Acces and egress of public transport

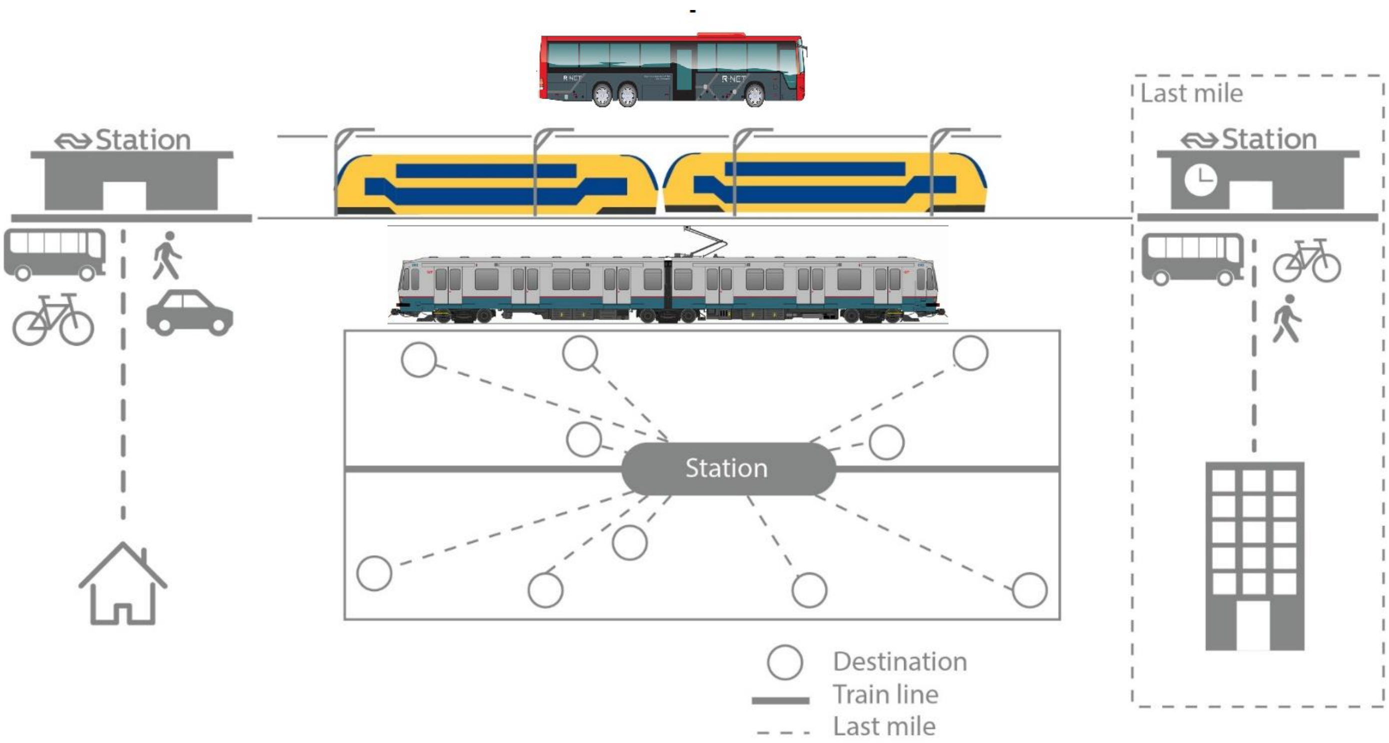
Bicycle and transit

dr. ir. Danique Ton

dr. ir. N. van Oort

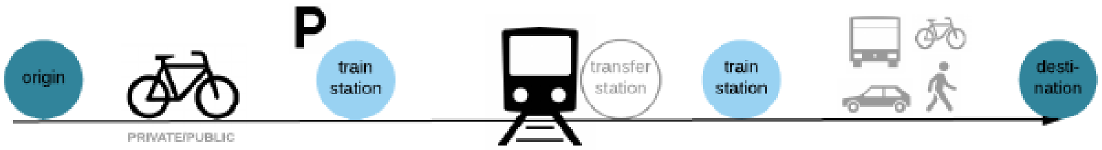
5825 Advanced Public Transport Operations and Modelling

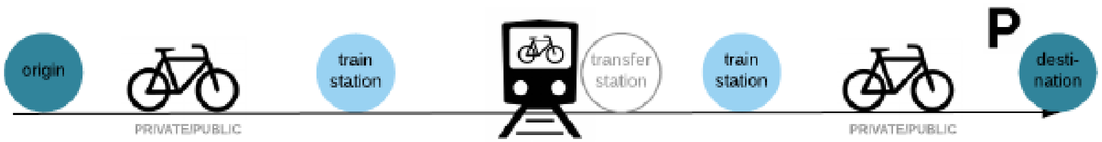
Access and egress / first and last mile



Modelling

- Mode choice (PT main part)
- Mode choice (access and egress)
- Station choice (origin and destination)
    - Time depending
    - Bicycle depending


P
origin
PRIVATE/PUBLIC
train station
transfer station
train station
desti-nation


origin
PRIVATE/PUBLIC
train station
transfer station
train station
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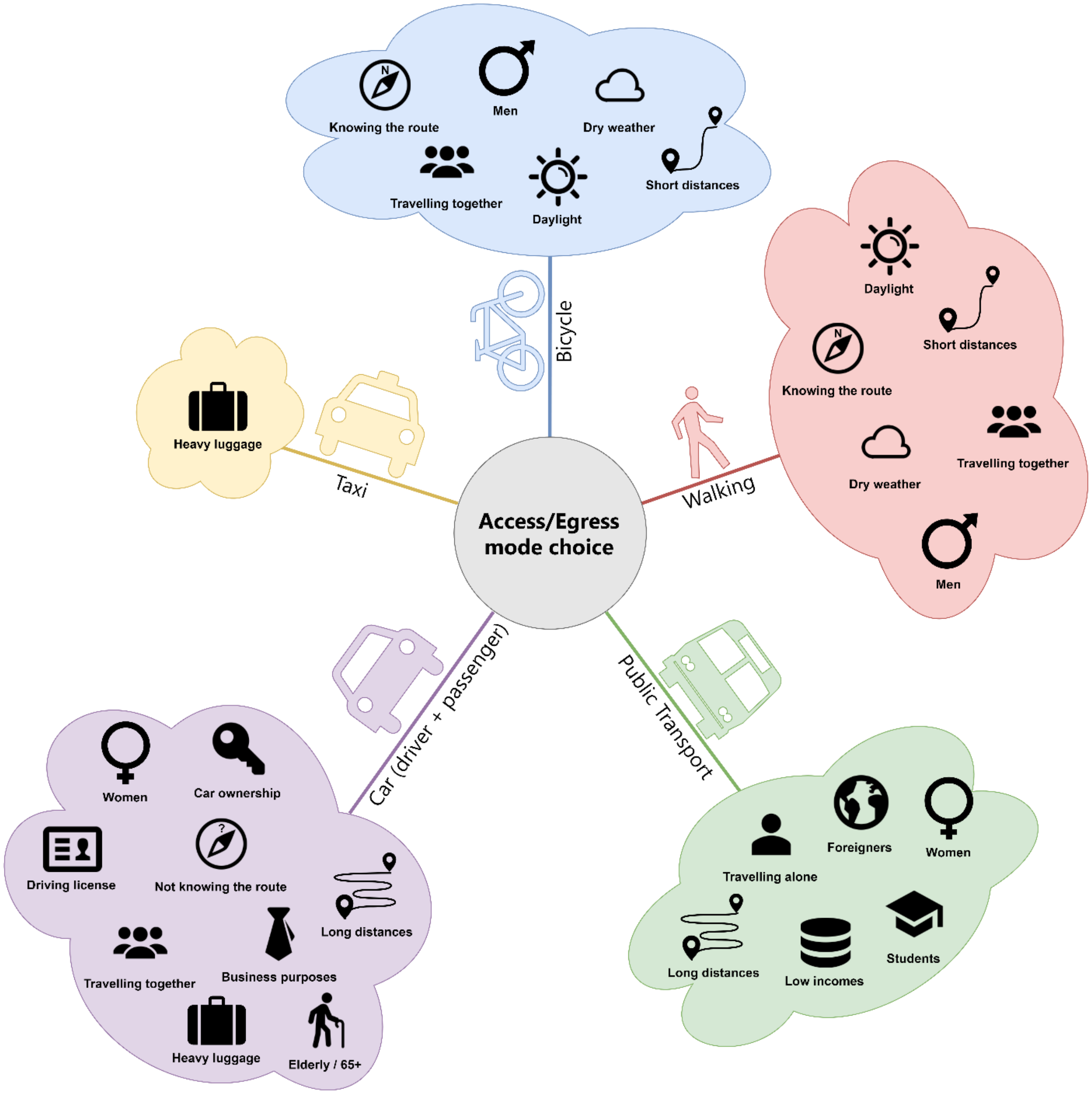
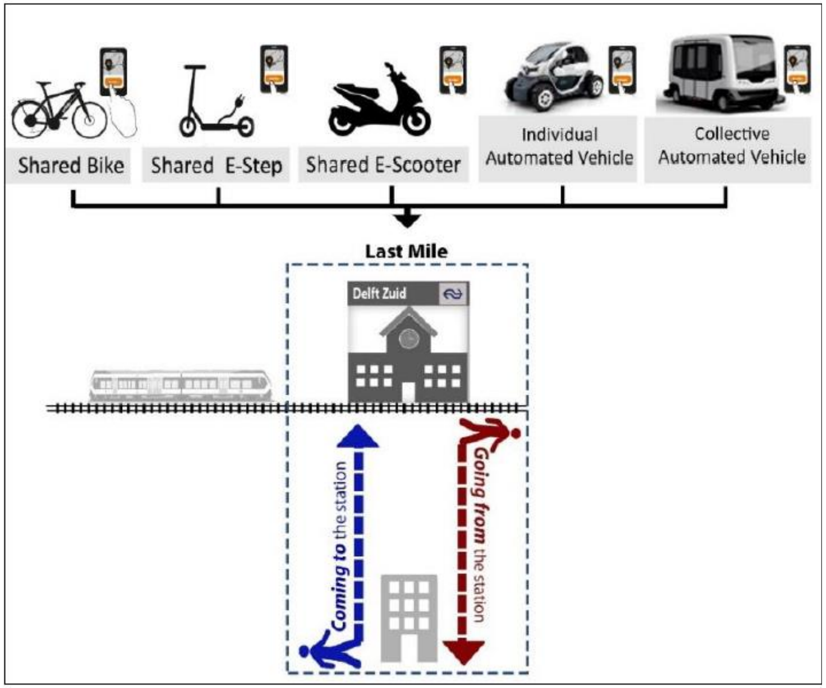
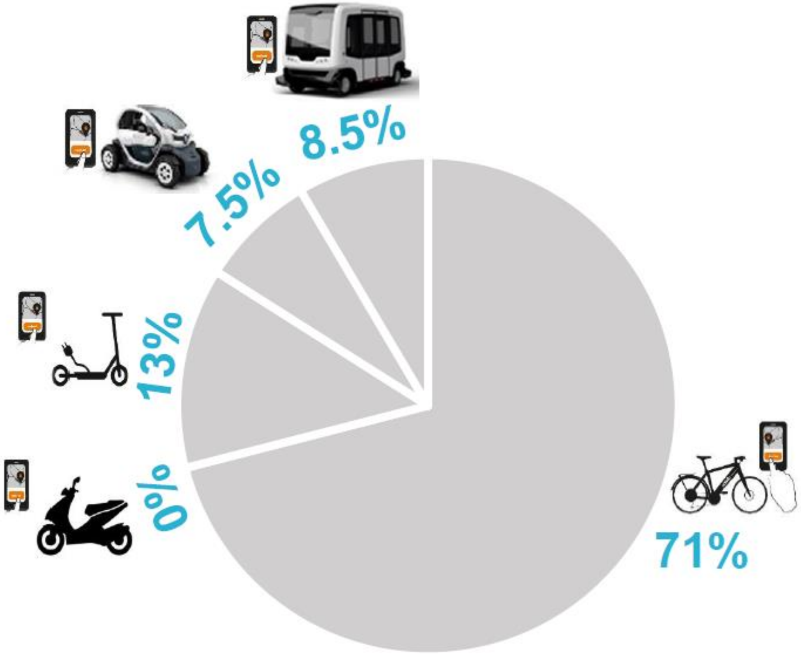
P
desti-nation


