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### Smart Cycling

*Meaning, Experience and Governance*

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## SMART CYCLING

### Meaning, experience and governance<sup>1</sup>

*Anna Nikolaeva, Marco te Brömmelstroet,  
Rob Raven and James Ranson*

#### **Introduction**

Cycling experiences a boom of attention from policy-makers and scholars across the world (Fishman 2016). The same can be said about the ‘smartification’ of mobility (Manders et al. 2018). The latter is increasingly imagined as a seamless service whereby the customary distinctions between public/private and collective/individual start to disappear – for example, through the mobility-as-a-service paradigm (Docherty et al. 2017). While currently most hype is centred on driverless vehicles, smart cycling technologies are also attracting interest from communities, businesses and decision-makers, at urban, national and transnational governance levels. These innovations can potentially alter how cycling is experienced, understood and governed. Arguably, the specificities of cycling as a distinct – strongly embodied, highly interactive – mode of transport call for more sensitivity towards these kinds of questions than other modes (Larsen 2014; Vivanco 2013; te Brömmelstroet et al. 2017).

Smartification of cycling is a phenomenon that attracts interest both of stakeholders traditionally interested in cycling and new communities, organisations and industries, with potential for new alliances emerging around narratives of smart technology, liveability and environmentalism. A variety of smart cycling devices, such as connected helmets, connected bicycles, smart glasses and other accessories, enter the production phase supported by enthusiastic funders on platforms such as Kickstarter and Indiegogo. These developments might challenge Behrendt’s observation that cycling is still mainly perceived in mainstream transport planning policies as an ‘offline activity’ (Behrendt 2016:157). We argue that in order to understand the mechanisms and impacts of these possible changes we need to better understand the diverse landscape of innovations developed, supported and promoted by individuals, companies and state and non-state actors.

Smart cycling innovations as of yet have not been systematically reviewed, and their potential role in future mobility systems has not been thoroughly discussed. In this chapter we map and analyse the landscape of smart cycling innovation and identify its key features: what does it say about the imaginaries of the futures of smart cycling and about how mobility presents are contested or maintained? If we are to engage with smart cycling futures, we need to understand where we are (not) going, and perhaps more importantly: what and where we are departing from. This will increase our awareness of what is being sold, which will allow us to reflect on its desirability and potential negative externalities, instead of sleepwalking into them.

The questions leading our mapping and analysis are as follows: what kind of ideas about cycling, cyclists and cycling environments are brought to the fore by individuals and companies that produce and promote smart cycling innovations? How do they give meaning to/make sense of smart cycling? What is emphasised, and what stays in the shadows?

## Theoretical embedding

### *Meanings of mobility*

We draw on research that emphasises the meanings of mobility, most notably Cresswell (2001, 2006), Adey (2010). According to Cresswell (*ibid.*), mobility is an entanglement of physical movement, meaning and practice. Our interest here is mainly in the meanings of mobility that can be conveyed through representations of movement in texts and imagery and are important to consider since they ‘can shape social relationships, and . . . alter the way we think about and act towards them’ (Adey 2010:38). Meanings, or ‘ideological codings’ (Adey 2010), of mobility thus both reflect attitudes towards particular social practices in specific contexts and shape those practices, contributing to the production of relationships between people, places and things (Adey 2010:82; Cresswell 2001:20). Since mobilities are always ‘produced and given meaning within the relations of power’ (Cresswell: *ibid.*), they are differentiated along the lines of gender, class, ethnicity and so forth. While in terms of mobility practices, this means that some groups may be enabled to move faster or more comfortably than others, in terms of meaning, some mobilities may be deemed as desirable, modern or ethical while others as dangerous, shameful or criminal. While positive representations may lead to investment in particular types of infrastructures and facilitate particular mobilities, negative perceptions may lead to exclusion of particular groups, violence against certain mobile subjects or failure to account for particular needs in policy and planning. How mobile subjects are imagined is thus crucial in understanding ‘the politics of mobile futures’ as these imaginaries ‘may subsequently become normalized as narratives, knowledges, strategies and interventions that reshape the conditions of everyday life for the future of these

imagined citizens' (Jensen and Richardson 2007:138). Following this, it is crucial to interrogate representations of cyclists and cycling in innovation discourses.

### ***Scripts of innovations***

Our research is informed by the ways of thinking about innovations (or any deliberately designed objects) introduced by science and technology studies. In particular, we use the notion of 'script' (Akrich 1992; see also Cox 2017) – a set of presumptions about how an object should be used as well as a set of implicit assumptions about the world in which this object would work. Every designed object carries such 'script' and with it also a vision of the world, however implicit this may be. As such, 'technical objects have political strength. They may change social relations, but they also stabilize, naturalize, depoliticize, and translate these into other media' (ibid.:222). Though, Akrich points out, it is possible that the scenarios mediated by the objects, and thus the worlds 'inscribed' in them, are rejected or contested by users, she nevertheless maintains that 'it is likely that the script will become a major element for interpreting interaction between the object and its users' (Akrich 1992:216). Adopting this perspective, we thus argue that through analysing descriptions of innovations as written by designers and marketers, we can reconstruct the worlds that these innovations presuppose is existing or should be existing, and by doing that we gain insight in the connections between people, places and things that these innovations deem desirable.

