

**Rethinking the
production of
space for cycling
using
Lefebvre's spatial
triad**

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Abstract

This research rethinks how today cities produce cycling infrastructure. It develops an analytical framework based on Henri Lefebvre's spatial triad of interconnected 'moments' in the production of space, and applies it to contemporary cycle space. The study has as its goal to generate an understanding of the production of cycle space that engages with the social aspects of space and bring to the foreground the dialectical tensions existing between Lefebvre's triadic 'moments' in the process of the production of space for cycling. Taking a comparative perspective, the research investigates representations of cycle space, cycle spaces of representation, and spatial practices of cycling in the production of cycle space in a low-cycling city, Newcastle upon Tyne, United Kingdom, and in a high-cycling city, Rotterdam, the Netherlands. The findings of this research, first, suggest that there is interaction between the elements of the triad, and second, that in the process of the social production of cycle space there may be stages when there are tensions between the triadic spaces, but also stages when they more or less coincide.

Keywords

Cycling, Lefebvre, Production of Space, Cities, Comparative Research

1. Introduction

"Every society produces a space, [...] its own space"

- Henri Lefebvre, *The Production of Space* (1991, 31)

More than ever, cities are transforming into cycling cities. Many see cycling as a magical cure to all sorts of urban issues. Indeed, there are many potential benefits to cycling. As research continues to show, cycling is beneficial for personal health, fitness and well being (Landsberg et al., 2008; Timperio et al., 2006; Handy et al., 2002); it is even associated with happiness (McIlvenny, 2015; Whitaker, 2007); it reduces air pollutant emissions (Lindsay et al., 2011), and congestion (Dill & Carr, 2003); and, too, cycling provides improved access to businesses and reduces health-care costs through healthier workforces (Blue, 2013). Complemented by the idea that more bicycle infrastructure will invariably increase cycling (Lugo, 2013), cities are now implementing bicycle infrastructure at a rapid pace.

However, the installation of cycling infrastructure is not always without problems. Recent cycling research suggests that it may actually cause for tensions and conflicts. Lubitow et al. (2015) showed how the installation of a bicycle lane on *Paseo Boricua*, a central corridor in a large Puerto Rican community in Chicago, USA, was met with fierce community resistance. In the eyes of the community, bicycle lanes are only used by affluent White people, and therefore the community feared that the implementation of cycle infrastructure would be a catalyst for gentrification (see also Lubitow & Miller, 2013).

Duarte et al. (2014) similarly showed how a newly developed bicycle lane in the Brazilian

city of Curitiba became a site of controversy and protest when the city's largest local cycling lobby movement, *Cicloguacu*, was not included in the initial plan-making of the bike way.

In Launceston, TAS, Australia, too, the implementation of a bicycle network became subject to intense community conflict as showed by Vreugdenhil & Williams (2013). The introduction of white, on-road line markings there resulted in community concerns about the 'simple' line markings giving the city's roads an unforeseen complexity.

When it comes to infrastructure, it seems that among planners there exists a rather technical understanding of space. Yet, the above studies show that infrastructure, and more specifically bicycle infrastructure, is actually embedded with social dimensions. When ignoring these aspects of space, infrastructural changes can thus become the loci of social tensions. These tensions may even go deeper than outspoken community resistance and protest. For instance, Stehlin (2014; 2015) and Hoffmann (2014) demonstrated that cycle infrastructure development in San Francisco and Minneapolis, USA is being integrated into urban regeneration and gentrification strategies, and as such reproduces spatial and social inequalities (see also Hoffmann & Lugo, 2014).

To better understand such deep tensions as well as those that arise more on the surface, a comprehensive understanding of the production of cycling space is needed – one that engages with the complex social dimensions of space. This research therefore has as its goal to create thorough understanding of the *social* production of cycle space and develops an analytical framework that provides critical insights into where and how tensions may arise in the process.

The paper takes Henri Lefebvre's work on the social production of space and develops a framework based on his spatial triad of representations of space, spaces of representation, and spatial practices (Lefebvre, 1991). It looks at the production of cycle space through Lefebvre's concept of the social production of space, because it is an extremely comprehensive conceptualization of space and includes physical as well as social elements of space. Next to that, it is well capable of bringing to the surface social tensions. Yet, Lefebvre's production of space rarely informs empirical research, even though an empirical application of Lefebvre seems valuable for at least two reasons: it can help steering the direction of research into areas that would otherwise not be studied when thinking about space in a more technical way; second, and perhaps more importantly, it can help answering a whole series of questions about the production of space that even go beyond this paper's investigation of the production of bicycle space.

Finally, in order to create robust understanding that holds across contexts, the paper takes a comparative case study approach and looks at the production of cycle space in a low-cycling city, Newcastle upon Tyne, United Kingdom, and in a high-cycling city, Rotterdam, the Netherlands. The main research question of this study is as follows: *How is contemporary space for cycling socially produced?*

First, this paper turns to Lefebvre's theory on the social production of space. It then explores how to use Lefebvre's spatial triad in empirical research. The paper moves forward by discussing methodology. Subsequently, it presents the study's results. The paper finishes with a discussion and conclusion on the findings.

2. Lefebvre's social production of space

Among scholars in the fields of planning and geography Lefebvre's (1991) work on the production of space is held in high regard. His conceptualization of space is extremely comprehensive as well as sensitive to social tensions. Lefebvre's direct engagement with town planning and urban regeneration, moreover, has made that his theory on the social production of space is highly relevant for studying city transformation.

Lefebvre's (1991) most profound claims are that (a) space is political and that (b) space is produced. For Lefebvre, space is not just something physical that is 'out there', like Cartesian space or a container for that matter, but it is full of social meaning and social power relationships, and indeed produced. Therefore, Lefebvre claims, space is a social product.

He argues that space actually consists of various kinds of space, which he aimed to bring together within his theory (p. 16). According to Lefebvre, space, firstly, is conceived. Conceived space is rational, it is the space of knowledge. Secondly, space is lived. Lived space is symbolic space that is imbued with social meaning, norms, values and experiences. And lastly, space is perceived. Perceived space is the physical, material space.

Lefebvre conceptualised the conceived-lived-perceived triad in a triad of interconnected 'moments': representations of space, spaces of representation, and spatial practices. There exist different readings of what elements the three 'moments' consist. While most scholars seem to agree over what Lefebvre meant by representations of space, over what the other two 'moments' consist of there seem to be different ideas. Buser (2012, 6) deems that spaces of representation refer to memories, feelings, social norms, values and experiences. Leary (2013, 7) adds a second element to spaces of representation, namely emotional, artistic interpretations of space by poets, writers, painters and others who create artistic representations of space. Moreover, in spatial practices he sees three elements: (1) the physical, material city and its routine maintenance; (2) its major redevelopment in the context of neo-capitalist state power structures; and (3) routines of daily life that conform with official representations of space. Considering the scope of this research and its relation to cycling, it sees the spatial triad as follows:

- Representations of space
Rational, abstract accounts of space, shot through with knowledge of space (Lefebvre, 1991, 41) produced by technocrats such as planners, engineers, architects
- Spaces of representation
Space of inhabitants and/or users (p. 39), symbolic space imbued with feelings, norms, values, and experiences
- Spatial practices
The physical, material space and related routines of daily life of society members (p. 38)

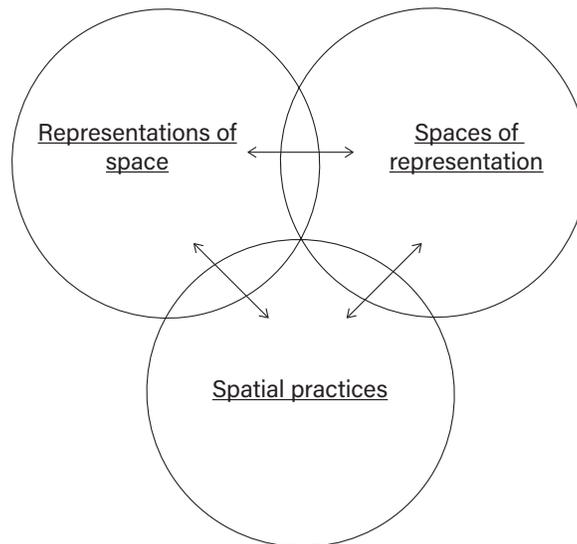


Figure 1 Interaction and intersection in Lefebvre's spatial triad

Lefebvre explains that dialectical relationships exist between the elements of the triad (p.39). In other words, the elements are interconnected (Figure 1). Lefebvre became mostly concerned with the power of representations of space over spaces of representation. Living in 1960s Paris, Lefebvre experienced to his eyes the large-scale urban regeneration that was going on at the time. He argued that, if space is indeed produced, and its mode of production be specified on the basis of a historical time period, there is a space that is characteristic of capitalism (p. 126). Accordingly, Lefebvre claimed that capitalist space is dominated by the bourgeoisie – by those who have the power to create representations of space.

This research, however, does not engage greatly with Lefebvre's critique of capitalist space, but it more so uses Lefebvre's spatial triad to inform this study's investigation of the elements of the spatial triad. The next paragraph explores how the spatial triad can be used in empirical research.

3. Exploring how to use Lefebvre's spatial triad in empirical research

Although Lefebvre's work has inspired many academics, with David Harvey and Edward Soja probably being among the most well known examples (see, for example, Harvey, 2012; Soja, 2010), only few have engaged with Lefebvre in empirical research (see Ng et al., 2010; Buser, 2012; Leary, 2013, Oakley, 2014; Leary-Owhin, 2016).

Among the few accounts is Buser (2012). He uses Lefebvre's production of space to examine strategies of metropolitan region-making in the Capital District, NY, USA. Guided by Lefebvre's triad, he, on the one hand, conducted interviews with politicians, planners, business leaders and non-profit organizations active in the metropolitan regional network, and, on the other, reviewed planning reports, strategies and policy documents. Although it is clear that Buser's research is informed by Lefebvre's spatial triad, he is not very explicit about his research design, and, as such, his paper seems to be only loosely grounded in Lefebvre's framework.

