university-based partners were trained in scientific research and inference but lacked knowledge on the local historical and institutional context, community organizers and action researchers affiliated with Yayasan Kota Kita facilitated contextual understanding and mediated exchanges with research subjects. The incorporation of secondary research and field observation in the multi-method research design further illuminated the broader transportation landscape and urban built environment beyond those experienced by respondents.

To select 10 sets of focus group participants from the neighbourhoods with the lowest access to public transportation networks and highest poverty rates relative to the rest of the city, we conducted a two-tiered mapping method. The first step used GIS mapping tools to determine which populations had access to the city's public transportation network, comprising the three-line Bus Rapid Transit (BRT) system and the 10-line network of *angkot* (minibuses). We mapped the population living within a buffer of both 200 m and 500 m distances along the 13 routes, to identify those with walkable access to the existing transit system. The second step of the process mapped
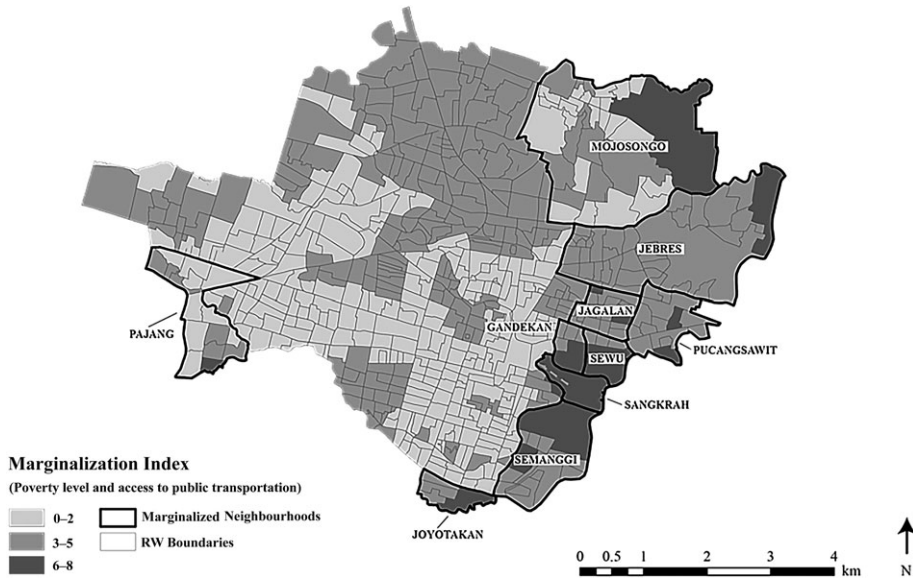
Figure 1. *Focus neighbourhoods based on marginalization index.*
Source: **Prepared by author.**

levels of neighbourhood-level poverty. Here, we first analysed neighbourhood level economic conditions among Solo's 51 *kelurahan*, or neighbourhoods, before honing into the Rukun Warga (RW), or neighbourhood sub-units, examining the percentage of households below the poverty level or receiving government income subsidies (in the absence of household-level data). Following that, we layered the two maps and identified the neighbourhoods that had both high poverty rates and were furthest from existing transit lines (Figure 1). The result was the selection of 10 neighbourhoods: Mojosongo, Jebres, Jagalan, Pucangsawit, Gandekan, Sewu, Sangkrah, Semanggi, Joyotakan, and Pajang.

For each of the 10 economically and transit-marginalized neighbourhoods, we structured a Focus Group Discussion (FGD) to better understand the daily mobility of women that live in these areas and identify their bicycling needs and barriers in Solo. Questionnaires comprised three parts: (1) transportation options, (2) barriers and needs and (3) ideas for improving bicycling conditions. A team of four YKK researchers conducted outreach to community leaders at the level of the RW and RT (subunit of RW, consisting of a cluster of neighboring households) to coordinate the meetings and invite women and girls living in the respective neighbourhoods and communities. The discussions were conducted in Bahasa Indonesia and lasted about two hours each. Each participant was compensated Rp. 20,000 for their transportation expenses. The research team refrained from audio or video-recording the interviews to uphold participant confidentiality but took notes throughout the discussions.

Additionally, YKK researchers administered two sets of surveys at local factories based on an earlier feasibility study that had identified female factory workers among population groups with higher rates of bicycle usage. The survey questions asked the women about their mode choice for various activities, their commute time, as well as their opinions on the conditions for cyclists in Solo. Following the focus group

interviews and surveys, the team of Kota Kita and university-based researchers, including the authors, analysed the notes and survey data before distilling findings.