### **Methodology**

The novelty of the subject and the goal to explore the meanings of smart cycling innovations led us to choose the constructivist grounded theory (Charmaz 2006) that builds on Strauss and Corbin (1998). Grounded theory methodology, despite some variations, can be broadly defined by an inductive orientation and the goal to develop theory from data rather than apply theory to data.

For the purposes of our paper, we focused on innovations using ICT or internet of things (IoT) solutions in cycling, ranging from ICT-enabled cycling gadgets and connected bikes to digitally enhanced cycling environments. This methodological choice makes us exclude other potentially relevant cycling innovations and, in particular, electrically assisted cycling (e-bikes). There is extensive academic and societal debate about the differences in techniques, the potential changes in the geographical range of cycling (eg Plazier et al. 2017a) and in the range of the target population (eg Plazier et al. 2017b; de Kruijf et al. 2018). In the Netherlands e-bikes are a mainstream part of the bicycle portfolio (in 2018, 40% of bicycles sold were e-bikes).<sup>2</sup> In our view, excluding this from our analysis on mobility futures is justified because of this already ongoing debate and its manifestation in parts within mainstream cycling presents, typified even as 'the new normal' by some.<sup>3</sup>

Following the distinct approach of grounded theory methodology to sampling as discussed by Charmaz (2006:Chapter 5), we began with a broad scanning of the landscape of cycling innovation in the initial sampling stage. We ‘followed’ a variety of cycling-related accounts communities, blogs, organisations and companies on Twitter and Facebook, checking our news feeds every day. In addition, we did a systematic search on social media every other day over the course of a year and a half (January 2016 to June 2017) using search terms ‘smart’ AND ‘cycling’ and ‘cycling’ AND ‘innovation’. Innovations discussed or promoted on social media often were linked to crowdfunding platforms Indiegogo and Kickstarter, where we also conducted periodic searches using the above search terms. As this research is embedded in a larger transdisciplinary consortium, ‘Smart Cycling Futures’, we are part of a professional network in the Netherlands through which newsletters and updates on cycling innovation in the Netherlands as well as abroad are circulated. Regular discussions within the above-mentioned network as well as presentations at national and international cycling community events helped cross-check our list. In accordance with the goal of the chapter, we aimed to cover a spectrum of ICT- and IoT-mediated solutions to urban mobility issues that involve cycling and thus achieve some diversity of kinds of innovations.

We used standard coding techniques, such as initial coding and focused coding (Charmaz 2006), having performed about 3,500 coding operations. We inductively created 1,045 codes in the initial coding phase, which we aggregated into seven key themes in the focused coding. These themes are seven types of changes in how cycling can be experienced, given meaning to and organised, according to innovators. Most themes are aggregations of multiple categories – distinct kinds of change within a theme.

We collected and analysed texts by the developers of 86 innovations. For pragmatic reasons, data collection focused on press and social media in English, Dutch and Danish. While this approach has its limitations, it allows us to start reflecting on how smart cycling futures may be articulated and enacted differently across geographies and particularly start to identify differences between mature cycling environments (the Netherlands and Denmark) and those where cycling represents a minor share of the modal split (eg the UK, the United States, France and others).<sup>4</sup>

## Results

### *Changes in the bicycle: simplicity and connectedness*

From the descriptions of ‘connected’ bikes as well as other innovations promising to alter the functions of the bicycle, a composite description of a ‘smartified’ bicycle arises. It is promoted as a combination of the ‘simplicity’ of a ‘regular’ bicycle with promises around the convenience that ICT enhancements offer.

The latter often imply a lack of features that supposedly mean extra hassle for the cyclist, such as holding on to one's keys:

You no longer have to pull out your keys or fidget with a bulky lock.

(LINKA)<sup>5</sup>

YoBike is bike-rental made easy. Anytime, anywhere, no docks or fobs. Just tap your phone and go.

(YoBike, see also Urbee, Student-Bike, Mobilock)

The connectedness of a bicycle to a smartphone is seen as another key feature that can make any bicycle 'smarter' (eg Hexagon, SmartHalo). A smart bicycle encapsulates the negotiation between past and future – retaining the bicycle's traditional simplicity while embracing 'simple' and functional smart tech design. Thus, 'sleekness', 'simplicity', 'elegance' and 'connectedness' are key features of a smartified bicycle (eg VanMoof Electrified S, Linkalock, Brightspark, Blubel, Sherlock). Smart bicycle accessories often offer 'seamless' integration into an existing bicycle structure while promising a multitude of functions and possibilities. Thus, the creators of Smart Halo, a device that can be mounted on the steer to provide navigation, lights, anti-theft alarm, fitness goals tracking, call and SMS notifications and more, emphasise the minimalist non-obtrusiveness of the design:

With no visible screws, it is refined yet subtle, as it merges perfectly with any type of bike. This is the smart biking device you've been waiting for. ONE MINIMALIST INTERFACE. INFINITE POSSIBILITIES. SmartHalo's circular interface has been designed to keep you focused on what matters: the road. Simple yet versatile, this luminous halo can guide you around, track your fitness goals and much more.