A more straightforward empirical application of Lefebvre is provided by Leary (2013). He investigates the production of Castlefield – a new public space in an old industrial area in Manchester. Through archival research and interviews he, first, studied how official representations of space in the form of modernist planning discourse influenced spatial practices of planning and regeneration of Castlefield. Second, in order to study spaces of representation, he researched how particular symbolic spatial practices taking place in Castlefield's public space contributed to spaces of representation. And, third, he reviewed televisual spaces of representation concerning Castlefield.

Unwin (2000), one of few critics of Lefebvre, claims that there is little empirical and methodological value in Lefebvre's work on the production of space. Yet, Leary (2013) argues otherwise. He poses that an empirical application of Lefebvre provides for a rich picture of the phenomena of interest. He found the usefulness of empirically employing Lefebvre's work on the production of space in its encouragement of a historical approach and the acceptance of a wide range of data as valid. Also he found thinking through what official representations of space, spaces of representation and spatial practices meant in the context of empirical research challenging, and it led him to study material that would otherwise be unlikely to be included into the research (e.g. some particular official representations). Buser (2012) adds that using Lefebvre in empirical research helps yielding an understanding of space as a continuous social process.

Lefebvre's work only seems to provide clues that can inform empirical research. It does not propose any specific research methods, hence there is no consensus about what the best approach and best methods are for researching the production of space. The next chapter introduces the cases and discusses how Lefebvre's production of space informs this empirical research.

4. Methodology

This study takes a comparative and descriptive case study approach. It compares two cases, in two different countries, and aims to describe how today space for cycling is produced. The approach is comparative, first, because by comparison of two contexts that are different in terms of cycling 'maturity' (see next paragraph), robust understanding is developed of how cities (across contexts) produce space for cycling. Second, this approach was chosen, because it was anticipated that it would provide insights into the extent and manner of similarity and difference between two cases (Nijman, 2007, 1) - here, similarities and differences in (tensions in) the production of cycle space. The approach is also explorative as it aims to develop hypotheses and propositions for further inquiry (Yin, 2009, 9).

The research furthermore takes a mixed method approach. It aims, through triangulation of methods, to corroborate quantitative and qualitative data in order to provide greater validity and completeness, but also, more practically, to answer different research questions. In recent years, mixed method research has become increasingly common in the social sciences and has developed into a distinctive research approach in its own right (Bryman, 2006, 97).

4.1 Cases and case selection

The study searched for maximum variance in levels of cycling 'maturity' (Harms et al., 2014) – meaning the levels of cycling and experience with developing cycle space – in the two cases, because it was expected that cycle space would be produced differently depending on levels of cycling 'maturity'. In other words, it searched for two contexts that could be thought of as being in different stages of the process of the production of space for cycling. The research thus is a diverse case study research (Gerring, 2006, 79). The cases, more practically, were also selected on the basis of availability of recently developed bicycle projects (finished within the last two years).

The two selected cases are low-cycling Newcastle upon Tyne in the United Kingdom and high-cycling Rotterdam in the Netherlands. Newcastle here was considered to be the less 'mature' case in terms of cycling, and its process of the production of cycle space being in a less stable phase than Rotterdam, which was considered to be the more 'mature' case. Both of the cities recently made efforts to become more bicycle-friendly and developed a number of cycle projects in the last two years (Newcastle City Council, 2011; Gemeente Rotterdam, 2015a).

In each case study city a unit of analysis was selected in the form of a road that saw the implementation of cycle infrastructure. Considering this research' aim to develop thorough understanding of how space for cycling is produced, it was important, when selecting the units of analysis, that they were somewhat ordinary or mundane cycle projects, so they would speak for or could be exemplary of a larger number of cycle projects. Extraordinary projects were thought to be too unusual to inform broad understanding. Besides, Lefebvre (1991) is essentially concerned with 'everyday' urban life and the 'everyday' urban experience, and so it was expected that everyday cycle projects would be appropriate for an investigation that uses his theory.

In order for making the comparison workable, the units of analysis were chosen such that they were situated in a similar context and have a similar status as a road. This was also done to minimize a context bias. The units of analysis that were selected are a stretch of Great North Road (from now on GNR) in the case of Newcastle, and, in the case of Rotterdam Burgemeester Baumannlaan/Burgemeester Josselin de Jonglaan (from now on BBBJJ). Both of the units of analysis were considered to be mundane, because, first, the cycle solutions that were implemented there are quite common solutions, and second, the neighbourhoods in which the roads are situated were considered to be relatively mundane residential neighbourhoods.

GNR is a main route leading into the city centre of Newcastle. A stretch of about 500 metres of the road, lying in the more suburban and middle class neighbourhood of Gosforth, was redeveloped in phases between 2014 and 2015 to also include cycle infrastructure. Just to name but a few cycle solutions that were developed there: a junction with waiting boxes for people cycling, a separated (from cars) cycle lane, bus stop bypasses for cyclists, and a roundabout with a shared space for cyclists and pedestrians.

BBBJJ, similarly, is a main route and connects the middle class, residential neighbourhood of Overschie with the Rotterdam inner city. A stretch of about 650 metres was redeveloped in phases between 2013 and 2015 and saw the implementation of separated cycle lanes (whereas before they were situated directly on the sides of the road), a roundabout with separated cycle infrastructure, and a shared space between cars and cyclists along part of a small parallel road to BBBJJ. An impression of the two roads can be found through: <https://youtu.be/pOauo-1Uvq8> (see also paragraph 4.5 and Figures 2 & 3).

4.2 Research framework

In order to conduct this Lefebvrian study of the social production of cycle space, Lefebvre's 'moments' of representations of space, spaces of representation and spatial practices, were, first, operationalized. Applied to the field of cycling, Lefebvre's concepts then became: representations of cycle space, cycle spaces of representation, and spatial practices of cycling. To each concept of the spatial triad a sub-research question and appropriate research methods were ascribed. To each, also belonged a different set of units of observation. Table 1 gives an overview of the research framework.

The following sections discuss how each 'moment' in the production of cycle space was operationalized and what research methods were deployed to subsequently research each of the triadic spaces.

'Moment'	Representations of cycle space	Cycle spaces of representation	Spatial practices of cycling
Sub-question	What representations of cycle space are deployed in the production of cycle space and whence do they derive?	What rhetoric of experiences, feelings, norms and values constitute cycle spaces of representation?	How is cycling practiced and cycle space used, and by whom?
Method(s)	Semi-structured, in-depth interviewing & content analysis	Participatory observations & on-street interviews	Video observations
Units of observation	Cycle design manuals and guides, policy documents	Users of cycle space	People cycling (in relation to physical features of cycle space)

Table 1 Research framework

4.3 Researching representations of cycle space

Lefebvre steered this research into the direction of investigating cycle design guides. Lefebvre (1991) states that representations of space are official accounts that are “shot through with knowledge” (41), that they reduce space to abstract concepts (106), and are used by planners, architects and the like. In relation to the production of cycling space then, cycle design guides were considered to be relevant study objects.

Two qualitative methods were employed to study representations of cycle space. First, semi-structured, in-depth interviews with key actors in the production of cycle space, including policy makers, traffic engineers and cycling lobbyists, were conducted. The interviews served as a means to explore what the most important representations of cycle space are in the production of contemporary cycle space (also to confirm that investigating cycle design guides was appropriate for this study). The method of semi-structured, in-depth interviewing was chosen, because it was expected that it would provide detailed and subtle information as to how exactly the representations are used in practice – information that may well be overlooked when official representations would be investigated in isolation.

Secondly, the representations that were mentioned by the interviewees as the most important ones being deployed in the production of cycle space were analysed by means of content analysis. The analysis looked at, on the one hand, what cycle design solutions were promoted in the official representations of cycle space, the thoroughness and scope of the representations, and the imagery included. On the other hand, it looked at cycle policy documents to understand the policy context in which cycle space is produced.

In Newcastle a total number of 7 in-depth, semi-structured interviews were conducted between September and December 2015. The interviews lasted from 30 minutes to 3 hours. One interview was conducted with a transport policy maker, three interviews were conducted with traffic engineers, and three cycling lobbyists were interviewed. Next to that, two cycle design guides were analysed (Transport for London, 2014; Sustrans, 2014), a local transport policy document (Tyne and Wear Integrated Transport Authority, 2011), and a cycle transport policy document (Newcastle City Council, 2011).

In Rotterdam a total number of 5 in-depth, semi-structured interviews were conducted between January and April 2016, lasting from approximately 1 to 2 hours. One interview was conducted with a cycling policy maker, two interviews were conducted with traffic planners (similar to traffic engineers in Newcastle, although in Rotterdam the interviewees rather identified as traffic planners), and two cycling lobbyists were interviewed. Besides, two cycle design guides were analysed (CROW, 2006; CROW, 2015), a local policy document on transportation (Gemeente Rotterdam, 2015b), and a policy document specifically focussing on cycling (Gemeente Rotterdam, 2015a).

4.4 Researching cycle spaces of representation

In order to research cycle spaces of representation, on-street interviews with cycle space users were undertaken and participatory observations were done. Lefebvre (1991, 41) explains that spaces of representation contain symbols, meaning, memories, dreams and images. It is the space of users (39). Hence this study decided to investigate cycle space users’ experiences and the feelings, norms, and values they attach to the cycle spaces under investigation.

It was decided to do on-street interviews, because it was expected that the method would allow for engagement with a relatively large number of participants during a limited amount of time. It was assumed, too, that being on-site with the participants would be beneficial. For instance, it could help participants to talk about their experiences with and feelings about the cycle spaces un-

der investigation, and, too, they would be able to directly point out specific aspects of the space.

