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BLITS
Brussels Labo voor Inspanning & TopSport

Assessing the overall health benefits/dis-benefits of cycling

PODIUM DISCUSSION: Velo-city Vienna 2013

Bas de Geus

Dept. Human Physiology

VRIJE UNIVERSITEIT BRUSSEL • SCIENTIA VINCERE TENEBRAS •

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MEDICINE & SCIENCE
IN SPORTS

Review

Health benefits of cycling: a systematic review

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The purpose of this study was to update the evidence on the health benefits of cycling. A systematic review of the literature resulted in 16 cycling-specific studies. Cross-sectional and longitudinal studies showed a clear positive relationship between cycling and cardiorespiratory fitness in youths. Prospective observational studies demonstrated a strong inverse relationship between commuter cycling and all-cause mortality, cancer mortality, and cancer morbidity among middle-aged to elderly subjects. Intervention studies among working-age adults indicated consistent improvements in cardiovascular fitness and some improvements in cardiovascular risk factors due to commuting cycling. Six studies showed a consistent positive dose–response gradient between the amount of cycling and the health benefits. Systematic assessment of the quality of the studies showed most of them to be of moderate to high quality. According to standard criteria used primarily for the assessment of clinical studies, the strength of this evidence was strong for fitness benefits, moderate for benefits in cardiovascular risk factors, and inconclusive for all-cause mortality, coronary heart disease morbidity and mortality, cancer risk, and overweight and obesity. While more intervention research is needed to build a solid knowledge base of the health benefits of cycling, the existing evidence reinforces the current efforts to promote cycling as an important contributor for better population health.

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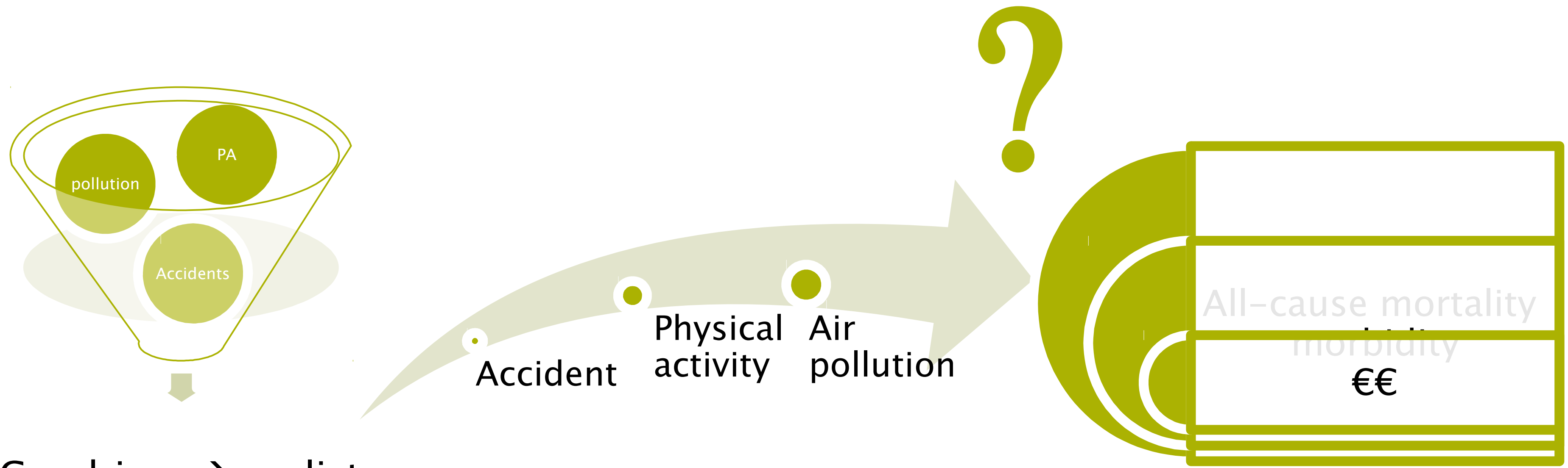
Unfortunately…

- Cycling (in urban environment) is more than only physical activity
  - cycling is also related to:
  - *bicycle accidents*: cyclists incur higher crash risks than motorists (in particular car drivers) in terms of accidents per distance (BRSI, 2009; Elvik, 2009)
  - *air pollution*: exposure cyclist >> car driver (Int Panis, 2010)

Predictive models



Car driver → cyclist
Anno: 2013

Anno: 2053

Cost–benefit analysis

Available studies: e.g.

