UNIVERSITY OF AMSTERDAM

UvA-DARE (Digital Academic Repository)

The human infrastructure of a cycling city: Amsterdam through the eyes of international newcomers

Nello-Deakin, S.; Nikolaeva, A.

DOI
10.1080/02723638.2019.1709757

Publication date
2021

Document Version
Final published version

Published in
Urban Geography

License
CC BY-NC-ND

Link to publication

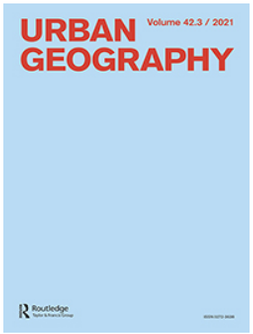
Citation for published version (APA):
Nello-Deakin, S., & Nikolaeva, A. (2021). The human infrastructure of a cycling city: Amsterdam through the eyes of international newcomers. *Urban Geography*, *42*(3), 289-311. https://doi.org/10.1080/02723638.2019.1709757

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: https://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, P.O. Box 19185, 1000 GD Amsterdam, The Netherlands. You will be contacted as soon as possible.

UvA-DARE is a service provided by the library of the University of Amsterdam (https://dare.uva.nl)

Download date:16 Sept 2026



Urban Geography

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rurb20

The human infrastructure of a cycling city: Amsterdam through the eyes of international newcomers

Samuel Nello-Deakin & Anna Nikolaeva

To cite this article: Samuel Nello-Deakin & Anna Nikolaeva (2021) The human infrastructure of a cycling city: Amsterdam through the eyes of international newcomers, Urban Geography, 42:3, 289-311, DOI: 10.1080/02723638.2019.1709757

To link to this article: https://doi.org/10.1080/02723638.2019.1709757

© 2020 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

Published online: 05 Jan 2020.

Submit your article to this journal

Article views: 11882

View related articles

View Crossmark data

Citing articles: 7 View citing articles

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=rurb20

URBAN GEOGRAPHY
2021, VOL. 42, NO. 3, 289–311
https://doi.org/10.1080/02723638.2019.1709757

Routledge
Taylor & Francis Group

OPEN ACCESS Check for updates

The human infrastructure of a cycling city: Amsterdam through the eyes of international newcomers

Samuel Nello-Deakin and Anna Nikolaeva

Department of Geography, Planning and International Development, University of Amsterdam, Amsterdam, The Netherlands

ABSTRACT

Although place-specific social norms play at least as important a role as physical factors in encouraging cycling in mature cycling cities, few studies have explored these factors in detail. In order to address this research gap, this paper offers a qualitative exploration of what makes Amsterdam a "cycling city". Through semi-structured interviews, the article explores the main factors which encourage cycling uptake among international newcomers to Amsterdam. Instead of relying on a division between "hard" and "soft" factors, we approach the city as a sociotechnical system, arguing that the material and social factors which encourage cycling in Amsterdam are co-constitutive. We identify seven main factors encouraging cycling, whichtend to be mutually reinforcing and highlight the critical role of the "human infrastructure" formed by cyclists themselves in encouraging cycling. Finally, our analysis uncovers a temporal dimension of cycling uptake, showing that many newcomers become increasingly reliant on cycling over time.

ARTICLE HISTORY
Received 7 May 2019
Accepted 22 December 2019

KEYWORDS
Cycling; local mobility culture; Amsterdam; human infrastructure

Introduction

In a growing number of cities, cycling is increasingly seen as a promising answer to a variety of urban problems, including mobility-related issues such as traffic congestion, urban pollution and transport carbon emissions, but also wider issues of public health and urban vitality (Fishman, 2016; Pucher & Buehler, 2010). As emphasized by Darnton (2016), urban cycling offers the potential to not only improve the urban mobility system, but also to create more attractive places and cities to live in. As cities worldwide struggle to develop urban livability, health and climate mitigation policies under constrained budgets, increasing cycling rates as a cost-effective means of furthering these goals has become a key aspiration for urban policy-makers worldwide (Blue, 2013). By and large, most urban policies seeking to encourage cycling have focused on urban planning and design measures, and in particular on the provision of dedicated cycling infrastructure. The assumption seems to be that if we plan our cities following the principles of "bicycle-oriented development" (Fleming, 2011), we will be able to increase cycling levels. Following a "build it and they will come" logic, cities from all over the world have turned

CONTACT Samuel Nello-Deakin s.nello@uva.nl Department of Geography, Planning and International Development, University of Amsterdam, Postbus 15629, Amsterdam, NC 1001, The Netherlands

© 2020 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.
This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (http://creativecommons.org/licenses/by-nc-nd/4.0/), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.

to mature cycling countries such as the Netherlands and Denmark in an attempt to identify and import best practice planning measures related to cycling (Pucher & Buehler, 2008; Pucher & Dijkstra, 2000). A well-known bicycle planning consultancy, for instance, explicitly seeks to "Copenhagenize" cities around the world (Colville-Andersen, 2018), while a recent scheme to improve local cycling conditions in London is officially known as the "mini-Holland" programme (Aldred, Croft, & Goodman, 2019). In both these cases, these transformations inspired by Danish and Dutch practice focus overwhelmingly on infrastructural and physical design measures.

However, various historical, sociological and anthropological accounts (e.g. Feddes & de Lange, 2019; Henderson & Gulsrud, 2019; Kuipers, 2013; Oldenziel, Emanuel, de la Bruheze, & Veraart, 2016; Oosterhuis, 2015; Vivanco, 2013) have noted that we cannot understand the preponderance of cycling in Dutch and Danish cities by looking only at "hard" factors such as urban form and cycling infrastructure. Instead, they argue that place-specific politics of urban mobility, social norms and cultural setting are at least as important as urban planning and design in encouraging cycling in mature cycling cities. This contention is supported by recent statistical studies which suggest that city-wide "soft" factors related to social norms and cultural setting are more important than urban form and infrastructure in encouraging cycling in mature cycling cities such as Copenhagen (Haustein, Koglin, Nielsen, Sick, & Svensson, 2019) and various German cities (Thomas, Kenworthy, & Lanzendorf, 2013; Thomas & Lanzendorf, 2016). The quantitative aggregate nature of these studies, however, means that they have been unable to explore these factors in detail.

With a view to addressing this research gap, the present study provides a qualitative exploration of the place-specific factors which encourage cycling among international newcomers in Amsterdam. More specifically, our paper explores the cycling experiences of international newcomers in Amsterdam, with a focus on the main factors which led them to take up cycling after moving to the city. To this end, we carried out and analyzed 26 in-depth semi-structured interviews with international newcomers who did not cycle regularly for transportation before arriving to the Netherlands, but who took up cycling (in various degrees) after moving to Amsterdam. In doing so we build on the mobility biographies approach (Müggenburg, Busch-Geertsema, & Lanzendorf, 2015), as well as on existing literature on long-distance relocation to a different "mobility culture" (Thomas & Lanzendorf, 2016). The reason for focusing on international newcomers is that, unlike most of Amsterdam's residents, they do not have a Dutch "national habitus" which assumes that cycling is normal (Kuipers, 2013). This makes it possible to discount the role played by the "in-built" propensity to cycle among the Dutch, and focus more clearly on the role of place-specific factors in encouraging cycling.

The present article offers an important addition to the existing literature in various respects. Firstly, our study seeks to provide a holistic perspective on cycling cities which speaks not only to urban planners and transport researchers, but to mobility scholars and urban geographers more broadly. While studies in the fields of urban planning and transport are often premised on a rigid theoretical distinction between "physical" and "social" or "hard" and "soft" factors in encouraging cycling (e.g. Forsyth & Krizek, 2010; Heinen, van Wee, & Maat, 2010) in the present study we approach the city as a sociotechnical system, arguing that the material and social factors which encourage cycling in Amsterdam are thoroughly entangled and co-constitutive of each other. In

particular, we argue that the concept of "human infrastructure" (Lugo, 2013) offers a useful lens through which to look at mature cycling cities, allowing us to bridge the gap between material and social factors in encouraging cycling. As our findings illustrate, the "human infrastructure" formed by Amsterdam's critical mass of cyclists contributes to encourage cycling both through its *physical* presence on the streets, and through its role in creating a *social* environment favorable to cycling.