Knowing the route
Men
Dry weather
Travelling together
Daylight
Short distances
Bicycle
Heavy luggage
Taxi
Daylight
Short distances
Knowing the route
Travelling together
Dry weather
Men
Walking
Access/Egress mode choice
Car (driver + passenger)
Public Transport
Women
Car ownership
Driving license
Not knowing the route
Long distances
Travelling together
Business purposes
Heavy luggage
Elderly / 65+
Foreigners
Women
Travelling alone
Long distances
Low incomes
Students

Stam, B. (2018)

Stated preference first/last mile station Delft Campus

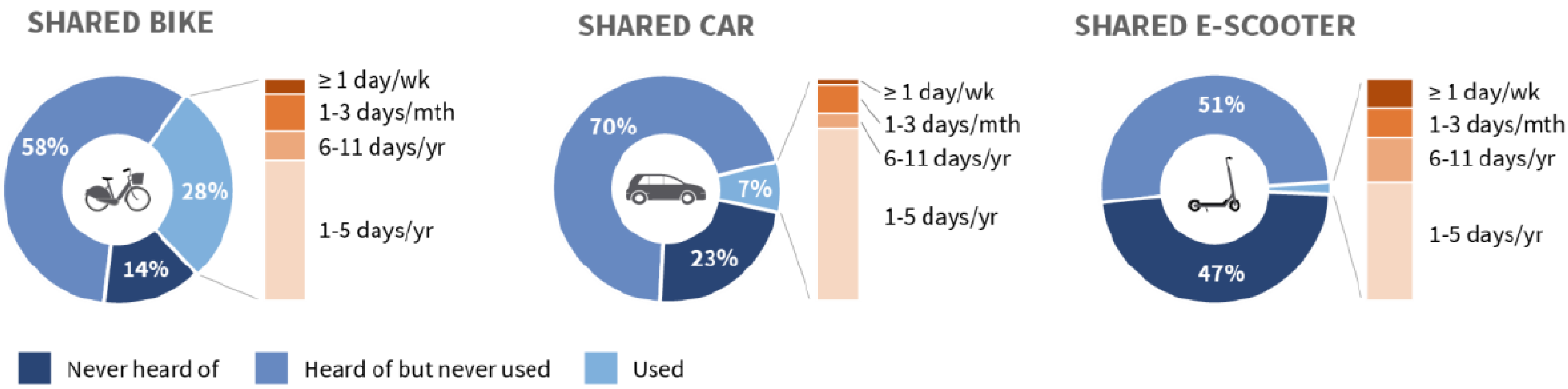




Torabi et al. 2019

- Demand responsive transport
- Autonomous shuttles

Usage and familiarity



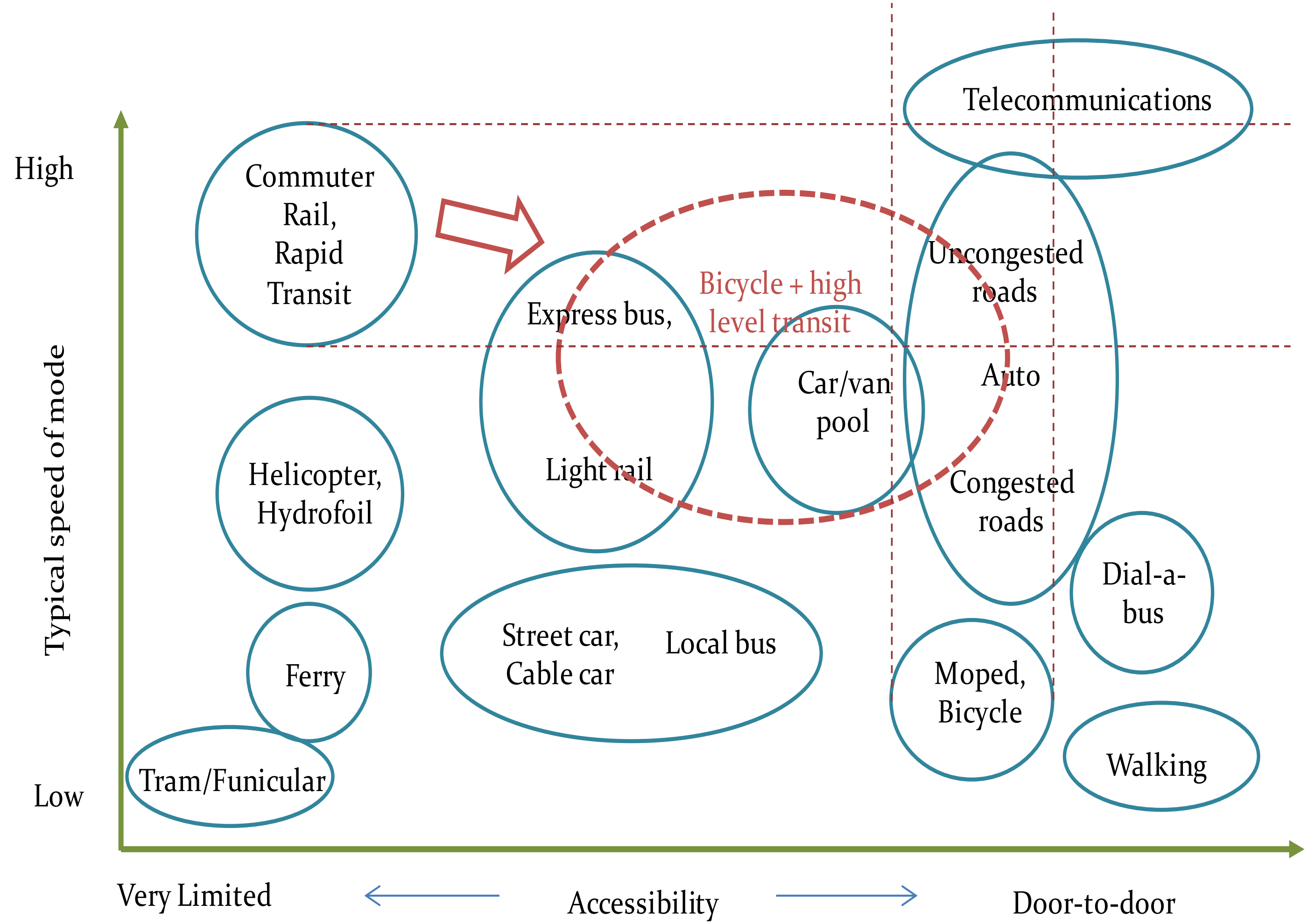
Arendsen (2019)

The bicyle and transit mode

Minister Van Veldhoven:
"We hebben meer fiets, meer OV en meer brains nodig"

Fietsparkeercongres 2019

Combining best of both worlds

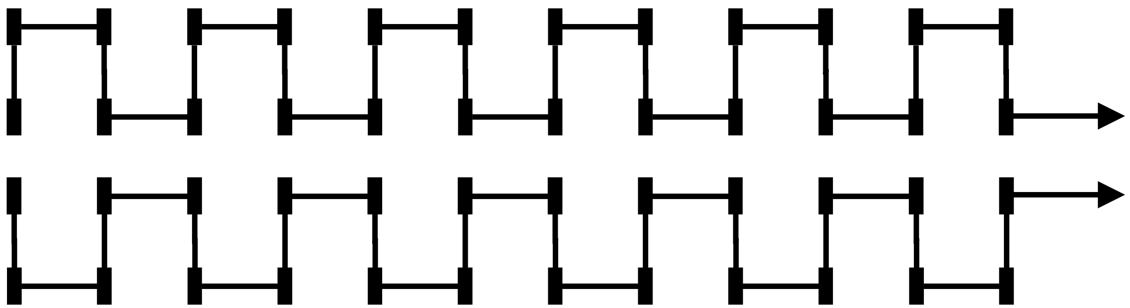


[Kager et al. (2016), Shelat et al. (2017)]

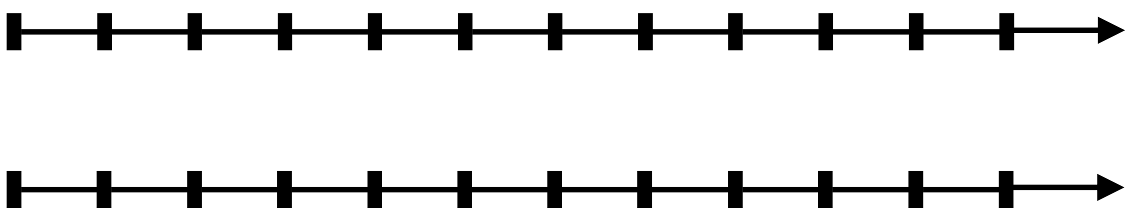
Potential Bicycle and Transit

- Improving access and egress
- Improving door to door mobility
- Enhanced Public transport design

Network design dilemma



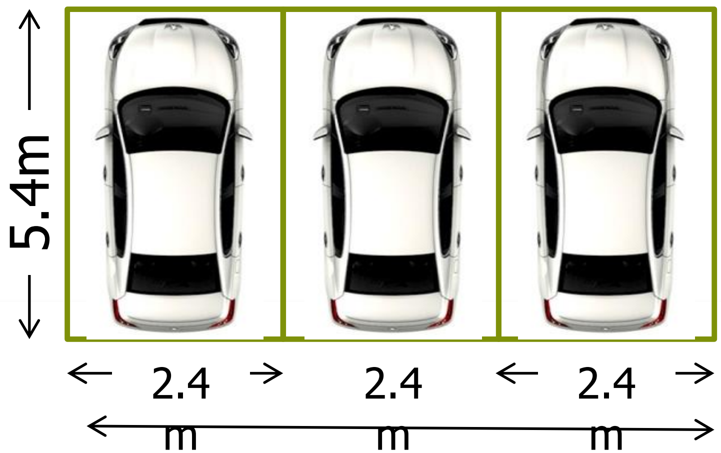
Many stops
Short access, long in-vehicle time



Few stops
Long access, short in-vehicle time

Benefits of station access by bicycle

- substantially less expensive (than car based access)
- smaller parking footprint



$1,000 (600 Euro) per bicycle stored

$4,000 (2,400 Euro) per bicycle stored

$40,000 (25,000 Euro) per car space

Challenges

Research objectives

Increasing modal share of sustainable transport (door-door)