- de Hartog et al., 2010: all–cause mortality
- Rojas–Rueda et al., 2011: all–cause mortality
- Holm et al., 2012: DALY (mortality & morbidity)
- Ralb & de Nazelle, 2012: Economic cost: mortality
- Cavill, 2010 (Review): Economic cost: infrastructure
- Gotschi, 2011: Economic cost: infrastructure
- Aertsens & de Geus, 2010: Economic cost: accidents

all-cause mortality

Do the Health Benefits of Cycling Outweigh the Risks?

Jeroen Johan de Hartog,[1] Hanna Boogaard,[1] Hans Nijland,[2] and Gerard Hoek[1]

- 500,000 people make a transition from car to bicycle for short trips on a daily basis in the Netherlands

Stressor	Relative risk	Gain in life years[a]	Gain in life days/ months per person[a]
Air pollution	1.001 to 1.053	–1,106 to –55,163 (–28,135)	–0.8 to –40 days (–21 days)
Traffic accidents	0.996 to 1.010[b] 0.993 to 1.020[b]	–6,422 to –12,856 (–9,639)	–5 to –9 days (–7 days)
Physical activity	0.500 to 0.900	564,764 to 111,027 (337,896)	14 to 3 months (8 months)

all-cause mortality

Do the Health Benefits of Cycling Outweigh the Risks?

Jeroen Johan de Hartog,[1] Hanna Boogaard,[1] Hans Nijland,[2] and Gerard Hoek[1]

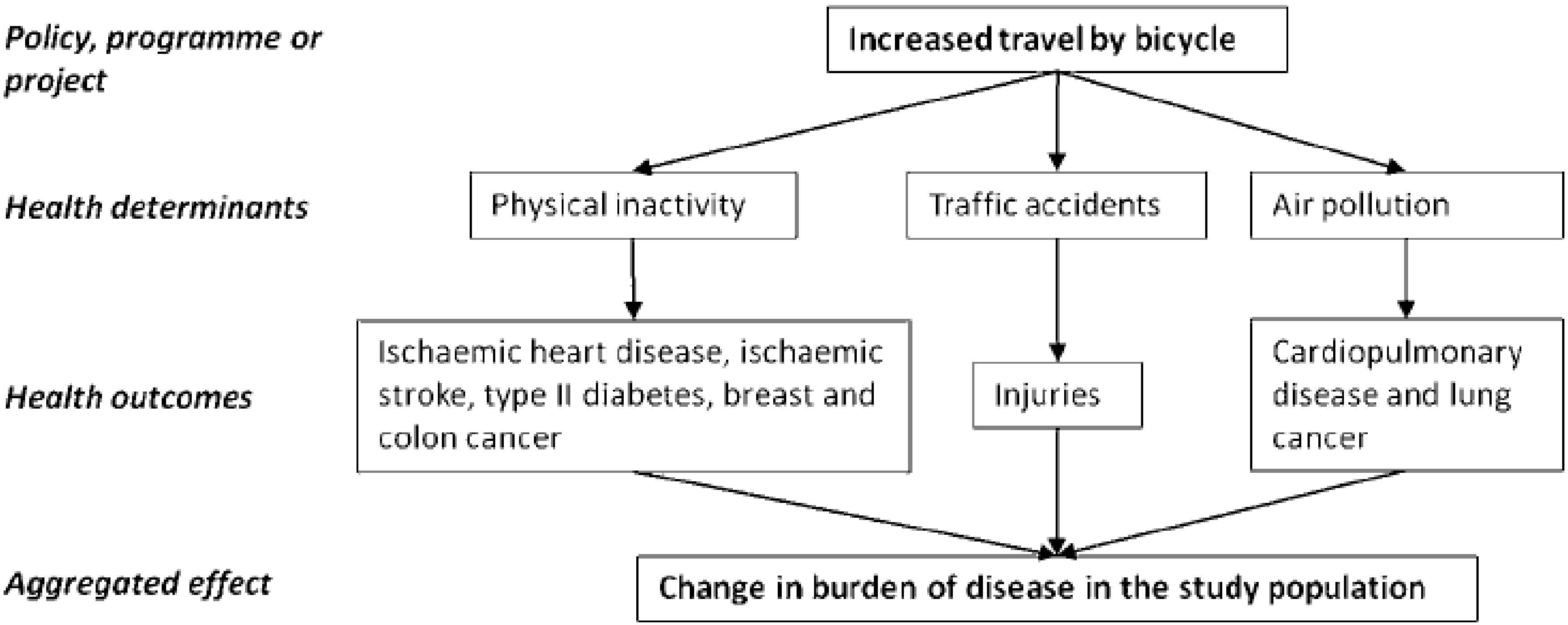
CONCLUSIONS: On average, the estimated health benefits of cycling were substantially larger than the risks relative to car driving for individuals shifting their mode of transport.

