Active mobility and health:
Insights from the PASTA project

Evi Dons, VITO, Belgium
Thomas Götschi, UZH, Switzerland
on behalf of the PASTA consortium

This project has received funding from the European Union’s Seventh Framework Programme for research; technological development and demonstration under grant agreement no 602624-2.
A Broadband Project on Active Travel and Health

HEALTH.2013.3.3-1: **Social innovation for health promotion.**

FP7-HEALTH-2013-INNOVATION-1. EU research should aim to identify, develop and better understand innovative approaches to reduce sedentary behaviour and enhance the level of physical activity in the population. Research should include the evaluation of innovative on-going initiatives that reduce sedentary behaviour, enhance the level of physical activity combined with dietary or other interventions. In this context, research should include the identification of "good practices", as well as the analysis of their economic and social benefits and impact. Correlates will have to be detected (such as cultural, environmental, economic, psychological and others) that inhibit or promote the individuals capacity to increase physical activity, reduce sedentary behaviour and self-regulate their dietary or other relevant behaviour. Research may cover various areas affecting lifestyle (e.g. sports, health, education, transport, urban planning, working environment, leisure) as well as different intervention levels (local, national, European). As a social innovation it should address the role of diverse public and private entities, such as business, including social enterprises, civil society organisations and public authorities, as well as their interaction. The views of potential end-users should be integrated in the design of the project as well as the methodology for assessing impact and outcomes throughout the project. The project should have a strong communication strategy.
FP7 Call Title: Social Innovation for Health Promotion

What could possibly be innovative about walking and biking?

• Judging from footprints discovered on a former shore in Kenya, it is thought possible that ancestors of modern humans were walking in ways very similar to the present activity as many as 1.5 million years ago.
• Bicycles were introduced in the 19th century in Europe.
Background

What’s our starting point?
Health Associated with Active Travel in the Course of Life

- Compared to driving, wellbeing was higher when using active travel or public transport.

Relative risk for all-cause mortality for 11.25 MET hours/week of walking

\[ R = 0.89 (0.83, 0.96) \]

\[ \chi^2(15) = 43.73, \ p < 0.0001 \]

\[ p = 0.016 \]
Individual vs. Public Health Perspective

Individual perspective
How healthy or unhealthy (risky) is AT?

Public health perspective
What is it worth to society?
The Role of Public Health in the Promotion of Active Travel

1. Determinants
2. Behaviour
3. Impacts

1. Fixed Factors
   (e.g., topography, weather, demographics)
2. Modifiable Factors
   (e.g., land use, road design, socioeconomic, attitudes)
3. Policies, measures
   (infrastructure investments, campaigns)

Active travel
(surveys, diary, app)

Health impacts
(benefits and risks)

Adapted from „Moving Active Transportation to Higher Grounds“ Conference, Washington DC, April 2015
The Role of Individual Health in Active Travel Behavior

1. Determinants
2. Behaviour
3. Impacts

1. Policies, measures (infrastructure investments, campaigns)
   - Fixed Factors (e.g., topography, weather, demographics)
   - Modifiable Factors (e.g., land use, road design, socioeconomics, attitudes)

2. Active Travel (surveys, diary, app)

3. Health Impacts (benefits and risks)
   - Short term
   - Long term

Individual Motivation

Adapted from „Moving Active Transportation to Higher Grounds“ Conference, Washington DC, April 2015

www.pastaproxject.eu
Towards a Comprehensive Conceptual Framework of Active Travel Behavior: a Review and Synthesis of Published Frameworks

Thomas Götschi¹ · Audrey de Nazelle² · Christian Brand³ · Regine Gerike⁴ · on behalf of the PASTA Consortium
Literature Review (quasi systematic)

- Found 26 «new and conceptual» frameworks.
- Identified common and unique features.
- Integrated in a single diagram.
Known Determinants of Active Mobility