1 To understand the bike and transit combination

Benefits

Users

Behaviour

Potential

2 To design optimal bike and transit transport

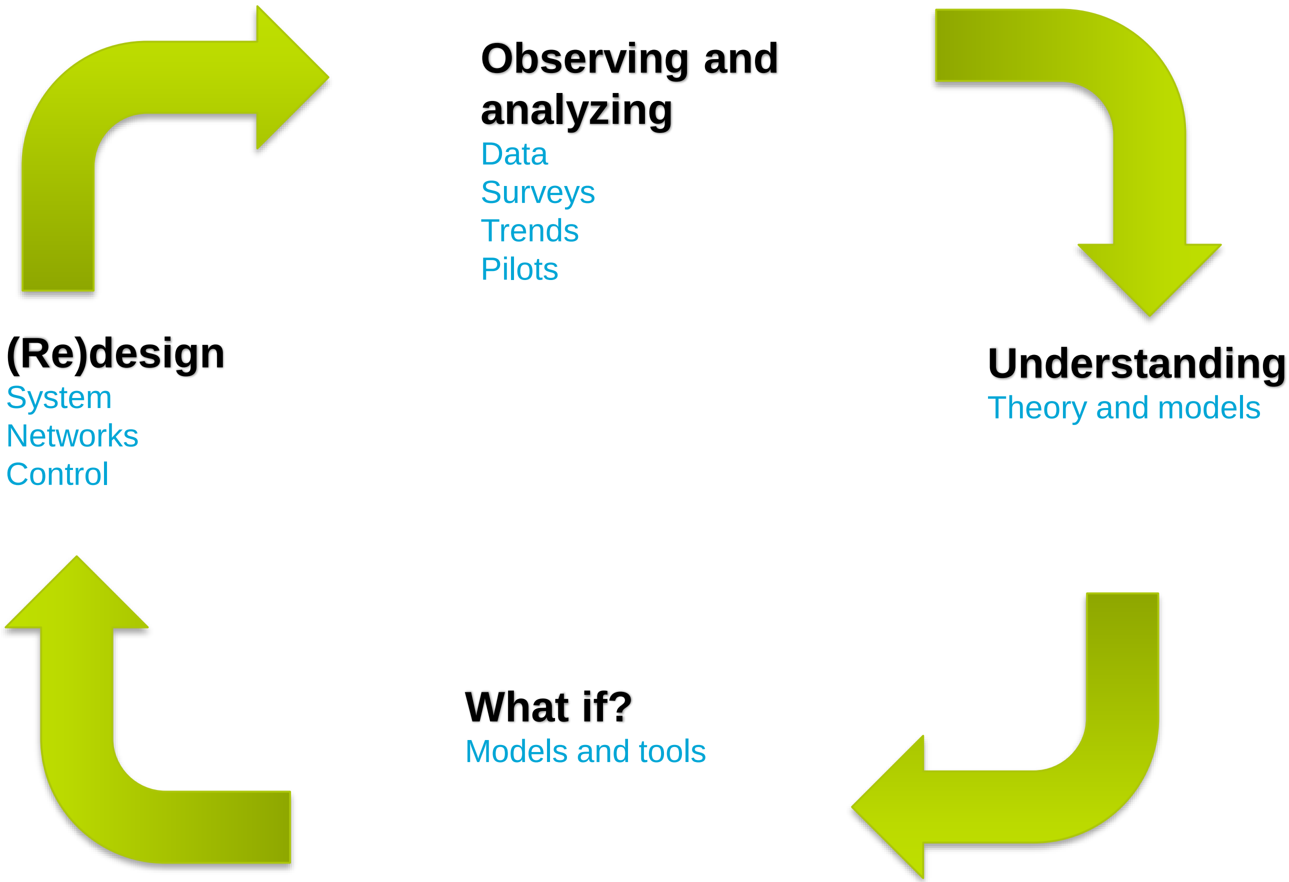
Routes, parking

Transit networks

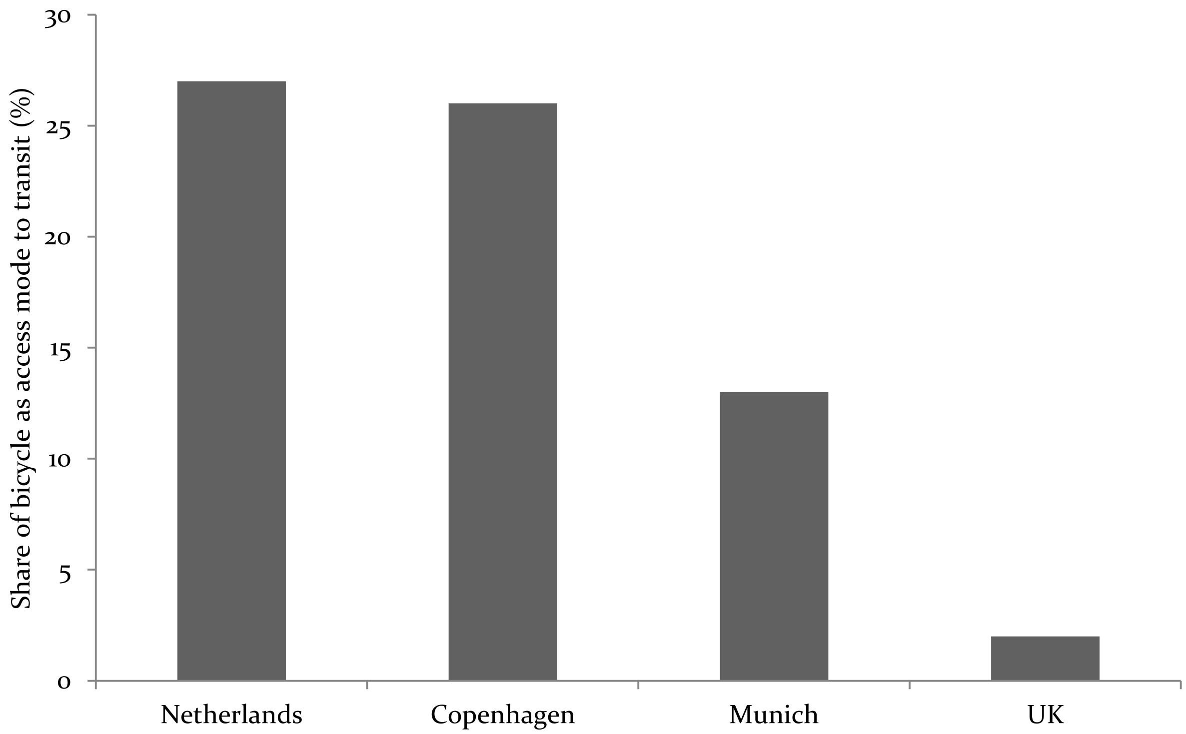
Sharing facilities

Integrated design

Research and design cycle

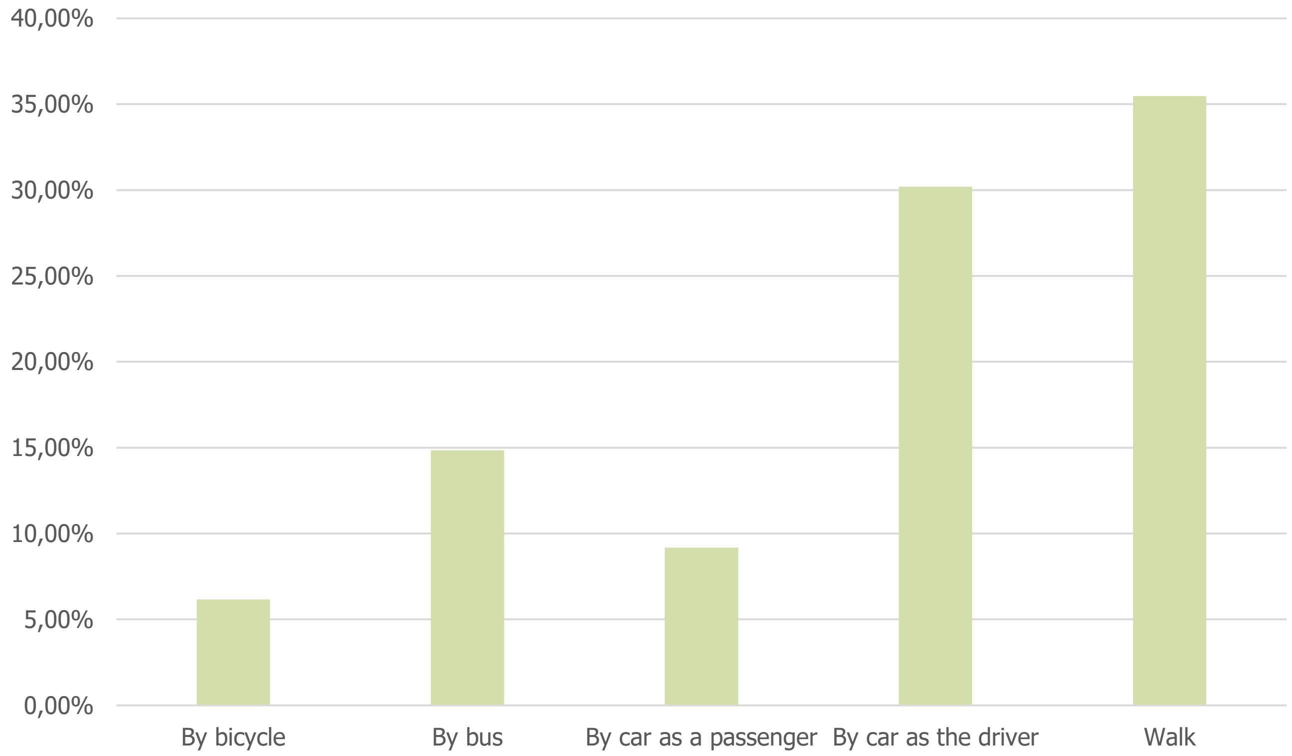


Modal share



Share of bicycle as access mode to transit (%)
30
25
20
15
10
5
0
Netherlands
Copenhagen
Munich
UK

Melbourne

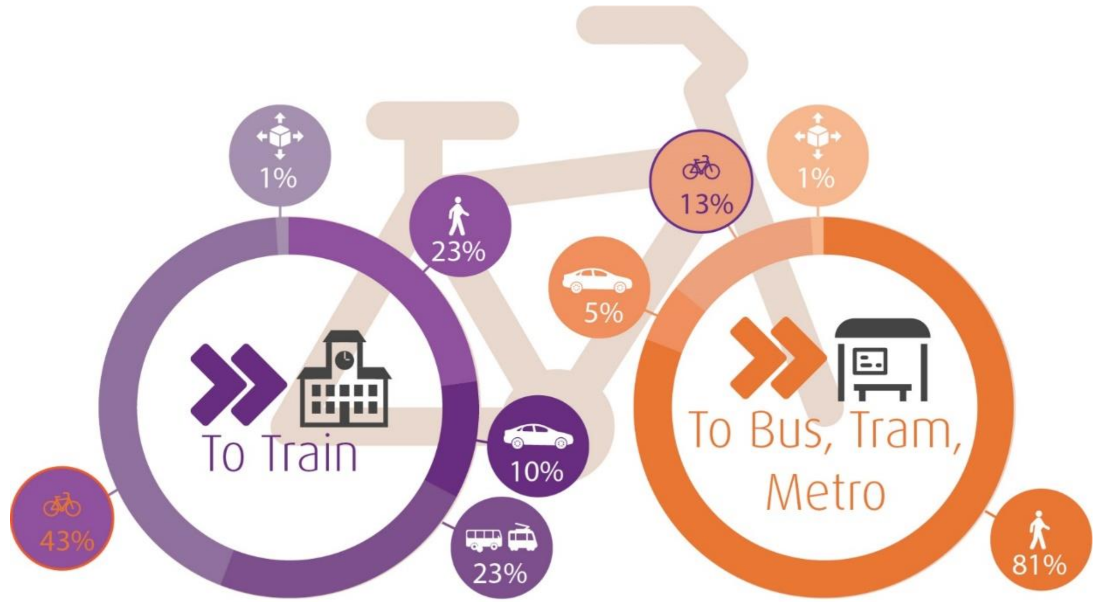


Geoff Rose (2019)

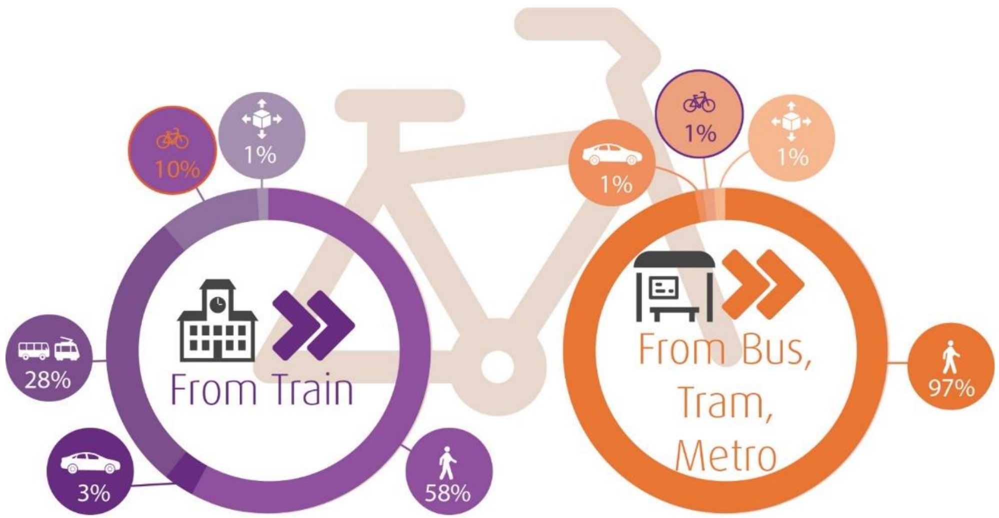
Potential market for cycling as an access mode (Melbourne)

- 71% can ride a bicycle
- 57% have access to a private bicycle
- 43% interested if better cycling infrastructure was connected to the station
- 35% willing to use a public share bike to access station

Geoff Rose (2019)