Research findings

Mobility barriers and challenges

Upon first glance, cycling appears to be gaining heightened policy attention and resources from the City as indicated by the dedicated slow lanes and Car Free Sundays. Closer examination reveals that the slow lanes, which are to the side of the streets, uphold the citywide modal hierarchy that privileges individual motorized vehicles on streets. As stated by one interviewee, 'The sidewalks, designed for walking, are in fact occupied by street vendors, while slow lanes are occupied by parked cars' (Parsini, pers. comm., Dijitoe Factory, August 2016). Not only are motorcycles and cars able to move with comparatively greater ease and speed on city streets, they further impose challenges and barriers for cyclists that share the road. According to one respondent, 'When I travel by bicycle on the streets, it's often so crowded with congestion that I am afraid of being hit or crushed [by a motorized vehicle]' (Kusratmini, pers. comm., Joyotakan, May 2016). A number of respondents noted that the significant traffic, and high speeds, on the main roads around the city made bicycling difficult, as demonstrated by one quote, 'When there are so many vehicles, it scares me!' (Ngadinem, pers. comm., Jebres, May 2016). Another interviewee explained her decision not to cycle on the basis that 'there is no separation between cars and motorcycles versus bicycles' (Suprapti, pers. comm., Dijitoe Factory, August 2016). Beyond concerns of physical safety, interviewees expressed a sense of losing their place on the streets, as in the following quote, 'Many motorcycles are inconsiderate, making cycling uncomfortable' (Yuyun Yuni Astuti, pers. comm., Sangkrah, June 2016). Among speeding motorcyclists, cyclists can feel defenseless, sluggish, and out of place. This was an especially common perspective among women in older age groups, who had firsthand experience of the rapid proliferation of motorized vehicles and consequent changes in the quality of city streets and movement through urban space. One woman reflected, 'Bicycling in Solo has gotten harder as the bicycle has lost the competition with other modes of transportation and become marginalized' (Alif Zuhfa Aninda, pers. comm., Gandekan, May 2016). Such insights reveal that the impacts of cycling infrastructure investments and policies are felt in relative—rather than absolute—terms. Despite continuing improvements in street paving and slow lanes, the predominance of motorized vehicles on the street leads to a sense of marginalization among cyclists.

Another shortcoming of the general cycling improvements such as the slow lanes and Car Free Sundays is that they are concentrated in the city center, further away from neighbourhoods of residence and many of the lower income, and more transit underserved, areas of the city. This makes them largely inaccessible to the majority of the city's female cyclists, who tend to cycle at the neighbourhood scale and are deterred by traffic safety issues from entering the arterial roads that connect to the city center. The trip purposes for which women respondents frequently use the bicycle— shopping, recreation, and social visits—tend to take place within or proximate to their neighbourhoods (more on this later). As summed by one respondent, 'I use the bicycle only for short distances, not to go far away' (Suryani, pers. comm., Gandekan, May 2016). For those whose daily activities take place within the neighbourhood, cycling can provide a feeling of self-sufficiency and freedom. As expressed by a woman from Mojosongo, 'I don't feel limited in my travel. I can bicycle everywhere I want, but I

only need to go to the market or around the neighbourhood' (Ibu Sayekti, pers. comm., Mojosongo, May 2016). That said, many women must go outside their neighbourhoods to fulfill various trip purposes related to their household and family roles and responsibilities. Those who endure the unsafe and uncomfortable experiences of traveling on the city's main roads to do so report being further stymied by a lack of secure and affordable places to store their bicycles at different sites. In the words of one interviewee, 'Sometimes people don't respect cyclists, especially when we want to park. There's just no space for bicycles' (Haryanti Ibu Subur, pers. comm., Pajang, 2016). Another woman highlighted the uneven costs of parking: 'There is little difference between motorcycle and bicycle parking' (Siti Narimah, pers. comm., Sangkrah, June 2016). Even when women are willing to pay the same rates that motorcycles must pay, their needs are not accommodated, as described by this woman from Semanggi, 'In Singosaren Market, the parking attendant doesn't allow bicycles to park there, even if we are willing to pay the same rate as motorcyclists' (Hartini, pers. comm., Semanggi, April 2016). Such insights show the limitations of a singularly downtown centric approach that fails to consider the actual locations of most bicycle users along with their storage needs once they get downtown.