The on-street interviews in the case study areas were conducted with different users of space – cyclists, pedestrians, and drivers. The decision to differentiate by transport mode was made, first, because cycle space exists in a context of a road that is used by multiple road users and thus cycle spaces of representation are not solely formed by cyclists; and, second, because variation in experiences, and norms and values, between the different road users was expected, because, first, the practices of these modes of transportation vary, and, second, because they use the space under investigation differently.

The users were asked questions about how they experience cycling, driving and/or walking on the roads under investigation, how they explicitly feel when cycling, driving and/or walking, how they feel about the cycling infrastructure, and if they have any particular memories of the road that possibly include cycling, driving and/or walking. The on-street interviews lasted from 3 up to 30 minutes. The on-street interviews were recorded and transcribed. In Newcastle 30 on-street interviews were conducted with 10 cyclists, 7 drivers, 8 pedestrians, and 5 participants who identified with multiple modes of transportation (e.g. cycling and driving). In Rotterdam, too, 30 interviews were conducted, however, with 6 cyclists, 5 drivers, 10 pedestrians. 9 respondents belonged to the group of participants identifying with multiple modes of transportation.

The transcripts of the on-street interviews were analysed using a phenomenological heuristic research method. The method that was used was based on Lindseth & Norberg’s (2004) phenomenological research method for researching lived experience that, first, “naively” (p. 149) reads a transcription to grasp its meaning as a whole. Practically, the text is read several times to help the reader switch from a natural attitude to a phenomenological attitude, meaning that the reader becomes attentive to feelings and symbolic values that are discussed in the text. Then, the text is structurally analysed – important parts (i.e. conveying experiences, feelings, values) are condensed from the text and themes are attached to them (Table 2). Subsequently, the themes that derive from the structural analysis are summarized. And, lastly, results are formulated in a phenomenological heuristic way, which is essentially everyday language that tries to capture and express respondents’ lived experiences.

Phenomenological heuristic methods are commonly used in caring and nursing research practices, but not so much in the field of urban studies. However, increasingly researchers in the latter field study people’s lived experiences, hence borrowing from fields such as caring and nursing research seems relevant.

<u>(Part of) transcript participant</u>	<u>Condensation</u>	<u>Theme</u>
Cyclist: ‘Cause these things [or-cas; cycle specific infrastructure] I think it’s silly. Going behind the bus stop: silly.	Thinking that the design is unintelligible	Feeling detached
Have a green lane, but not...	Not agreeing with design	Being unsatisfied
I’ve tried once before to get round about the bus stop but there was too many people waiting for the bus. It stops you.	Unpleasant experience	Feeling bothered
What the idea was of behind the bus stops, I don’t know.	Not understanding the design of the bus stops	Feeling detached

Table 2 Example of structural analysis

The approach is useful for bringing to the surface feelings, and symbolic values and experiences of respondents, since it helps to make the researcher sensitive of those aspects in a transcription. This was especially appropriate for this research on people's lived experiences. However, the method relies heavily on the interpretation of transcripts of the researcher, which may cause researcher biases.

Complementary, to the on-street interviews, participatory observations were done. The participatory observations consisted, first, of partaking in cycling and walking in the case study areas myself (unfortunately it was not possible to drive), and, too, the journeys of cyclists and pedestrians were followed to get a better idea of how a journey might be experienced. Second, in both Newcastle and Rotterdam I cycled along the case study roads with a cycling lobbyist. The 'cycling alongside' essentially involved cycling and talking (interviewing) about the lobbyists' experiences, feelings, norms and values connected to the relevant case study roads. Following Clark & Emmel's (2010) 'walking alongside', 'cycling alongside' in this case, was assumed to be particularly appropriate for the purposes of this research, because it potentially provides for accounts of place that interweave with individual spatial experiences. The decision to undertake 'cycling alongside' with lobbyists was made, because they would be able to provide special insights into the interconnection of representations of cycle space and cycle spaces of representation, being a link between citizens and local governments. However, it was also assumed that lobbyists' views would be more critical than 'average'. The study therefore was careful with letting the results of the 'cycling alongside' influence the research on cycle spaces of representations too much.

4.5 Researching spatial practices of cycling

Lefebvre (1991, 38) sees in spatial practices routines of daily life in relation to the material city. Applied to the production of cycling space then, this study looks at everyday practices of cycling. To study how cycling is practised and cycle space is used, video observations at each case study site were done. It was decided to do video observations, because this way observations could be quantified, which, it was assumed, would provide for robust data about cycling practices and cycle space use. Also because of the many activities going on at the same time in the cycle spaces under investigation, it was assumed that video recording would be useful. It allowed for analysing observations over and again (e.g. replaying, fast-forwarding, slowing down) in order to capture most information.

In total 6 hours of video were recorded of which 3 hours at the case study road in Newcastle and 3 hours at the case study road in Rotterdam. In each case study road a differentiation between parts of the day was made. In each city there was recorded one hour on a weekday morning between approximately 8:30 AM and 10:00 AM; one hour on a weekday afternoon between approximately 12:00 PM and 3:00 PM; and one hour on a weekday evening between approximately 5:00 PM and 6:30 PM. A five minute compilation of morning video recording sessions of the two cases can be found through the following hyperlink: <https://youtu.be/pOauo-1Uvq8>.

In both cases, video was recorded at three different places along the road (Figure 2 & 3). At each place, 20 minutes of video was recorded, making a total of 1 hour of recordings per part of the day (e.g. in the morning three times 20 minutes of recording, in the afternoon three times 20 minutes of recording, etc.). Additionally, preliminary research found that in each road under investigation, different cycle design solutions were implemented. The specific places of recording were chosen such that the use of these various cycle infrastructure solutions could be observed. For instance, in Newcastle, one video location was at a roundabout with cycle infrastructure (Figure 2, a) and another at a straight stretch of street with cycle lanes (Figure 2, b). The recordings were also done at three different locations along the case study roads to get a better sense of how the road as a whole was used.

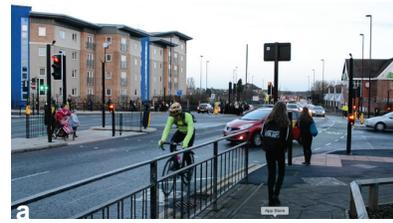
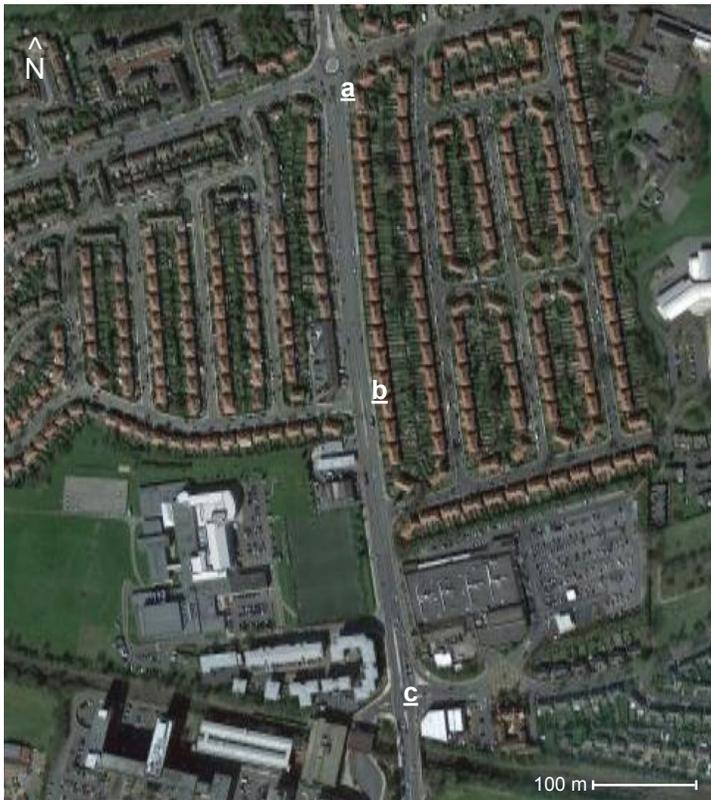


Figure 2 Video observation locations Great North Road (Sources: Left: Google Maps, 2016; Right: Film stills by author)

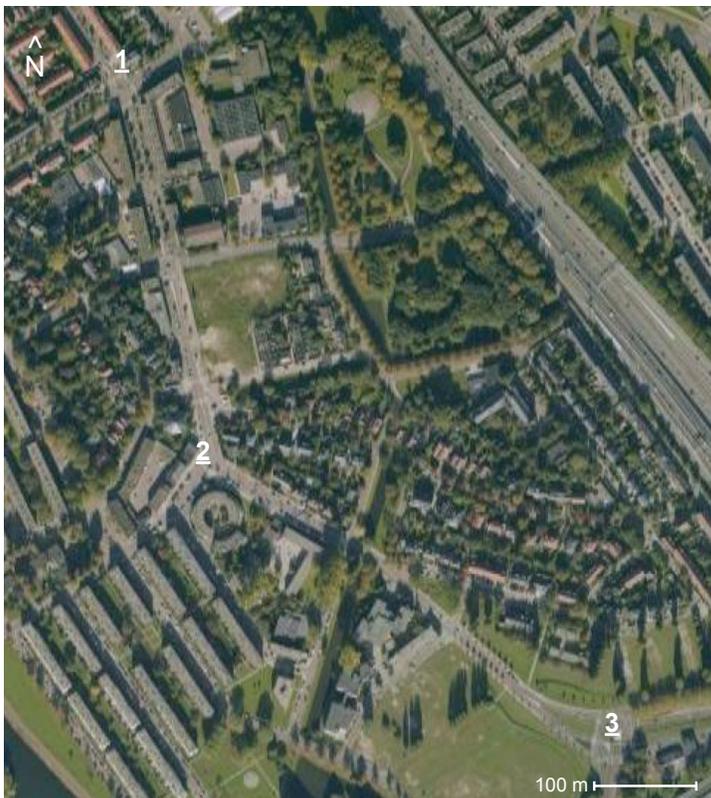


Figure 3 Video observation locations Burgermeester Baumannlaan/Burgermeester Josselin de Jonglaan (Sources: Left: Google Maps, 2016; Right: Film stills by author)