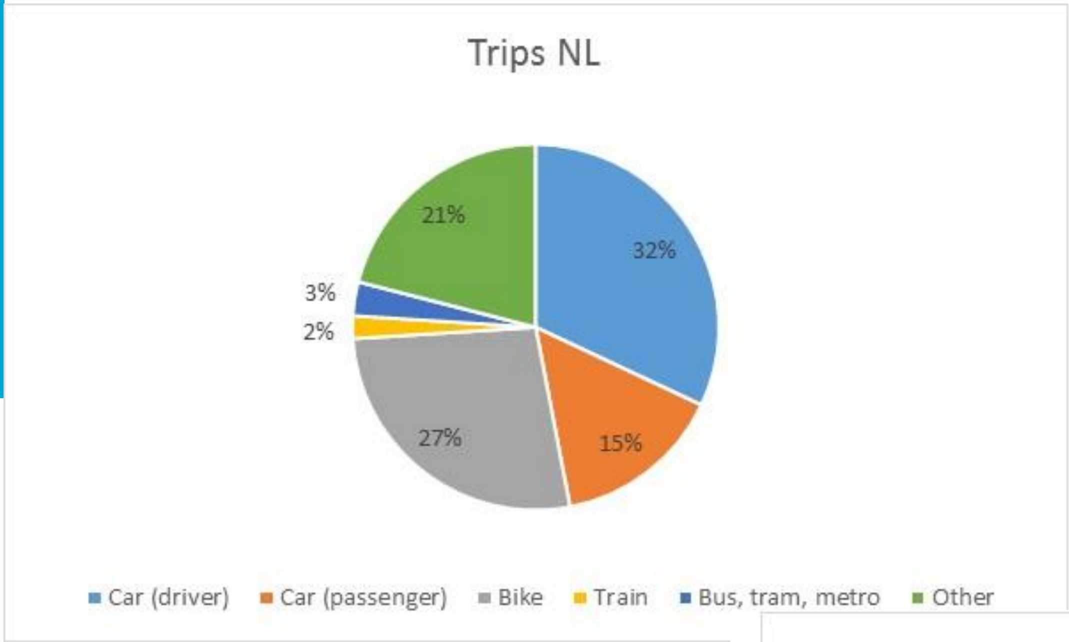


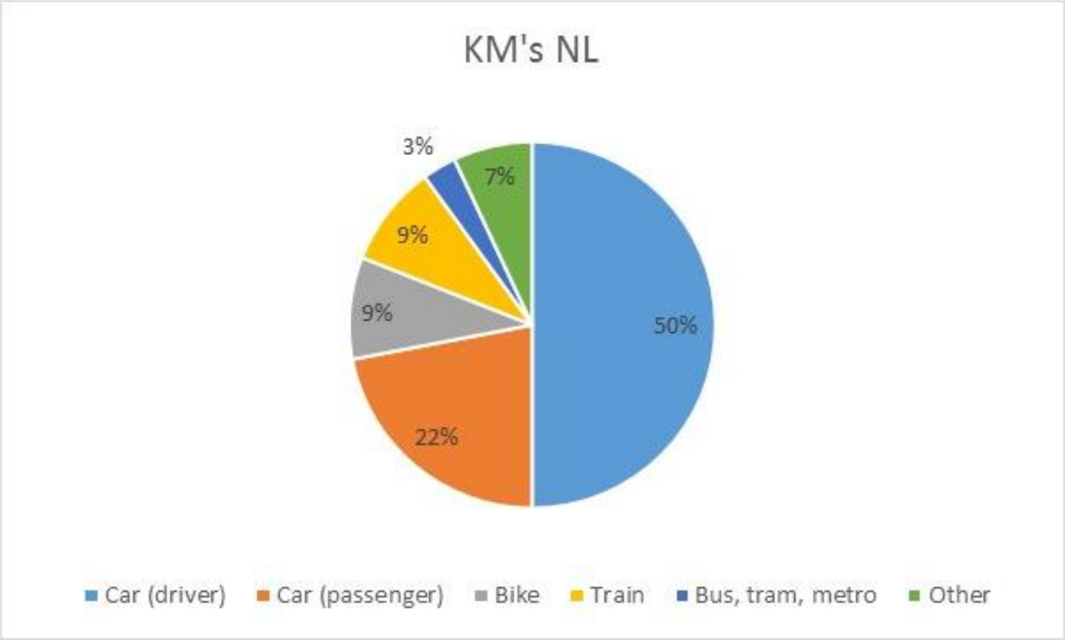
Access transport



Egress transport

Shelat, S. et al. (2018). Analysis of the trip and user characteristics of the combined bicycle and transit mode. Research in Transportation Economics.


Trips NL
32%
15%
27%
2%
3%
21%
Car (driver)
Car (passenger)
Bike
Train
Bus, tram, metro
Other


KM's NL
50%
22%
9%
9%
3%
7%
Car (driver)
Car (passenger)
Bike
Train
Bus, tram, metro
Other

Factors

- Think of 1 positive and 1 negative factor affecting the bicycle+transit combination
- Example from birth country
- Teams of 2 or 3

39 FACTORS IN 8 GROUPS

1. Culture & attitudes towards cycling and rail
2. Characteristics cycle-rail users
3. Rail system
4. Train journey
5. Station typology
6. Region’s bikeability
7. Bicycle journey
8. Competition other modes

Van Mil, J.F. et al. (2018), Insights into factors affecting the combined bicycle transit Mode, CASPT conference, Brisbane

Factors (1/3)

FACTOR	INFLUENCE ON CYCLE-RAIL USE
Culture & Attitude	
local and national transport policy	depends
high level of cycling	++
high level of rail use	++
positive attitude towards cycling	+
positive attitude towards rail	+
low perception of barriers	+
car as status symbol	-
User Characteristics	
higher level of education	depends
many 20-39 year olds	depends
high number of students	++
high levels of employment	+
high share of males	+
share of mid/high income	+
high number of frequent rail travellers	+
many people able to cycle	+
large households	-
many travellers with heavy luggage	-
wearing smart clothes	-
Competition other modes	
trip distance first/last mile 1 - 3.5 km	++
much congestion for cars	+
good BTM network	-
high car ownership	--
inexpensive BTM travel	--

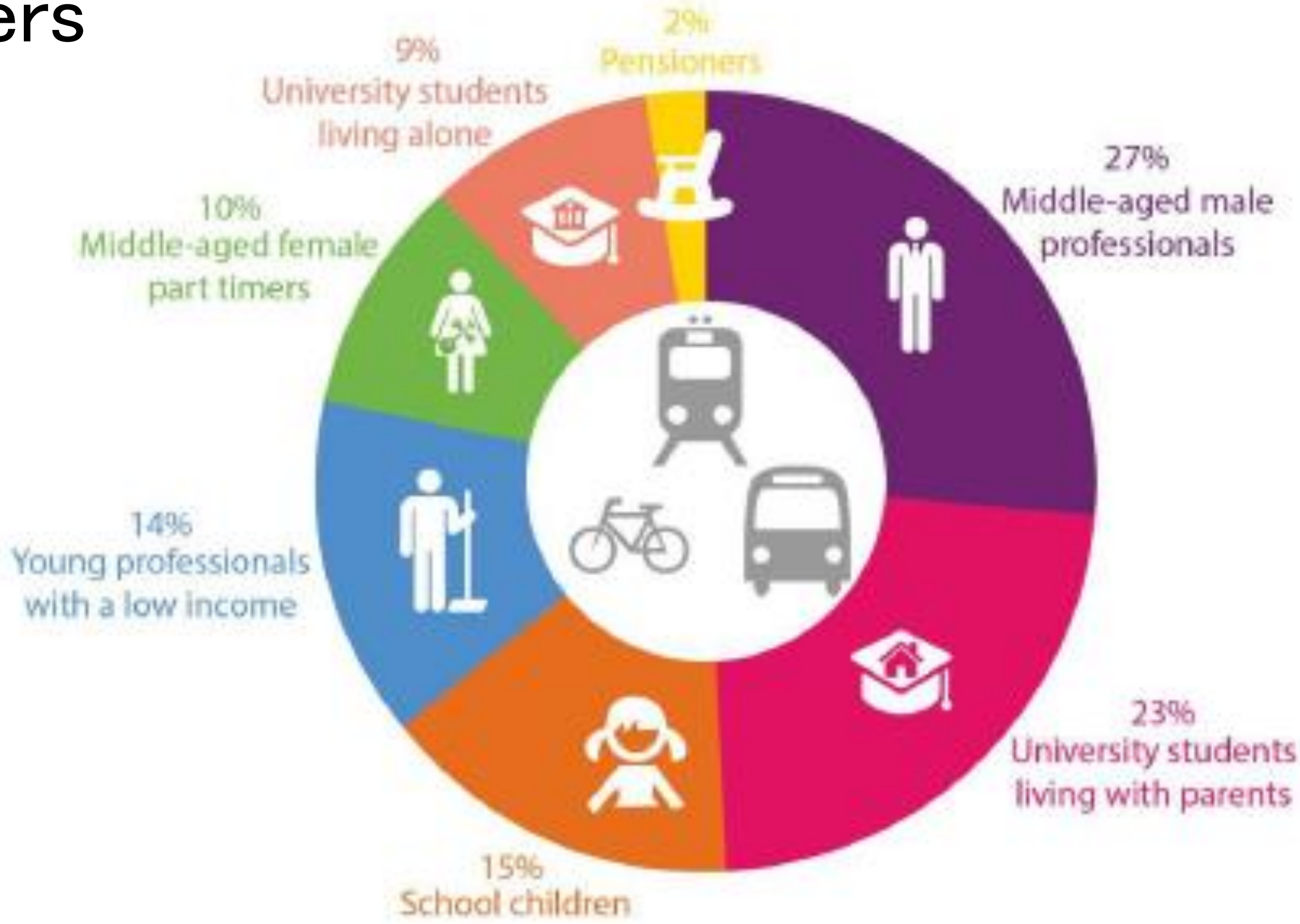
Factors (2/3)

FACTOR	INFLUENCE ON CYCLE-RAIL USE
Rail System	
high (service) level of train	+
large distance between stations	+
high train frequency	+
Rail Journey	
trips of 20min+	+
no other transfers required	+
Station Typology	
close to production-zones (e.g. dwellings)	++
terminal station	+
station category urban medium / rural small-sized	+
close to attraction-zones (e.g. university)	+

Factors (3/3)

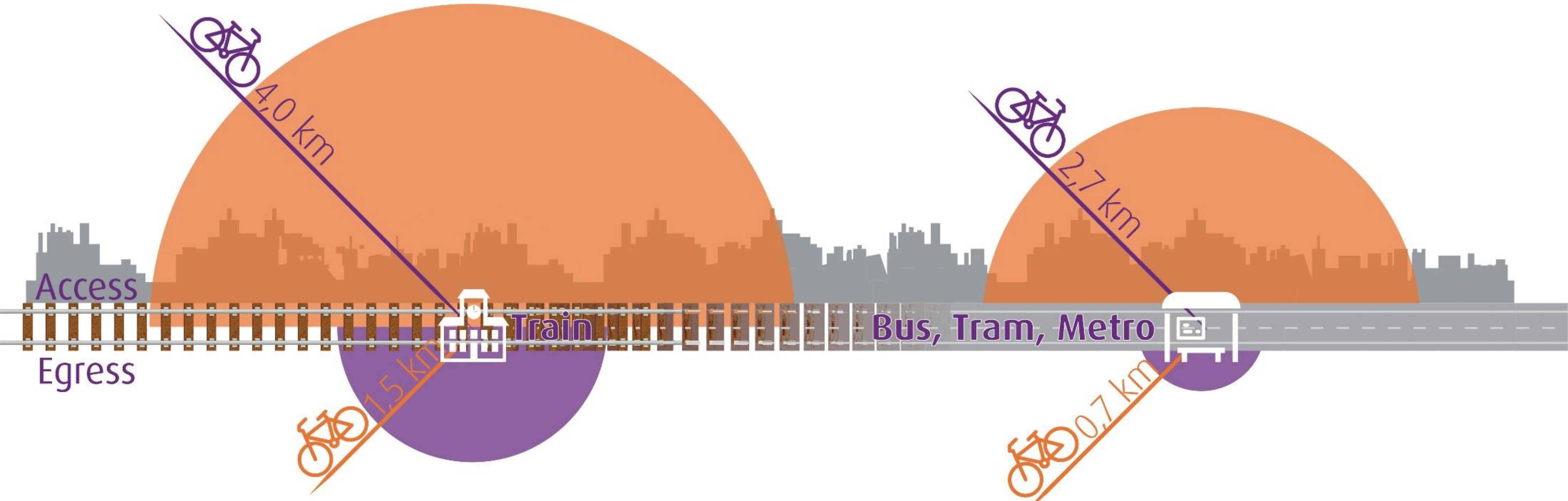
FACTOR	INFLUENCE ON CYCLE-RAIL USE
Regions bike ability	
early sunset	0 / -
long winters	-
hilly	-
low temperatures	-
rainy weather	--
Bicycle Journey	
small distance between station and cycle highway	++
good quality of cycling lanes	+
high quantity of cycling lanes	+
often right of way	+
large number of other cyclists / bicycle lane volume	+
direct cycle routes to station (directness)	+
high levels of safety	+
good route knowledge	+
high bicycle ownership	+
good storage facilities at/near home	+