Secondly, and at a more fundamental level, our study also contributes to redress the relative dearth of qualitative studies focusing on mature cycling cities. With a couple of exceptions (e.g. Gössling (2013) and Larsen (2016) on Copenhagen), most existing qualitative studies on urban cycling (e.g. Jones, 2005; Lugo, 2013; Pooley, Horton, Scheldeman, & Harrison, 2010; Steinbach, Green, Datta, & Edwards, 2011) have been carried out in cities with low cycling levels, where cycling is likely to be shaped by a very different set of factors than in mature cycling cities (Larsen, 2016). Although such research is invaluable in helping us understand the barriers many cities face in increasing cycling levels, it does little to help us understand what a *mature* cycling city is actually like. In other words, what are the defining characteristics of a cycling city, and how are they experienced by its residents in their daily lives? Thirdly, and in comparison to previous studies on Copenhagen (Gössling, 2013; Larsen, 2016), the present study seeks to advance our knowledge of the processes shaping the *uptake* and *maintenance* of cycling practices in a mature cycling city. Through our focus on international newcomers, the present study furthers our understanding of how individuals with no previous "cycling habitus" (Kuipers, 2013) become socialized into the city's cycling culture. Identifying the key factors which encourage cycling among newcomers in Amsterdam, we suggest, is useful in helping us understand the extent to which these factors might be replicable or transferrable to another geographic context.

We begin by briefly introducing recent theoretical accounts of infrastructure as a sociotechnical system and their application to cycling, to continue by providing some background context on cycling in Amsterdam. This is followed by a more detailed methodology section and the presentation of our findings, in which we identify seven main factors encouraging cycling among international newcomers and discuss the temporal dimension of cycling uptake, which emerged as a prominent theme in our analysis. In the conclusions and discussion, we summarize our findings, point out directions for future research and reflect on the implications of our study for policy.

The sociality of urban (cycling) infrastructure

Largely influenced by developments in the field of science and technology studies, social scientists have increasingly sought to complicate traditional ideas of infrastructure as inert physical structures, pointing instead to their thorough entanglement with social practices. As noted by Star (1999), infrastructure is always relational: "Infrastructure both shapes and is shaped by the conventions of a community of practice" (p. 381). Drawing upon this general trend in the social sciences, various urban scholars have argued that we need to conceptualize urban infrastructures – or even the city as a whole – as a sociotechnical assemblage which is inevitably *both* physical and social. As suggested by Amin (2014), it is possible to "reimagine the city as both a social and a technical arrangement" in which "urban infrastructures are shown to be social in every respect" (p.

138). Critically, people themselves may be seen a form of urban infrastructure (Simone, 2004). Building upon Lefebvre's ideas of social space, Simone (id.) argues that the flexible, mobile intersections of residents and transactions in Johannesburg (which are provisional, but also highly regular and enduring in time) form an essential part of the city's fabric which constitute a form of infrastructure in their own right.

To some extent, ideas of infrastructure as a sociotechnical system and of people themselves as infrastructure have been echoed in recent accounts of urban mobility. Jensen's (2013) "Staging Mobilities" framework, for instance, argues that urban mobility is not only the outcome of staging "from above" by planners, engineers, and designer, but also of staging "from below" by people themselves as they move throughout the city, performing and acting out their role as mobile actors. In the specific case of cycling, Latham and Wood (2015) note how cycling practices are not only shaped by physical infrastructure itself, but also the formal regulations and tacit conventions guiding its usage – an infrastructural configuration which they propose to refer to as an "infrastructural settlement". Likewise, Vreugdenhil and Williams (2013) argue that we should not see cycling infrastructure only as a technical artifact, but also a social one co-constituted by a range of different actors, including cyclists and drivers themselves. As they put it, "any distinction positing a world of road design and engineering with all its physical materiality of concrete and cambers as separate from that of public perception, emotions and effects cannot be sustained" (id., p. 290). In a similar vein, Lugo (2013) has argued cyclists (and other road users) can be seen a form of "human infrastructure" themselves. In her own words, " … human infrastructure in the form of group rides, social networks of activists, and the presence of bike commuters during rush hour encourages cycling. Human infrastructure in the form of honking, yelling, and other aggressive motorist behaviors discourage cycling (p. 206)". Both as a result of their sheer presence on the street and their ability to influence political action as an organized collective, cyclists themselves contribute to shaping the politics of urban mobility, which in its turn may transform streets and change minds (Henderson & Gulsrud, 2019; Macmillan & Woodcock, 2017). In this paper, we draw upon these perspectives to discuss cycling in Amsterdam.

Cycling in Amsterdam

If we chose to focus our study on Amsterdam, it is because it constitutes a paradigmatic example of a "cycling city". The Netherlands is the world leader in cycling (Pucher & Buehler, 2008), and although some smaller cities in the Netherlands have higher cycling rates, Amsterdam offers a richer and more complex case study as a result of its greater size. In contrast to a number of recent studies on Copenhagen's cycling culture (Gössling, 2013; Larsen, 2016), there also appears to be a lack of comparable studies focusing on Amsterdam.

As in many European cities, cycling in Amsterdam came to be a popular means of transport at the turn of the 20th century, rapidly becoming the preferred mode of transport to move around the city during the 1920s and 30s (Oldenziel et al., 2016). Cycling retained its popularity till 1950; from then onward, the prioritization of motorized traffic led to a rapid decline in cyclist numbers, which dropped to approximately half by 1960. Unlike in other European cities, however, cycling never disappeared from

Amsterdam. From the 1970s, a combative movement of social protest managed to halt the decline in bicycle use and led to a gradual shift in urban policy back in favor of the bicycle (Jordan, 2013; Oldenziel et al., 2016). This strong political and social support for cycling materialized in the steady roll-out of cycling infrastructure, accompanied by aggressive traffic calming and parking reduction strategies to discourage car use. Especially from the 1990s onwards, cycling use has grown remarkably, even if it continues to be lower than at the start of the 20th century. Meanwhile, individual car ownership has gradually decreased and currently stands at 24%[1]. Nevertheless, and as Oldenziel et al. point out, urban cycling policy in the past few decades has been largely reactive: more than seeking to promote cycling use, its function has been to accommodate the rising number of cyclists in the city.

By 2017, the mode share of cycling in Amsterdam had reached 35%, making it the most popular mode of transport for intra-city trips (compared to 25% private vehicle, 23% walking and 16% public transport)[1]. As shown in Nello-Deakin and Harms (2019), however, cycling rates are uneven through the city, varying from 21% in suburban neighborhoods to above 50% near the city center. This difference is partially attributable to differences in population density, which vary between approximately 4,000/km^2 in peripheral neighborhoods to above 10,000/km^2 in central neighbourhoods1. However, residents with a non-Western background also tend to cycle significantly less than those with a native Dutch background[2]. Since residents with a non-Western background also tend to live further away from the city center, this socio-spatial polarization contributes to strengthen the difference in cycling rates between the urban core and the surrounding periphery (Nello-Deakin & Harms, 2019).

Methodology

In order to collect data, 26 semi-structured interviews were carried out with 28 international newcomers to Amsterdam[3], none of whom had cycled regularly for transportation in their previous country of residence. All interviewees had been living in Amsterdam for more than 6 months but less than 3 years at the time of the interview. The rationale for this criterion was to select participants who had had time to settle down in Amsterdam, but who had not lived there for so long that they had lost their sense of being "new" to the city.

Given the relative difficulty of targeting respondents with the required profile, interviewees were selected using a form of convenience sampling. Nevertheless, the sampling strategy also included a purposive element: we tried to achieve a mix of interviewees which provided a relatively even spread of residential locations, as well as a wide range of nationalities and backgrounds. Our aim was not to cover all city neighborhoods, but to ensure a representative mix of neighborhood types in our sample (i.e. historical city center, neighborhoods inside the A10 highway ring, and neighborhoods outside the A10 ring – see Figure 1) corresponding to differences in cycling levels within Amsterdam. Interviewees were recruited using a variety of methods, including posters and flyers at select locations (e.g. public library, university), social media groups of international

[1]Data from *Amsterdamse Thermometer van de Bereikbaarheid* (2019), Municipality of Amsterdam. Available at https://assets.amsterdam.nl/publish/pages/905215/atb_2019.pdf.