Not all barriers to cycling are infrastructural. Susceptibility to harassment and crime along with cultural norms also discourage women from cycling. Many of participants reported experiences of being harassed, attacked, or robbed while travelling or knew of other woman who had. One woman from Joyotakan insisted, 'Women who go to the market in the early morning get robbed when they travel alone' (Triana S., pers. comm., Joyotakan, May 2016). Identified as a particularly hazardous time for travel, the early mornings are when essential trips to the market and mosque take place—as well as times of low public transit access, leaving few options for travel. An interviewee from Sangkrah saw particular modes and locations, rather than times, as higher risk: 'Women who use the bicycle are vulnerable in terms of safety, especially in quiet areas. In the city center, it's safe but in deserted areas, it's a little bit dangerous for women cyclists' (Sugeng, pers. comm., Sangkrah, June 2016). A number of women further remarked on the experience of being harassed by men and boys, some calling out to women on the street, and others exposing themselves to women. Another interviewee remarked on the intersection of safety risks and cultural norms, 'I can't go home so late, and I don't want to; it's dangerous for women' (Shabila Istiqomah, pers. comm., Jagalan, June 2016). Many interviewees expressed the opinion that women should not travel in the dark, especially girls, in part to minimize the risk of becoming crime victims. A young woman commented, 'My parents absolutely will not allow me to go hang out with friends at night' (Alung Dwi Puramasari, pers. comm., Pajang, April 2016). Unraveling the time restrictions on travel among women and girls, respondents reflected that it was not simply being out in the dark but rather traveling alone, at slower speeds (as often occurs on bicycle or walking), and in conditions of lesser visibility or fewer 'eyes on the street' that enhanced the vulnerability of female travellers to potential attackers. Whether or not they are founded, such perceived fears and social norms circumscribe women's travel times to daylight hours and discourage non-motorized travel.

Mobility preferences and behaviors
Despite significant barriers and challenges, many women and girls still prefer to bicycle around Solo. Understanding why they do is critical to addressing existing obstacles and promoting cycling more widely. In discussing reasons for cycling, one woman

explained her strong reliance on the bicycle in income terms, 'I have no other choice. My salary can only buy rice and vegetables. I can't even afford to pay for public transport' (Ngadinem, pers. comm., Jebres, May 2016). A 13-year-old girl from Pucangsawit highlighted reasons of self-sufficiency, 'Cycling is convenient and doesn't require me to bother my parents since I can go by myself' (Sofia, pers. comm., Pucangsawit, June 2016). As echoed by a number of adult respondents, the need to depend on a driver, often a male relative, to get around by motorcycle can be disabling so as to enhance the appeal of the bicycle as a means of more independent mobility. While motorcycle ownership rates have dramatically risen for the city as a whole, many working class and poor households still struggle to purchase motorcycles, even with widening access to cheap credit, and when they do, men tend to gain priority access. A number of women who identified the motorcycle as their primary mode of transportation did not actually drive the motorcycle themselves but were dropped off and picked up by male relatives. In addition to factors of cost and autonomy, respondents described the experience of riding the bicycle as 'fun', 'relaxing', and 'healthy'. For those with little time in their daily routines to exercise, the bicycle provides a chance to exercise while traveling, in some cases justifying longer travel times. Along with recreational and health benefits, one interviewee identified environmental reasons, namely that bicycling 'does not cause air and noise pollution' for cycling.

While preferring to get around by bicycle for different reasons, most women cycle at the neighbourhood scale, where the availability of smaller, local roads eases the experience of cycling. Among our respondents (n = 152), of whom 56 per cent reported using the bicycle as their primary mode of transportation, distance appeared a key factor mediating modal choices and patterns. Respondents indicated a preference to use bicycles, or walk, for shorter distances and use motorized vehicles for longer distances. As a whole, the most commonly reported purpose of travel was for shopping (33 per cent total), whether at the market (21 per cent of reported trips) or small neighbourhood kiosks (12 per cent), followed by work-related travel (18 per cent). Examining the relationship between women's trip purposes and modal choices, we can see that for market trips, the vast majority of respondents (80 per cent) went by bicycle, compared to 15 per cent by motorcycle and 5 per cent by walking. Trips to the local kiosks were entirely conducted on non-motorized modes—86 per cent by bicycle and 14 per cent by walking. Of work-related trips, 70 per cent were conducted by bicycle, compared to 24 per cent by motorcycle, and 6 per cent by walking; none of the women took transit to work.[3] Respondents additionally reported travelling for social visits (10 per cent), recreation (10 per cent), neighbourhood-level errands (7 per cent), religious trips (5 per cent), and dropping off/picking up children at school (3 per cent); most of these trip types were undertaken by bicycle or walking.[4] For girls specifically, the most prevalent daily trip was getting to and from school, followed by social visits and trips to the kiosk. For trips to school, 52 per cent of female students rode a bicycle, compared to 23 per cent that got dropped off or drove by motorcycle, over 20 per cent that walked, and a mere 5 per cent that went by transit. Such findings indicate that the bicycle is a critical enabler of access to educational and employment opportunities but still more commonly used for shopping trips, in addition to social and leisurely purposes.