Users



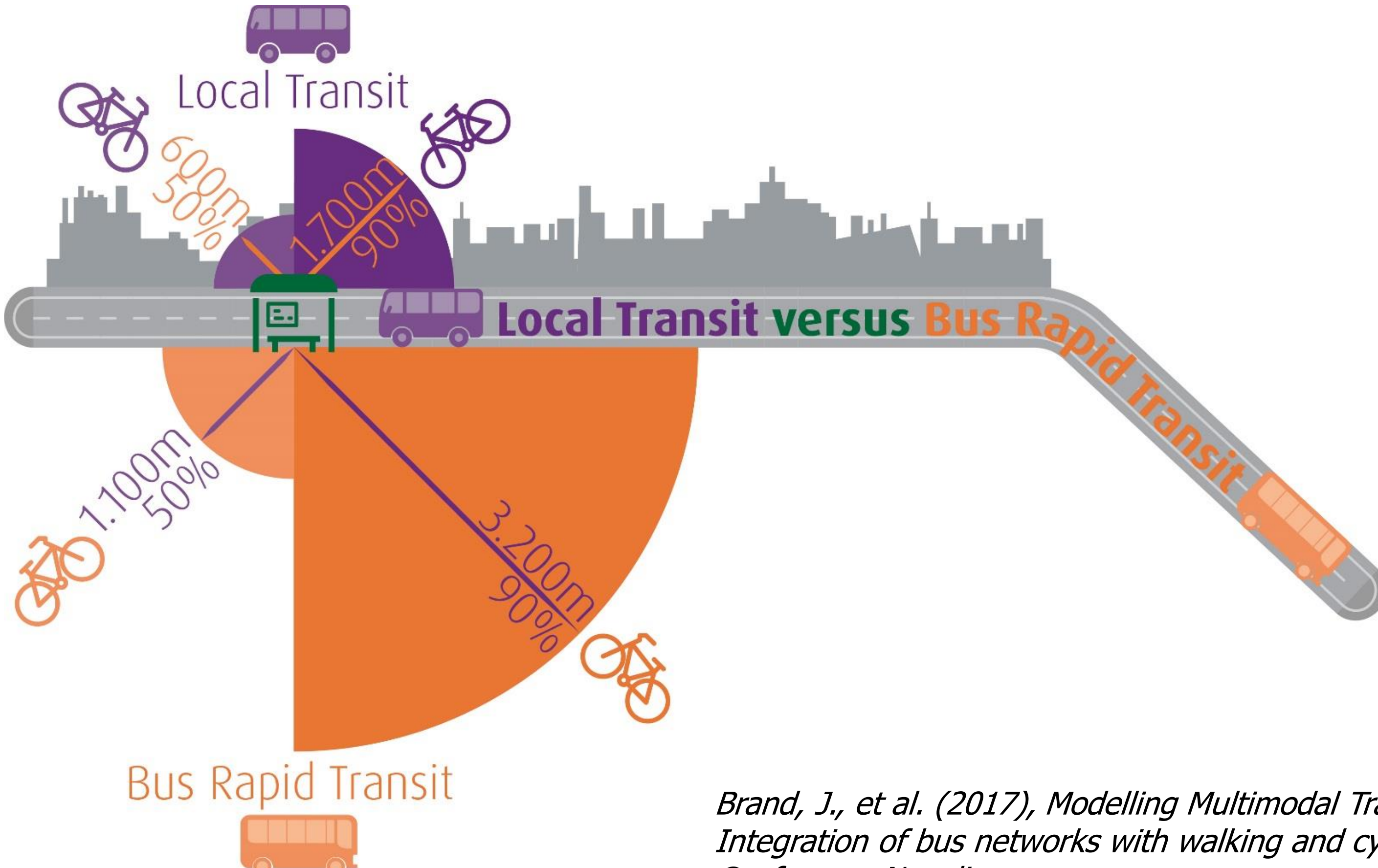
Shelat, S. et al. (2018). Analysis of the trip and user characteristics of the combined bicycle and transit mode. Research in Transportation Economics.

Catchment areas



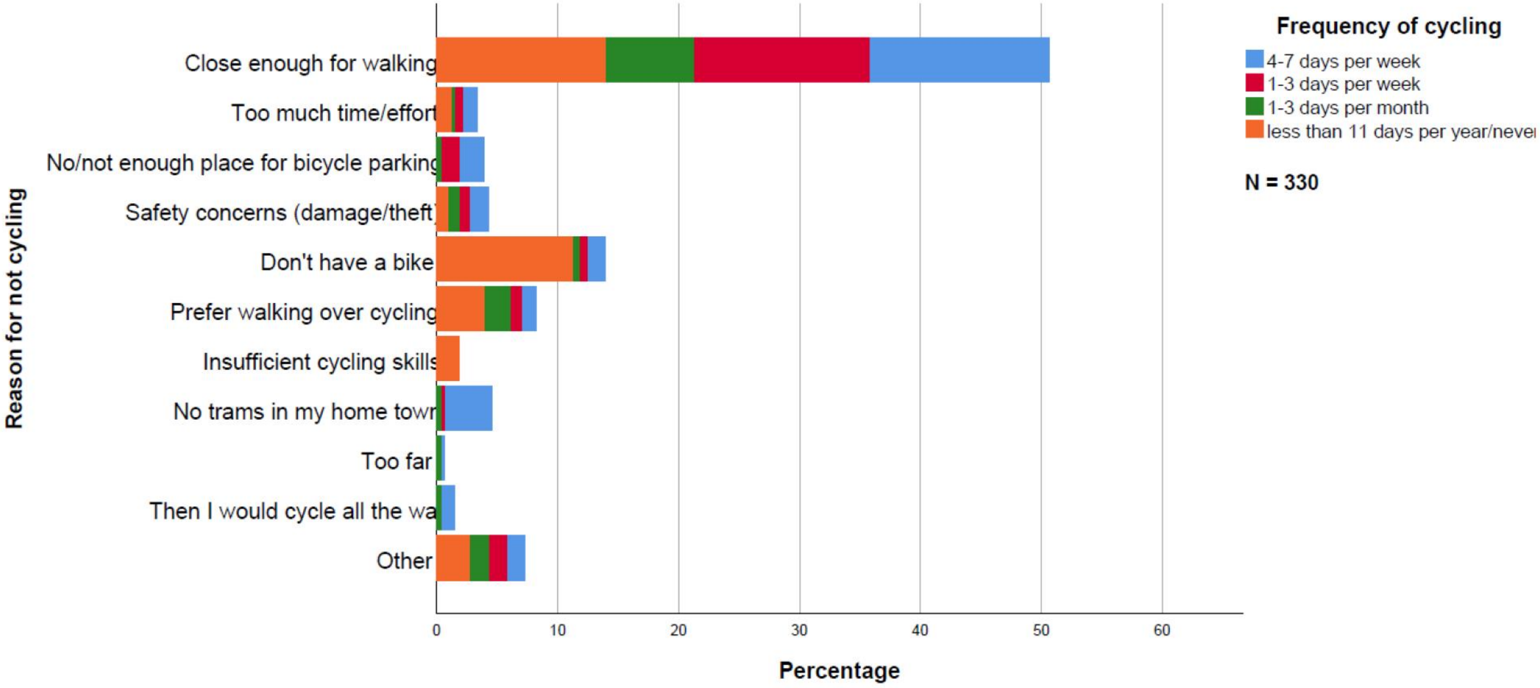
Shelat, S. et al. (2018). Analysis of the trip and user characteristics of the combined bicycle and transit mode. Research in Transportation Economics.

Impact of PT quality on catchment areas



Brand, J., et al. (2017), Modelling Multimodal Transit Networks; Integration of bus networks with walking and cycling, MT-ITS Conference Napoli.

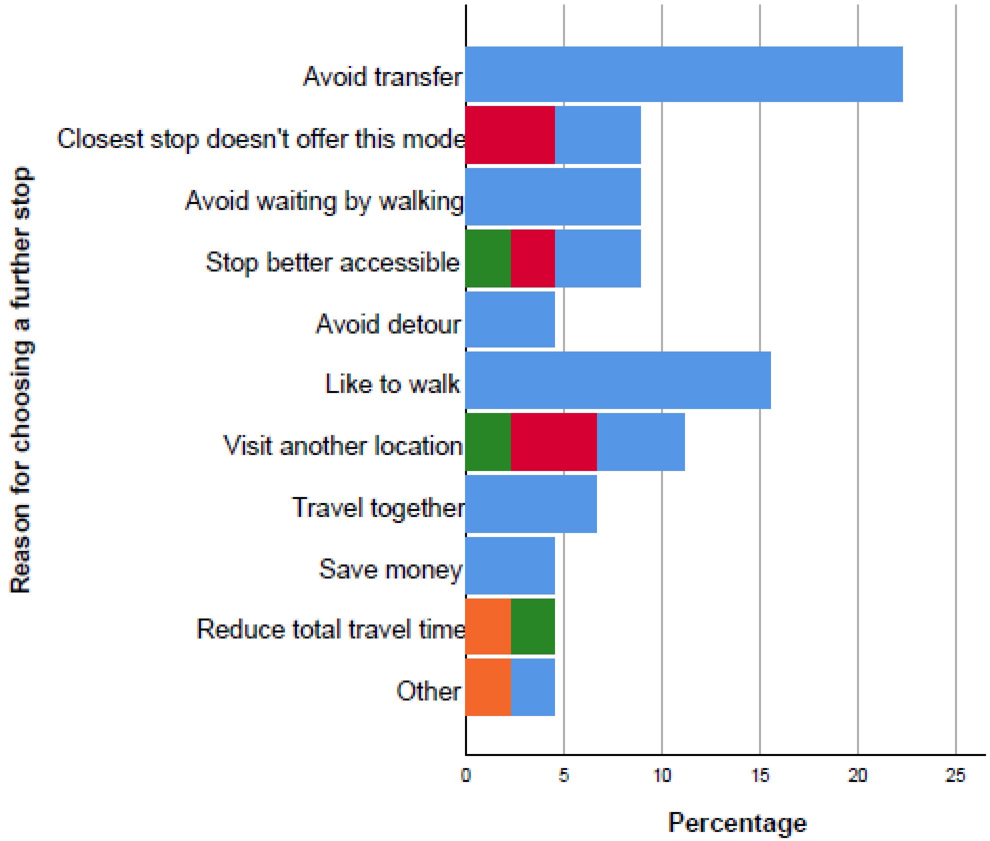
Reasons not to cycle?



Rijsman et al. (2019)

Station choice

Reasons to chose further stop



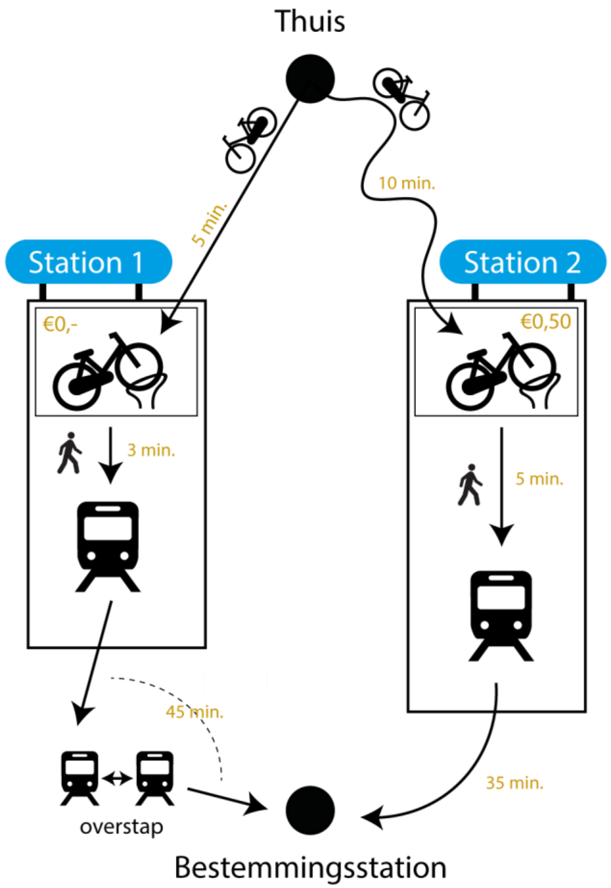
Rijsman (2018)

Factors that have the most influence

The five strongest factors are used for the choice experiment:

- *Bicycle travel time*
- *Train travel time*
- *Transfer time (time needed to park a bike and walk to the platform)*
- *Directness (number of transfers in train trip)*
- *Costs of bicycle parking*