- **Rationale factors (mode choice)**
  - Distance, duration, purpose
- **Psychological factors**
  - Attitudes, TPB, etc.
- **Geographical factors**
  - Topography, neighborhood, routes
- **Time factors**
  - Weather, time of day, day of week
- **Safety**
  - Perceived and objective
Description and Classification of Active Mobility Measures

Literature review and assessment of state-of-the-art of AM WP1 (PASTA - Deliverable – D1.1)

Policies to increase walking and cycling, Design of urban environment, Residential densities, Mixed land use, Bikeability, Walkability, Infrastructure, street connectivity, facility provision, Slope, Weather, Travel time / distance, Effort, Perceived safety, Safety, (Motorised) traffic speeds, Higher volume vehicles, Traffic calming, Cycle tracks, Large vehicles, Compulsory bicycle helmets, Safety in numbers, Social norm, Normalisation of active mobility, Social support, Socio-economic factors generally, Age, seniors, Age, children, No access to car, Car ownership, Physical ability, Ethnic groups, Lower income, Higher income, Higher socioeconomic position and not owning a motor vehicle, Low socio-economic status areas, Educational level, Area- and individual-level income, Dog ownership, Costs of other modes
Review of Reviews: Measures to Promote Active Mobility


http://activelivingresearch.org/ActiveTravelreview
BMJ Open

Physical Activity through Sustainable Transport Approaches (PASTA): a study protocol for a multicentre project

Regine Gerike, Audrey de Nazelle, Mark Nieuwenhuijsen, Esther Anaya, Ione Avila-Palencia, Tom Cole-Hunter, Evi Dons, Ulf Eriksson, Sonja Kahlmeier, Michelle Laeremans, Francesca Racioppo, Elisabeth Raser, Davide Rosi, Christian Schweizer, Arnout Standaert, Thomas Götschi, on behalf of the PASTA collaboration

DOI 10.1186/s12889-015-2453-3

STUDY PROTOCOL

Physical Activity through Sustainable Transport Approaches (PASTA): protocol for a multi-centre, longitudinal study

Seven Case-study Cities

- Walking
- Cycling
- Public Transport
- Private motorised
What are the determinants of active travel?
What are effective measures to promote active travel?

What is the interrelation between active travel and physical activity?

What are the health impacts of active travel?

**PASTA Research Objectives**

- **Context**
  - Physical environment
    - Transport options
    - Built environment
    - Natural environment
  - Social Environment
  - Planning practice

- **Individual**
  - Individual characteristics
    - Socio-demographics
    - Home and work location
  - Socio-geographical factors
    - Neighborhood perceptions
    - Perception of travel choices
  - Socio-psychological factors
    - Extended theory of planned behaviour
  - Trips
  - Travel choices

- **Impacts**
  - Physical activity
  - Travel behaviour
  - Safety incidents
  - Health benefits from PA
  - Environmental impacts
  - Health risks from AP
  - Injury risks from travel
  - Net health impacts
Study design, methods and tools
Physical Activity Through Sustainable Transport Approaches

Online Survey

Welcome to the PASTA survey!

Completing this questionnaire will take about 5 minutes.

With many thanks and best wishes from the PASTA team.

How did you find out about this survey?

- Friends, neighbours or relatives
- News or other media (newspaper, radio, TV)
- Employer/Workplace
- By mail (letter, mailout)

Do you do any moderate-intensity sports, fitness or recreational (leisure) activities for at least 10 minutes? (35%)

- Yes
- No
Longitudinal Online Survey

- Before/after, trend evaluation
- Active travel and physical activity vary in time
- Lots of questions to ask
Rolling recruitment, hibernation for participants affected by „top measures“

- Polygon
- Yes
- No
- New user

- TM group?
- BQ answer
- < hibernation start?