More closely attending to differences in mobility preferences and behaviors across women of different age groups brings to light a combination of urban-spatial and socio-cultural factors at play. Female students in elementary and middle school have the highest rates of cycling, but the rates significantly drop off after the transition to high

school. In part, this appears to be a factor of distance, as lower grade schools tend to be located within the neighbourhood boundaries of many students—at a relatively convenient biking distance for the girls that parents generally feel comfortable with, while high schools are typically located outside of students' immediate neighbourhoods. Compared to 79 per cent of girls aged 12–15 who reported biking as their primary mode of transportation, only 5 per cent of girls aged 16–23 did so, while the vast majority (64 per cent) reported that they drive or get a ride on a motorcycle, and 7 per cent reported taking public transportation to school. Besides spatial factors, lacking enforcement of the legal driving age and ban on motorcycle parking on school premises also appeared to matter. The failure to implement the 'Bike to School' campaign across the city is exhibited in this quote from a student in Pajang, 'There is a bicycle promotion in my school, but students still use motorcycles and are allowed to park them inside the school' (Astri Putri, pers. comm., Pajang, April 2016). Parents and school administrators widely condone motorcycle use among students under 18-years of age due to its convenience. Peer pressure and social status also influence modal choices, as indicated by these quotes from students: 'In my school, most students use motorcycles, so that's why the bicycle is not popular' (Tasya Anisa Putri, pers. comm., Joyotakan, May 2016); 'many students prefer motorcycles because it's prestigious'; 'the bicycle is not cool anymore' (Tasya Anisa Putri, pers. comm., Joyotakan, May 2016). An adult interviewee observed, 'Girls tend to worry more about being ridiculed and experience more shame about riding bicycles, but boys don't have that problem' (Nimas, pers. comm., Jagalan, June 2016). Such self-consciousness on the part of girls may relate to the transition into womanhood, complete with expectations about proper behavior, appearance, and athleticism (Hanson, 2010).

Gendered roles and responsibilities within families and households further shape cycling patterns. Among adult respondents, women aged 18–34 reported the second lowest rates of cycling (32 per cent choosing cycling as their primary mode) after girls 16–25 years of age. As wives and mothers, women in this age group and life stage often balance a variety of daily tasks, including transporting goods for household consumption and taking care of younger children. One interviewee described her fear of crossing major intersections while cycling to and from the market with a shopping basket. Another woman attributed her inability to cycle regularly to the simple fact that 'I am usually with my kids' (Erna, pers. comm., Sewu, May 2016). Some of the younger adult women, like the older female students, may also be susceptible to social perceptions and status implications of bicycling. In contrast, 64 per cent of women in the next two age groups—35–49 and 50–69 years of age—cycle much more regularly. In particular, the former group uses the bicycle as a primary mode of transportation and for a large variety of trip types, including shopping, taking children to and from primary school, work-related trips, and social and recreational purposes. The higher rates of bicycling in this age range may also exert positive peer effects that counter social insecurities about cycling and status associations with the motorbike. Many of the women aged 50–69 reported having cycled for most of their lives and continuing to do so despite emerging health issues and physical challenges. Having grown up and matured before mass motorization, they also saw the prospect of driving motorcycles as less appealing, some deeming it 'scary', and others referring to restrictions placed by their own children out of cited safety concerns. Compared to younger women, this age group generally had shorter trip destinations and did not feel the need to travel across the city.