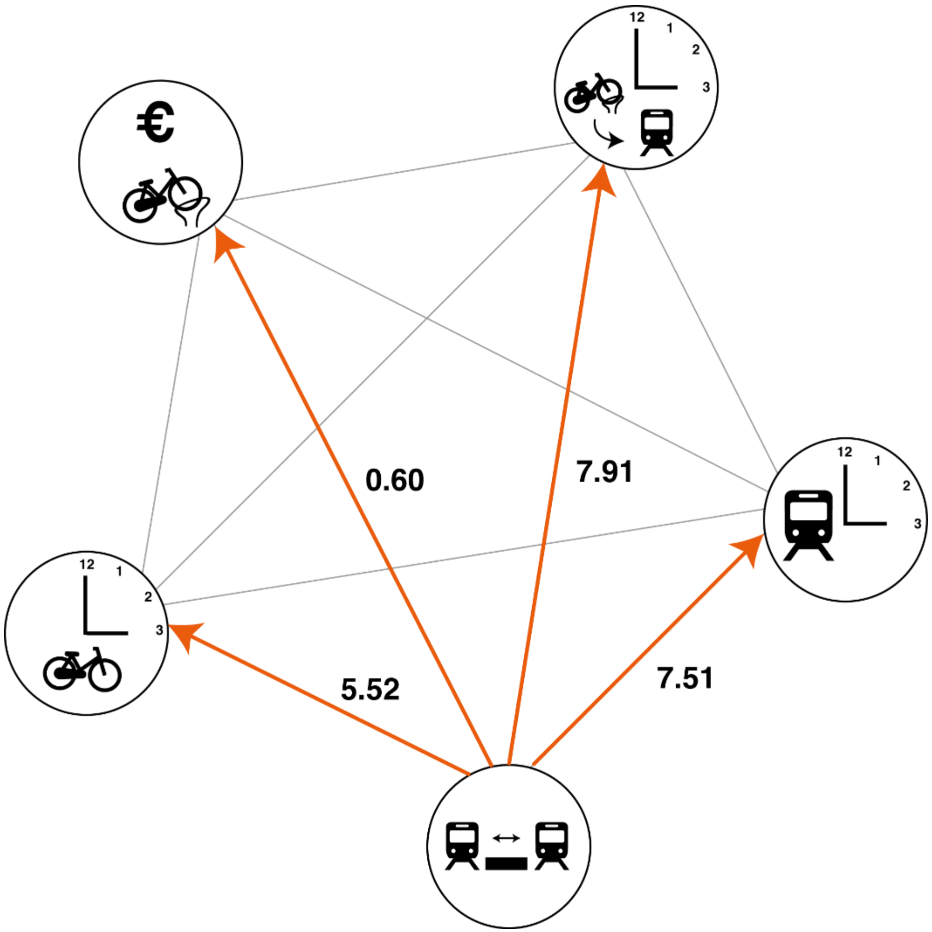
Impact of factors – *Choice experiment*



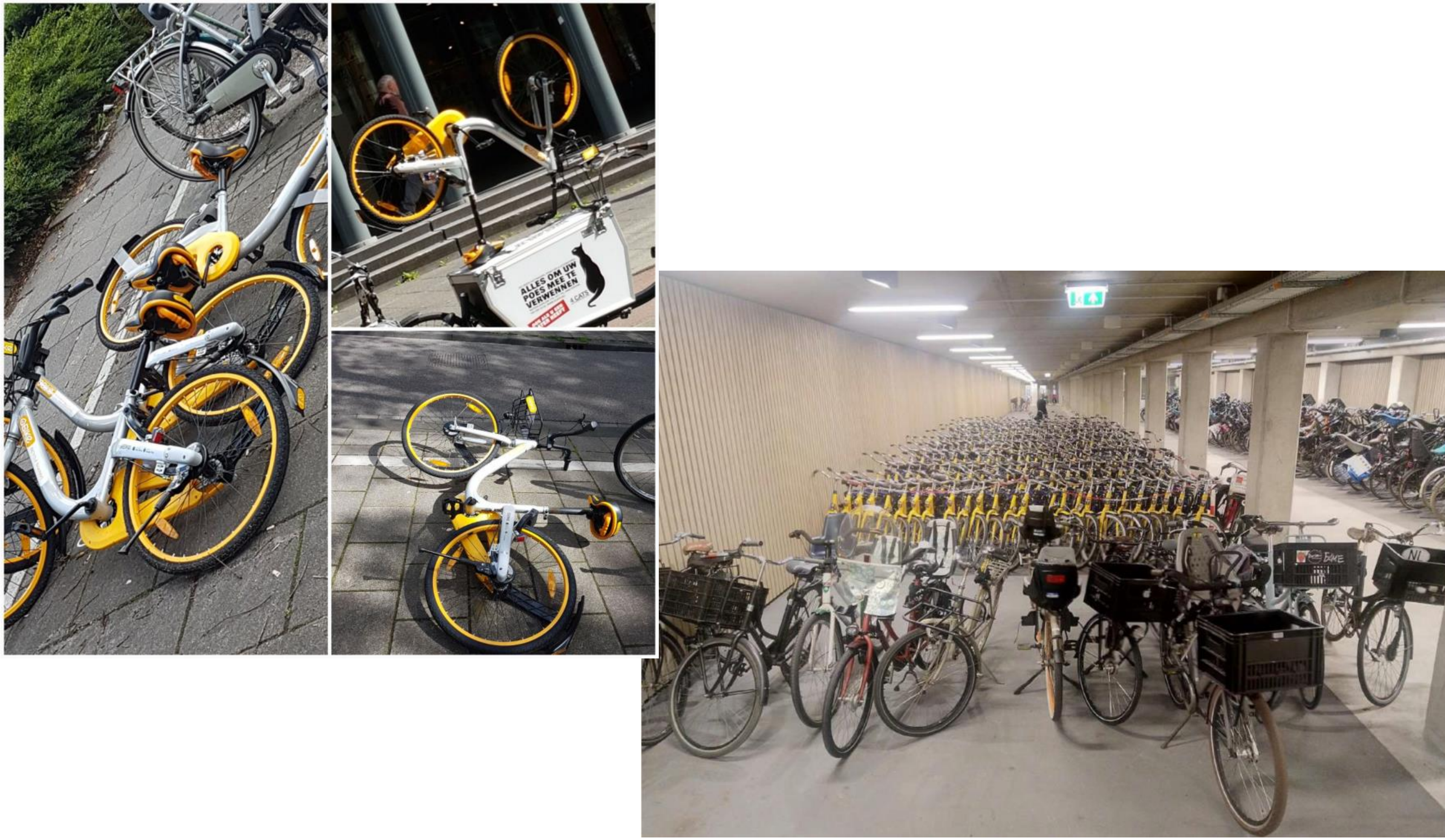
269 respondents

Van Mil, J.F. et al. (2018), Insights into factors affecting the combined bicycle transit Mode, CASPT conference, Brisbane