KEY WORDS: air pollution, biking, cycling, life table analysis, modal shift, physical activity, traffic accidents. *Environ Health Perspect* 118:1109–1116 (2010). doi:10.1289/ehp.0901747 [Online 30 June 2010]

DALY

- Holm et al., 2012
  - 33% trips in Copenhagen by bicycle

 → 50% car trips 2-10 km & 33% car trips 10-15 km to cycling ➔ cyclists to 42%



DALY

- Proposed increase in cycling could reduce the burden of disease in the study population by 19.5 DALY annually:
  - (+) physical inactivity: 76.0 DALY
  - (–) air pollution: 5.4 DALY
  - (–) traffic accidents: 51.2 DALY

Economic cost: mortality

- Rabl & de Nazelle (2012)
  - Shift car → bicycling: commute of 5 km (one way) 5 days/week 46 weeks/yr
  - evaluating 4 effects:
  - health benefit by PA
  - public health benefit due to reduced pollution
  - individual exposure to ambient air pollution
  - individual risk of accidents

→ Mortality ➔ €€

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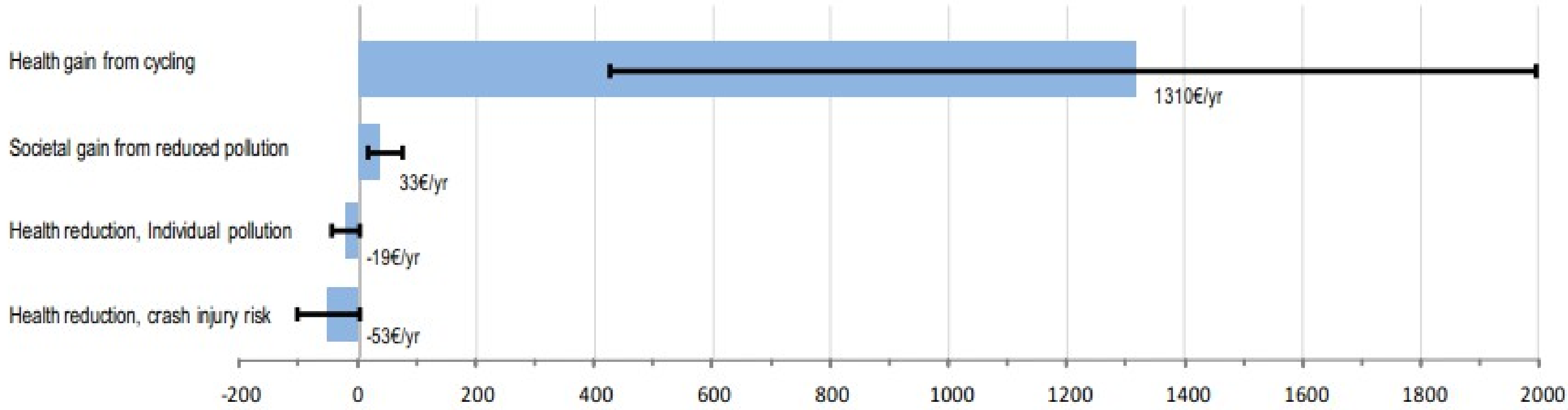
Economic cost: mortality