(SmartHalo)

### ***The relationship between the cyclist and the bicycle***

Cycling innovations can reconfigure the relationship between the cyclist and the bicycle in subtle or dramatic ways. The following two categories are particularly prominent in the analysed texts.

#### ***From owning to using a bicycle***

First, a number of innovations offer a cyclist a relationship with a bicycle in which any issue will be taken care of by a third party, such as a repair service that one can summon using a mobile application (HonorCycles) or the provider of the bicycle – a bicycle sharing or a bicycle leasing company (Urbee, Student-Bike). In the latter case, the bicycle can even be replaced by an identical one (Bikeshare

050, Student bike, Urbee). One no longer has to tinker with their bicycle, as it becomes an equivalent of Netflix, a service rather than a possession (see also Petzer 2017). A bicycle becomes an interchangeable commodity that somebody else takes care of, whereas an owner is becoming a user or a subscriber, freed from the commitment to take care of the bicycle as ‘everything is taken care of’ (Urbee, see also Yobike). Furthermore, smart locks expand the fleet of shareable and interchangeable bikes into the realm of owned, personal bicycles: ‘every bike can be a part of a rental or bike sharing system’ (Mobilock). The peculiar materiality of one’s personal bicycle ceases to matter.

### *A deeply personal relationship*

Another type of relationship, in particular, but not exclusively, manifested in cycling innovations targeting theft as an issue, presents a contrasting vision of the relationship between the cyclist and the bicycle. It is a deeply personal relationship that some innovations promise to mediate and safeguard. The bicycle is ‘your sacred two-wheeler’ (SmartHalo) that can ‘recognize you’ as you approach (LINKA, see also Wink Bar, VanMoof Electrified S, SmartHalo). The language may presume a special, lived relationship between the cyclist and the bicycle: ‘Should you become separated, the Lyra’s upgradeable GPS system is designed to help reunite you two’ (Lyra).

### *The relationship between the cyclist and social environment*

Cycling innovations bear a potential to bring to life, or exclude, particular mobile socialities, encouraging or prohibiting interactions on the move, mediating relations between different modes, challenging or confirming existing hierarchies on the road. While some innovations promise to bring people together or capitalise on already existing or presumably existing communities, others lead to the removal of social transactions.

### *Technology mediating or replacing human-to-human interaction*

A chief goal of a number of innovations is to mediate interaction between traffic participants, either viewed as something functional or as arena of civilised or playful sociality. In the first category, we find a variety of devices that help communicate the cyclist’s intentions (eg to turn, to break) to others (Smart Jacket, Blinkers, Goledbag, Blinkers). In the second, we see a number of concepts designed to enhance playfulness and social cohesion, on and beyond the cycle path:

‘Light Up Your Mood’ (LUYM) is a concept that responds to a lack of social contact among foreign students who are living in the Netherlands. It provides the opportunity to feel connected. A part of the bicycle will

be lighted with a color. This color communicates a message to its surroundings, depending on the mood of the student. It is a tool to encourage students to travel by bike and interact with others more often. By cycling together, instead of alone, we would like to improve students' experience with cycling. Social connections, trust and fun are the core values of LUYM.

*(Light Up your Mood)*

If you want to say 'thanks' to a driver behind you, you can raise your hand and the jacket shows a 'Thank you' smiley on the back.

*(Smart Jacket, see also the Social Light)*

Smart cycling technologies also offer possibilities to be in touch with people who are not sharing the road with you. 'Ride sharing' – sharing data such as route, photos or videos – are also enabled by some innovations, potentially reconfiguring the sociality and the spatiality of a bike ride that 'friends from all parts of the world can view' (Hexagon). A ride can be recorded, 're-lived' and shared in improvised social networks (Sena X1, see also Solos glasses).

In some cases, technology is supposed to replace human-to-human interaction altogether. One example is through introducing systems of communication that are replacing jobs currently done by humans – which is 'costly and time-consuming' – such as the job of a bicycle parking guard (Cloudfietsenstalling).

### *Connectedness and mobile collectivities*

A number of texts appeal to the idea of a community that would be created through the use of an innovation. Envisioned communities may be communities of data exchange (Blubel, RoadwareZ), but also offline mobile collectivities emerging spontaneously or through collaborative planning (Nachtnet):

I didn't just want to make a slick cycling gadget, I actually wanted to create a community that could engage and communicate together to create safer journeys. And one of the things I kept thinking about is well what if every time someone rang a bell we would be able to use that data to find safer routes.

*(Blubel)*

If cyclists use Nachtnet Fiets [Cycling Night Network] together they increase the feeling of social safety for the users. This increases the chances of meeting a fellow cyclist on Nachtnet Fiets. Moreover, you can arrange to make use of Nachtnet Fiets together. Colleagues, friends, sportsmen that use the same route, can now more easily arrange to bike along.