Morning GNR, Morning BBBJJ,
Newcastle Rotterdam

User gender/age
info

Female		3	33
	F+c=0		F+c=1
Male		31	35
	M+c=0		M+c=1
Child (boy)		8	4
Child (girl)		0	0
Gender unknown		1	1
Total		43	73

Clothing and equip-
ment

Reflective clothing		20	0
Helmet		41	0
Headphones		0	1

Bicycle types

Race bike/road bike		17	0
Mountain bike		22	1
City bike		7	71
Box bike		0	1
Unknown type bike		0	0

Other bike charac-
teristics

Child seat(s)		0	4
Panniers		8	26
Basket		1	12

Non-conformist
characteristics

Male		3	4
Female		1	4
Child (boy)		7	0
Child (girl)		0	0
Gender unknown		1	0

Other cycle space
users

Scooters/mopeds		0	23
Mobility scooters		0	1

Other behaviour

Cycling and calling		0	1
Cycling and smoking		0	0

F+c = Female + a child on childseat
(or two children)
M+c = Male + a child on childseat
(or two children)

Table 2 Example of structural analysis

Every 20 minutes of video were then analysed on the basis of basic user info such as gender and age (it could only be observed whether users were children or adults), clothing and equipment, and bicycle characteristics. Subsequently, the results were summarized for the morning, afternoon, and evening (see Table 3).

It was also analysed how many users did not conform to how the cycle space was supposed to be used (in the eyes of the traffic engineers and, more generally, in relation to traffic rules). Lefebvre (1991, 38) states that spatial practices are the routines of daily life that conform to representations of space. When these routines do not conform, Lefebvre suggests that more 'authentic' spaces of representation inform spatial practices and that representations of space thus not completely 'capture' spatial practices. It seems therefore relevant to analyse users' non-conforming cycling behaviour, because it can tell something about the degree of which representations of space 'meet' spatial practices.

Non-conforming behaviour in this study included not using or ignoring the dedicated cycle space and forging other routes, using the dedicated cycle space in the wrong direction, and cycling on the pavement (although cycling on the pavement is allowed in the UK and it is not in the Netherlands, cycling on the pavement in the UK context was also accepted as non-conforming behaviour for the purpose of this study, because it ignored the dedicated cycle infrastructure). It was analysed how cyclists move through space (conforming as well as non-conforming) by applying Copenhagenize's concept of "desire lines" (see Copenhagenize Design Company, 2013). The method basically sketches out the routes that cyclists follow in a particular space and looks at what routes are used most or are most desired.

Finally, it was analysed what other users, besides cyclists, used the cycle spaces under investigation, such as people on mopeds and people using mobility scooters. Some non-conventional behaviour like cycling and calling was noted and more general observations were done as well, which did not involve counting.

5. Research results: Newcastle

This chapter one by one discusses the findings of the research on representations of cycle space, cycle spaces of representation, and spatial practices of cycling in the case of GNR, Newcastle. Each sub-paragraph is divided into a more general and mostly quantitative overview section and a section that examines the findings more in-depth and mostly qualitative.

5.1. Representations of cycle space

5.1.1 Overview

Table 4 shows an overview of key representations of cycle space in the production of cycle space in the case of GNR. It too shows by whom the representations are produced and what are the key findings of the content analysis.

<u>Key representation of cycle space</u>	<u>Producer</u>	<u>Key findings content analysis</u>
London Cycling Design Standards (LCDS)	City of London	- Little standardized - Limited coverage - Little coherent
Sustrans Design Manual for cycle-friendly design	Sustrans	- Considerably standardized - Limited coverage

Table 4 Key findings research representations of space in the case of GNR, Newcastle

5.1.2 In-depth analysis

The interviews with traffic engineers found that national standards and guidelines for the development of cycle infrastructure are largely missing in the UK context. In the absence of such documents, numerous cities across the UK, including Birmingham, Bristol, Cambridge and London, have produced their own guidelines. In Newcastle, the London Cycling Design Standards guide (LCDS) serves as a first reference in the development of cycle infrastructure.

The LCDS consists of a set of more general recommendations as to developing cycle infrastructure as well as more detailed design principles. As to the more general recommendations, the LCDS is highly in favour of separating cyclists from other road users, encourages a network approach to cycling, and promotes taking account of how users behave (i.e. designing from a cyclist point of view). The LCDS further encourages experimenting with design solutions, trials, and temporary solutions to foster change.

On a more detailed design level the LCDS does various recommendations toward, for instance, cycle track separation, junctions, markings, crossings, and parking. Figure 4 below shows an example of a recommendation as it is included in LCDS. The LCDS provides guidance mostly by showing pictures of best practices of around the world. As a result, the design guidance comes across little standardized, and does not promote a much cohesive design language. Besides, little technical information is provided regarding, for instance, measures of cycle specific features.

The interviews found that the traffic engineers of the city of Newcastle tend to work closely together with those working for a national sustainable transport charity called Sustrans. Therefore, another primary document that is used in the development of cycle infrastructure is Sustrans' 'Design Manual for cycle-friendly design'. Compared to the LCDS, the Sustrans Design Manual provides – besides best practice example pictures – more technical information. The guidance seems also to be more standardized for at least the graphics communicate a standardized cycle design language (Figure 5). Yet it only covers sort of the basics of cycle space design (e.g. most common situations).

While these two documents may well be the two most consulted in the production of cycle space in Newcastle, what the interviews revealed, though, is that the traffic engineers involved in the design process look at multiple design guides and tend to incorporate the guidance that they find best or most appropriate for a particular scheme. The following quote by a Newcastle traffic engineer exemplifies this:

"So the London Cycle Design guide, we tend to look at that first [...] and we'll pick the things that we like and then maybe we'll do some other things that are a bit different [...] We look at all sorts [guidelines] and what really happens is that you look at the advice and the guidance there and you pick the bits that you like, and the bits that you don't, you just... Don't look at them."

So, in the absence of national standards, traffic engineers of the city of Newcastle look at a mixture of guidelines. The following quote of a traffic engineer explains quite tellingly what the result is of having such a great variety of different cycle design guides around:

"[...] there's no national standards to work to... So what happens is, if you as a cyclist, if you went to different cities you would see slightly different things, you know, different coloured pavements, different sorts of signs, different treatments of crossings, some people have more you know shared space, where cyclists and pedestrians be together, there's other cities who don't like shared space at all, so it's really quite different."



Figure 4 LCDS design recommendation separation using car parking (Source: LCDS, 2011)

Separation using car parking in Seville (left) and Copenhagen (right)



Separation using car parking in Newham (left) and Amsterdam (right)

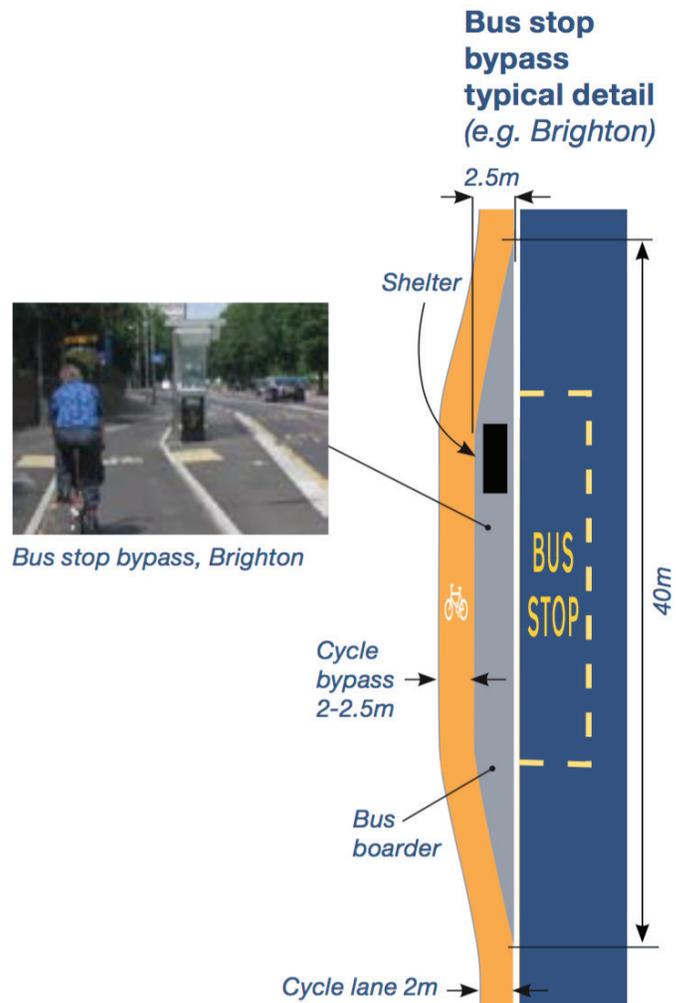


Figure 5 Bus stop bypass design recommendation in Sustrans Design Manual (Source: Sustrans Design Manual, 2014)

Moreover, another interviewee (traffic designer) pointed out that not only one can find different treatments between cities, but also within cities, including Newcastle. One can also see different things within the city of Newcastle, because, according to the interviewed the traffic engineers, the city is still experimenting with cycle space design to find out “what works and what not” so to say.

What is furthermore worth mentioning is that the interviewees stressed that cycle space or cycle infrastructure design outcomes are highly influenced by its designers. Guidelines and manuals can promulgate certain solutions, but design outcomes lie essentially in the hands of the designers. This finding links to another two important findings. First, the interviewed traffic engineers and designers underlined that there is never enough space in a road to allocate as much space to every road user as official representations often times recommend. Therefore, compromises have to be made. For example, if one wants to allocate more space to cyclists, one has to take space from pedestrians or cars.

