Changing Structures Induce Changing Behaviour: Streetscape Revitalisation and Human Mobility

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1 ABSTRACT

The preceding contributions of Frey and Emberger in this workshop prepare the theory-based path from the layer-based model of human behaviour to the acting principles of a human-centered design of urban spaces, streetscapes and transport structures.

Designing transport infrastructures and urban streetscapes poses an ethical challenge for the human being a part of a socio-technical regime. Not only are humans of course in every stage of life and health every-day users of these designed structures, some also act as planning agents of the very same – either as planners or in a public participation. Densely intertwined with the ethics question of properly designing urban mobility structures is the question on where and how to start the change of structures. Overcoming mental barriers among planners and decision makers as well as users not yet accustomed to a changed streetscape pose a considerable challenge for shaping society's dynamically evolving urban transport regimes.

Human mobility behaviour is subject to "fast" adaptability, if change management techniques are applied, ie. comprehensive information is available on a wide scale beforehand of the intervention. As large scale sporting events of the past have shown, such quasi-permanent transformation (closures for vehicular traffic) evoke the transport system's flexibility in reacting on such events: mobility patterns adapt.

Because this paper claims to provide a synopsis of evidence and examples of changes in behaviour due to changed structures, it culminates with four sets of examples following these main lines of thought:

(1) Example: Active modes friendly settlement structures

(2) Example: Commuting infrastructure

(3) Example: Parking place pricing and and locations

(4) Example: Rredifining road space usage

We conclude with highlighting the behavioural flexibility of mobility, the impacts of such behavioural changes from the urban dwellers' perspectives and the importance of making such changes conceivable beforehand.

Keywords: Planning; Structures; Behavioural change; Mobility, transport planning

2 INTRODUCTION

Infrastructural design poses ethical challenges on engineers in special and on society in general (Brezina and Frey, 2013). These challenges range from small-scale application of fair share policies to large-scale ubiquitous access policies (Brezina et al., 2014). Thus questions of well-being ("Is it a good place to live?"), justice ("Who get's the benefits and who the harm?"), sustainability ("How long can this place last?"[1]) and legitimacy ("Who should make decisions about the places?") need to be thoroughly addressed when it comes to designing streetscapes fit for the future (Kirkman, 2010). Streetscape revitalisation policies have been discussed and applied in the last decades for improved liveability and sustainability of once strongly car-oriented streetscapes (Brezina, 2005, Buehler and Pucher, 2011, Schopf and Emberger, 2013, Topp and Pharoah, 1994). In recent studies, car-free urban space design has also received attention under an alternative perspective, eg. its role in shaping first and last mile decisions (Tight et al., 2016).

The model of "structures inducing mobility data" was introduced more than a decade ago (Knoflacher, 2001a, 2007) and recently enhanced to include planning and education (Frey, 2014). In its latest shape, the model links planning (and the education of stakeholders therein) with the measured data through the structures and the behaviour that these induce. The concept of mental barriers describes the phenomenon in a

[1] We consider it crucial to point out that sustainability is not a matter of duration alone but needs to include a qualitative component as well: Cultural, economic and ecological sustainability.

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society that a large body of knowledge on existing and sought-for solutions to improve conditions for active means of transportation exists, but lacks real-life implementation (Brezina and Castro Fernandez, 2017). Although this model enables a good understanding of the planning system, still a great number of decision-makers exist which have mental barriers to apply this knowledge to design sustainable transport systems properly.

Looking at policies which transform urban streetscapes in favour of active modes offers another enlightening perspective. Humans have become as much a product of technology as technology is a product of humans (Dries, 2004). Fig. 1 depicts an individual's energy consumption on the basis of embededness in a socio-technological regime during periods of time and with different delimitations (Brezina, 2010). For example, the fourteen-fold difference between a cycling human and a human fully embedded in the technological age is clearly visible. So changing structures for a changed behaviour is also reflected in reduced energetic density.