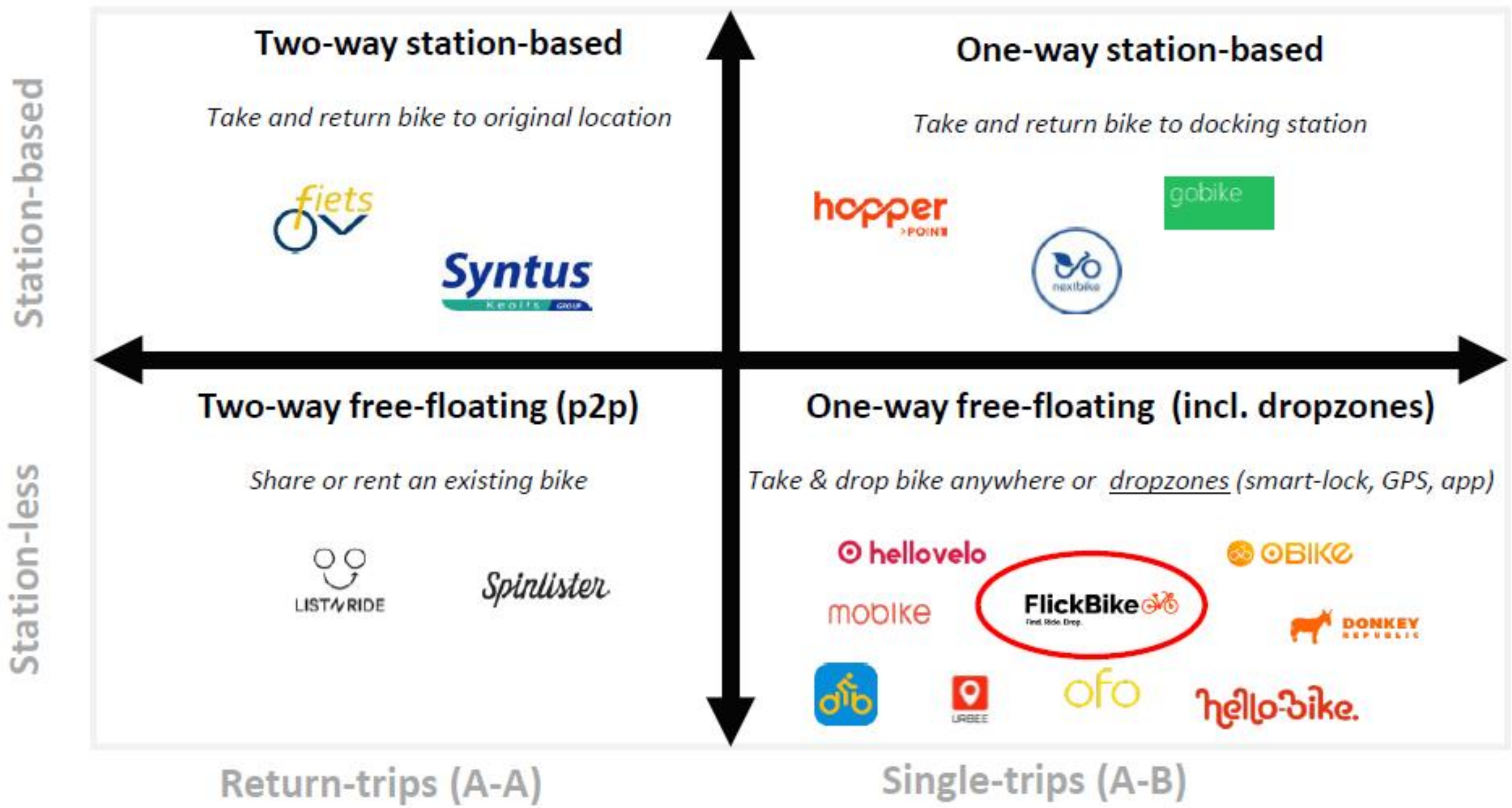
Transfer




Shared bikes

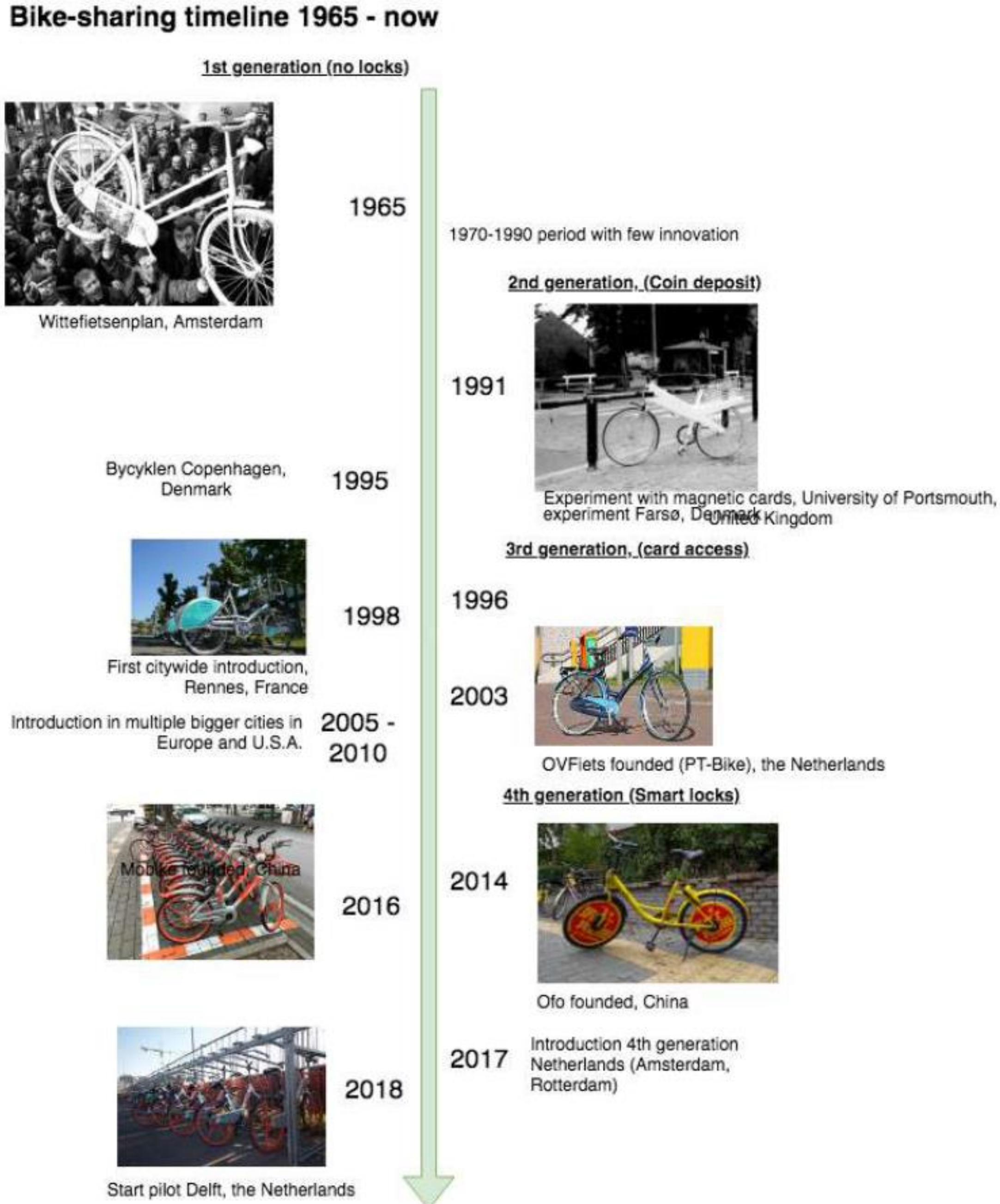


[Boor et al. (2019)]



> 1600 schemes operating
391 others are under construction in more than 50 countries

Van Waes et al. 2018


Bike-sharing timeline 1965 - now
1st generation (no locks)
1965
Wittefietsenplan, Amsterdam
1970-1990 period with few innovation
2nd generation, (Coin deposit)
1991
Experiment with magnetic cards, University of Portsmouth, United Kingdom
experiment Farsø, Denmark
Bycyklen Copenhagen, Denmark
1995
3rd generation, (card access)
1996
1998
First citywide introduction, Rennes, France
2003
OVFiets founded (PT-Bike), the Netherlands
Introduction in multiple bigger cities in Europe and U.S.A.
2005 - 2010
4th generation (Smart locks)
2014
Ofo founded, China
Mobike founded, China
2016
2017
Introduction 4th generation Netherlands (Amsterdam, Rotterdam)
2018
Start pilot Delft, the Netherlands

Boor, S. (2019)

4 generations of bike sharing

1st generation
- 1965, in Amsterdam: White Bikes
- Regular bikes
- Free
- The program collapsed within days.

2nd generation
- 1991-1993 Denmark
- Specially designed for intense utilitarian use with solid rubber tires and wheels with advertising plates,
- Coin deposit.

4 generations of bike sharing

3rd generation

- Bikeabout 1996, Portsmouth University, England
- Magnetic stripe card
- Variety of technological improvements:
- Electronically-locking racks or bike locks
  Telecommunication systems
  Smartcards
  Mobile phone access
  On-board computers.

- 2003: Velo'v: 1,500 bikes in Lyon
- 2007: Paris Vélib: 7,000 bikes -> 23,600 bikes

- New programs in Brazil, Chile, China, New Zealand, South Korea, Taiwan, and the U.S

4 generations of bike sharing

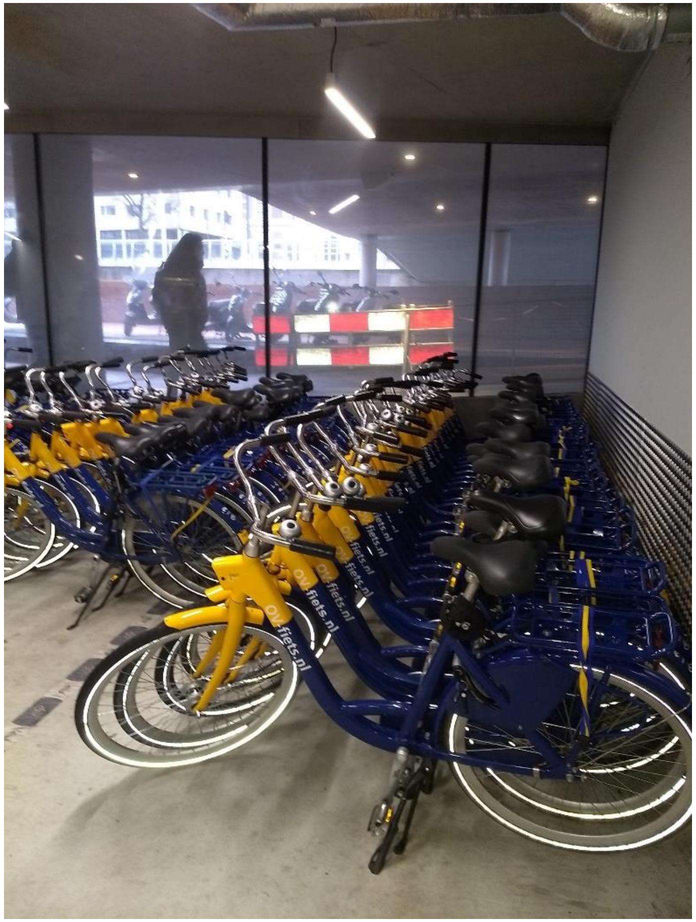
4th generation

- Dockless bikes
- 2008-2013: China, Germany, US,

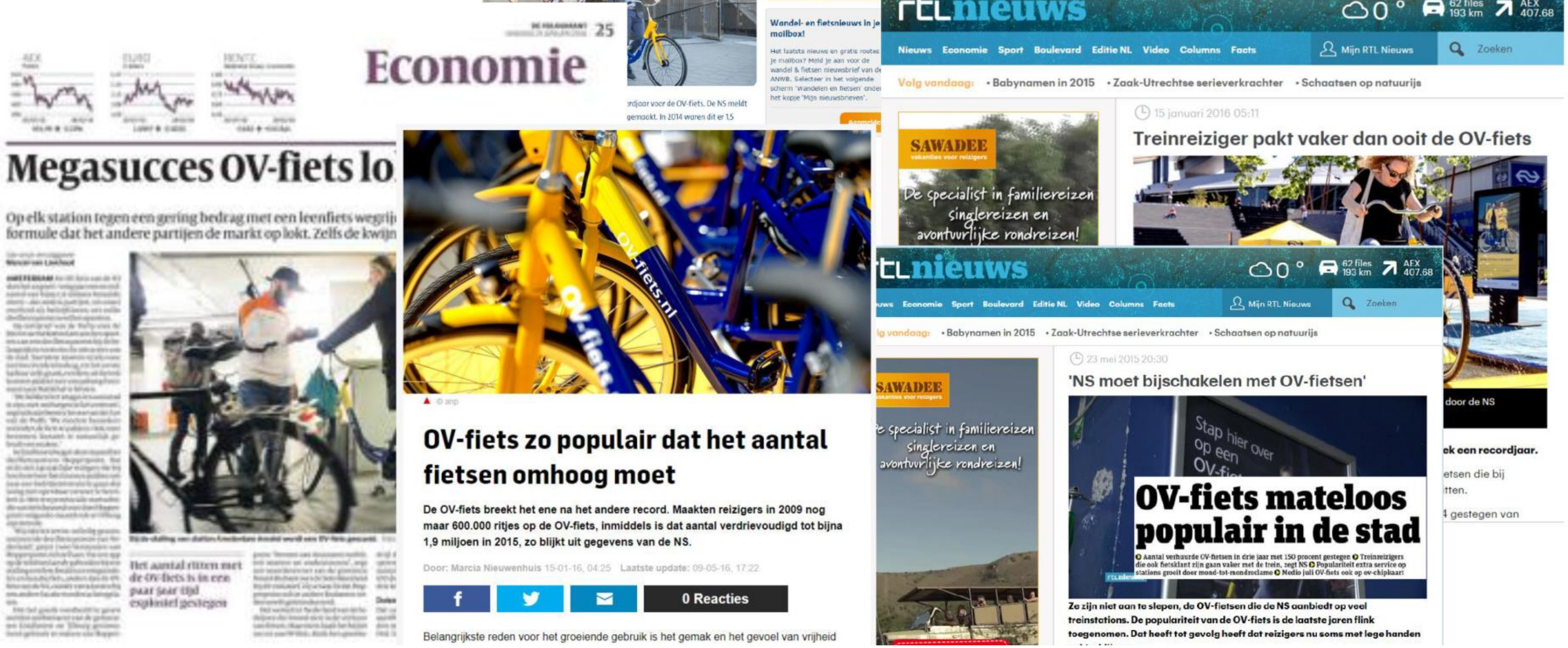
- 2015: Ofo and Mobike, China.
  Integration of mobile payment and GPS tracking technology
- 2017: Obike, Singapore
  LimeBike, United States
  Gobee Bike, Hong Kong

OV Fiets (PT-Bike)

- Started in 2003
- Docked system
- 2003: 800 Bikes ; 100,000 trips
- 2017: 14.500 bikes ; 3,200,000 trips
- 3.2 million trips in 2017
- 300 locations in NL

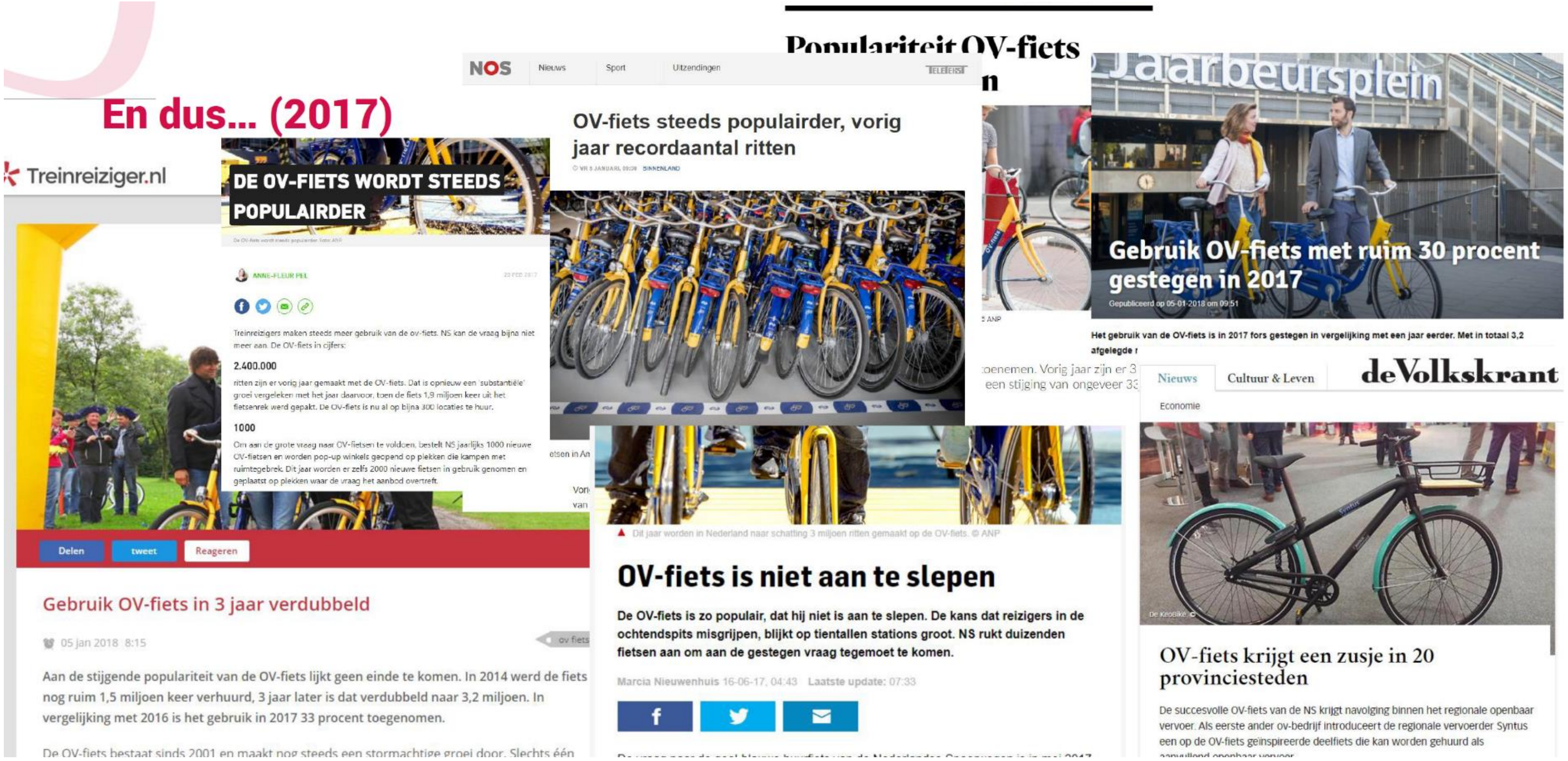


En dus… (2016)

Kager R. (2018)

En dus… (2017)



Treinreiziger.nl

Delen tweet Reageren

Gebruik OV-fiets in 3 jaar verdubbeld

05 jan 2018 8:15

Aan de stijgende populariteit van de OV-fiets lijkt geen einde te komen. In 2014 werd de fiets nog ruim 1,5 miljoen keer verhuurd, 3 jaar later is dat verdubbeld naar 3,2 miljoen. In vergelijking met 2016 is het gebruik in 2017 33 procent toegenomen.