Second, the interviews found that official representations of space by which traffic engineers design space may become, after time, engrained in the mind-set of those who design. Two traffic designers working for Sustrans mentioned that the mind-sets of the traffic engineers working for the city of Newcastle are still very much engrained by older official representations, partly because cycle space design guidelines were absent for a long time. Those older representations were dominated by motorized traffic design and did not put so much weight on cycle space design, or did not even cover cycle space design at all. The following quote of a Sustrans traffic designer exemplifies this in relation to national design guidance, but, as the interviewee pointed out, it may too go for cycling infrastructure design:

“The design guidance in the UK now is Manual for Streets, but it’s like... I think because it doesn’t have lots of numbers in it, it’s just like guidance, it’s like not so thoroughly. Frequently I have experiences, the engineer will tell me something, it doesn’t sound right, so I refer to Manual for Streets and it’s like they’re totally wrong [...] ‘Cause they’re so unfamiliar with it [Manual for Streets], they’re still used to this old like guideline and guidance [Design Manual for Roads and Bridges], so unfortunate [...] And with cycle-infrastructure... it takes a lot of re-educating people, it’s not just engineers, it’s the general public, it’s contractors...”

In the case of GNR, traffic engineers thus deploy what can be regarded as a little standardized and coherent body of representations of cycle space. Moreover, they are little used to work with these representations.

5.2 Cycle spaces of representation

5.2.1 Overview

Table 5 below shows an overview of the respondents’ characteristics of the on-street interviews that were conducted on GNR. It, too, shows a top five of recurring themes that resulted from the phenomenological analysis of the interviews.

5.2.2 In-depth analysis

Except for five respondents, all respondents identified as either being a driver, a pedestrian or a cyclist – as if these modes of transportation are mutually exclusive. This may indicate that respondents identify strongly with one mode of transport and less with others, because they do not engage in multiple modes of transport.

Drivers underwent most negative experiences with Great North Road. Negative experiences oc-

	Identifies as Driver	Pedestrian	Cyclist	Multiple modes
Gender				
Male	3	3	6	3
Female	4	5	4	2
Total	7	8	10	5

Age group				
18-25	1		1	
26-35	1	1	4	1
36-45	2	1	3	2
46-55	2	1		2
56-65	1	2		
65+		3	2	

Resident/not resident				
Resident	4	6	3	3
Not resident	3	2	7	2

Top five recurring themes

- Feeling unsatisfied/unhappy with (cycle) infrastructure
- Feeling unsafe
- Being uncertain about how space is supposed to be used/feeling detached
- Feeling like new cycle space is improvement
- Tensions between drivers and cyclists

Table 5 Overview respondents' characteristics and recurring themes from phenomenological analysis

curred mostly due to congestion issues, but also drivers showed negative feelings towards cyclists as well as the newly implemented cycle infrastructure on the street, as shows the following quote:

"I certainly don't like that bike lane [...] because if you have a look and you see where the bus stop is... [...] They cross onto the flow of traffic and nearly get themselves run over and then blame the cars because they think they've got the right of way being on a bike."

- Male respondent: not resident; age group 56-65; identifies as driver

All road users showed concerns over safety (a theme that also relates to the former quote). Drivers and pedestrians showed not so much concern over their own safety per se, but more so over the safety of cyclists and, too, their own safety in relation to cyclists. For example, a respondent (pedestrian) stated that she was scared to come near a cycle lane, because she was afraid to be overrun by someone cycling.

Cyclists, on the other hand, are more concerned about their own safety. Yet while most people cycling found the new cycle infrastructure on GNR an improvement, safety remains an issue for them, especially along parts of the street where they do not feel protected and feel vulnerable.

These feelings about safety relate to feelings of uncertainty as to how the space is supposed to be used. Complemented by the findings of the 'cycling alongside' with a cycling lobbyist, several cyclists stated that parts of GNR's cycle space are unclear, which generates feelings of detachment – not feeling connected to and not understanding the cycle space. The following quote exemplifies this:

Summa-
rized

Morning Afternoon Evening

User gender/age
info

Female	3	1	4	8
	F+c=0	F+c=0	F+c=0	F+c=0
Male	31	9	23	63
	M+c=0	M+c=0	M+c=1	M+c=1
Child (boy)	8	6	1	15
Child (girl)	0	0	0	0
Gender unknown	1	6	23	30
Total	43	22	51	116

Clothing and equip-
ment

Reflective clothing	20	9	29	58
Helmet	41	11	34	86
Headphones	0	0	0	0

Bicycle types

Race bike/road bike	17	3	22	41
Mountain bike	22	16	17	54
City bike	7	3	9	18
Box bike	0	0	0	0
Unknown type bike	0	0	3	3

Other bike charac-
teristics

Child seat(s)	0	0	0	0
Panniers	8	2	8	18
Basket	1	0	0	1

Non-conformist
characteristics

Male	3	3	6	12
Female	1	0	0	1
Child (boy)	7	3	1	11
Child (girl)	0	0	0	0
Gender unkown	1	0	3	4

Other cycle space
users

Scooters/mopeds	0	0	0	0
Elderly scooter	0	0	0	0

F+c = Female + a child on childseat
(or two children)
M+c = Male + a child on childseat
(or two children)

Table 6 Quantitative findings video observations GNR

"This [crossing] is very funny. The way that... What are you supposed to do as a cyclist when you arrive here? I don't know. Often people are meandering around, not necessarily onto the stop."

- Male respondent; resident; age group 26-35; identifies as cyclist and driver

Drivers and pedestrians, too, showed feelings of detachment or not connecting to the space, mostly because they do not relate to the cycle infrastructure or do not understand why cycle infrastructure was or needed to be developed on GNR.

Another recurring theme was the existence of tensions between drivers, pedestrians and cyclists. Some drivers and cyclists showed direct negative feelings towards the other. For instance, a driver referred to cyclists as "stupid cyclists" and a cyclist referred to drivers as "horrendous drivers".

Lastly, several cyclists stated that the cycle infrastructure along GNR has a low-quality and temporary feel to it, which makes them feel uncomfortable cycling along GNR. For instance, a respondent stated that he now felt relatively comfortable cycling along GNR, but he mentioned that he was concerned that some of the poles and bumps separating the cycle lane from the motorway would come loose once temperatures would drop in winter and that he then would try to find a different route to get to work.

5.3 Spatial practices of cycling

5.3.1 Overview

Table 6 shows the quantitative findings of the video observations of spatial practices of cycling on GNR.

5.3.2 In-depth analysis

On GNR the share of male cyclists is much higher than the share of female cyclists. Also no girls have been observed cycling on GNR, just a few boys.

Nearly three quarters (74%) of all observed cyclists on GNR wear a helmet and half of all cyclists (50%) wear reflective gear (Figure 6). Moreover, the mountain bike is the most popular bike on GNR. Almost half (46%) of all cyclists observed on GNR cycle on a mountain bike, closely followed by people on race/road bikes (35%), only a minor share of people (16%) cycle on city bikes.

The video observations suggest that cycling is mostly undertaken for commuting purposes. Most cyclists were counted during the morning hours and (early) evening hours, which suggests that people cycle to work and back.

Additionally, about a quarter of all cyclists (23%) do not make proper use of the dedicated cycle space. Adult male cyclists practiced about half (44%) of the non-conforming cy-

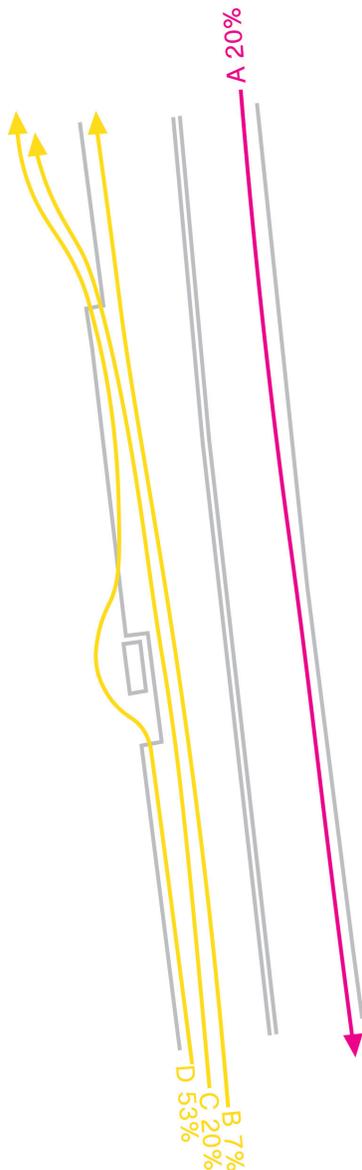


Figure 7 Non-conforming cycling with cyclists following lines A and D conforming to how cycle space is supposed to be used; cyclists following line B completely ignoring dedicated cycle space; and cyclists following line C partly ignoring cycle space

Figure 6 Spatial practices of cycling on GNR



Figure 8 Vehicular cycling strategies on GNR

Vehicular cycling

cling – please note that male cyclists are overrepresented in Newcastle. Their non-conforming cycling was mostly practiced in the form of ignoring the dedicated cycle infrastructure and thus staying on the motorway between cars (Figure 7).

The other group of non-conforming cyclists consisted of young boys (41%). The non-conforming cycling of these boys was mostly practiced in the form of cycling on the pavement (Figure 6). On a side note, the interviews with traffic planners and engineers found that one of the aims of the re-development of GNR was to build cycle infrastructure that would be suitable for a competent 11-12 year old cyclist. The video observations show that children, to a large extent, do not make use of the dedicated cycle infrastructure along GNR and also in most cases they are accompanied by an adult figure.

What else could be observed is that, in absence of dedicated cycle infrastructure along certain parts of GNR, cyclists take on so-called vehicular cycling strategies, meaning that cyclists tend to behave somewhat like cars. For example, it was observed that cyclists, who want to make a right turn at one of the junctions along GNR, make themselves bigger than they are by standing up on their pedals and cycling in the centre of the motorway (Figure 8).