- Estimated mortality costs and benefits per individual switching from car to bicycle for work trips* in large European cities

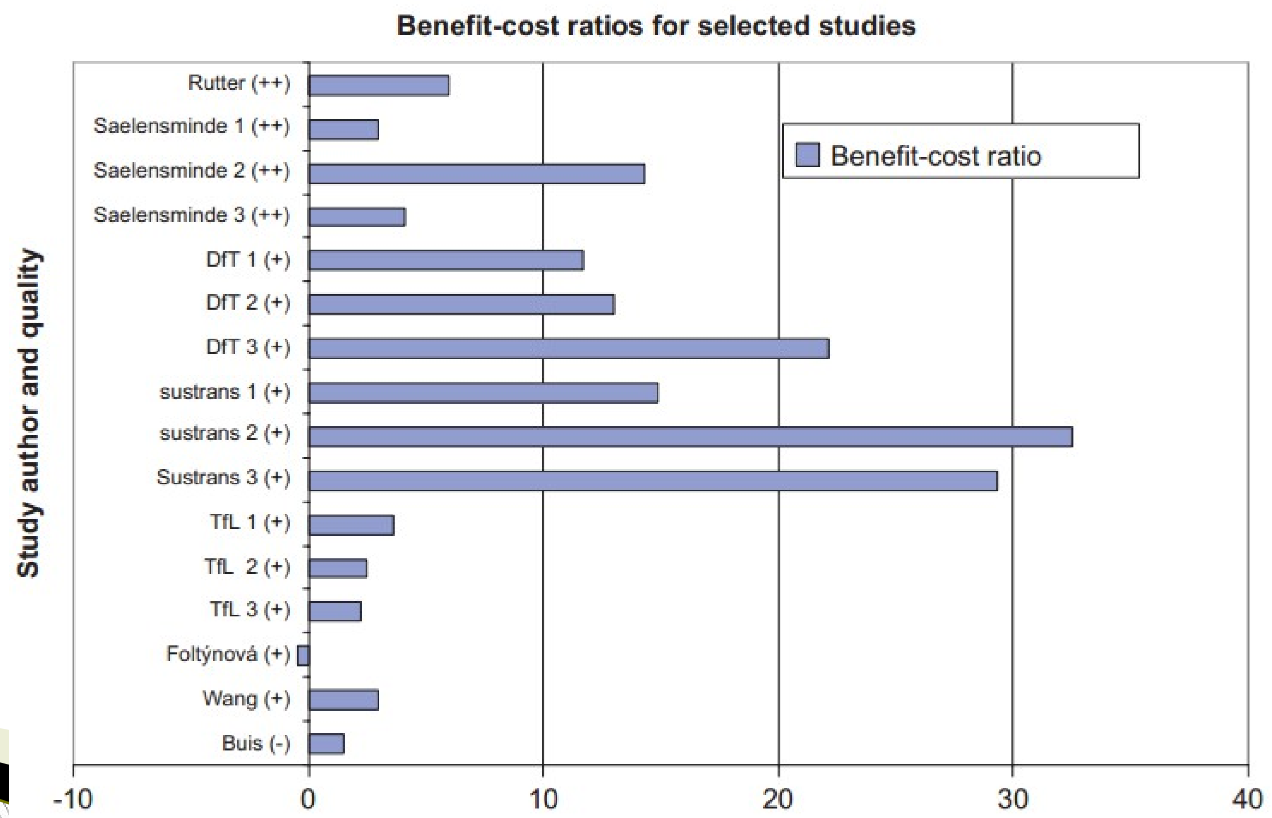


* 2x5km daily roundtrip, 5 days per week, 46 weeks per year

Error bars represent upper and lower (%% confidence intervals.