Navigating and negotiating mobility

Having examined the various conditions and factors constraining cycling among low income, transit-underserved women in Solo along with their cycling preferences and behaviors, we now turn to strategies that women use to navigate and negotiate their mobility as well as their recommendations for pro-cycling interventions in the city. During interviews, many respondents suggested the expansion of the slow lane cycling network beyond the major arterial roads in the urban core, to connect with neighbourhood-level streets and networks. One interviewee stated, 'Extending bicycle lanes to the city's outskirts, where people live would attract more people to use the bicycle' (Anyta, pers. comm., Jagalan, June 2016), while another's wish for 'a bike lane from the neighbourhood to main road' (Dwi Purwanti, pers. comm., Semanggi, April 2016) put it in reverse terms. To the extent that bike trips typically begin and end at home, respondents felt that the city government's pro-cycling initiatives should account for Solo's polycentric urban structure and corresponding residential dispersion in promoting cycling ridership for utility trips in addition to leisurely and recreational purposes. Climate factors also merit attention, particularly in tropical regions like Indonesia. One woman envisioned, 'Along the slow lane, trees should be planted, so cyclists rest when they get tired' (Arintina, pers. comm., Pucangsawit, June 2016). Another suggested that a first step might be to simply activate existing slow lanes before adding vegetation and amenities. She asked, 'What's a slow lane without law enforcement to make the slow lane useful for cyclists and not for motor-cycles or street vendors?' (Suprihatin, pers. comm., Pucangsawit, June 2016). Hence respondents proposed physically expanding slow lanes to neighbourhood environments where they already cycle as well as greening and regulating the slow lanes for easier use.

But to what extent can improved slow lanes challenge the current modal hierarchy whereby individual motorized vehicles increasingly dominate the roads and public space more generally? For women having to travel longer distances beyond the neighbourhood, a common strategy was to travel on secondary roads. One respondent reasoned, 'If I drive on the main road with cars, motorcycles, and trucks, it is really difficult, but I can more easily pass them on the small roads' (Yani, pers. comm., Jagalan, June 2016). Another elaborated, 'On these roads, congestion is not a barrier, because the bicycle is small and it is easy to go anywhere' (Sudiyem, pers. comm., Mojosongo, May 2016). In other words, the smaller, more local roads can create bottlenecks for motorized vehicles, which bicyclists can bypass by navigating the spaces at the sides of the roads and between traffic. By re-claiming the main arterials in addition to traveling on smaller roads and more local streets, cyclists could take more direct travel routes, move at higher speeds, and reach further destinations. This requires active interventions across a range of road and street typologies to calm, limit and, in some cases, exclude motorized traffic. Interviewees also emphasized the importance of upgrading cycling infrastructure to promote comfort and convenience akin to that experienced by motorists. One recommended, 'We need cycling infrastructure like traffic lights, rest areas, and parking spots to make the conditions good for cycling. Then it would be easy to invite and encourage people to cycle' (Suprihatin, pers. comm., Pucangsawit, June 2016). Several reiterated the importance of increasing parking spaces for bicycles in public areas to better enable trip chaining for women who have to fulfill multiple purposes on their journeys. The shared premise among these suggestions is the importance of levelling the competition between cycling and individual motorized transport.

Beyond physical infrastructural interventions, interviewees suggested economic incentives that could make bicycles more competitive relative to motorcycles. Despite the higher total cost of motorcycle ownership, buyers widely finance motorcycle purchases with little down payment and low monthly payments. One interviewee explained, 'Buying a new motorcycle can be easier than getting a bicycle, because motorcycle credit is so low. To buy a new bicycle, we have to save money, but to buy a new motorcycle, we can just use credit' (Nur Fitriati, pers. comm., Sewu, May 2016). In Indonesia, used motorcycles can be purchased through credit-based financing at even lower rates. When asked what changes would promote cycling, another respondent claimed she would switch 'If I didn't have enough money to buy gasoline for my motorcycle' (Tasya Anisa Putri, pers. comm., Joyotakan, May 2016). Where the cost of travel proves to strongly influence modal choices, some respondents claimed that the cost of motorcycle ownership could be even cheaper than taking public transit. Indeed, many of the interviewed women and girls reside in neighbourhoods underserved by transit—a function of our sampling methodology—and must make intermodal connections, combining both informal and formal modes of transit, even to get to the city center. As described by a woman from Jebres, 'I go around selling fresh fish from the market, and it's much faster and less tiring when I use the motorcycle' (Sri Sumarsih, pers. comm., Jebres, May 2016), suggesting that the time efficiencies alone can make the motorcycle more cost effective. Reflecting on her challenges of transporting and selling fresh fish using multimodal transit connections or the bicycle brings into clear relief the necessity of multipronged approaches to promoting utility cycling among women, including lowering costs of ownership and operation, transport infrastructure improvements, and even vehicle redesign for greater functionality.