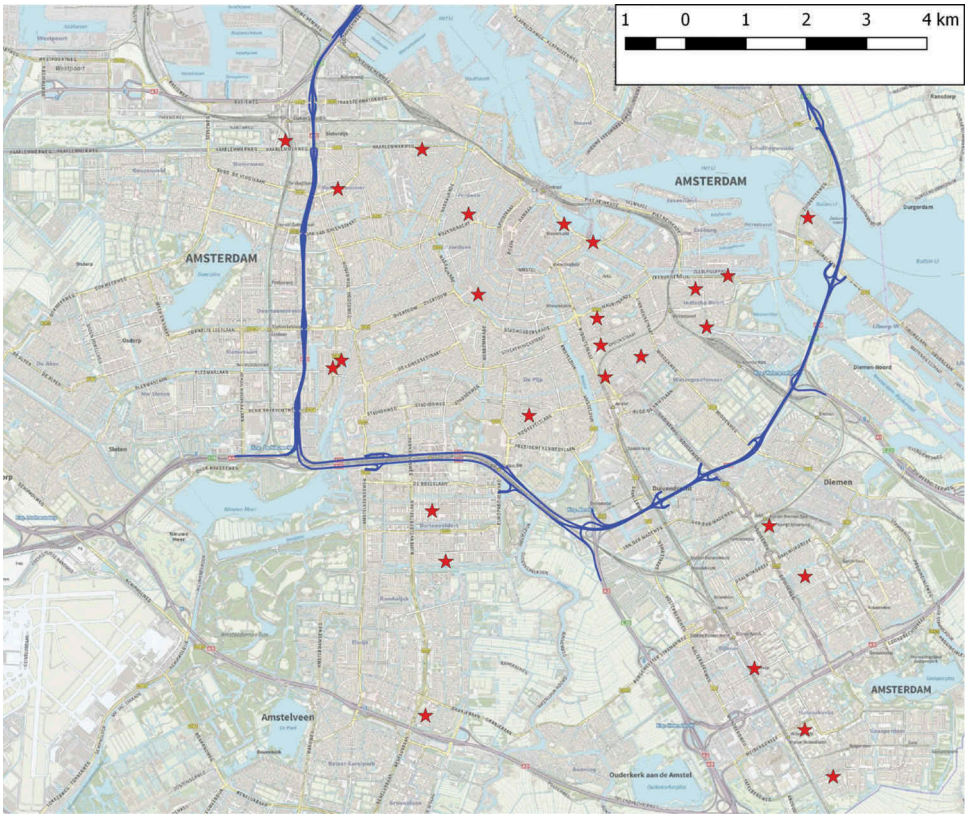


Figure 1. Residential location of interviewees (A10 highway ring highlighted in blue).

residents in Amsterdam, and chain-referral. In addition, seven interviewees were recruited through a neighborhood center providing cycling lessons for female newcomers – mostly from non-Western countries – with no previous cycling experience.

A list of interviewees with a summary of relevant characteristics is provided in Table 1. Despite the variety of backgrounds, it can be seen that interviewees are predominantly young (20–40), highly educated and childless. This is undoubtedly partly due to our recruitment strategy, but these characteristics are also partially representative of the profile of recent international newcomers to Amsterdam (CBS, 2017). The number of interviews to be conducted was determined by the principle of "data saturation"; that is, the point at which conducting further interviews no longer yields any significant additional findings (Guest, Bunce, & Johnson, 2006). The eventual sample of 26 interviews is in agreement with average sample sizes for qualitative research of this kind (Mason, 2010). Most interviews were conducted in English (17), but some were conducted in Dutch (6), Spanish (2), and French (1), all of them by the main author. Interviews lasted between 30 minutes and 1 hour and took place in a variety of locations according to the preference of the interviewee (e.g. home, university, cafe).

Interviews began by discussing interviewees' overall mobility behavior after moving to Amsterdam, and then zoomed in on cycling. Interviewees were asked about their views of Amsterdam's cycling culture, the reasons which had driven them to take up cycling, and

Table 1. List of interviewees.

Interview	Name	Age	Gender	Country	Education	Current Occupation	Household Size	Children 0-7	Children 7-17	Car Ownership	Cycling Frequency
1	Laura	26	F	Spain	Master	Creative/retail	2	0	0	0	Daily
1	Miguel	26	M	Spain	Master	Creative/retail	2	0	0	0	Regularly
2	Alice	53	F	USA	Master	Engineering	1	0	0	1	Occasional
3	Iris	41	F	South Africa	Master	PhD student	3	1	0	0	Daily
4	Soo-jin	35	F	South Korea	Master	Creative/catering	2	0	0	0	Daily
5	Marina	32	F	Spain	Bachelor	Catering	4	0	0	0	Daily
6	Patrick	33	M	Togo	Vocational training	Catering	2	0	0	0	Daily
7	Mark	31	M	South Africa	Bachelor	Master student	3	0	0	0	Regularly
8	Sadiq	19	M	Pakistan	Bachelor*	Bachelor student	1	0	0	0	Regularly
9	Pavel	24	M	Czech Republic	Bachelor	Master student	1	0	0	0	Daily
10	David	40	M	USA	Bachelor	Publishing	3	1	0	0	Daily
11	Stephen	35	M	USA	Master	Nonprofit	4	2	0	1	Daily
12	Alma	35	F	Hungary	Master	IT consulting	2	0	0	1	Occasional
13	Leila	20	F	Syria	High school	Retail/student	1	0	0	0	Daily
14	Fatima	28	F	Sudan	Bachelor	None	4	2	0	0	Learning to cycle
15	Pedro	18	M	Portugal	Bachelor*	Bachelor student	1	0	0	0	Regularly
16	Ranim	27	F	Syria	High school	None	4	1	1	0	Daily
17	Maria	26	F	Italy	Master*	Master student	2	0	0	0	Daily
18	Mina	36	F	Iran	PhD	None	1	0	0	0	Daily
19	Jane	30	F	UK	Bachelor	None	2	0	0	0	Learning to cycle
20	Tereza	26	F	Czech Republic	Master*	Law/Master student	4	0	0	0	Occasional
21	Jasmine	23	F	UK	Bachelor	Hospitality	2	0	0	0	Occasional
21	Adrian	28	M	Australia	Bachelor	Hospitality	2	0	0	0	Occasional
22	Ryan	31	M	Phillipines	Bachelor	Advertising	1	0	0	0	Regularly
23	Vainius	26	M	Lithuania	Master	Catering	4	0	0	0	Occasional
24	Nour	28	F	Morocco	Bachelor	None	4	2	0	1	Learning to cycle
25	Madidah	32	F	Eritrea	Primary	None	3	0	1	0	Learning to cycle
26	Lucy	30	F	Singapore	Bachelor	Logistics	1	0	0	1	Occasional

*Current student.

their own cycling experiences. Existing theoretical frameworks on the determinants of active travel behavior (e.g. Götschi, de Nazelle, Brand, & Gerike, 2017; Wang, Chau, Jackie, & Leung, 2016) were used as a starting point for creating interview questions, but these were refined as new issues emerged during the initial interviews. The interview guide was used flexibly to meet the circumstances of each interview, allowing interviews to proceed in a conversational manner and making it easier for interviewees to share the experiences they considered relevant. Interviewees were also presented with a map of Amsterdam, which supported the discussion by allowing interviewees to pinpoint destinations and trips within the city. All interviews were transcribed and subsequently coded in sequential order by the main author. Although the interview questions provided a starting point for developing some of the initial codes (e.g. "cycling in home country" "public transport", "urban form", "access to bicycle"), the majority of codes were developed inductively from the data. As codes began to repeat themselves and present particular instances of bigger themes, we gradually merged them into seven overarching categories (e.g. "cycling is faster" and "cycling is cheaper" were subsumed under "cycling is more competitive"), which became the seven factors listed in the findings section. In order to preserve interviewees' anonymity, we use fictitious names throughout the article.

Findings

Main factors encouraging cycling

The analysis of interviews led us to identify seven main factors encouraging cycling uptake among newcomers. As previously mentioned, these factors are derived inductively from the interviews themselves. Since different factors tend to interact and reinforce each other, there is some overlap between factors. This also means that they do not lend themselves to clear organization by category or order of importance; accordingly, we have simply listed them in an arbitrary order.

Access to a bicycle is easy and inexpensive

The widespread availability of opportunities to access or purchase a bicycle at a low cost came across as an important factor encouraging cycling uptake, since it contributed to lower entry barriers to cycling. The presence of small bicycle shops throughout the city meant that interviewees – 15 of whom acquired a bicycle immediately upon their arrival in Amsterdam – had little difficulty in finding a place to purchase a bicycle. Indeed, the overabundance of bicycles in Amsterdam translates into a vibrant and competitive secondhand bicycle market where it is easy to obtain an inexpensive bike (generally for less than €100) through a variety of channels.

12 out of 28 interviewees obtained a bike through informal channels (e.g. acquaintance circles, social media groups), while 6 interviewees had personally bought a bicycle at a local bicycle shop. The flea market at Waterlooplein, where cheap bikes (often with a dubious origin) can be found, also emerged as a popular place to purchase a bicycle: 8 interviewees had purchased a bike there. In various cases, interviewees had also obtained a bicycle for free as a leftover from a previous tenant, a spare bike from a friend or family, or (for newcomers with refugee status) as a donation from the Municipality of

Amsterdam. Finally, two international students had obtained their bicycle through *Swapfiets* (a popular long-term lease bike company).