*(Nachtnet)*

Electronic information boards in Copenhagen appeal to all cyclists as a mobile collective: 'Take care of each other' ('Pas på hinanden').



Being connected while on the move is a promise that a variety of innovations make, yet the supposedly desirable types of connectedness vary. Quite a few innovations offer the possibility to be alerted to and take phone calls while cycling:

Cyclists often miss important calls because of street noise and vibration. This is the thing of the past with SmartHalo's personal assistant.

*(SmartHalo, see also LINX Smart Helmet, Project Jacquard)*

Commonly, smart wearables not only offer the possibility to use one's mobile phone with hands on the handlebars but also offer to mediate communication with one's 'riding partners' (Sena X1 Helmet, see also LINX Smart Helmet, LIVALL, XON Ride-1). As these innovations connected to a smartphone can also stream music, dictate directions and read text messages aloud, they offer a ride that is customised to one's preferences and can keep the cyclist in her own social bubble, connected to her usual contacts, but isolated from her immediate environment.

### *Empowerment and mobilisation of communities*

Some texts explicitly use community rhetoric to mobilise cyclists for a broader change in mobility regimes and urban living:

Together we can build the case for substantial and sustained funding for cycling infrastructure, by reporting potential improvements and danger zones in our local areas. . . . Together let's build a better cycle network.

*(BikeBlackspot App, #endbiketheft)*

Crowdsourcing knowledge in some cases is framed as more than a pragmatic and cost-efficient solution to data gathering, but as an opportunity to forge community and societal contributions:

Just by riding your bike, you help designing your city.

*(SmartHalo, also see Blubel, ICON, B-Riders)*

In two cases, cycling innovation is framed as a way to mobilise the community to make a direct monetary contribution to societal goals:

The app sets regular distance challenges for the community to aim at. Every user's journey along the cycle route contributes to the overall target. If the target is reached a local Isle of Wight charity gets a donation.

*(Smart Corridor, see also Ring-Ring)*

Especially in the texts from the contexts where cycling is marginal, the idea of a community is evoked in the context of facing a common enemy – usually,

the bike thief or a common problem, which usually means being or feeling unsafe.

First and foremost, we are cyclists, just like you. And, just like you, we want to be safer on the road.

*(Brightspark, see also RoadwareZ, Lock 8)*

Content focusing on theft and safety plays into a call for community action and cohesion, for building on representative power and perhaps forging one global cycling community. In the contexts where cycling is marginal, frustrations with bicycle theft and lack of safety are presented as two major impediments to the 'ease' of cycling (an omnipresent term) as an enjoyable social and functional practice, and innovation is offered as a tool to galvanise and inspire cyclists as a marginalised group.

### ***Relationships between modes***

Smart cycling innovations can mediate different types of relationships on the road across the world. In a variety of contexts where cycling is seen as a marginal mode, the major selling point of the innovation is its supposed ability to make one 'visible' to others (eg Brightspark, Lumos, Hexagon, Livall, Goledbag). As these solutions are described, what seems to be at stake is not only one's safety, but potentially, empowerment, confidence, and the respect of others: 'distinguish yourself' (Hexagon); 'Even in the darkness you can show up' (Wink Bar); 'be seen' (Goledbag, Lumos). The text advertising Blinkers, Swiss-developed bike lights that communicate a cyclist's behaviour to others, goes as far as to frame this bicycle accessory as the solution to cyclists' marginal position on the road:

Blinkers is the one thing that was missing for cyclists to be safer and to be a natural part of the road. It packs everything you need to be seen, understood and respected by everyone else in the road.

*(Blinkers)*

Such framings place the responsibility for one's safety and empowerment with the cyclists rather than other road users, regulation or empowering infrastructures:

Brightspark means more than brighter lights – it empowers you to attract the attention of any driver. Even more, car drivers will immediately recognize that there is a vehicle approaching, as the two lights can help them see your width. Brightspark increases your perceived presence and size by projecting laser indicators on your side. This way, pedestrians and drivers are guaranteed to notice you and to be able to better estimate your intentions.

*(Brightspark, see also Livall, Wink Bar, Cyndicate System, VUP Plus Backpack, ICON)*

While we have come across a similar narrative on visibility and safety in the descriptions of Dutch innovations (Bikescout, Smart Jacket), we have not found the same emphasis on empowerment and respect. Also, the number of innovations targeting this specific problem in the texts coming from ‘mature’ cycling environments is lower. In one case the same issue of the presumed unpredictability of cyclists is proposed to be resolved through informing drivers at crossings about approaching cyclists (Bikescout). The responsibility for cyclists’ safety in this case lies with the driver, warned by the LED lights on the road surface

### ***The relationship between cyclists and the spatial environment***

This theme is particularly prevalent in the set of innovations that target mature cycling contexts, in which cycling infrastructure innovations are more prominent. The scenarios of how interactions with the (usually urban) landscape are unfolding are related to the relationships between modes discussed above.