6. Research results: Rotterdam

Analogous to the former paragraph, this paragraph discusses the findings of the research on representations of cycle space, cycle spaces of representation, and spatial practices of cycling in the case of BBBJJ one at a time. Each sub-paragraph is again divided into a more general and mostly quantitative overview section and a section that examines the findings more in-depth and mostly qualitative.

6.1 Representations of cycle space

6.1.1 Overview

Table 7 shows what representations of space are primarily deployed in the production of cycle space in the case of BBBJJ in Rotterdam.

<u>Key representation of cycle space</u>	<u>Producer</u>	<u>Key findings content analysis</u>
CROW publications	<i>Centrum voor Regelgeving en Onderzoek in de Grond, Water en Wegenbouw en de Verkeerstechniek (CROW)</i>	- Standardized - Broad coverage - Coherent - Methodical
Sustainable Safety	<i>Stichting Wetenschappelijk Onderzoek Verkeersveiligheid (SWOV)</i>	- Standardized - Coherent

Table 7 Key findings research representations of space in the case of BBBJJ

6.1.2 In-depth analysis

Primarily publications of *Centrum voor Regelgeving en Onderzoek in de Grond, Water en Wegenbouw en de Verkeerstechniek* (CROW) inform the development of cycle infrastructure in Rotterdam. CROW is a national non-profit technology platform for transport, infrastructure and public space. Through research and through panel meetings with traffic engineers and others involved in

the field of traffic design it develops practical and standardized knowledge toward (the design of) infrastructure, public space, traffic and transport. Its body of publications is extensive and covers a large area of traffic design. Just as an indication, publications range from cycle parking design to solutions to regional public transport issues, and from detailed design examples of weed resistant surfaces to roundabout design. CROW also operates a separate platform named Fietsberaad that focuses specifically on bicycle policy and cycle infrastructure design.

CROW publications contain example imagery as well as more detailed and standardized technical guidance (Figure 9). Moreover, it provides procedural advice. Figure 10 shows an example. It shows a graph that can be used by traffic engineers to decide what road profile is most appropriate or desirable in a certain case, based on motorized vehicle intensity and the effective road width. Accordingly, it can be argued, that CROW guidance is methodical. One interviewee (traffic planner), moreover, explained how the development of cycle infrastructure is approached in Rotterdam, and stated that it is done according to fixed methodical orders with a clear role for CROW publications in making design decisions.

The city of Rotterdam is subscribed to the full body of publications of CROW. As such, traffic planners, engineers and designers working for the city of Rotterdam have access to a wide range of standardized publications that can inform the design of cycle space. Already when traffic designers are schooled in the Netherlands, they learn to work with CROW publications, as the following quote of one of Rotterdam’s traffic planners demonstrates:

“Back when I was in university, at the TU Delft [Delft University of Technology], we had to go to the library to look into the publications, actual printed ones. Now everything is online. It’s much easier. If you are designing a bicycle street you just look for ‘bicycle street’ and you find all publications that say something about it.” [Translated by author]

Although the interviews with traffic planners found that, in the Rotterdam context, CROW guidance is at the basis of any design, more often than not, traffic planners cannot follow all the set out standards and recommendations for cycle infrastructure design, because in a lot of cases there is not enough space available in a street to meet all requirements. So in most cases designing is a process of giving and taking, negotiating, making concessions, and making compromises.

The interviews furthermore found that, in the design of bicycle infrastructure in Rotterdam, the Sustainable Safety principles that were developed in the early 90s in the Netherlands today remain of high importance. The main idea of this vision is that accidents must be prevented as much as pos-

<u>Sustainable Safety principle</u>	<u>Description</u>
<i>Functionality</i> of roads	Roads are categorized hierarchical and monofunctional: “flow” road, “distributor” road, “access” (residential) road
<i>Homogeneous</i> volumes, speeds, and directions	Equal volumes, speeds and directions at moderate and high speeds
<i>Recognizable</i> road design (design language) and <i>predictable</i> road course and road user behaviour	Consistency and continuity of road design that support expectations of road users
<i>Forgivingness</i> of the environment and of road users	Injury limitation through a forgiving road environment and anticipation of road user behaviour
<i>State awareness</i> by the road user	Ability to assess one’s capability to handle the driving task

Table 8 Sustainable Safety principles (Source: Adapted from SWOV, 2012)



Figure 9 Example of how to design a bicycle street, with example picture (above left) and more technical guidance (right) (Source: CROW, 2006)

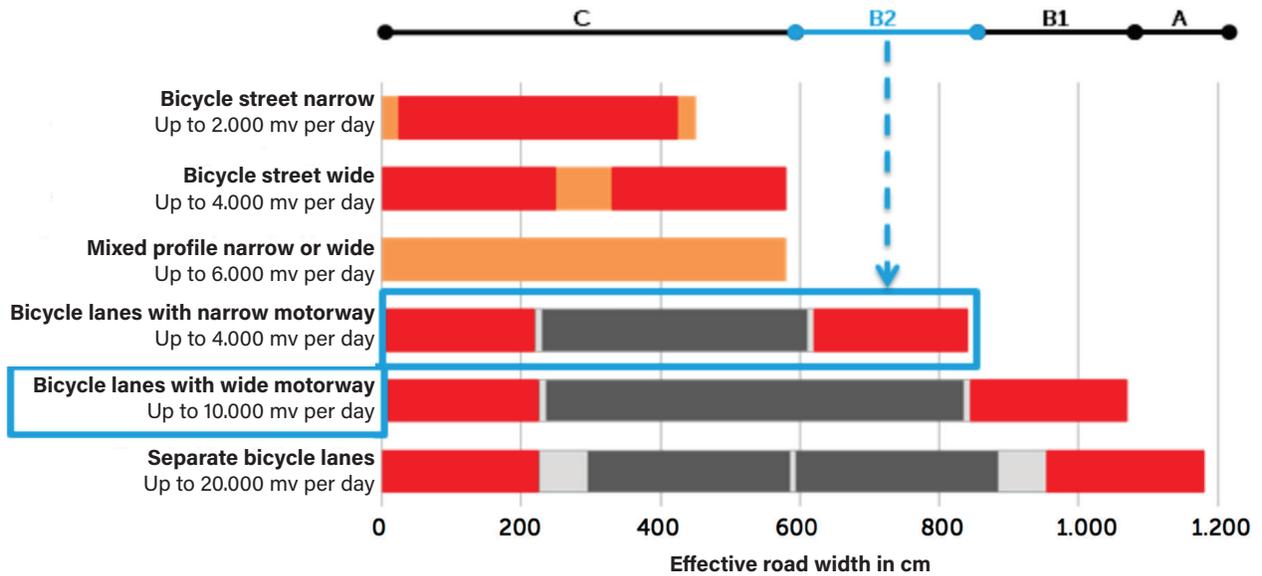
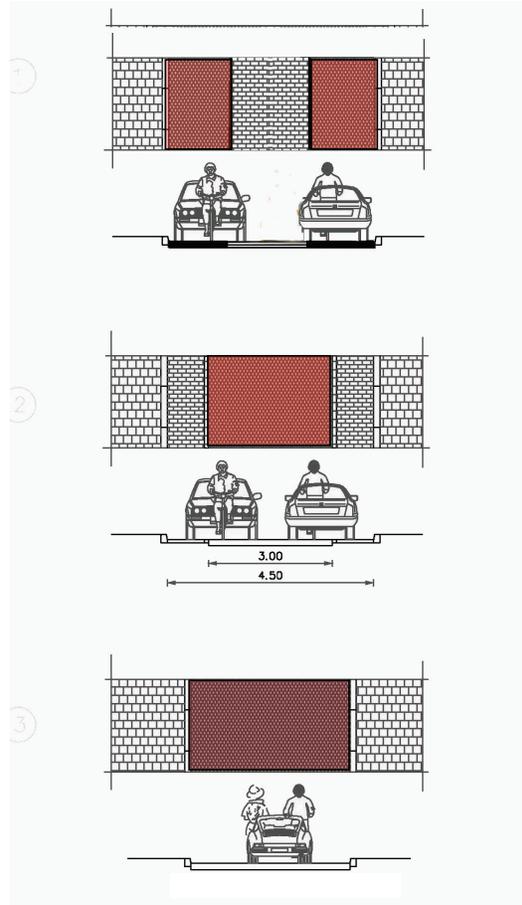


Figure 10 The following example belongs to the above figure: Take, for instance, a road with an effective road width of 700 cm and a motorized vehicle (mv) intensity of 7.000 vehicles per day. Based on vehicle intensity one would go for 'Bicycle lanes with wide motorway'. However, based on effective width one would opt for 'Bicycle lanes with narrow motorway'. It is then up to the traffic engineer to decide whether to widen the entire road and go for 'Bicycle lanes with wide motorway', or to somehow bring down motorized vehicle intensity and go for 'Bicycle lanes with narrow motorway'. Red = bicycle lane; grey = motorway (Source: Adapted and translated from Dutch by author from CROW, 2015, 5)

sible, and in places where this criteria cannot be met serious injury must be prevented. The Sustainable Safety vision consists of five principles (Table 8). In terms of design, Sustainable Safety hugely promotes the separation of different modalities, standardization and a coherent design language. Lastly, Sustainable Safety has in turn influenced CROW publications.

Thus, in the case of BBBJJ in Rotterdam, traffic planners deploy, what can be regarded as a standardized, cohesive, methodical, and thorough body of representations of cycle space - and they have experience working with them.

6.2 Cycle spaces of representation

6.2.1 Overview

Table 9 again shows an overview of the respondents' characteristics of the on-street interviews that were conducted on BBBJJ. It also shows a top five of recurring themes that resulted from the phenomenological analysis of the transcripts.