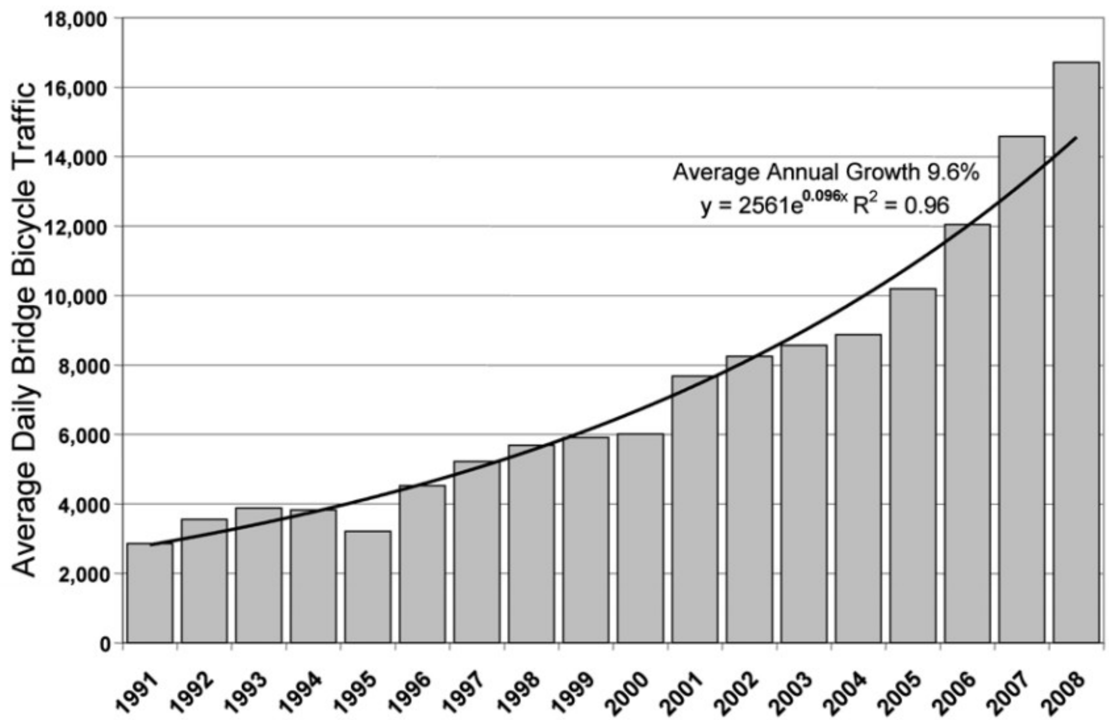
Economic cost: infrastructure

- Cavill et al., 2008 (review)
  - transport infrastructure and policy + walking and/or cycling and health effects
  - median benefit-cost ratio (BCR): 5:1



Economic cost: infrastructure

- Gotschi (2011)
  - Calculations made for Portland (US)
  - Outcome:
  - health care cost savings
  - value of statistical life savings



Economic cost: infrastructure

- By 2040, investments $138 to $605 million will result:
  - health care cost savings of $388 to $594 million
  - fuel savings of $143 to $218 million
  - savings in value of statistical lives of $7 to $12 billion.

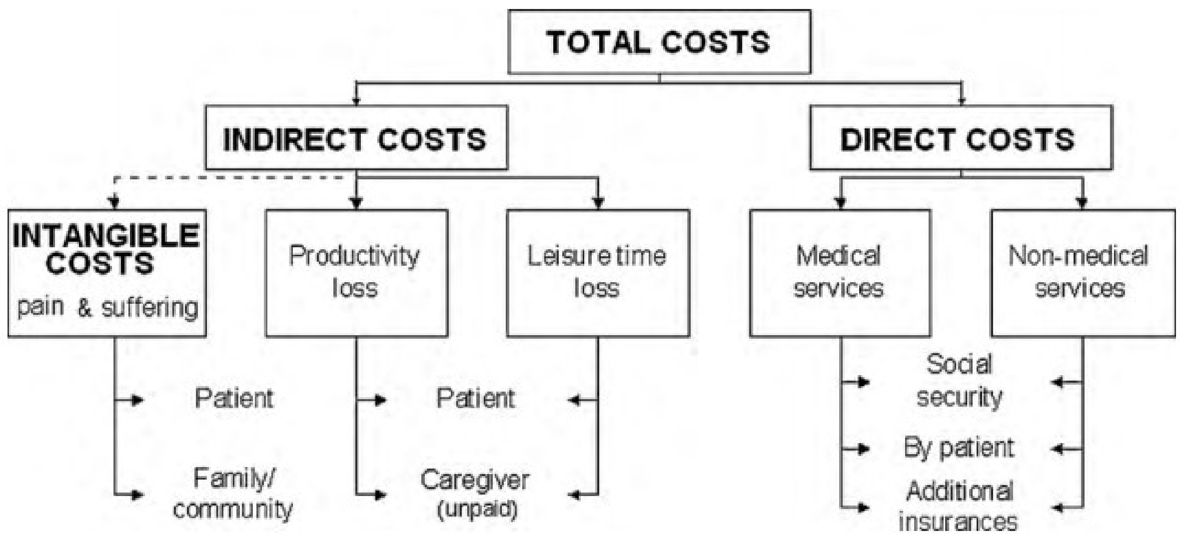
  - BCR for health care and fuel savings: 3.8:1 – 1.2:1
  - order of magnitude larger when value of statistical lives is used.