As the interviews made patent, the cheapness of secondhand bikes is critically dependent on the fact that they are extremely basic, sturdy bicycle models. As put by Stephen (35, USA), "everybody goes for a 100-euro piece of shit". For many interviewees, bicycles were considered a semi-disposable commodity, prone to being regularly discarded, replaced, or stolen (8 interviews reported having a bike stolen). Pedro (18, Portugal), for instance, explained: "I bought a bike here near the supermarket near uni from this homeless man who was trying to sell a bike for 40 euros … That bike lasted about two days". In the most extreme case, Leila (20, Syria) had had her bike lost or stolen seven times within 1.5 years.

Paradoxically, the prevalence of bicycle theft seems to have helped lower the entry costs to cycling for various interviewees, who stated they knew or suspected they had bought a stolen bike. Vainius (26, Lithuania), for instance, had first started cycling after buying a stolen bike for 13€: "I know this spot where they sell stolen bikes, you have to go there in the middle of the night, near Leidseplein … I've bought like 15 bikes for my friends there … It's like really black market." After having his own bike stolen and borrowing a friend's bike in the interim, Pedro (18, Portugal) also explained how he might end up having no choice but to buy a stolen bike: "Once I make enough money from Deliveroo I'll probably have enough money to invest in a new bike … Probably not from a reliable source, maybe it will have to be a cheap or stolen bike. I'm not going to be able to afford another 300-euro bike" (Pedro, 18, Portugal). Of course, this does not mean bicycle theft is an incentive to cycling in itself, but it does suggest that widespread bicycle theft – and the informal second-hand market associated to it – are a prominent symptom or consequence of the abundance of inexpensive bikes within the urban landscape. While in some cases this allowed interviewees to benefit from the low price of stolen bikes, in other cases interviewees had experienced bike theft in a much more negative light; namely, they themselves had suffered the inconvenience of having had a bike stolen.

Cycling is more competitive than other modes of transport

All interviewees identified the greater competitiveness of cycling compared to alternative transport options as a main reason for cycling in Amsterdam. For most interviewees, this competitiveness was primarily related to the time efficiency, flexibility and low cost of cycling compared to other forms of transport.

Public transport. Cycling was most often compared with public transport, which was seen as its closest competitor. Many interviewees pointed out that public transport was almost inevitably slower than cycling for short journeys, particularly in the city center, a situation which is exacerbated by the frequent need to transfer between lines. As put by Sadiq (19, Pakistan), "Today I had to be here at 3.30, so I left at 3.10, but if I had to walk to the metro station, I would have to leave my house at 2.50 ". In addition, various interviewees experienced public transport as complicated and unreliable in comparison to cycling: "I remember a couple of times for work I ended up taking the tram because I didn't have my bike, and you sort of feel stranded, oh my goodness, it's going to be so difficult to get to where I need to" (Stephen, 35, USA). Inside the A10 ring, the proximity of most destinations meant that cycling was generally perceived as faster than public

transport, with the opposite being true outside of the ring. In addition, many interviewees used the A10 ring as a mental divider of what they considered to be within cycling distance. While estimates of the maximum time interviewees would be willing to cycle ranged between 20 minutes and 1 hour, most answers gravitated around 30 minutes, which roughly coincides with the geographical extension of neighborhoods inside the ring.

Interestingly, interviewees' perceptions of the quality of public transport were mixed: Amsterdam's public transport network was seen as excellent by some, but insufficient by others. Various interviewees considered Amsterdam's provision of public transport to be poor compared to their experiences in other countries: "Here PT transportation facilities are a bit too limited, it's very limited compared to London or Seoul" (Soo-jin, 35, S. Korea). Other interviewees, however, considered public transport provision to be good, even though cycling was still faster for them: "Public transport is good, the tram is super easy to use, but it's more convenient to ride" (David, 40, USA).

For many interviewees, the relatively high cost of public transport offered an additional incentive to cycle: "The metro is more expensive, if I come here, it is 6 euros every day … Cycling is free!" (Ranim, 27, Syria). For interviewees with a more comfortable economic situation, this consideration was less important. Only five interviewees thought they would cycle significantly less if public transport were free, suggesting that other considerations are ultimately more important for most interviewees. Having said this, a large number of interviewees said that if public transport were free, they would probably take it more in cases of inclement weather.

Walking. Even though many interviewees expressed their fondness of walking as a means of moving around and discovering the city, most interviewees found that in the majority of cases, cycling was simply more convenient than walking for trips beyond a few hundred meters. In many cases, trips were not actually beyond walking distance, but the availability and ease of hopping on the bike was difficult to resist. As Miguel (26, Spain) put it, it is not that it is too far to walk, but rather that "well, if you have a bike, then you just take the bike". For some interviewees, cycling was also used as a faster alternative to walking for last mile trips to a metro or train stop, particularly by those living outside the A10 ring. For Sadiq (19, Pakistan), living in the suburbs beyond the ring, his neighborhood simply felt to unappealing and boring to walk in, pushing him to cycle instead. In addition, he considered cycling to be better in terms of personal safety: "If I'm coming back late at night, then I would prefer to be on a bicycle than on foot". The one notable exception to this was the historical city center (pre-19th century), in which many interviewees preferred to walk than cycle because of its tourist-related overcrowding, lack of bicycle parking and pedestrian-scale environment.

Driving. Driving was generally considered to be the least attractive option to move around Amsterdam: slow, expensive and marred by the difficulty of finding a parking spot. As a result, the majority of interviewees did not consider driving as a viable option to get around Amsterdam, particularly in central neighborhoods. To a large extent, this was attributed to Amsterdam's relative lack of car-oriented infrastructure, as well as its extensive traffic calming and restrictive parking policy strategies. In addition, however, various interviewees explained that driving in Amsterdam felt "scary" because of the

presence of so many cyclists: in the words of Alma (35, Hungary), "we used our car once to go to the city center, and afterward, we were like, let's never do that again". Similarly, Ryan (31, Philippines), noted that "I feel like I'd just kill someone". Although numerous interviewees had used a car at some stage (e.g. car rental, carsharing, friends' car), they had mainly done so for trips outside the city or for carrying unwieldy items. Only five interviewees owned a car, and in all cases only used it regularly for trips outward from the city. A small number of interviewees living beyond the A10 ring, however, stated that if they were to settle there for the long term they might consider purchasing a car.

Cycling is part of the Amsterdam lifestyle

Various interviewees considered that an important reason for their choice to cycle was that it was an essential part of the "Amsterdam lifestyle". As put by Iris (41, S. Africa), there exists a diffuse social norm which sees cycling as the natural way to move around Amsterdam: "You know, that's just how you get around … That's just what people seem to do, everyone has a bike". Likewise, many interviewees saw cycling as a key component of the city's image: "Esthetically it's a nice fit to the city, it's kind of like a part of the image of the city at this point" (Pedro, 18, Portugal).

This idea expressed itself in various ways. To begin with, the international reputation of Amsterdam as a "cycling city" meant that many interviewees anticipated they would cycle before they had actually moved to the city. In some cases, this anticipation was associated with a romanticized image of cycling in Amsterdam, as well as by previous visits as a tourist. In other cases, it was strengthened by information from the internet, friends, or housing agency, all of which mentioned cycling as the easiest way of getting around. The expectation of cycling before moving to Amsterdam is clearly illustrated in the following excerpts:

> "From Spain you hear that everyone here cycles, so you expect you'll do it as well" (Marina, 32, Spain)

> "I had a mindset that when I come to Amsterdam I have to bike" (Sadiq, 19, Pakistan)

> "We moved for my work, but we were excited because we knew it was going to bring a very different lifestyle, including going to work by bike" (Stephen, 35, USA)

Once in Amsterdam, many interviewees emphasized the importance of the "when in Rome" logic in encouraging them to cycle. Seeing that most people seemed to cycle, they decided to fit in: "The truth is that it's impossible not to become infected [by cycling]" (Marina, 32, Spain). Likewise, "it definitely encourages me to see other people cycling, because it looks fun" (Pedro, 18, Portugal). While this process often worked through observation alone, in some cases interviewees' social circles had played a more direct role:

> "What inspired me was someone at work, at the time I moved originally I was working at the KLM offices in Amstelveen, and there was a co-worker who said: you know, I know where you live, and I know a path you could take that is just beautiful to get to the office if you bicycle and not drive. I said, really, and I got all excited, and I actually walked across the street at lunchtime that day to buy a bicycle from a store across the street, and I think that probably the next day I started cycling, and it was fabulous, it was through the Amsterdamse Bos [forest] and it was just beautiful". (Alice, 53, USA)

For some interviewees, the decision to cycle also responded to a more explicit wish to become better integrated into Dutch society. As argued by David (40, USA), "part of the draw of biking here is that it's built into society". Asked about main reason she was learning to cycle, Jane (30, UK) answered: "To integrate, I think that's the main thing, to feel that I'm part of Amsterdam and Dutch culture … When you're walking along and you see that there are three people on the pavement and sixty people on bicycles, you're like, right … ". The perception of cycling as an important part of social integration was especially noticeable in the case of newcomers with a refugee status who did not know how to cycle before moving to the Netherlands; to some extent, they tended to view cycling lessons as an "expected" part of what they had to do in order to integrate into Dutch society (much like taking Dutch language lessons).