#### ***Interactive landscape***

For example, Warmtesensor (‘Warmth Sensor’) in Rotterdam is supposed to react to the presence of many cyclists at a crossing and provide green lights to cyclists longer and more frequently. Groenvoorspeller (‘Green Predictor’) and Schwung (‘Dash’) also react to approaching cyclists and extend the green light for them. The Spinning Wheels installation in Copenhagen ‘registers movement’ so that ‘the light “spins” in the same direction as passing cyclists and pedestrians’. The light then ‘slowly fades out until the next person passes through’. Other innovations in contexts where cycling rates are high, such as Flo, Evergreen and Volg Groen in the Netherlands, and green waves in Copenhagen, Denmark, provide a different kind of interaction: the cyclist receives information on how to adjust her speed to catch the green light for one or a number of consecutive traffic lights. Electronic information boards in Denmark and P-Route in the Netherlands also provide cyclists with information about the traffic situation and the availability of bicycle parking spots, respectively.

#### ***Adaption of cyclists to environment***

In the texts produced in and for contexts where cycling is marginal, interactions with the landscape often envisage a cyclist trying to temporarily establish her presence in the cityscape – for example, through using laser projection on the road (Brightspark, Blinkers), while the urban landscape hardly reacts to her presence. As discussed above, in the data coming from ‘mature’ cycling environments, the urban landscape is more often interactive, responding to cyclists’ movements or presence (eg Warmtesensor, Volg Groen, Bikescout).

In both data sets, responses to urban pollution came across as another framing of the relationship between cyclists and the urban environment. The WAIR scarf, designed in France and meant to protect cyclists from air pollution and

gather data on pollution in different parts of the city, is presented as an adaptation to changing urban environment:

At WAIR, we believe that assisting you, city dwellers, against air pollution is critical. . . . Your environment has changed a lot lately; it is time for your clothes to take the same turn.

*(WAIR)*

An app designed to accompany the scarf is meant to help cyclists choose cleaner routes: 'Discover SUPAIRMAN by WAIR, your best friend in town to ride safely, away from pollution!' (WAIR). Similarly, a Dutch innovation 'Ring a Bell' aims to help cyclists navigate away from polluted areas: the smart bell changes colour depending on air quality. Both innovations gather data in order to create more awareness of air pollution, yet they also have a potential to redistribute cyclists in the city, reducing the visibility of cyclists in some areas and increasing it in others. A number of other texts mention pollution as an important issue, while calling for more cycling as a way to make cities cleaner (B-Riders, Groenvoorspeller, TringTring, Sitraffic Sibike). Thus, the cyclist is summoned to become a harbinger of environmental change and to adapt while the change has not yet taken place.

## ***Experience and meaning of cycling***

### *Customisation of experiences*

Smart cycling innovations envisage a variety of supposedly desirable changes in how cycling can be experienced and what it might mean in one's life. The imaginaries of smart cycling vary greatly: from a non-stop commute to an adventure, from a relaxed exploration to a target-focused performance. This sheer diversity underscores another feature of smart cycling that we have identified across different types of innovations and geographical contexts: customisation of one's cycling experience. Innovations promise to get food delivered from your favourite restaurants (UberEats), identify spots at your favourite parking facility (P-Route), play 'your favourite music' (Sena), 'recharge your favourite gadget' (Hexagon), and work as 'your personal assistant', allowing you to take important calls while cycling (SmartHalo). As one is cycling past infrastructure innovations, the ride can be customised to suit one's speed or aesthetic preferences:

Personal advice. Flo measures your speed and uses it to give you an advice. This way every cyclist receives a personal advice. This improves your chances to catch the green light!

*(Flo, see also Bikenow)*

Cyclists can adapt the light level of the adjustable LED lighting alongside the cycle path. Depending on the time of year and weather conditions, cyclists can increase or decrease lighting level as they desire.

*(Re-Light)*

We have come across appeals to three major types of cycling as an experience that innovations sought to improve or make possible.

### *Non-stop cycling*

The first type is cycling without stopping or with minimal interruptions. Especially in the Dutch context, cycling without stopping at crossings is presented as a pleasant experience that a cyclist is seeking (Groenvoorspeller, Volg Groen, Evergreen, GoLight Avenue). Groenvoorspeller even coins a term for this: ‘staying in your cycling flow’ (in Dutch: ‘in je “fietsflow” blijven’).

### *Cycling as a target-driven performance*

Another way that cycling is framed is as a form of physical performance, characterised by exertion and challenge:

Set Goals. Get Fit. Bike Hard. Feel like surpassing yourself? You can set fitness goals in the app and SmartHalo will display your progress in real time, right on your handlebar.

*(SmartHalo)*

A number of innovations offer tracking one’s performance through monitoring health parameters, speed and distance cycled (Blubel, Hexagon, Garmin Garla Vision, Livall, Sena, XON-Ride 1). Cycling here is presented as a focused, target-driven experience while the innovation in question enables maximum information provision on one’s performance and minimal distraction from pursuing one’s goals.