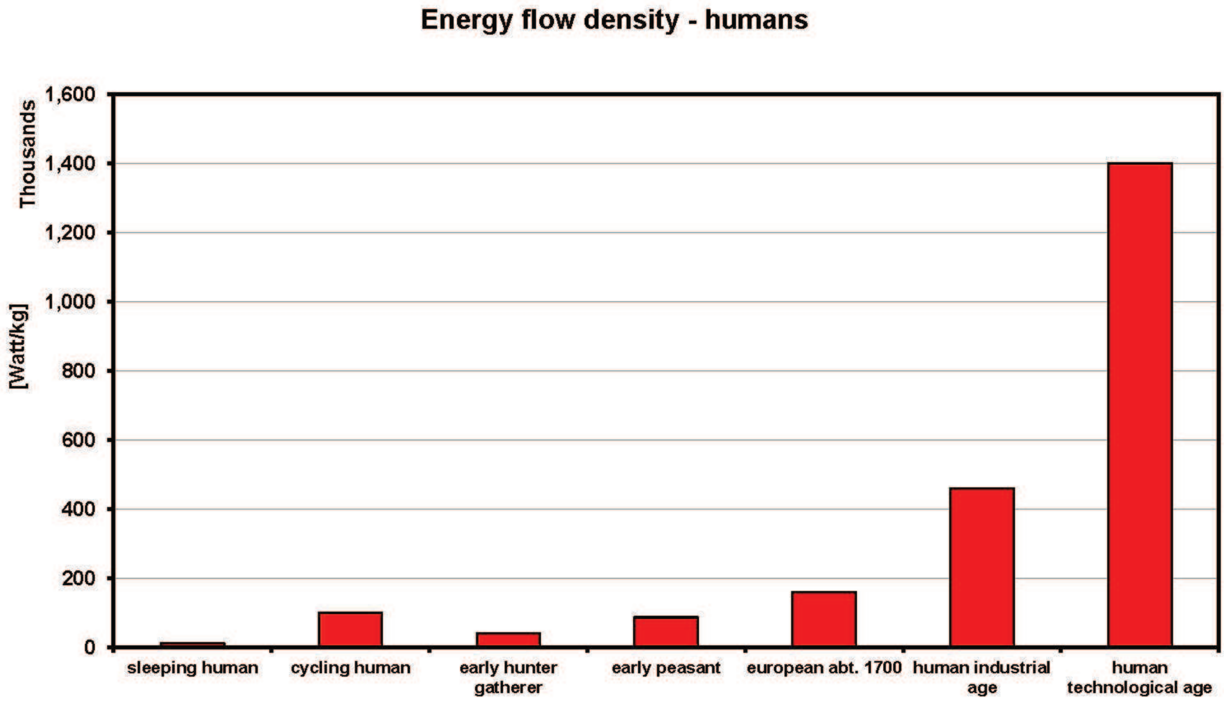

Fig. 1: Intensity of human energy consumption in a socio-technological regime during periods of time and with different delimitations. (Brezina, 2010) based on (Chaisson, 2001).

In contrast to wide spread popular belief, human behavioural patterns are subject to high adaptability. Therefore short-term individual as well as mid-term disruptions in transport regimes can not only be absorbed but used purposefully. It appears that wide spread and early-on distributed information on forthcoming changes plays a vital role in smoothly shaping transport regime transitions (Frey et al., 2010, Tennoy et al., 2017).

On the individual level human behavioural adaptability is clearly observable – subject to very different physical structures. A survey of cyclists' traffic light behaviour in five settings with differing cycling-friendliness (see Fig. 2) illustrates the adaptability of human mobility behaviour: the less cycling-friendly the infrastructure is, the lower is the rate of traffic rule adherence (Brezina and Hildebrandt, 2016). The five surveyed settings were: 1 – Cycling path crosses one car lane; 2 – Cycling path crosses more than one car lane; 3 – Push-button traffic light for cyclists; 4 – Cycling path crosses pedestrian path and 5 – Cumulation point of cycling crashes after red light violation. Clearly visible is the low traffic rule adherence rate (~ 70 % from dark brown until yellow) with setting three, where cyclists had to push a button and wait for receiving green light permission to continue their ride.

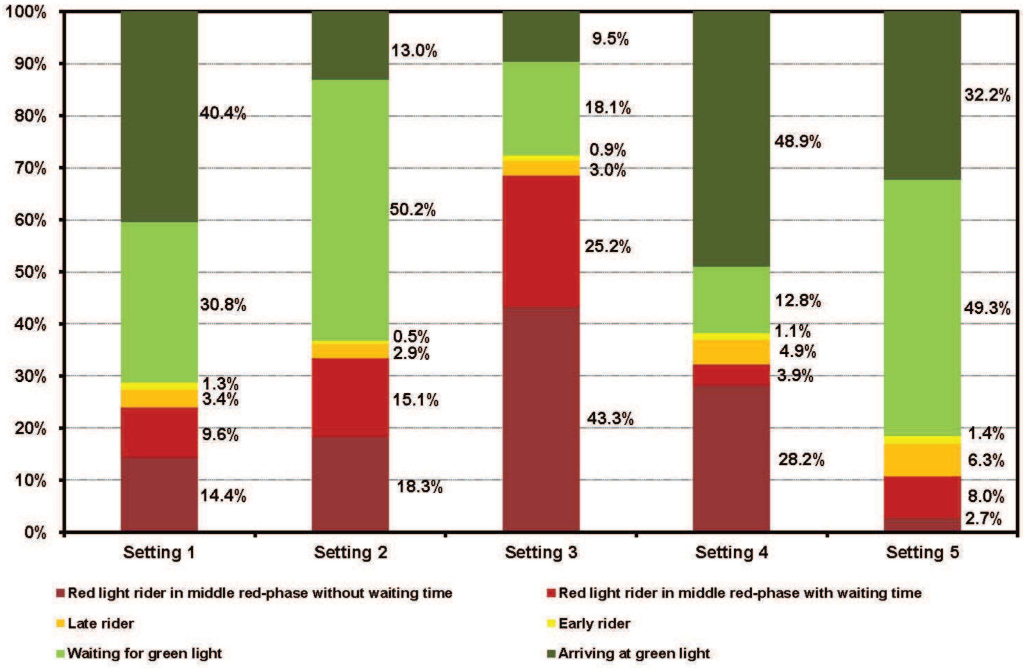

Fig. 2: Bicycle rider behaviour at five traffic light settings, from red light riding to waiting for green light (Brezina and Hildebrandt, 2016).