There exists a social pressure to cycle

The normality of cycling among friends, acquaintances or family members played an important role in encouraging interviewees to cycle. Various interviewees noted that cycling was assumed to be the default mode of transport among their own social circles: "You make the assumption that you always have a bike and that everyone else around you is doing the same – I don't know anybody who has a bike and also doesn't have that same intention" (Stephen, 35, USA). As recounted by Tereza (26, Czech Republic), this results in a social pressure to cycle: " If you don't have a bike you're weird, in an exaggerated kind of way … People judge you". (Tereza, 26, Czech Republic). Various interviewees expressed that they needed to cycle in order to be able to travel together with other people who would want to do so by bike: "If we promise to meet somewhere with friends and then visit Noord together, then I need a bike, because I'm pretty sure they'll come by bike" (Soo-jin, 35, S. Korea). As noted by Lucy, (30, Singapore), cycling makes coordinating trips with other people much easier: "If you cycle and the other person takes a tram, it's quite awkward". In the case of Nour (28, Morocco) being able to cycle together with her family was actually the main reason she decided to learn to cycle: "My son said, mama, it's not fun that you don't have a bike, the three of us have bikes and you don't".

The existence of a perceived social pressure to cycle, however, varied significantly depending on interviewees' social circles and neighborhood of residence. In general terms, it appeared to be strongest among university students, interviewees living and socializing primarily within the A10 ring, and those operating within Dutch (rather than international) social circles. Soo-jin (35, S. Korea), for instance, had married a Dutchman and received his grandmother's old bike as a gift from the family as a clear encouragement for her to cycle. In her own words, "I think people would find I'm strange, especially Dutch people couldn't get how cycling is so difficult for me … They think I'm a bit whiny sometimes". For interviewees living or working outside the A10 ring, however, cycling was much less omnipresent in their immediate surroundings: instead of seeing cycling as a hegemonic mode of transportation, they tended to view it more as a personal choice.

The city is built for cycling

Most interviewees emphasized the importance of the city being "built for cycling" in encouraging or enabling cycling. While interviewees often had difficulties in pinning down exactly what elements contributed to this, their reflections on this topic revolved around factors related to urban form, as well as to the presence of traffic infrastructure,

regulations and conventions which favor cycling over other forms of transport. In terms of urban form, interviewees clearly pointed out to two factors encouraging cycling, namely the city being flat and relatively small. As put by David (40, USA), "this is a village compared to London". For interviewees living within the A10 ring, Amsterdam's size meant that most destinations were seen as falling within biking distance.

More than urban form, however, the majority of interviewees emphasized the critical role of Amsterdam's traffic infrastructure in encouraging cycling. Understandably, Amsterdam's extensive network of cycling paths was seen as the most obvious part of this infrastructure. Interviewees' answers made it clear that it was generally impossible to separate the "physical" infrastructure itself from the social practices which shaped its usage. As various interviewees highlighted, cycling infrastructure in Amsterdam only works because car drivers in Amsterdam are predominantly cautious and considerate toward cyclists. As Marina (32, Spain) remarked, this is probably because most drivers are themselves cyclists, but also because there are so many cyclists that drivers have no choice but to yield to them. Indeed, the sheer numbers of cyclists in the road means that "one of the most recognizable things of cycling in Amsterdam is you're in a flow … You're kind of protected in this flow of continuous going" (Maria, 26, Italy).

Both as a result of material infrastructures themselves and the tacit conventions guiding their usage, cycling was generally experienced as being prioritized in the traffic hierarchy, making it more pleasant than either walking or driving: "If you are on a bike, then you are the number one person in the traffic, then all the cars and pedestrians need to watch out … You are on the top of the food chain … If you walk, it's your responsibility to look out for bikers" (Alma, 35, Hungary). Similarly, Pavel (24, Czech Republic) "pretty soon figured out cyclists have right of way most of the time, there is this acknowledgment of the other person even by drivers and most people on foot".

In addition, various interviewees also noted that the city's "infrastructural settlement" (to borrow the term from Latham & Wood, 2015) is not only shaped by road users themselves, but also by an explicit political commitment to prioritize cycling at a municipal level. In part, this commitment is scripted into material infrastructure itself: as Vainius (26, Lithuania), argued, Amsterdam's traffic infrastructure heavily nudges people toward cycling: "They kind of give you a freedom of [mode] choice, but in a way they choose it for you". However, this commitment also manifests itself in a series of less tangible ways: as an example of this, Alice (53, USA), mentioned the fact that bicycle lanes are officially plowed first after snow. In the words of Maria (26, Italy), you simply "know your needs as a cyclist are taken into account".

Although all interviewees acknowledged the critical role of cycling infrastructure in fostering cycling, the majority of them appeared to view it as a *prerequisite* rather than an active encouragement to cycle. In this sense, few interviewees mentioned cycling infrastructure as a main reason for taking up cycling; when this topic came up during interviews, it was mostly in relation to the lack of cycling infrastructure in their home country (and the consequent impossibility to cycle there). Nevertheless, a small number of interviewees who cycled mainly for recreation did mention the presence of infrastructure as a motivation for cycling: "It's like, you can cycle, there's these big paths, they're are safe and you can just do it, the main thing [i.e. reason for cycling] is just because we can" (Adrian, 28, Australia).

Cycling is fun and enjoyable

In varying degrees, most interviewees stressed the enjoyment provided by cycling as an important reason for taking up cycling. When asked about the main reason for choosing to cycle in Amsterdam, Alice (53, USA) stated that "I just thought it seemed fun". For many interviewees, this enjoyment did not derive only from the joy of riding, but also from the role of cycling in providing physical exercise, a mental break from their daily routine, or the chance to engage with the city and the outdoors: "I don't like crowded public transport, I prefer to have fresh air and a nice ride to work (Tereza, 26, Czech Republic). For Nour (28, Morocco), the subjective feeling of freedom provided by cycling was one of the main reasons she decided to learn how to cycle. Indeed, the importance of enjoyment as a reason for cycling is underscored by the fact that many interviewees cycled less or stopped cycling altogether when conditions for cycling became unpleasant (e.g. poor weather, crowded city center, dull surroundings). For very small number of interviewees, however, the embodied experience of cycling did not constitute an encouragement to cycling, but simply a drawback that they just had to put up with. Soo-jin (35, S. Korea), for instance, noted that "[Cycling] is just something I have to do . . . I don't find it's enjoyable, actually".

While many of the intrinsic mental, social and emotional benefits provided by cycling (see Krizek, 2019) may be independent of geographic context, interviewees' answers suggested that there is something particular about the enjoyment of cycling in a mature cycling environment like Amsterdam. As various interviewees commented, what makes cycling in Amsterdam enjoyable is that its cycling-friendly infrastructural settlement allows safety concerns to drift into the background, thereby transforming cycling into an actively pleasant activity. In addition, a couple of interviewees mentioned how the constant presence of other fellow cyclists in Amsterdam transformed cycling into an enjoyable form of sociality, in which it is easy to talk to your cycling companion or greet other passing cyclists. Finally, a number of interviewees also noted that (a large part of) Amsterdam is particularly beautiful by most urban standards, making it particularly enjoyable to cycle in it.