### *Cycling as an experience valuable in itself: exploration and safe adventure*

The last framing of cycling that we have identified is quite different from the first two: cycling as exploration, adventure and an experience valuable in itself. Thus, some innovations offer cyclists an opportunity to learn more about their natural or cultural environment (Fietsy, Smart Corridor) or encourage active exploration made possible by the peculiar pace of cycling (Ring-Ring).

While in some texts, cycling by itself is presented as pleasant, other innovations suggest improvements to make it even more fun:

The sensors would activate a series of lights along the path sequentially, following the bicycle, creating a fun and memorable interactive space on a bike lane.

*(Illumilane)*

A feature of most of the representations of cycling as an adventure is a certain amount of assistance or guidance. Navigation assistance is a common feature of

many innovations (eg Blubel, Gobike, RoadwareZ, LINX Smart Helmet, Garmin Varia Vision, Solos):

Beeline is a smart compass for your bike. . . . Beeline is built for everyday adventuring. After all, where's the fun in being told exactly what to do? Take back control of your ride and explore your city with Beeline.

*(Beeline)*

The Wink is a smart handlebar connected to your smartphone. With the Wink bar you'll never get lost anymore. Thanks to its turn-by-turn navigation system, the Wink bar can guide you through any adventures by the blinking of its lights.

*(Wink Bar)*

Adventuring with smartified cycling means being guided while still, presumably, retaining the sense of freedom, autonomy and surprise. Smart cycling is a safe, carefully monitored adventure, or an engineered challenge with smart technology meant to amplify the existing pleasures of cycling, while removing the challenges that are supposedly hindering the experience.

### ***Governing cycling***

In this theme we included categories that represent profound systemic changes in how cycling can be organised and governed as a mobility mode.

### ***Automobilisation of cycling***

A key change that smart technology promises to bring to cycling is granting cyclists the similar possibilities and privileges that drivers already have. This has the potential to profoundly change the nature of cycling as a mode, the rights of cyclists and possibly their responsibilities. The automobility system may openly be mentioned in such texts, or the word choice may allude to the language associated with driving. For example, the German mobile application Sitraffic SiBike offers 'green waves' to cyclists and uses the language associated with automobility for cycling infrastructure:

A 'green wave' is what drivers have come to expect. . . . To date, 'green waves' were aligned exclusively with the speeds of motor traffic. Very soon, however, Sitraffic SiBike will be extending the advantages of a 'green wave' to cyclists as well – on cycling highways, fast cycling lanes, roads or cycling paths.

*[emphasis added] (Sitraffic Sibike)*

Other examples of offering 'green waves' to cyclists, such as Volg Groen (Follow Green) and GoLight Avenue in the Netherlands, and green waves for cyclists in

Copenhagen, Denmark, promise to improve the ‘flow of cycling traffic’ (Volg Groen), ‘minimal time losses’, ‘direct city to city connections’ and ‘few stops (GoLight Avenue). A ‘more efficient journey’ thanks to a 17% travel time reduction is promised for cyclists (Green waves for cyclists). Thus, the descriptions of innovations emphasise values that can be seen as borrowed from automobility discourses such as unimpeded flow and minimal time losses.

Another solution borrowed directly from the automobility system is information provision. Electronic information boards in Denmark and P-Route digital signs in the Netherlands provide cyclists with information about the traffic situation and available bicycle parking spots in a manner nearly identical to existing parking information screens for cars.

Other direct transfers from the automobile world include specific safety solutions such as turn indicators (eg Blinkers, Brightspark, Livall), lights that automatically switch on when a cyclist slows down (eg Hexagon, Lumos) and a ‘smart’ bicycle helmet with an airbag that inflates in case of an accident (Hövdning).

### *Surveillance, data collection and data-driven governance*

Cycling at the moment, together with walking, continues to be a largely un surveilled mobility mode. Of course, in some places cyclists may be seen on surveillance cameras in public spaces, but for privately owned bicycles, there are no systematic data collection processes in place, no possibilities to track individual journeys such as for driving, using public transportation, flying and so on. As our analysis shows, smart cycling innovations can change this radically. The methods and the purposes of data collection differ.

Safety is one of the common justifications for equipping a bicycle (accessory) with a GPS tracker. Most frequently, this is advertised as solution to bike theft or, rather, retrieval after theft (Lyra, Sherlock, SmartHalo, VanMoof Electrified S, Lock8). In a few examples, safety in traffic and social safety are addressed. Thus, LIVALL helmet is equipped with a sensor that would react to the bump in case of an accident and the LIVALL Riding App would send an SOS message to a chosen contact. In some cases, the descriptions of innovations envisage whole (mobile) communities of surveillance keeping an eye on each other:

If someone in the group gets into trouble or falls from their bike, RIDE-1 will capture the event and alert the other riders. RIDE-1 can also create alert warning areas (areas where bike accidents frequently happen) by using data from other people’s sensor logs.

*(XON Ride-1, see also RoadwareZ)*

In some cases, measuring the number or the speed of cyclists and tracking their movements in real time is the crucial part of the functioning of an innovation (eg infrastructural innovations at crossings such as Warmtesensor, Flo, Bikescout). In

other cases, the rationale is different: measurements are framed as necessary for a larger change in cycling policy.