DE OV-FIETS WORDT STEEDS POPULAIRDER

ANNE-FLEUR PEL

Treinreizigers maken steeds meer gebruik van de ov-fiets. NS kan de vraag bijna niet meer aan. De OV-fiets in cijfers:

2.400.000

ritten zijn er vorig jaar gemaakt met de OV-fiets. Dat is opnieuw een 'substantiële' groei vergeleken met het jaar daarvoor, toen de fiets 1,9 miljoen keer uit het fietsenrek werd gepakt. De OV-fiets is nu al op bijna 300 locaties te huur.

1000

Om aan de grote vraag naar OV-fietsen te voldoen, bestelt NS jaarlijks 1000 nieuwe OV-fietsen en worden pop-up winkels geopend op plekken die kampen met ruimtegebrek. Dit jaar worden er zelfs 2000 nieuwe fietsen in gebruik genomen en geplaatst op plekken waar de vraag het aanbod overtreft.

NOS Nieuws Sport Uitzendingen

OV-fiets steeds populairder, vorig jaar recordaantal ritten

Gebruik OV-fiets met ruim 30 procent gestegen in 2017

Het gebruik van de OV-fiets is in 2017 fors gestegen in vergelijking met een jaar eerder. Met in totaal 3,2

OV-fiets is niet aan te slepen

De OV-fiets is zo populair, dat hij niet is aan te slepen. De kans dat reizigers in de ochtendspits misgrijpen, blijkt op tientallen stations groot. NS rukt duizenden fietsen aan om aan de gestegen vraag tegemoet te komen.

Marcia Nieuwenhuis 16-06-17, 04:43 Laatste update: 07:33

deVolkskrant

Nieuws Cultuur & Leven

Economie

OV-fiets krijgt een zusje in 20 provinciesteden

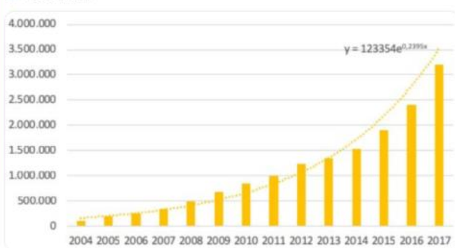
De succesvolle OV-fiets van de NS krijgt navolging binnen het regionale openbaar vervoer. Als eerste ander ov-bedrijf introduceert de regionale vervoerder Syntus een op de OV-fiets geïnspireerde deelfiets die kan worden gehuurd als

Kager R. (2018)

En dus... (2018)

"Exponential growth is exhibited when the rate of change—the change per instant or unit of time—of the value of a mathematical function is proportional to the function's current value" ~@Wikipedia

Tweet vertalen



OV-fiets: 41% extra fietsen en 33% meer ritten

12 okt 2018 12:16

ov fiets

De populariteit van de OV-Fiets blijft enorm toenemen. Dit jaar zijn er tot 1 oktober al ruim 3 miljoen ritten gemaakt. Dat is een stijging van zo'n 33% ten opzichte van dezelfde periode vorig jaar. Om de groei te kunnen blijven faciliteren wordt het aantal fietsen de komende maanden fors uitgebreid. Er komen in totaal 6.000 fietsen bij.

Stormachtige groei

Alleen al op de verschillende locaties rond Utrecht Centraal komen er 600 fietsen bij, rond Amsterdam Centraal 750. Maar ook op kleinere stations wordt het aantal fietsen uitgebreid. Zo krijgen ook Putten en Ermelo er een fiets bij. Aan het einde van het jaar zal Nederland 20.500 OV-fietsen tellen. Ter vergelijking: in 2015 waren dat er nog 8.500. Al sinds 2003 groeit het gebruik van de OV-Fiets stormachtig. Slechts één keer kwam de jaarlijkse groei net onder de tien procent

Kager R. (2018)

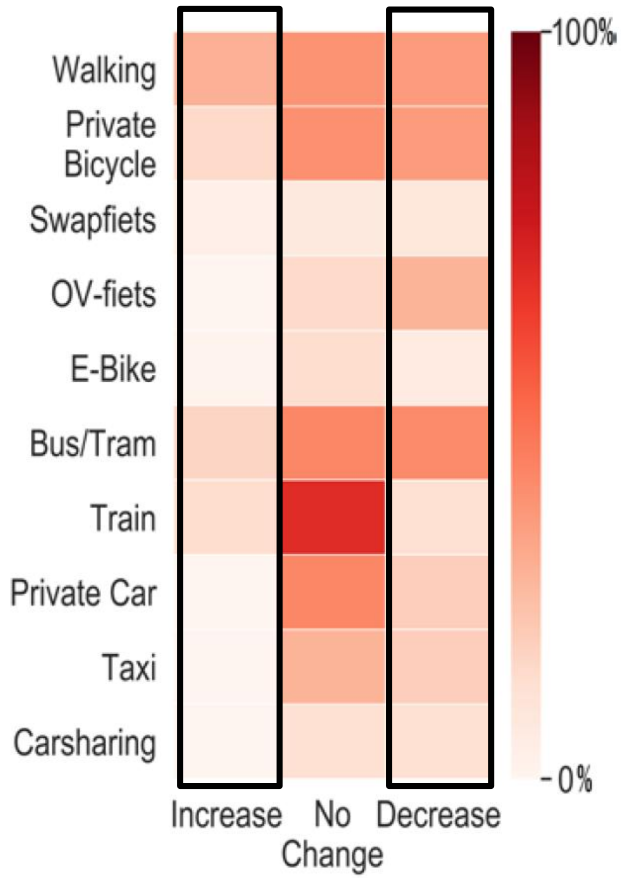
Bike sharing China

- 2005: Started in Beijing
- 2008: first dockless bike sharing system in Hangzhou with 2800 bikes
- 2016: > 400 cities operating docked bike-sharing
  > 890,000 bikes in 32,000 stations
  > 20,000,000 users.
- 2017: 23 million dockless shared bikes
  50 million orders per day
  >106 million registered users

Pros and cons

Effective mobility
Efficient city
Economy
Environment
Equity
5xE

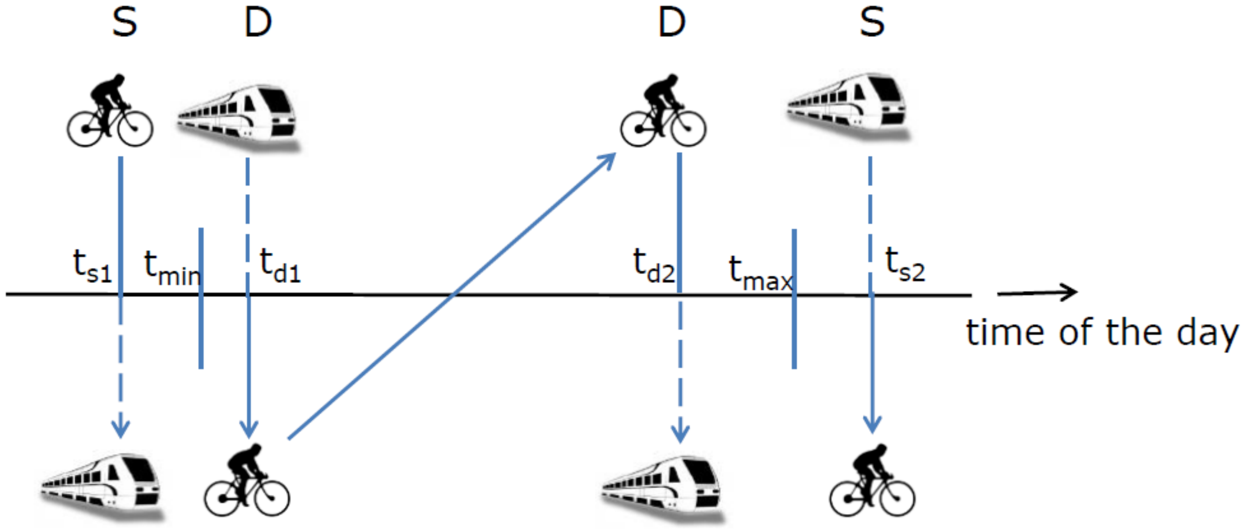
Modal shift?



(a) Modal Shift as a result of Mobike

Future: 5th generation?

Peer-peer bike sharing



5-20% reduction

Correia et al. (2018)

Conclusions

- Bike and PT combines benefits of both
- Potential to improve door to door services
- Potential for enhanced quality and efficiency of PT

- Relatively new research area
- Many knowledge gaps

- Challenging: data acquisition and analysis

- To do: Part 2: (Improving) integrated design -> models to support design

Reading material

Basic: Brightspace

Van Mil, J.F.P., T.S. Leferink, J.A. Annema, N. van Oort (2018). Insights into factors affecting the combined bicycle-transit mode. CASPT conference, Brisbane.

Additional: Brightspace

Brand, J., N. van Oort, B. Schalkwijk, S. Hoogendoorn (2017), Modelling Multimodal Transit Networks; Integration of bus networks with walking and cycling, MT-ITS Conference Napoli.

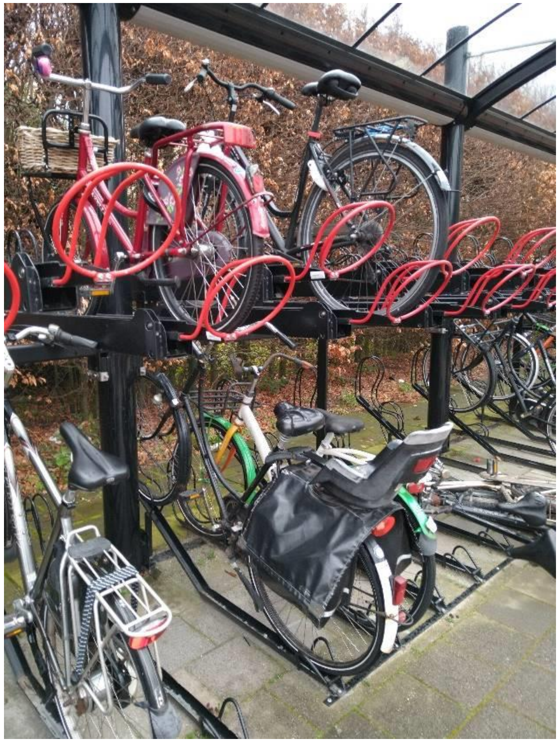
Correia et al. (2018), Potential of peer-to-peer bike sharing for relieving bike parking capacity problems at railway stations

Shelat, S., R. Huisman, N. van Oort (2018). *Analysis of the trip and user characteristics of the combined bicycle and transit mode. Research in Transportation Economics.*

Ma, X, Y. Yuan, N. van Oort, S. Hoogendoorn (2020), Investigating Impact of Bike-sharing Systems on Modal Shift: A Case Study in Delft, the Netherlands, *Journal of cleaner production*

Rijsman et al. (2019). Walking and bicycle catchment areas of tram stops: factors and insights. *MT-ITS conference*

Questions / Contact



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More publications:
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www.smartPTlab.tudelft.nl

Lab Active Mode

Lab Smart Public Transport