	Identifies as Driver	Pedestrian	Cyclist	Multiple modes
Gender				
Male	4	3	3	4
Female	1	7	3	5
Total	5	10	6	9

Age group

18-25	1			2
26-35			1	3
36-45	2		1	2
46-55	1		2	2
56-65	1		2	
65+			4	1

Resident/not resident

Resident	2	9	4	6
Not resident	3	1	2	3

Top five recurring themes

- Feeling satisfied with cycle infrastructure
- Feeling cramped
- Tensions between different road users
- Feeling informed about/connected to space
- Feeling familiar/proud

Table 9 Overview respondents' characteristics and recurring themes from phenomenological analysis

6.2.2 In-depth analysis

A large number of respondents identified with multiple modes of transportation. For instance, numerous respondents would identify as being a cyclist as well as a driver. Through the respondents'

experiences with multiple modes of transportation, they are able to switch perspectives and understand the behaviour and experience of other road users. The following quote exemplifies this:

"When I'm in the car I'm always careful that, especially at roundabouts, I give priority to cyclists [...] Because when I'm on a bike myself, I want priority myself too... I also indicate directions [...] Because when I'm in my car, I want cyclists to indicate directions too." [Translated from Dutch by author]

- Female respondent; resident; age group 36-45; identifies as driver, cyclist and pedestrian

Most respondents are happy or satisfied with the cycle infrastructure on BBBJJ. A substantial number of respondents said that there really is not much to remark about BBBJJ in terms of cycle infrastructure.

Negative experiences with BBBJJ occurred mostly among drivers. The negative experiences of drivers consisted of congestion issues as well as feeling cramped at certain junctions, which was a result of less space allocation to cars according to the interviewees (which this paper comes back to below). However, not only drivers mentioned that they feel cramped. Also a small number of pedestrians and cyclists mentioned that they feel cramped at certain junctions of BBBJJ.

Relating to that, the on-street interviews found that people are also aware of cycling's rise, paired with tendencies to take space away from the car. One of the respondents mentioned that cycling is "hot", and another two respondents talked about current tendencies of reallocating space from the car to cyclists (and pedestrians). These findings may suggest that people are connected to current public debate over space, and feel connected to BBBJJ.

"You know what they do these days? They make streets smaller so that cars slow down." [Translated from Dutch by author]

Female respondent; age group 46-55; resident; identifies as pedestrian and driver

There could, furthermore, be identified some tensions between different road users. Especially between pedestrians, on the one hand, and drivers, on the other, there seem to be tensions. For example, a number of pedestrians showed negative feelings towards the behaviour of drivers by referring to drivers as being "reckless" or "rude" (translated from Dutch by author).

Quite exemplary of the attitude of drivers towards cyclists, one respondent (driver) stated that cyclists on BBBJJ have "an arrogant attitude" (translated from Dutch by author) towards other road users and feel like all other road users "just have to adhere" to their behaviour. The respondent added that, to some extent, cyclists have the right to act that way, because, being relatively vulnerable road users, the interviewee agreed that drivers have to abide to cyclists' behaviour. Cyclist did not show any strong negative feelings toward other road users.

Lastly, the on-street interviews found that people feel familiar with BBBJJ and, to some extent, feel proud even. For example, several respondents were wondering why I was looking at such a "normal" street and would, after answering a few questions, continue to talk about some of their special memories of BBBJJ.

6.3 Spatial practices of cycling

6.3.1 Overview

Table 10 shows the quantitative findings of the video observations of spatial practices of cycling on BBBJJ.

Summa-
Morning Afternoon Evening rized

User gender/age info

Female	51	33	65	149
	F+c=6	F+c=1	F+c=2	F+c=9
Male	34	35	63	132
	M+c=1	M+c=1	M+c=1	M+c=3
Child (boy)	7	4	3	14
Child (girl)	2	0	8	10
Gender unknown	5	1	5	11
Total	99	73	144	316

Clothing and equip-
ment

Reflective clothing	0	0	0	0
Helmet	0	0	1	1
Headphones	1	1	3	5

Bicycle types

Race bike/road bike	1	0	6	7
Mountain bike	1	1	7	9
City bike	94	71	129	294
Box bike	3	1	2	6
Unknown type bike	0	0	0	0

Other bike character-
istics

Child seat(s)	10	4	8	22
Panniers	36	26	49	111
Basket	14	12	19	45

Non-conformist char-
acteristics

Male	2	4	6	12
Female	6	4	5	14
Child (boy)	1	0	0	1
Child (girl)	0	0	0	0
Gender unknown	1	0	1	2

Other cycle space
users

Scooters/mopeds	26	23	34	83
Mobility scooters	1	1	2	4

Other behaviour

Cycling and calling	2	1	1	4
Cycling and smoking	0	0	1	1

F+c = Female + a child on childseat
(or two children)
M+c = Male + a child on childseat
(or two children)

Table 10 Quantitative findings video observations BBBJJ

6.3.2 In-depth analysis

On BBBJJ the gender division of cyclists is pretty much balanced. Half of the total number of observed cyclists (50%) was female and nearly half (46%) was male. The gender of a small number of cyclists (4%) could not be observed.

There was only one cyclist observed who was wearing a helmet. There were no cyclists observed who were wearing reflective gear. Moreover, there were 9 adult female and 3 adult male cyclists observed who were carrying children on their bikes (up to two children), which suggest that they find the cycle space safe enough to ride on with children. Moreover, numerous children were observed cycling on BBBJJ without being accompanied by an adult figure.

The city bike is the most popular bike among cyclists on BBBJJ. Nearly all cyclists observed on BBBJJ were riding Dutch-style city bikes (93%). Other types of bikes are only marginally used (3% of all counted cyclists ride a mountain bike; 2% a race/road bike; 2% box bike).

Most cyclists were counted during the morning hours and during the evening hours, which suggest that cycling is undertaken for commuting purposes. It was furthermore observed that a substantial number of bicycles have panniers (35% of all observed bicycles) and/or baskets (14% of all observed bicycles), which may indeed suggest that cycling is mostly undertaken for commuting purposes as well as running errands. Indeed, there were observed a substantial number of people running errands by bicycle, such as grocery shopping.

A small number of cyclists (9%) did not conform to the way that the cycle space is supposed to be used. Adult female cyclists practiced about half of the non-conforming cycling. The other half of non-conforming cycling was practiced by adult male cyclists. Most non-conforming cycling was practiced in the form of wrong-way riding and cycling on the pavement.

The video observations, lastly, suggest that cyclists on BBBJJ practice cycling somewhat 'passively'. For instance, cyclists have been observed listening to music through their headphones while cycling, using a phone while cycling, and smoking while cycling. These observations suggest that cycle space may feel to those cyclists somewhat like second nature. This may also go for those cyclists who were observed cycling in pairs, and having a chat while cycling, which was observed numerous times.

On a final note, it is not only cyclists who use the cycle space on BBBJJ. Also quite a substantial number of scooter and moped riders (83 in total) have been observed making use of the cycle space. Elderly on mobility scooters are also making use of the cycle space, although to a much lesser extent (4 observed in total). In the Netherlands, it is legal for scooter and moped riders (up to 25 km/h) and elderly on mobility scooters to drive on cycle lanes.

7. Discussion

The findings of the research on representations of cycle space, cycle spaces of representation, and spatial practices of cycling in both the case of Great North Road (GNR), Newcastle as well as Burgermeester Baumannlaan/Burgermeester Josselin de Jonglaan (BBBJJ), Rotterdam, suggest, likewise Lefebvre (1991, 39), that there exist some interesting dynamics between the triadic spaces.

First of all, it appears that there is interaction between official representations of space, on the one hand, and spaces of representation on the other. In the case of GNR, most notably,

Figure 9 Cycling while using phone on BBBJJ

Cycling while using phone



Cycling together

Figure 10 Cycling together on BBBJJ

the LCDS and Sustrans Design Manual influenced the design of cycle infrastructure. With the LCDS being a mixture of different cycling design solutions and little standardized, and the Sustrans guide being more standardized, but lacking coverage, the design of cycling infrastructure along GNR is in parts incoherent. This seems also due to the fact that the traffic engineers who designed the infrastructure are not so much used to working with current representations of cycle space.

There seems to be interaction with cycle spaces of representation, although it may be better to speak of tension. Namely, people cycling on GNR have difficulties understanding and connecting to the cycle space as they feel like the space is unclear. Most important to note here is that cyclists, but also drivers and pedestrians, show feelings of detachment, and perhaps we can even speak of feelings of alienation. Also all road users show concerns over safety.

A second point of interaction can be identified between official representations of cycle space and cycle spaces of representation in the case of GNR. The representations of cycle space that are deployed in the production of cycle space there (LCDS and Sustrans Design Manual) promote experimentation and temporary solutions. Within spaces of representation, several respondents stated that they feel like the cycle space of GNR has a low-quality, temporary feel to it.

In the case of BBBJJ in Rotterdam, most notably, CROW publications and Sustainable Safety principles influenced the cycle design solutions. Since both CROW publications and Sustainable Safety principles provide nationally standardized guidelines and communicate a cohesive design language, the cycle infrastructure that is produced on BBBJJ can be thought of as standardized and coherent. In terms of interaction between representations of space and spaces of representation, it seems that due to representations of cycle space being standardized, people cycling on BBBJJ found the cycle infrastructure very “normal”, felt satisfied, familiar, comfortable, and connected to the space.

Secondly, it seems that there is a dynamic between spatial practices of cycling, on the one hand, and representations of cycle space and cycle spaces of representation on the other. In Newcastle, it can be observed that a large share of cyclists wears safety gear, and cyclists taking on vehicular cycling strategies i.e. cyclists behaving somewhat like cars. There may be a relation there to representations of cycle space being little standardized and concerns over safety within spaces of representation.