Thus, in Copenhagen, the municipality claims to use data collection in order to create connected infrastructures facilitating cycling with a minimal number of stops and traffic information provision.

Today, green waves function in isolation without any coordination behind them. For this reason, work is being carried out to link them together. It must be possible for the green waves to be monitored and adjusted by means of a traffic management system based on measurements of the cyclists' real travel time, number of stops and so on (Green waves for cyclists, see also Electronic information boards).

In the Netherlands, the online cycling network performance tool, CyclePRINT, promises to help 'you understand how to use the power of cycling as a transport mode to unlock your city', as it is supposed to translate 'your GPS data into policy relevant insights and enable its' users to analyse current behaviour, investigate future network enhancements and monitor bicycle network performance in a more detailed way' (CyclePRINT).

A number of other applications frame data collection as a secondary function offering the policy-maker data on speeds, routes, numbers of cyclists and carbon dioxide emissions (Bikescout, GoLight Avenue, Ring-Ring). Cyclists are supposed to make use of the primary function of the innovation, while data gathering takes place in the background. Other innovations explicitly frame cyclists as data gatherers on a mission to improve their habitat. Ring a Bell, a bike bell measuring pollution in the Hague not only warns a cyclist when she turns to a more polluted street, but also collects the data and as such is 'handy for every inhabitant of the Hague who wishes to be outside and breathe clean air but also delivers insights to policy-makers' (Ring a Bell).

Finally, surveillance is also offered for non-strategic goals – for example, for an enhanced accountability as part of the service: thus, one can trace their food moved through the city by the UberEats rider; an employer using Burn Fat not Fuel application stimulating cycling instead of driving 'is provided with an overview of the cycled kilometres per employee'.

### ***The cyclist: identities and lifestyles***

How are cyclists themselves envisioned in smart cycling promotional material? Texts describing innovations are selling not just smart technology and a somehow enhanced experience of mobility; they are also selling lifestyles and constructing a variety of identities to do so.

#### ***Flexible and smart lifestyles***

While this is not explicitly said, the emphasis on independence, flexibility, ease and customisation as well as the presentation of the bicycle as a liberating, personalised mode of transport suggests that smart cycling technology is supposed to be



conducive to the inner-city lifestyles of the young middle class and cater to their increasingly complex, ‘connected’ lifestyles, where work and life are at the same time balanced and fused. One can be on an adventure and yet track their performance, listen to one’s favourite playlist and still be able to take ‘important calls’ (Livall), connect to others when one feels like it and disconnect at a click or remain ‘always connected’ (Student Bike). The notions of freedom, flexibility and lack of commitment are presented as the ideal of mobility desired by the imagined user:

No rules, no instructions – you’re free to pick your own path.

*(Beeline)*

In the case of urban logistics, flexibility is a selling point both for the consumers and the couriers. Thus, TringTring offers an image of independence to the prospective ‘tringer’: ‘Determine your own working hours. No boss. Healthy body. Fresh head’ (see also Foodora). Consumers of services, in their turn, are offered a sort of understanding of the complicated busy lifestyles they have and are offered speedy indulgence:

Your work, your friends, your sports. Always busy. TringTring gives you a little bit more time. Stay at home, and have your groceries delivered.

*(TringTring)*

Cycling here becomes co-constitutive of an identity of a modern urbanite: agile, adaptable, ‘smart’ and aware of the sustainability impact of her actions, too busy to walk to the store or ready to hop on a bicycle for an ‘easy’ money earner.

The envisioned users of 56 out of 86 innovations in the data set are supposed to have a smartphone, and there are also many indications of smartness and connectivity as important parts of one’s lifestyle, such as mentions of tablets and laptops that the cyclist carries, social networks and so on. Smart cycling technology supposedly caters to a tech-savvy audience:

It’s also been designed to be as smart as everything else in your life, shipping with its own smartphone app and anti-theft tracking designed to make bike theft a thing of the past.

*(Van Moof Electrified S)*

### *Elegance, fashion and style*

Elegance, fashion and good looks represent another set of important codes, especially in the texts coming from contexts where cycling is marginal. The imagined users presumably care about their style:

And, as we know, that you care about the style of your bike, we’ve designed two different types of handlebars to meet your expectations!

*(Wink Bar)*

A LIFESTYLE ACCESSORY. The WAIR scarves are real daily apparel accessories! We wanted to integrate our protection in a lifestyle accessory, available in different colors or prints, so you can match them with your own style, every day. . . . Protect your style and your lungs.

(WAIR, see also *Lumos, Brightspark, Van Moof Electrified S*)

## Conclusions: contested presents, contested futures

In this chapter we have uncovered what the smartification of cycling can bring into the ways cycling is practiced, given meaning to and governed. The aim was to map the landscape of smart cycling innovation in its diversity, and the grounded theory approach to data analysis has facilitated revelation of the variances while identifying seven common themes. Within most of the seven themes, we found significant differences between the implications of the promises of different innovations for cycling. Smart cycling futures are fraught with internal contradictions and tensions. For example, promotional materials appeal to the idea that cycling offers adventure and freedom, but they propose varying degrees of engineering such ‘adventurous’ rides. Likewise, aspirations for and understandings of sociality and connectedness are ambivalent, as they are complemented by catering to the desire for individualism and solitude.