Costs bicycle accidents

- Costs (Belgium):
  - I. **minor** (<24 hrs hospital) bicycle accidents (Aertsens, 2010)
  - II. **major** (>24 hrs hospital) bicycle accidents (de Geus, (in prep))

- Cost of illness approach

→ estimate ≠ different cost categories (US Environmental Protection Agency (EPA, 2006)



Composition of the total cost for society related to illnesses and injuries, based on EPA (2006).

I. Minor accidents

- average total cost:
  - €841 (95% CI: 579–1205) / 1 accident
  - €0.125 / 1 kilometre cycled

- What does this imply for society?

➔ estimate total cost of minor bicycle accidents:

€88–183 million/year

II. Major accidents

- Direct costs:
  - calculated per victim

€	MAJOR	MINOR	% MAJ/MIN
Doctor visits	2,368		
Chirurgical	3,550		
Medication	235		
Ambulance	32		
Material	433		
TOTAL	**6,618**		

II. Major accidents

- Indirect costs:
  - calculated per victim

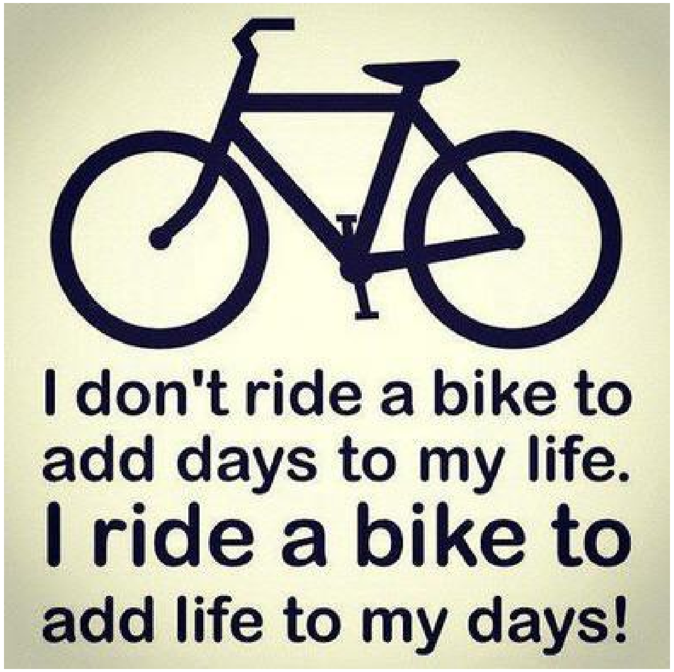
€	MAJOR			MINOR	% MAJ/MIN
	Permanent	Temporary	Total	Total	
Productivity loss	/	44,437	44,425		
Compensation work disability	2,376	4,739	7,115		
Intangible costs	457	12,636	13,093		
TOTAL	**2833**	**61,812**	**64,633**		

Economic costs: accidents

- Veisten et al. (2007)
  - hospitals in Norway in the period 1990–1997
  - economic costs of (all) bicycle injuries

    → ≅ €300 million / year

Summary


I don't ride a bike to
add days to my life.
I ride a bike to
add life to my days!

Positive or negative €€ balance?