In Rotterdam, it could be observed that people practice cycling somewhat ‘passively’ on BBBJJ, suggesting that the space feels ‘natural’ to them. Also cyclists seem to feel safe enough to ride on BBBJJ with little children and children ride on BBBJJ without being accompanied by an adult figure, which was, for example, rarely observed in the case of GNR. This may be linked to the standardized nature of representations of cycle space and, regarding spaces of representation, users feeling comfortable and connected to the cycle space.

Finally, the findings suggest that there exist a dynamic between spatial practices of cycling and representations of cycle space. The non-conforming behaviour of cyclists on GNR seems to show that the representations of cycle space that are deployed in the production of cycle space in that case do not ‘meet’ certain practices of cycling. In the case of BBBJJ, however, the non-conforming behaviour of cyclists is small, which may indicate that, to a large extent, representations of cycle space coincide with spatial practices of cycling. Put differently, the design guides appear to correspond with people’s cycling practices and use of cycling space.

As follows, it seems that in the social production of cycling space in the case of Newcastle there is tension or disjointment between representations of cycle space, cycle spaces of representation, and spatial practices of cycling. In Rotterdam, the triadic spaces seem to intersect, or coincide – a term also coined by Lefebvre (1991, 28) – more in the production of cycle space (Figure 11).

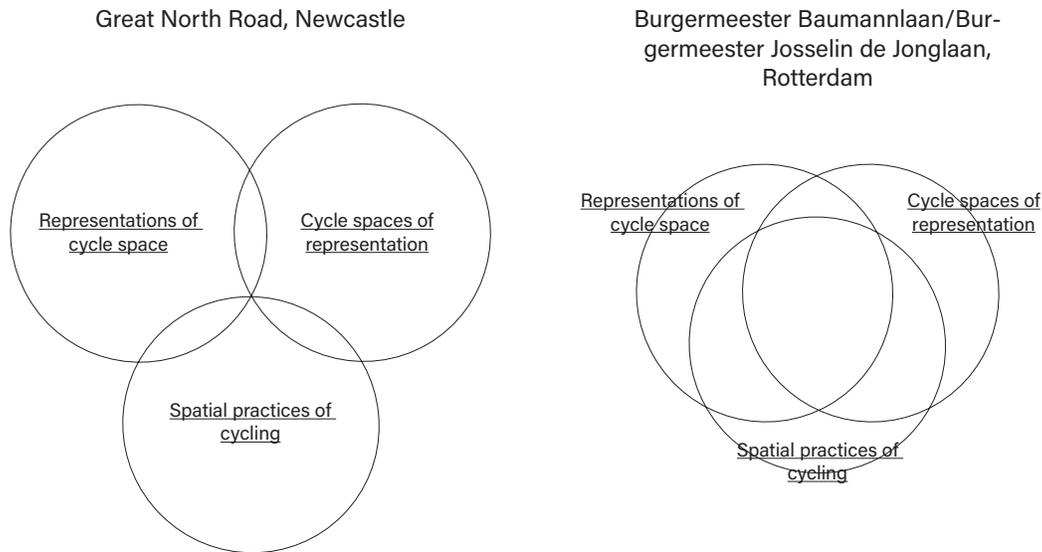


Figure 11 Tension or disjointment between the triadic spaces in the case of Great North Road, Newcastle; intersection or coincidence between the triadic spaces in the case of Burgermeester Baumannlaan/Burgermeester Josselin de Jonglaan, Rotterdam

The research provides several clues that indicate that the social production of cycle space is a continuous process in which there may be stages when representations of cycle space, cycle spaces of representation, and spatial practices of cycling more or less coincide, and stages when the triadic spaces are disjointed – when there are tensions between them. For instance, the traffic engineers of the city of Newcastle stressed that they are experimenting with bicycle infrastructure, and are still figuring out “what works and what not”, suggesting that there is searched for more coincidence between the elements of the spatial triad.

It is not to say, however, that coincidence between the triadic spaces is better per se, for urban development or progress will most likely cause tensions between the spaces. Nonetheless, the findings of this research do suggest that coincidence may very well be a viable goal to strive towards to.

8. Conclusions

This paper aimed to generate an understanding of the production of cycle space that engages with the social aspects of space and provide insights into the tensions existing in the process. It studied, using Lefebvre’s theory on the social production of space, how, in the cases of GNR in low-cycling Newcastle and BBBJJ in high-cycling Rotterdam, space for cycling is produced. This paper argues that tensions in the production of cycle space can be better understood by seeing the production of cycle space through the concept of the social production of space and thus as a dynamic between representations of cycle space, cycle spaces of representation, and spatial practices of cycling. In other words, it can be thought of as a dynamic between cycle design guides and the planners who deploy them, a rhetoric of experiences, feelings, norms and values around cycling, and people’s practices of cycling. It is between these elements that there can arise tension.

Then, to go into a little more detail as to the findings of the research on the elements of the spatial triad, the research, first, found that in both of the cases under investigation the designs of cycle infrastructure are influenced by current representations of cycle space in the form of cycle design

guides. In the case of GNR, national guidance is absent and therefore, most notably, the LCDS guide developed by the city of London and Sustrans' Design Manual for cycle-friendly design developed by the national transport charity are deployed in the production of cycle space. These guides were found to be little standardized and coherent and covering only common cycle infrastructure solutions.

In the case of BBBJJ in Rotterdam, CROW publications and Sustainable Safety principles are deployed in the production of cycle space. The research found that those representations are nationally standardized and coherent, and cover an extensive area of cycle infrastructure solutions.

The way in which official representations of cycle space are deployed in both cases is that they serve as a basis from which to design cycle space. The traffic engineers working for the city of Newcastle, however, seem not to be very used to working with contemporary representations of cycle space, also because in the context of the UK they have been developed only recently. The mind-sets of these traffic engineers are still largely influenced by older representations of space, which were dominated by automobile infrastructural design guidance.

The traffic engineers working for the city of Rotterdam seem to be much more used to working with representations of cycle space. This may be due to the fact that, already in school, traffic engineers in the Netherlands learn to work with CROW publications.

Second, in the case of GNR, cycle spaces of representation are characterized by a rhetoric of not understanding how the cycle space is supposed to be used. A share of the people cycling there feels therefore unsafe, uncomfortable, detached, and perhaps we can even speak of feeling alienated. This goes not only for people cycling, but also for people driving on GNR. A share of drivers also does not feel connected to the cycle infrastructure that has been developed there, but mostly because they hold negative feelings towards cyclists and cycling infrastructure. Some cyclists, furthermore, stated that they feel like the cycle space of GNR has a low-quality feel to it.

In the case of BBBJJ in Rotterdam, on the other hand, users – cyclists, drivers, and pedestrians – feel safer, more comfortable, and connected to the cycle space, mostly because the space feels very “normal” and familiar to them. There exist also some tensions between people driving and people cycling, but they seem to be more nuanced than in the case of GNR.

Third, in terms of spatial practices of cycling, the two cases differ a lot. In the case of GNR, this study found that cycling is male dominated and that people cycling take safety measures in the form of wearing safety gear, and, too, adopting vehicular cycling strategies.

In the case of BBBJJ, the gender division of people cycling is much more balanced and cyclists do not take safety measures like people do on GNR. It was even observed that cyclists practice cycling quite ‘passively’ on BBBJJ, almost to the extent that it seems that the cycle space feels to cyclists somewhat like second nature.

There is also more non-conforming cycling behaviour in the case of GNR than in the case of BBBJJ. On GNR about a quarter of the cyclists observed do not make proper use of the dedicated cycle infrastructure, and cycle instead on, for instance, the motorway or pavement.

The paper deems that there is certain logic in Lefebvre's theory on the social production of space that is well able to inform empirical research. Likewise Leary (2013), this research found thinking through what representations of space, spaces of representation, and spatial practices meant in relation to the development of space for cycling enlightening. Moreover, it led to study material that would otherwise not be investigated when thinking about space in a more technical, mainstream way. Using Lefebvre's theory on the production of space as a theoretical and empirical backdrop to this research, furthermore, has helped developing an analytical framework that is useful for bringing to the foreground where and how tensions exist in the production of cycle space. For instance, the

study suggested that representations of cycle space in the case of Newcastle do not 'meet' certain practices of cycling, which seems to cause tensions. Moreover, the study suggests that the elements of the triad coincide more in the case of Rotterdam than in the case of Newcastle.

Also beyond this paper's investigation the analytical framework developed in this paper helps to better understand tensions in the social production of cycle space. For example, if we use this framework to look at the tensions and conflicts arising from cycle infrastructure implementation as discussed by Lubitow et al. (2015), Duarte et al. (2014), and Vreugdenhil & Williams (2013) earlier in this paper, it seems that tensions arise due to the representations of cycle space by which planners produce cycle infrastructure being mostly technical and there being little engagement with cycle spaces of representation.

At least two hypotheses established out of this research. The first being that there is interaction between representations of cycle space, cycle spaces of representation and spatial practices of cycling. In other words, there is interaction between cycle design guides, the rhetoric of feelings, experiences, norms and values around cycling, and people's practices of cycling. The second being that, following Newcastle's traffic engineers' aims to generate more coincidence between the spaces, cycle spaces of representation and spatial practices of cycling inform representations of cycle space i.e. the rhetoric of feelings, experiences, norms and values around cycling and people's practices of cycling inform to the development of cycle design guides.

Future research on the social production of cycle space could aim to better understand the dynamics between the three spaces. It would highly benefit from a longitudinal approach investigating, for example, how cycle spaces of representation and spatial practices of cycling influence or inform representations of cycle space over time. For also according to Lefebvre (1991, 46) it is reasonable to assume that representations of space, spaces of representation, and spatial practices can contribute in different ways to the production of space.

If we are to agree that cycling will continue to transform cities, it is time that we look into a series of critical questions about the social production of cycling space: How and by what mechanisms do representations of cycle space, cycle spaces of representation, and spatial practices of cycling interact? How do spatial practices of cycling and cycle spaces of representation inform representations of cycle space over time? And how can intersection or coincidence between the elements of the spatial triad be advanced as cities transform into cycling cities?

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