Finally, a number of interviewees reflected on ways to address safety and sociocultural constraints on women's mobility as well as make cycling more enjoyable and socially desirable. In the words of one interviewee, 'Cycling together promotes safety and security for women' (Sri Sumarsih, pers. comm., Jebres, May 2016). For those who have suffered incidences of harassment, physical attack, or robbery while traveling on bicycle, riding with other women affords a sense of power and protection in numbers. Another respondent added, 'It is fun to bike to certain places together'. Several interviewees agreed, 'If there were a bike group in my neighbourhood, I would frequently join and bike together with others' (Denwanti, pers. comm., Semanggi, April 2016). Given gendered norms that constrain women and girls from leaving their homes outside of daylight hours, such group mobility can additionally help temper individual-level blame and judgment, and if occurring on a sufficient scale, can begin to shift perceptions and expectations about women's travel preferences and behaviors. Besides riding in critical mass, another idea was for women and girls to provide peer-instruction and support in bicycle training and maintenance. Some discussed the idea of initiating neighbourhood-based public education and outreach campaigns targeting different age groups of women, highlighting the health, convenience, and environmental benefits of cycling and offering bicycle accessories such as baskets and seats for carrying children as incentives. Some thought that mothers would be particularly amenable to such policy framing and outreach strategies. Others saw more value in focusing on girls 12–15 years of age, who have the highest rates of cycling and are at great risk of shifting to motorcycling in the coming years. To 'get rid of the negative stigma of cycling to school' (Nimas, pers. comm., Jagalan, June 2016) while building on existing citywide youth programs like 'Bike to School', interviewees suggested conducting direct outreach to parents and school administrators to help enforce the motorcycling ban among minors under age 17.

Concluding discussion

In this concluding section, we return to the conceptual tensions and normative questions delineated at the start of the paper. Solo's introduction of 28 km of 'slow lanes', along with 'Car Free Sunday' signal its commitment to expanding public space for active transport and leisurely activities as well as promoting a cleaner and safer urban environment. They also come on the heels of rapid economic growth, urbanization, and motorization in the region, which have been accompanied by a vast expansion of the road network and traffic volumes. Where they are currently concentrated in the center city and the slow lanes are overtaken by alternative uses other than cycling and walking, some of our respondents envisioned the extension of a cycling network to and from neighbourhoods throughout Solo. While commendable and necessary, these interventions are insufficient in addressing the uneven modal dynamics that these women confront when traveling by bicycle around Solo. Their descriptions of jarring encounters with motorized vehicles on major roads along with stated preferences for cycling on local and secondary streets with fewer cars and motorcycles and relatedly lower speeds indicates a much needed push back against the hegemony of individual motorized vehicles at a citywide scale. Cyclists do not and will not only travel on slow lanes, no matter how prolific the infrastructure investments and upgrades. Only by challenging the predominance of motorized vehicles across road and street typologies and enhancing the relative ease and convenience of bicyclists relative to motorists will cycling gain serious traction among women and more generally. This is less a matter of development and modernization than modal re-prioritization and sociospatial equity.

What can we take away from the cycling preferences and behaviors among women in Solo's low income, transit-underserved neighbourhoods? Our research indicates a strong reliance among respondents on cycling to fulfill a range of trip purposes. While critically enabling access to work and educational opportunities, the bicycle is most commonly used for shopping, in addition to facilitating social, recreational, and religious trips. Distance and time are key factors mediating modal choices and patterns among women. Not only do they prefer to cycle shorter distances, mostly at the neighbourhood scale, their tendency to undertake shorter, sequential trips within more circumscribed travel times (i.e. during daylight hours) can discourage non-motorized travel for chained trips. Women are more likely to cycle to workplaces and schools, as well as other destinations, activities, and opportunities, if they are located within neighbourhood boundaries and/or accessible by local and secondary roads and compatible with other trip purposes. Then what might be the outcomes and effects of more gender-inclusive and responsive cycling interventions? Without attention to urban land use development patterns, they may result in more trips for shopping, socializing, and leisure around home and motorized travel to work. As the growing trend of spatial sprawl and land use segregation in rapidly urbanizing contexts creates greater distances between areas of living and working, such emerging trends reaffirm the importance of spatially integrating different parts of the city—by means of transit networks, bikeways (as respondents suggested), and walking paths—to promote modal shifts away from private motorized travel at the citywide scale. Urban policies and planning protocols encouraging infill development in existing neighbourhoods and the city center may also help reinforce mixed use, compact, and dense historical settlement patterns.