Cycling is indispensable for grocery shopping and school trips

Various interviewees emphasized how daily routine trips in (large parts of) Amsterdam appear to be largely matched to the opportunities for mobility provided by the bicycle, in a way that makes it difficult to avoid cycling as a means of moving around. As Vainius (26, Lithuania) remarked, "When I came it was like instantly I clicked, with bicycles it's something different here, it has a different purpose". The indispensability of cycling for everyday trips and errands was particularly evident for two activities: grocery shopping and bringing children to school. While the tight integration of cycling with these activities can be partially seen as the outcome of previous factors, it came across as an important incentive to cycle in its own right. Most interviewees found that their nearest sizable grocery store was a little far to walk to, but easily reachable by bicycle. Moreover, 15 out of the 28 interviewees had a built-in basket or pannier on their bicycle which made it much easier to carry groceries than by foot or public transport. Indeed, various interviewees who lived within walking distance from grocery stores preferred to cycle there because of the ability to easily carry groceries (and save a couple of minutes). As Iris (41, S. Africa) noted, the integration of cycling with grocery shopping is ultimately part of

a much larger assemblage of Amsterdam-specific social practices: "I have had to change my lifestyle in terms of how we shop and cook and eat. At home [S. Africa], I'll go shopping once a week, you buy everything you need. I guess it's partly about the mode of transport, that you have a car and can put everything in it, but also that here we've got a tiny fridge and a student apartment. I mean, every day, we stop at the shop, and buy just for supper".

The integration of cycling with bringing children to school was described in analogous terms by various interviewees. Much as if children were a shopping bag in themselves, cycling makes it easy to carry small children around: "My daughter complains about walking, so if you throw her on a bike you don't have to listen to her" (David, 40, USA). In a similar vein, Iris (41, S. Africa) noted that "it just feels so impractical, to have to walk from the tram stop just to a school, and then I've got the pram, and I've got to leave it somewhere … ". In the case of David (40, USA), the decision to cycle his daughter to school also obeyed a temporal imperative, as it was the only way he could drop her off on his way to work and still arrive there on time: "I can't make that all happen unless I have a bike … I have to have one at this point. It would be very difficult because I have to drop my daughter off at school at a certain time, so I would be late for work, instead of being there at 9 I'd be there at 9.45". For Fatima (28, Sudan), being able to take her two small daughters to school by bike had in fact constituted the main reason she decided to learn to cycle. These findings appear to echo those of Eyer and Ferreira (2015), who found that mothers' cycling patterns in Amsterdam do not differ significantly from those of childless women, and that most mothers consider cycling children to school to be a practical and pleasant activity.

Cycling uptake as a temporal process

As evidenced by the discussion of the various factors shaping cycling uptake among interviewees, this process presented a clear *temporal* dimension. Interviewees did not simply switch from "not cycling" to "cycling", but their cycling behavior gradually evolved over time, responding to the interplay of various factors discussed above. In most cases, interviewees' initial decision to take up cycling was triggered by certain factors (e.g. availability of cheap bikes, need to travel together with friends), but their decision to continue cycling regularly was primarily shaped by other factors (e.g. competitiveness, flexibility), as well as by a series of potential barriers (e.g. bicycle theft, weather, overcrowding). Through the act of cycling itself, they then discovered a new set of "collateral" reasons for cycling (e.g. enjoyment, exercise). This suggests that the factors which encourage the uptake (and maintenance) of cycling are not static, but evolve through time: some factors may be crucial in encouraging cycling at a certain point in time, while others play a role at a different point.

Many interviewees reported becoming increasingly reliant on cycling over time: as David explained (40, USA), " I didn't really know how practical it would be, until now that I have a bike, where I can't imagine not having it" . Patrick (33, Togo) expressed himself in similar terms: "When I didn't have a bike, I didn't notice the simplicity of having one. Now, if I don't have a bike, I need to walk to Central Station and take the train or the tram there. I find all this too difficult, too far. The time it takes me to walk to the station, I'm already where I want to be by bike" (Patrick, 33,

Togo). Interviewees' increased reliance on cycling was largely due to the fact that they had gradually planned their lives around the possibilities for movement their bike afforded them: "The fact I can use a bike is actually one of the reasons I move around the city, if I need to go out to see a friend after work on Saturday night, I actually go out and do it because it's easy … Without a bike I would never go, because it's just too much … The time I would spend getting there, it's just not worth it" (Maria, 26, Italy).

For some interviewees, the tight integration of cycling within their daily routine meant that they ended up feeling considerably reliant or even dependent on cycling. This is clear from the answers given by interviewees when asked about what they would do if they were not able to cycle:

> "It would be 100% difficult without a bike. Once you get used to it … " (Sadiq, 19, Pakistan)
>
> "If I would have to give up biking, that would be super unpleasant and very inconvenient" (Pavel, 24, Czech Republic)
>
> "That would be extremely annoying because the rythm of my daily life here depends on the bike, in how much time I can get from one place to another" (Maria, 26, Italy)
>
> "I wouldn't be able to. If I don't have a bike today, I'm going to think all night about how I can get a bike tomorrow" (Leila, 20, Syria)
>
> "Not being able to use bike would cut off whole part of the city that I know I wouldn't drive to, I wouldn't take the metro to and I know it's too far to walk" (Alice, 53, USA)

Although individual trajectories of cycling uptake varied considerably, they also exhibited a significant degree of commonality. In Figure 2, we provide a composite representation of the process of cycling uptake common to the majority of interviewees. The figure displays four successive temporal stages, together with the main forces and processes shaping the evolution of cycling uptake through these four stages. The figure does not aim to propose a rigid conceptualization or reflect the experiences of all interviewees, but merely to illustrate how the factors which shape the uptake and maintenance of cycling evolve over time in interplay with cycling practices.

It is important to note that not all interviewees underwent the full trajectory of cycling uptake displayed. Only around a third of interviewees reached the fourth stage in Figure 2, considering they had become so reliant on cycling that they would be unable to do without it. For the most part, these interviewees lived in central neighborhoods within the A10 ring, and had a fairly busy and often variable daily schedule which involved frequent trips between a large range of destinations in the city. Other interviewees had not moved further than the second stage in Figure 2, and had not become particularly reliant on cycling. Most of these interviewees lived or worked outside the A10 ring, or had never begun cycling on a frequent basis in the first place. For Lucy (30, Singapore), who uses a company car to get to work outside of Amsterdam, and mainly uses her bike for grocery shopping trips, not having access to a bike would clearly not be a major problem: "There were 2 or 3 months where I couldn't find the key to my bike, so I just kind of left it there". In other cases, interviewees who did not consider themselves reliant on cycling did live in more central neighborhoods, but tended to live a less busy, more localized life which mainly

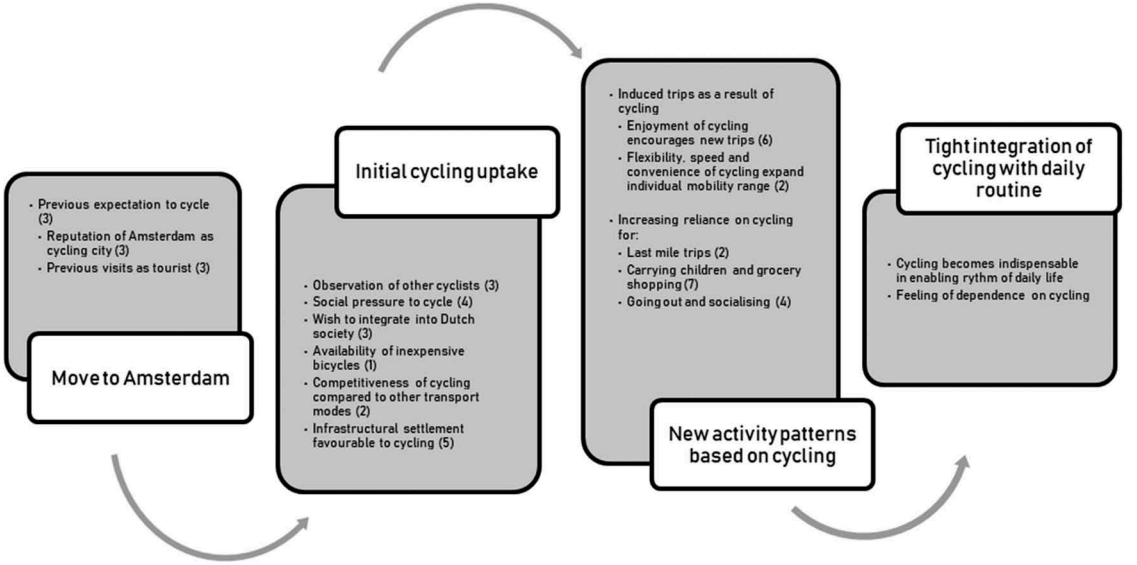


Figure 2. Cycling uptake as a temporal process (each item can be linked backed to one of the seven main factors discussed, numbered in parentheses).

involved pedestrian trips at a neighborhood scale, complemented by occasional public transport trips when necessary. Mark (31, S. Africa), for example, found that "everything is so close, if your bike breaks down you just walk … It shouldn't be too much of a hassle".

Conclusions and discussion

What makes a cycling city?