Although the costs related to cycling accidents, road infrastructure, air pollution are high

Cost–benefits (ratio) of being physically active on a daily basis outweigh the ‘negative’ costs

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On valorising the cycle user not the choice being made

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Structure of talk

1 Some theory

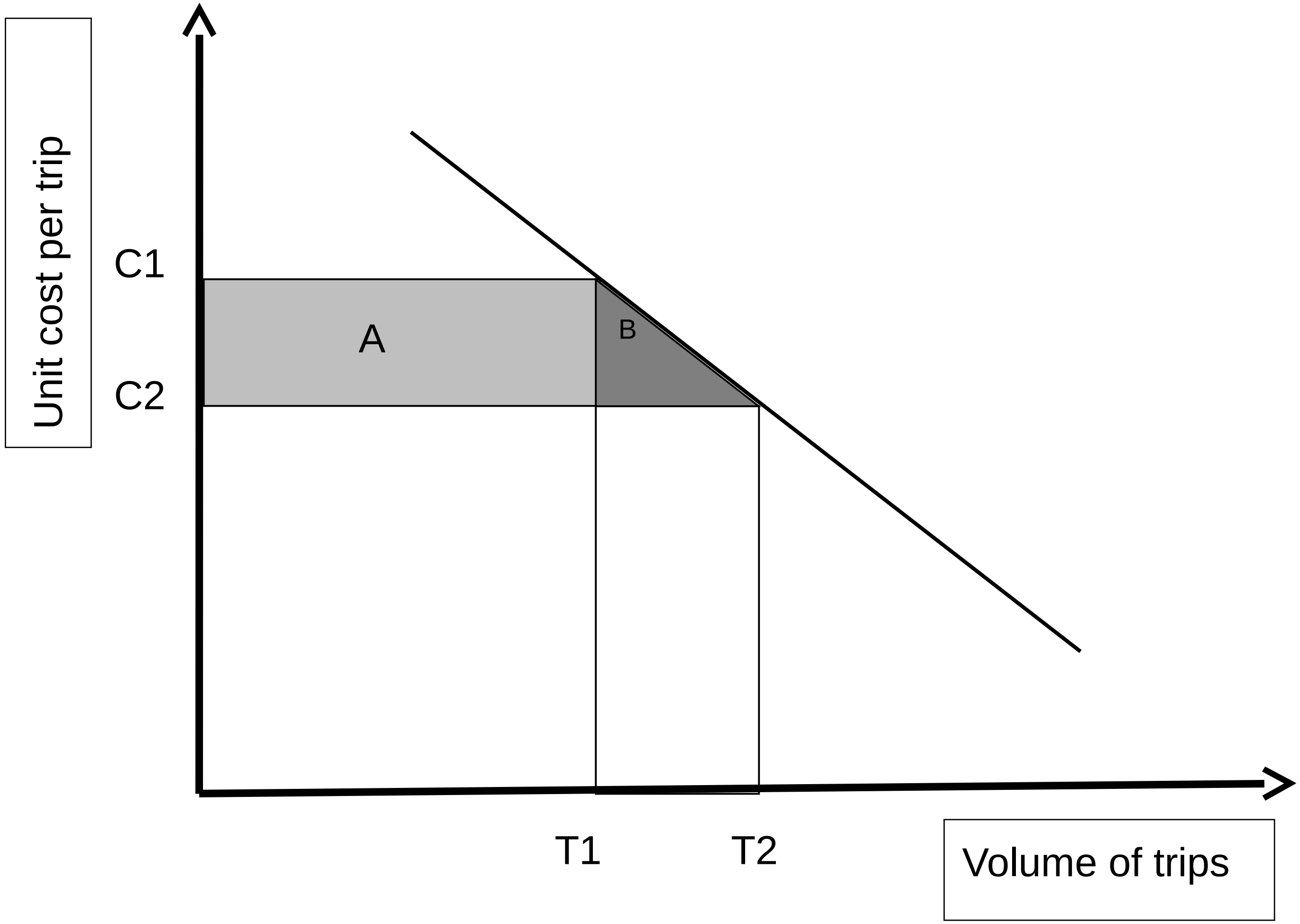
2 Benefits of cycle use

  – Monetisation of benefits
  – Journey ambience
  – User benefits

3 Conclusion

  – Valuing the user not the choice
  – Value of time benefits

1 Some theory



$$Consumer\ Surplus = (C_1 - C_2).T_1 + \frac{1}{2}.(C_1 - C_2).(T_2 - T_1) = \frac{1}{2}.(T_1 + T_2)(C_1 - C_2)$$