- TM Affected
- TM Control

- General sample

- Campaign start

- Hibernation
  - start hibernation
  - TM implementation buffer period
  - stop hibernation
Health and Air Pollution Add-on

- Real-life study design
- 40 healthy adults / city (Antwerp, London, Barcelona)
- 1 week, 3 seasons

Personal exposure to black carbon, GPS, Sensewear, ExpoApp, Zephyr bioharness

Health parameters: HRV, blood pressure, fundus photography, eNO, spirometry
Tracking Add-on: “PASTA on the Move”

- 546 participants were followed for up to 6 months
- using the commercial smartphone application “Moves” (https://www.moves-app.com/)
- track journeys and automatically detect travel modes
- 29 April 2016 – 9 January 2017
Tracking add-on: “PASTA on the Move”

<table>
<thead>
<tr>
<th>City</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antwerp</td>
<td>71</td>
<td>13.00</td>
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<tr>
<td>Barcelona</td>
<td>107</td>
<td>19.60</td>
</tr>
<tr>
<td>London</td>
<td>66</td>
<td>12.09</td>
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<tr>
<td>Örebro</td>
<td>31</td>
<td>5.68</td>
</tr>
<tr>
<td>Roma</td>
<td>131</td>
<td>23.99</td>
</tr>
<tr>
<td>Vienna</td>
<td>54</td>
<td>9.89</td>
</tr>
<tr>
<td>Zurich</td>
<td>86</td>
<td>15.75</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>546</td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Participants per city:
- Antwerpen: 13%
- Barcelona: 19%
- London: 19%
- Örebro: 6%
- Roma: 24%
- Wien: 12%
- Zürich: 16%
Sample Description

Who are the PASTA participants?
Recruitment Progress over Time

12,825 registrations
How did participants find out about the survey?

- **22%** Work
- **22%** Word of mouth
- **18%** Other organisations
- **13%** Outreach activities
- **12%** News
- **8%** Social media
- **13%** Public notice
- **12%** Random sampling
Sample description

- Participants by city:
  - Antwerp: 12%
  - Barcelona: 12%
  - London: 14%
  - Oerebro: 16%
  - Rome: 17%
  - Vienna: 15%
  - Zurich: 12%

- Age distribution:
  - 16-20: 2%
  - 20-30: 25%
  - 30-40: 27%
  - 40-50: 21%
  - 50-60: 17%
  - 60-70: 6%
  - 70-80: 2%
  - 80+: 0.1%

- Education levels:
  - No degree: 0.3%
  - Primary education: 1.2%
  - Secondary education / Further education: 26.0%
  - Higher education / University education: 72.5%
Distribution across Cities

Registrations $n = 12,825$
People started baseline $n = 10,691$
People finalized baseline $n = 8,567$

Number of registrations
Number of people who started baseline questionnaire
Number of people who finalized baseline questionnaire

Antwerp 1575 1244 1372
Barcelona 1939 1445 1372
London 1792 1446 1030
Örebro 2141 1401 1042
Rome 2090 1844 1562
Vienna 1804 1472 1182
Zurich 1484 1356 1135
10’000+ Participants, 87’000 Questionnaires
# How Representative is the PASTA Sample? (age)

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<thead>
<tr>
<th>City</th>
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<th>40-49</th>
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<tr>
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<td>9.4</td>
<td>7.5</td>
<td>6.3</td>
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<td>32.5</td>
</tr>
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<td>Barcelona PASTA</td>
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<td>5.9</td>
</tr>
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<td>Barcelona Delta</td>
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</tr>
<tr>
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<td>9.4</td>
<td>7.5</td>
<td>6.3</td>
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<td>9.7</td>
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<td>Rome Delta</td>
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<tr>
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<td>3.4</td>
<td>2.9</td>
<td>5</td>
<td>-8.8</td>
</tr>
<tr>
<td>Vienna City Census</td>
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<td>19.0</td>
<td>18.1</td>
<td>16.6</td>
<td>26.7</td>
</tr>
<tr>
<td>Vienna PASTA</td>
<td>27.3</td>
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<td>19.8</td>
<td>16.9</td>
<td>8.4</td>
</tr>
<tr>
<td>Vienna Delta</td>
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<td>27.7</td>
<td>19.8</td>
<td>16.9</td>
<td>8.4</td>
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<td>0.3</td>
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</table>
Travel Data