Based on our interviews with 28 international newcomers to Amsterdam, we identified the following seven main factors encouraging cycling uptake among newcomers: 1) access to a bicycle is easy and inexpensive; 2) cycling is more competitive than other forms of transport; 3) cycling is part of the Amsterdam lifestyle; 4) there exists a social pressure to cycle; 5) the city is built for cycling; 6) cycling is fun and enjoyable; and 7) cycling is indispensable for grocery shopping and school trips. In agreement with observed differences in cycling rates at a neighborhood level (Nello-Deakin & Harms, 2019), the strength of these factors appears to be highest in inner neighborhoods inside the A10 ring, somewhat lower in the pre-19th century historical city center, and significantly lower outside the A10 ring. This is the outcome of both spatial and social differences at a neighborhood level which tend to reinforce each other: if cycling is so popular in inner neighborhoods, it is partially because of their relatively dense urban structure, but also because the large numbers of cyclists create a social environment which itself encourages people living there to cycle.

Interviewees' own experiences of cycling uptake illustrate that the effect of each of these factors cannot be easily isolated; in practice, multiple factors overlap and reinforce each other. As argued by Macmillan and Woodcock (2017), urban cycling cultures are best understood as a complex system which is governed by a series of causal feedback loops related to social, political and spatial processes. As the present study illustrates, cycling practices are not so much the outcome of distinct environmental factors, but rather the product of *interactions* between different factors in time and space, and how these are woven into peoples' lives.

The factors identified offer a useful proxy for understanding what makes a "cycling city" or an urban environment conducive to cycling. To a certain extent, some of the factors echo commonly considered variables in statistical studies of environmental correlates of cycling (e.g. factor 5: "the city is built for cycling"). However, other factors – such as the widespread availability of cheap bikes (factor 1), for instance, or the usefulness of cycling to carry groceries (factor 7), appear to have been rarely considered before, and are difficult to place within a socio-ecological model of travel behavior (e.g. Götschi et al., 2017) which stipulates a clear conceptual distinction between "physical" and "social" factors. Indeed, many of the factors identified show how the material and social dimensions of a cycling city are inextricably linked as part of a wider sociotechnical assemblage. While (a large part of) Amsterdam may arguably be described as having a cycling-oriented "urban fabric" (Newman, Kosonen, & Kenworthy, 2016), this fabric is a social one as much as a material one. The fact that the city feels "built for cycling", for instance, is partially the outcome of physical traffic infrastructure, but also of the shared social conventions which govern the use of this

infrastructure and tend to give cyclists the upper hand. Similarly, the widespread availability of inexpensive bicycles relies on the material design characteristics of most Dutch bikes and has a physical presence in the form of abundant local bike shops, but can also be seen – perhaps primarily – as a social phenomenon involving the existence of robust formal and informal networks which facilitate the trading of secondhand bikes.

Existing cyclists as human infrastructure

With the possible exception of factor 2 (greater competitiveness of cycling), the majority of the factors which encourage cycling are at least partly dependent on the existence of a critical mass of existing cyclists. Following Lugo (2013), we suggest that it is useful to view Amsterdam's existing cyclists as a form of *human infrastructure* which plays a crucial role in reproducing the city's cycling culture – an argument which echoes some of the conclusions of Larsen's (2016) study of Copenhagen.

On the one hand, this human infrastructure encourages cycling through social mechanisms, such as by handing over inexpensive bicycles to newcomers and by exercising pressure on them to cycle. While our study has not looked at cycling activism and the politics of mobility, research by others (e.g. Feddes & de Lange, 2019; Henderson & Gulsrud, 2019; Macmillan & Woodcock, 2017) shows that the human infrastructure formed by the critical mass of urban cyclists also plays and important role in influencing political decision-making on the topic of urban mobility, thereby contributing to shape streets, laws and behavior.

On the other hand, this human infrastructure is also a profoundly material one. Through their physical presence on Amsterdam's streets, existing cyclists contribute to shape the city's infrastructural settlement in a way which forces other road users to defer to cyclists, thereby contributing to make cycling safer and more attractive. Moreover, the critical mass of cyclists moving around the city contributes to creating an atmosphere of conviviality among fellow cyclists, making it a social and mostly enjoyable activity. Interestingly, it could be argued that by taking up cycling, newcomers themselves become a part of the "human infrastructure" of the cycling city. In other words, we might say that interviewees themselves become part of one of the reasons which led them to take up cycling in the first place, thereby contributing to the daily reproduction of Amsterdam's local cycling culture.

For cities trying to increase cycling rates, an important implication of the centrality of human infrastructure in encouraging cycling is that there is no easy way for policy-makers to "transplant" it to contexts with low cycling levels. In other words, many of the factors identified as important in encouraging cycling are themselves the outcome of the normality of cycling. This means that the existence of a critical mass of cyclists may be essential to gain further traction for cycling.

Cycling uptake as a dynamic temporal process

Our findings suggest that we need to think of the factors which encourage cycling in mature urban cycling environments not as static forces, but as part of a *dynamic temporal process* which operates both at an individual and city-wide level. At an individual level,

interviewees' trajectory of cycling uptake exhibited a temporal dimension, in which the factors which encouraged them to cycle tended to change and evolve through time. As their cycling practices evolved, many interviewees discovered new reasons for cycling, potentially resulting in further changes to their cycling practices. In particular, various interviewees (mainly those living in central Amsterdam) reported becoming increasingly reliant on cycling over time, eventually leading to the tight integration of cycling within their daily routine and a feeling of dependence on cycling. This process of increased reliance of cycling at an individual level mirrors a similar dynamic at an aggregate city level: the more people cycle, the more the city becomes cycling-oriented (both spatially and socially), which in turn strengthens the incentives to cycle (Macmillan & Woodcock, 2017)

These findings suggest that a mature cycling city such as Amsterdam is characterized by spatial and social conditions which encourage cycling *throughout* the various stages of one's relationship with the practice of cycling. For cities seeking policy recommendations to increase the modal share of cycling, the case of Amsterdam suggests that we need to pay attention not only to the factors which encourage initial cycling uptake, but also to the evolving dynamics of cycling uptake and maintenance over time. In this respect, studies like the present offer a useful means to understanding the interplay of different factors and help inform policy and planning.

Limitations and directions for further research

Although our interviewee sample included respondents from a range of backgrounds (e.g. knowledge migrants, international students, refugees), it predominantly focused on a specific population subgroup (mostly childless young adults with above average education levels). This means that our findings need to be understood within this circumscribed context. Furthermore, the method used to target respondents consisted in a form of convenience sampling, raising the question of possible self-selection bias. More broadly, it could also be argued that the decision to move to Amsterdam constitutes a form of self-selection in itself: most interviewees had a positive attitude toward the city's cycling culture even before moving to it. In this sense, our interviewees might arguably have had a greater predisposition toward cycling than the mean.

In terms of further research, it would be interesting to conduct to explore the extent which the factors and trajectories of cycling uptake are comparable for a wider range of population groups, as well as for other mature cycling cities beyond Amsterdam. Likewise, it would be valuable to also investigate the experiences of newcomers who have *not* taken up cycling despite having moved to Amsterdam, and examine the contrasts with the present study.

Finally, we suggest that the existence of a perceived reliance or dependence on cycling among various interviewees points out to an interesting direction for further research – namely, whether there might exist such a thing as "bicycle dependency" in mature cycling contexts. If so, what are its effects for the city and for different social groups? While various studies have explored the existence of captive car drivers or public transport users (e.g. Beimborn, Greenwald, & Jin, 2003; Van Exel, De Graaf, & Rietveld, 2011), typically in relation to wider issues of car dependency (Dupuy, 1999; Newman & Kenworthy, 1996), to the best of our knowledge no studies have sought to

explore the potential existence of a similar phenomenon in relation to cycling. Admittedly, our study only uncovered the existence of *perceived* feelings of dependence on cycling among a specific subset of Amsterdam residents. In this sense, future research could explore whether such feelings on cycling are shared across different social groups, and the extent to which they are echoed by measurable indicators such as time, cost or accessibility.

Notes

1. Data from *Amsterdamse Thermometer van de Bereikbaarheid* (2019), Municipality of Amsterdam. Available at https://assets.amsterdam.nl/publish/pages/905215/atb_2019.pdf
2. This division derives from the official population categories used by Dutch Statistics Agency (CBS), which discriminates individuals on the basis of their parents' country of birth.
3. Two interviews were conducted with couples living together at the same address, resulting in a total of 26 interviews but 28 interviewees.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Netherlands Organisation for Scientific Research [438-15-160].