2 Benefits of cycle use

Benefit	Basis of estimation	Source of change
Noise	Change in average noise in decibels on ‘A’ weighted scale over 18 hour period.	Reduced motor traffic use
Local air quality	Change on emissions of particulate matter and nitrous oxides.	Reduced motor traffic use
Greenhouse gases	Change in fuel and energy consumption	Reduced motor traffic use
Consumer users remaining as car users	Change in journey times and costs (commute and other uses)	Reduced motor traffic use
Business users and providers remaining as car users	Change in journey times and costs	Reduced motor traffic use
Accidents	Change in numbers of collisions based on willingness to pay to avoid death and injury plus other collision related costs	Cycle use (which reduces cycle accident rate because of ‘safety in numbers’) and reduced motor traffic use
Physical fitness	Reduced mortality and work absenteeism	Cycle use
Journey ambience	Change in time on routes of different levels of ambience	Cycle use
Consumer users	Change in journey times and costs (commute and other uses)	Cycle use
Business users and providers	Change in journey times and costs	Cycle use

Journey ambience

Scheme	Value (2010 values and prices)	Source
Off-road segregated cycle track	7.03p/min (€5.00/hour)	Hopkinson & Wardman (1996)
On-road segregated cycle lane	2.99p/min (€2.13/hour)	Hopkinson & Wardman (1996)
On-road non-segregated cycle lane	2.97p/min (€2.11/hour)	Wardman et al. (1997)
Wide nearside lane	1.81p/min (€1.29/hour)	Hopkinson & Wardman (1996)
Shared bus lane	0.77p/min (€0.55/hour)	Hopkinson & Wardman (1996)
Secure cycle parking facility	98.14p (€1.16)	Wardman et al. (2005)
Changing and shower facility	20.82p (€0.25)	Wardman et al. (2005)

Value of travel time

Purpose	Value (2010 values and prices per hour)	Unit of account
Non-working time commute	£6.46 (€7.65)	Market price
Non-working time other	£5.71 (€6.76)	Market price
Working time car driver	£28.35 (€33.59)	Resource Cost
Working bus passenger	£21.69 (€25.70)	Resource Cost
Working time rail passenger	£39.65 (€46.97)	Resource Cost
Working time cycle user	£18.24 (€21.61)	Resource Cost

Valorise the user

- Börjesson and Eliasson (2012) emphasis on intrinsic benefits of time savings not on reduced car traffic and health benefits
- Perverse that provision for cycling predicated on basis of benefits to other modes.
- Value the users of a system, avoid valuing the ‘choice’
- Such user valorisation will place user needs centre stage in planning

Is travel utilitarian?

- Transport time is assumed ‘non-productive’
- But ‘expenditure’ of travel time variable suggesting it may not be uniformly unproductive.
- Some travel ‘undirected’, some ‘utilitarian’ travel has ‘excess travel’ within it
- Hence, there are benefits other than arriving at the destination.
- There is meaning associated with travel beyond desire to arrive

Are savings ‘valuable’

- A travel time ‘saving’ useful only if:
  - it can be transferred to a more desirable activity
  - Savings are large enough to be non-negligible
  - Something else ‘more worthwhile’ may not exist
- Savings consumed as opportunity to travel further

Savings for cycle users

- What are the proxy benefits for cycle users?
- Potential greater variability in intrinsic value for a cycle user:
- One extreme ‘worthless’
- Other extreme (in poor environmental conditions) extremely valuable
- ‘Value’ in better understanding of bicycle travel time savings.

Call for papers for Research in transportation business and management

- Business and management themes connected with cycling, with focus on bringing into transport theories and practices from other disciplines.
- 1. Governance structures
- 2. Strategy and management
- 3. Funding and investment
- 4. Operation of public bicycle schemes
- 5. Inter-modality management (including trains, taxis, buses, aviation and ferries)
- **Please respond to j.parkin@lsbu.ac.uk by 28th June 2013.**

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Edited by John Parkin