External tensions (ie between futures) also exist. Some innovators try to tackle the question of abandoned bicycles or the sheer number of bicycles on streets; others effectively stimulate putting more bicycles on streets. Some facilitate interactions with other cyclist; others, speed and focus. Some aspire to eliminate a need to have one’s own bike; others propel bike ownership to a whole new level (high-end bicycles), while some make bike ownership a prerequisite for a job.

We have also found significant differences between different geographical contexts. First, in the analysis of the innovations developed in/for mature cycling contexts, such as the Netherlands or Denmark, there is a prevalence of codes related to the system and infrastructure, while codes coming from the analysis of texts written in/for contexts where cycling is marginal more often are related to individuals – their quest for safety, comfort, performance and community. Second, we found indications that in the contexts where cycling infrastructure is more developed and cycling is perceived as a ‘normal’ way of moving around, the cyclist is less targeted with the need to equip herself with smart accessories in order to be ‘respected’. In contexts where cycling is marginal and where, presumably, infrastructure, formal regulations and informal norms of behaviour leave cyclists feeling invisible, ignored and endangered, innovators – often on the basis of their own experiences – propose ‘solutions’ that are supposed to make cyclists feel or be safer without any systemic change on the road. In fact, they thus may implicitly and unintentionally reinforce a contested understanding of the responsibility for safety.

Third, our data suggests that there is a trend in the way cycling is framed as a mobility mode in mature cycling contexts – we label it ‘automobilisation’ of

cycling. In the Netherlands and Denmark, the bicycle is increasingly treated as a car – a mobility mode that supposedly needs streamlining, more efficient organisation and potentially more regulation, especially when it comes to parking. Through smart cycling innovation, cyclists also increasingly receive ‘privileges’ similar to those that drivers have enjoyed for years: green waves, (occasional) priority at crossings, information on availability of parking places and so on. In the contexts where cyclists’ share in traffic is marginal, we talk about a different type of automobilisation of cycling: incorporating ‘safety’ features that mimic those of a car and presume that a cyclist needs to invest more effort in ensuring their own safety appears to be a common theme in innovations.

We thus conclude that just as cycling presents are multiple and contested, so will (smart) cycling futures inevitably be. Recognising the variety of paths that these futures may take and understanding in what kind of movements, meanings, practices and politics of mobility (Cresswell 2006) in the present they are rooted is important, for scholars, in order to understand transformations of cycling practices, cultures and policy contexts, and, for transport policy-makers and advocates, for informed decision-making. For instance, smart cycling innovations may thus advance and upscale specific new visions of cycling: for example, fast and focused cycling with minimal time losses and marginalise others such as slower, interactive practices (see also Popan 2019).

The key questions that follow from this are: what kind of social relationships will particular solutions facilitate or hinder? What kinds of lifestyle are seen as rational, desirable and trendy? And what lifestyles and mobile subjects are left invisible and ignored? These questions entail profound political choices to be made – choices that are not value-free, but that will inevitably leave their mark on our mobilities and public spaces. We therefore need to ask what the role of the state, non-state actors and citizens is in smart cycling futures. Which innovations receive support of the public and policy-makers? Which choices between those contradictory visions of present and future are made? Who makes these choices? How aware are such players of the potentially contested smart cycling future that they buy into? Who develops the new algorithmically governed infrastructures and defines conditions for automated decisions? Who receives a green wave and to the expense of whom, who is rewarded for cycling and who is excluded by new assemblages of meaning, movement and practice?

## Notes

- 1 This is a shorter version of the article: Nikolaeva, Anna, te Brömmelstroet, Marco, Raven, Rob and James Ranson. 2019. “Smart Cycling Futures: Charting a New Terrain and Moving Towards a Research Agenda.” *Journal of Transport Geography*, 79, 102486. <https://doi.org/10.1016/j.jtrangeo.2019.102486>. Reused with the permission of Elsevier.
- 2 According to RAI, the Dutch branch organisation of bicycle industry, see RAI Vereniging (2019).
- 3 According to Verkeersnet, Dutch online platform for transport knowledge, see Rottier (2019).

- 4 The Netherlands and Denmark are neither identical nor internally homogeneous in terms of cycling rates, cycling culture and infrastructure provision. Also, there are places with higher rates of cycling in non-cycling countries. Yet, this distinction clearly emerged in our analysis, and it helps illustrate the differences in aspirations of innovators, depending on which context they address.
- 5 The list of all innovations with the websites is available as an appendix to the following article: Nikolaeva, Anna, te Brömmelstroet, Marco, Raven, Rob and James Ranson. 2019. "Smart Cycling Futures: Charting a New Terrain and Moving Towards a Research Agenda." *Journal of Transport Geography*, 79, 102486. <https://doi.org/10.1016/j.jtrangeo.2019.102486>.

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