Respondents' strategies for navigating existing barriers and challenges to cycling and recommendations for pro-cycling interventions in the city carry important epistemic and processual implications. On the whole, interviewees shifted the focus away

from improvements in central areas to small-scale, dispersed improvements in neighbourhoods where public transportation is scarce, but where multi-purpose trips are frequent. They recast attention from major roads to secondary streets, where cars and motorcycles exert less command. They also highlighted ways to address safety and socio-cultural constraints on women's mobility as well as make cycling more enjoyable and socially desirable. This is to say that innovations and advancements in urban transport and mobility, though formally defined as the domain of professional planners and engineers (and increasingly tech entrepreneurs), often originate outside the halls of power and decision making. In Solo as well as other cities around the world, civil society and community groups are increasingly raising public awareness and pushing governments to promote alternatives to motorization as well as identifying opportunities for neighbourhood-scale improvements, so as to lend considerable resources and capacity to the promotion of new cycling infrastructures and services. Besides the political willingness of city officials to alter institutional arrangements and practices to better serve women constituents and those using active modes of transport, this calls for improved governmental capacity to conduct outreach and meaningful engagement with marginalized populations that are best situated to reveal policy and planning gaps as well as inform alternative solutions. Here, local NGOs and community groups, whether representing women, championing cycling, or otherwise, may play a bridging and mediating role as well as provide ideas and inspiration.

Finally, to what extent is Solo a model of progressive urban governance and what can other cities learn from Solo about promoting cycling in more gender-inclusive and responsive terms? Like many cities, it began with general cycling improvements that seek to expand public space for active transport and leisurely activities as well as promote a cleaner and safer urban environment. Yet, such interventions are largely inaccessible for the majority of female cyclists who cycle within or near their neighbourhoods, are typically unwilling to reclaim the spaces from alternative uses and may be deterred from cycling at Car Free Sundays by gender roles and safety risks. Nor are they effective at promoting cycling among men, who enjoy privileged access to motorized vehicles compared to their female partners and relatives and have little reason to take on the dangers, discomfort, and inconveniences of cycling in the current transportation landscape. A far more progressive and effective approach would be to prioritize the needs and experiences of those groups such as lower-income women residing in areas underserved by public transportation networks who face higher mobility constraints, tend to travel more frequently and closer to home, and play integral roles within families, household, communities, and neighbourhoods. This not only magnifies their potential benefits of cycling along with their capacity to effect modal shifts more broadly but also places them at great risk of motorization with continuing economic development and urbanization. Ultimately, promoting liveable, inclusive, and democratic urban environments will advance cycling and sustainable urban transport agendas. Urban inhabitants, beginning with women, will take to alternative transport modes en masse when they can travel more safely, comfortably, and enjoyably while fulfilling the ranging roles and responsibilities that they hold within families, social groups and organizations, neighbourhoods, and communities.

Endnotes

1. Men tend to have priority access to motor vehicles, whether due to the distribution of economic resources, advantaged labour market positions, or sociocultural norms. On the other hand, women are more likely to work outside of formal labour markets and business hours, while assuming a greater share of household responsibilities, such as shopping and caring for children or the elderly, which require more frequent, shorter journeys at off-peak hours.
2. This partly resulted from the city's batik workshops and plastic, tobacco, and textile factories sponsoring pro-cycling policies, such as bicycle bonuses and extensive parking facilities, for the largely female workforce.
3. The majority of work-related trips comprised getting to and from the workplace, with a subset of respondents (14 per cent) who also reported instances of selling goods by bicycle and picking up goods to sell.
4. Parsing the data a slightly different way, we can see that among the 56 per cent of respondents who reported using the bicycle as their primary mode of transportation, the primary trip purpose for adult female cyclists (aged 18–69) was again shopping (accounting for 55 per cent of cycling trips), at both markets (37 per cent) and neighbourhood kiosks (18 per cent), followed by work-related trips (33 per cent). Even the 44 per cent of women who reported a primary mode of transportation other than the bicycle preferred using bicycles for shopping, social visits, and recreational trips, followed by work-related purposes.

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