Understanding travel patterns and their determinants
Oversampling of Cyclists

<table>
<thead>
<tr>
<th>City</th>
<th>Walking</th>
<th>Cycling</th>
<th>Car</th>
<th>PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antwerp</td>
<td>11%</td>
<td>54%</td>
<td>28%</td>
<td>7%</td>
</tr>
<tr>
<td>Barcelona</td>
<td>20%</td>
<td>23%</td>
<td>41%</td>
<td>16%</td>
</tr>
<tr>
<td>London</td>
<td>38%</td>
<td>24%</td>
<td>17%</td>
<td>28%</td>
</tr>
<tr>
<td>Oerebro</td>
<td>46%</td>
<td>17%</td>
<td>35%</td>
<td>18%</td>
</tr>
<tr>
<td>Rome</td>
<td>29%</td>
<td>13%</td>
<td>12%</td>
<td>34%</td>
</tr>
<tr>
<td>Vienna</td>
<td>24%</td>
<td>16%</td>
<td>16%</td>
<td>42%</td>
</tr>
<tr>
<td>Zurich</td>
<td>22%</td>
<td>24%</td>
<td>27%</td>
<td>16%</td>
</tr>
</tbody>
</table>
Gender Split in Cycling

Cyclist: ♂ 54.5% | ♀ 45.5%
Non-cyclist: ♂ 45.4% | ♀ 54.6%

N = 5,650
Cycling as a Mode of Transport

- 77% think that “it saves time”
- 57% “find it comfortable”
- 23% consider it “safe with regards to the risk of traffic”
Health Attitude: Does it matter?

• “Cycling for travel offers personal health benefits”: 92% agree
  • “Very much agree” bike 4 minutes more than “very much disagree”
  • “Health is a criterion when choosing mode of transport”
  • “Very much agree” bike 20 minutes (+ 30%) more than “very much disagree” (72 min vs. 55 min/day)
Electric-assist Bikes (E-bikes/Pedelecs)

- E-bikers tend to be heavier than conventional cyclists
- E-bikers travel longer distances
- E-bikers achieve similar levels of physical activity as conventional cyclists

E-biking is a valuable source of physical activity, in particular for older people who benefit even more from physical activity.
Infrastructure Evaluation

What is the effectiveness of specific infrastructures?
London Case Study: Spatial analysis of cycling infrastructures

Exposure = affected population within buffers

Dose – response analysis = multiple exposures (quantity) and quality of interventions.
Behaviour Change Model (Stages of Change Diagnosis)

Trans-theoretical Model of the five stages of change. Based on Prochaska and Diclemente (1986)
Cycling Networks are Associated with Cycling Mode Shares

Mueller N. Et al. forthcoming
Antwerp Cycling Highway

Cost-benefit ratios indicate that the benefits of the cycling highway Antwerp-Mechelen (Belgium) are 2 to 14 times higher than the initial investment.

<table>
<thead>
<tr>
<th>Impact factor</th>
<th>euro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity (reduced mortality)</td>
<td>$1.2 \times 10^7$</td>
</tr>
<tr>
<td>Physical activity (reduced morbidity)</td>
<td>$2.3 \times 10^6$</td>
</tr>
<tr>
<td>Reduced air pollution society (mortality)</td>
<td>$7.4 \times 10^4$</td>
</tr>
<tr>
<td>Air pollution active mobility</td>
<td>$-8.9 \times 10^5$</td>
</tr>
<tr>
<td>Crash risk</td>
<td>$-1.4 \times 10^6$</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$+1.2 \times 10^7$</strong></td>
</tr>
<tr>
<td>Infrastructure construction costs</td>
<td>$-6.0 \times 10^6$</td>
</tr>
<tr>
<td><strong>Benefit:cost ratio</strong></td>
<td><strong>2.0</strong></td>
</tr>
</tbody>
</table>
Active Mobility and Physical Activity

Is active mobility a net gain, or does it substitute for other forms of physical activity (e.g. going to the gym)?
AM – PA relationship

Does an increase in walking and cycling translate into more physical activity?  
YES: active mobility helps to increase physical activity levels
Is self-reported PA reliable?