ORCID

Samuel Nello-Deakin http://orcid.org/0000-0002-4007-0148
Anna Nikolaeva http://orcid.org/0000-0001-8507-2772

References

Aldred, Rachel, Croft, Joseph, & Goodman, Anna. (2019). Impacts of an active travel intervention with a cycling focus in a suburban context: One-year findings from an evaluation of London's in-progress mini-Hollands programme. *Transportation Research Part A: Policy and Practice*, *123*, 147–169.

Amin, Ash. (2014). Lively infrastructure. *Theory, Culture & Society*, *31*(7–8), 137–161.

Beimborn, Edward A., Greenwald, Michael J., & Jin, Xia. (2003). Accessibility, connectivity, and captivity: Impacts on transit choice. *Transportation Research Record*, *1835*(1), 1–9.

Blue, Elly. (2013). *Bikenomics: How bicycling can save the economy*. Portland, OR: Microcosm Publishing.

CBS. (2017). Amsterdam groeit, vooral door migratie. Retrieved from: https://www.cbs.nl/nl-nl/nieuws/2017/45/amsterdam-groeit-vooral-door-migratie

Colville-Andersen, Mikael. (2018). *Copenhagenize: The definitive guide to global bicycle urbanism*. Washington: Island Press.

Darnton, Phillip. (2016). Why do cyclists just talk to themselves? *Transport Reviews*, *36*(1), 163–166.

Dupuy, Gabriel. (1999). *La dépendance automobile: Symptômes, analyses, diagnostic, traitements*. Paris: Anthropos.

Eyer, Amanda, & Ferreira, António. (2015). Taking the tyke on a bike: Mothers' and childless women's space–Time geographies in Amsterdam compared. *Environment and Planning A*, *47* (3), 691–708.
Feddes, Fred, & de Lange, Marjolein. (2019). *Bike city: How Amsterdam became the cycling capital of the wold*. Amsterdam: Uitgeverij Bas Lubberhuizen.
Fishman, Elliot. (2016). Cycling as transport. *Transport Reviews*, *36*(1), 1–8.
Fleming, Steven. (2011). The Bicycle Oriented Development (BOD): A new tool in urban resilience. *Resilience in Urban Design, the 4th International Urban* Design *Conference* (pp. 80–87). Gold Coast, Australia.
Forsyth, Ann, & Krizek, Kevin J. (2010). Promoting walking and bicycling: Assessing the evidence to assist planners. *Built Environment*, *36*(4), 429–446.
Gössling, Stefan. (2013). Urban transport transitions: Copenhagen, city of cyclists. *Journal of Transport Geography*, *33*, 196–206.
Götschi, Thomas, de Nazelle, Audrey, Brand, Christian, & Gerike, Regine. (2017). Towards a comprehensive conceptual framework of active travel behavior: A review and synthesis of published frameworks. *Current Environmental Health Reports*, *4*((3)), 286–295.
Guest, Greg, Bunce, Arwen, & Johnson, Laura. (2006). How many interviews are enough?: An experiment with data saturation and variability. *Field Methods*, *18*(1), 59–82.
Haustein, Sonja, Koglin, Till, Nielsen, Thomas, Sick, Alexander, & Svensson, Åse. (2019). A comparison of cycling cultures in Stockholm and Copenhagen. *International Journal of Sustainable Transportation*. doi:10.1080/15568318.2018.1547463
Heinen, Eva, van Wee, Bert, & Maat, Kees. (2010). Commuting by bicycle: An overview of the literature. *Transport Reviews*, *30*(1), 59–96.
Henderson, Jason, & Gulsrud, Natalie Marie. (2019). *Street fights in copenhagen: Bicycle and car politics in a green mobility city*. Abingdon: Routledge.
Jensen, Ole B. (2013). *Staging mobilities*. Abingdon: Routledge.
Jones, Phil. (2005). Performing the city: A body and a bicycle take on Birmingham, UK. *Social & Cultural Geography*, *6*(6), 813–830.
Jordan, Peter. (2013). *In the city of bikes*. New York: Harper Perennial.
Krizek, Kevin J. (2019). Measuring the wind through your hair? Unravelling the positive utility of bicycle travel. *Research in Transportation Business & Management*, *29*, 71–76.
Kuipers, Giselinde. (2013). The rise and decline of national habitus: Dutch cycling culture and the shaping of national similarity. *European Journal of Social Theory*, *16*(1), 17–35.
Larsen, Jonas. (2016). The making of a pro-cycling city: Social practices and bicycle mobilities. *Environment and Planning A*, *49*(4), 876–892.
Latham, Alan, & Wood, Peter R. H. (2015). Inhabiting infrastructure: Exploring the interactional spaces of urban cycling. *Environment and Planning A*, *47*(2), 300–319.
Lugo, Adonia. (2013). CicLAvia and human infrastructure in Los Angeles: Ethnographic experiments in equitable bike planning. *Journal of Transport Geography*, *30*, 202–207.
Macmillan, Alexandra, & Woodcock, James. (2017). Understanding bicycling in cities using system dynamics modelling. *Journal of Transport and Health*, *7*, 269–279.
Mason, Mark. (2010). Sample size and saturation in PhD studies using qualitative interviews. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, *11*(3).
Müggenburg, Hannah, Busch-Geertsema, Annika, & Lanzendorf, Martin. (2015). Mobility biographies: A review of achievements and challenges of the mobility biographies approach and a framework for further research. *Journal of Transport Geography*, *46*, 151–163.
Nello-Deakin, Samuel, & Harms, Lucas. (2019). Assessing the relationship between neighbourhood characteristics and cycling: Findings from Amsterdam. *Transportation Research Procedia*, *41*, 17–36.
Newman, Peter, & Kenworthy, Jeff. (1996). The land use—Transport connection: An overview. *Land Use Policy*, *13*(1), 1–22.
Newman, Peter, Kosonen, Leo, & Kenworthy, Jeff. (2016). Theory of urban fabrics: Planning the walking, transit/public transport and automobile/motor car cities for reduced car dependency. *Town Planning Review*, *87*(4), 429–458.

Oldenziel, Ruth, Emanuel, Martin, de la Bruheze, Adri A Albert, & Veraart, Frank. (2016). *Cycling cities: The European experience: Hundred years of policy and practice*. Eindhoven: Foundation for the History of Technology.

Oosterhuis, Harry. (2015). Ingebakken gewoonte of buitenissige liefhebberij? Een vergelijking tussen nationale fietsculturen. *Sociologie*, *11*, 3–30.

Pooley, Colin, Horton, Dave, Scheldeman, Griet, & Harrison, Richard. (2010). Shaping the city for walking and cycling: A case study of Lancaster. *Built Environment*, *36*(4), 447–460.

Pucher, John, & Buehler, Ralph. (2008). Making cycling irresistible: Lessons from the Netherlands, Denmark and Germany. *Transport Reviews*, *28*(4), 495–528.

Pucher, John, & Buehler, Ralph. (2010). Walking and cycling for healthy cities. *Built Environment*, *36*(4), 391-414.

Pucher, John, & Dijkstra, Lewis. (2000). Making walking and cycling safer: Lessons from Europe. *Transportation Quarterly*, *54*(3), 25–50.

Simone, AbdouMaliq. (2004). People as infrastructure: Intersecting fragments in Johannesburg. *Public Culture*, *16*(3), 407–429.

Star, Susan Leigh. (1999). The ethnography of infrastructure. *American Behavioral Scientist*, *43*(3), 377–391.

Steinbach, Rebecca, Green, Judith, Datta, Jessica, & Edwards, Phil. (2011). Cycling and the city: A case study of how gendered, ethnic and class identities can shape healthy transport choices. *Social Science & Medicine*, *72*(7), 1123–1130.

Thomas, Klinger, Kenworthy, Jeffrey R., & Lanzendorf, Martin. (2013). Dimensions of urban mobility cultures – A comparison of German cities. *Journal of Transport Geography*, *31*, 18–29.

Thomas, Klinger, & Lanzendorf, Martin. (2016). Moving between mobility cultures: What affects the travel behavior of new residents? *Transportation*, *43*(2), 243-271.

Van Exel, Job van, De Graaf, Gjalt, & Rietveld, Piet. (2011). I can do perfectly well without a car! *Transportation*, *38*(3), 383–407.

Vivanco, Luis. (2013). *Reconsidering the bicycle: An anthropological perspective on a new (old) thing*. London: Routledge.

Vreugdenhil, Roger, & Williams, Stewart. (2013). White line fever: A sociotechnical perspective on the contested implementation of an urban bike lane network. *Area*, *45*(3), 283–291.

Wang, Yu, Chau, Chi Kwan, Jackie, Ng, & Leung, Tzeming. (2016). A review on the effects of physical built environment attributes on enhancing walking and cycling activity levels within residential neighborhoods. *Cities*, *50*, 1–15.