Vigorous-intensity PA: YES
Moderate-intensity PA: underestimated
Sedentary time: inaccurate
Safety

Exposure adjusted crash risks
Exposure Adjusted Crash Rates

- Valid comparisons
- Identification of safety factors

Crashes

Exposure

>900 bike crashes

>200 crashes on foot
Exposure Adjusted Bicycle Crash Rates

Per «hours cycled»

Per «km cycled»

Travel Diary Sub-Sample (participants = 2,101 ; crashes = 496 )
# Crash Risk Factors (Preliminary Results)

<table>
<thead>
<tr>
<th>Effects</th>
<th>Hazard Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex - Female</td>
<td>0.80 (0.63, 1.01).</td>
</tr>
<tr>
<td>Age – 35-50</td>
<td>0.78 (0.61, 1.00).</td>
</tr>
<tr>
<td>Age – 50+</td>
<td>0.90 (0.66, 1.21)</td>
</tr>
<tr>
<td>City - Barcelona</td>
<td>1.18 (0.79, 1.77)</td>
</tr>
<tr>
<td>City - London</td>
<td>1.47 (1.04, 2.09)*</td>
</tr>
<tr>
<td>City - Oerebro</td>
<td>0.22 (0.09, 0.49)***</td>
</tr>
<tr>
<td>City - Roma</td>
<td>1.27 (0.89, 1.79)</td>
</tr>
<tr>
<td>City - Wien</td>
<td>1.44 (1.08, 1.91)*</td>
</tr>
<tr>
<td>City - Zurich</td>
<td>1.53 (1.10, 2.11)*</td>
</tr>
</tbody>
</table>

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ‘ 1

(based on km)
Concerns about Air Pollution

Are they justified?
Concern over health effects of air pollution

- **NO\textsubscript{2}**
  - High
  - Low

- **PM\textsubscript{2.5}**
  - High
  - Low

The chart shows the percentage of people worried about air pollution in various cities. The data is categorized by concern level:
- Not worried at all
- Not worried
- Neither worried nor not worried
- Worried
- Extremely worried

The cities listed in the chart are Antwerp, Barcelona, London, Oerebro, Rome, Vienna, and Zurich.
Concern over health effects of air pollution

Being male, having children in the household, being more physically active, and higher NO₂ at the home address → higher concern over health effects of air pollution
BMI

What happens when you start cycling?
BMI analysis

Key gaps addressed:

- Cross-sectional analysis vs. longitudinal analysis
- Taking into account important covariates like leisure-time PA
- Many participants using many different modes
- Multicentre study
BMI analysis

Results from the cross-sectional analysis

![Graph showing BMI difference (kg/m²) per additional day per month for different modes of transport and cycling frequency.](image)
BMI analysis

- Translate BMI in kilograms.
- Reverse causality.
Conclusions
Achievements and outlook
Conclusions

- **Contributions in terms of innovative research**
  - Successful implementation of a cutting-edge online survey
    - Recruitment, online platform,
  - Innovative longitudinal study design
- **Unique data set in terms of size and contents**
- **Some unique findings**
  - Crash rates
  - Effects of active mobility on BMI, (and other health endpoints)
  - E-bikes
  - ...and many more to come!
Recap and Outlook

Ample gaps in (quantitative) understanding of active travel remain!

*PASTA research progress timeline*

2014: can we measure it?
2015: can we find participants?
2016: can we clean all that data?
2017: can we analyze all this?
2018: can we find funds to continue analyzing?

(Research) progress is a slow vehicle! - keep pushing!
Thanks to our Collaborators

B. Alasya, E. Anaya, I. Avila-Palencia,

Advisory Board: K. Dziekan, A. Ahrens, M. Jerrett, A. Davis
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