On the other hand, on a systemic level, it is necessary to understand streetscape revitalisation as change management within a civic and urban environment. This need for an accompanying long-term engagement asks for a variety in public involvment (before, during and after the reconstruction) and for interaction with planning departments and authorities on different levels and with different civic stakeholder groups (Lokar, 2015).

3 EXAMPLES

In this section we show four examples to delimit the application – knowingly or uncnciously – of evolutionary-based planning principles for influencing human mobility behaviour by alteration of underlying structures.

3.1 Example 1: Active mode friendly settlement structures

First-off, let us take a view on the impact of dwelling and mobility provision on mobility behaviour as living conditions are considered to be crucial for people's mobility choices (Knoflacher, 2007, Schwanen and Mokhtarian, 2005).

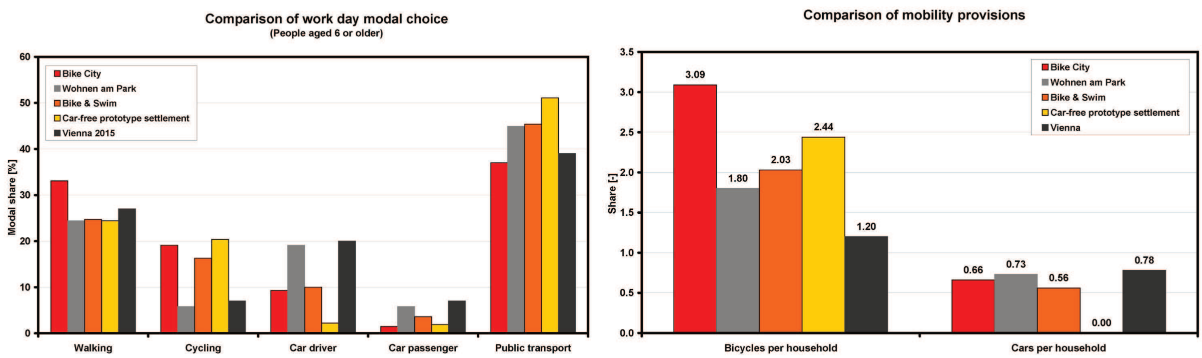

Fig. 3: Bicycle and car ownership per household (left) and modal share (right) of different settlements and Vienna in comparison. Data: (Mensik et al., 2012).

Fig. 3's left side shows bicycle and car ownership of Vienna's "Bike City", "Bike & Swim" and the "Car-free prototype" settlements and compares the results with one other typical settlement ("Wohnen am Park") and the City of Vienna. The mentioned settlements have been built with enabling the idea of car-reduced living in mind. Therefore reduced or no ("Car-free prototype settlement") car parking is provided and alternative forms of mobility are highly favoured, either by built form and/or by organizational matters. In the "Bike City" more than twice as much bicycles are available as mobility choice than in the total city itself. The right side of Fig. 3 illustrates the results: work day modal choice of inhabitants aged six years or older. Clearly active modes (+ 6 % walking and + 13 % cycling) are well developed, while the use of cars, either as drivers (- 18 %) or as passengers (- 5,5 %), is significantly smaller. It was shown in an environmental study (Ornetzeder et al., 2008) that car-free living reduces transport-induced CO2 emissions through permanently induced travel changes, the latter being ascribed to improved social contacts.

3.2 Example 2: Commuting infrastructure

Secondly a radial representation of commuting flows for nine corridors into Vienna based on a dual modal share (cars vs. public transport) is given. The data stem from the year 2010 and are structured in corridors by presence or absence of high capacity infrastructures, ie. motorways and/or commuter railways (S-Bahn). Such a structured depiction (Fig. 4) clearly illustrates the wide spread impact of infrastructure decisions on mobility behaviour of commuters. While the provision of a motorway and commuter rail establishes a 71 % to 29 % proportion in favour of private cars, the decision to restrain from building a motorway and providing commuter-rail only instead results in a proportion of 53 % to 47 % (car vs. rail). The decision to provide neither frequent and reliable rail-bound public transit services nor a motorway strongly deforms the proportion in favour of private cars to 79 % to 21 % (car vs. rail). Although the last two corridors ("Gänserndorf" and "Klosterneuburg") do provide public transport, bus lines and a regional rail service, such services are not as capable as commuter rail and thus attract less people away from using cars.

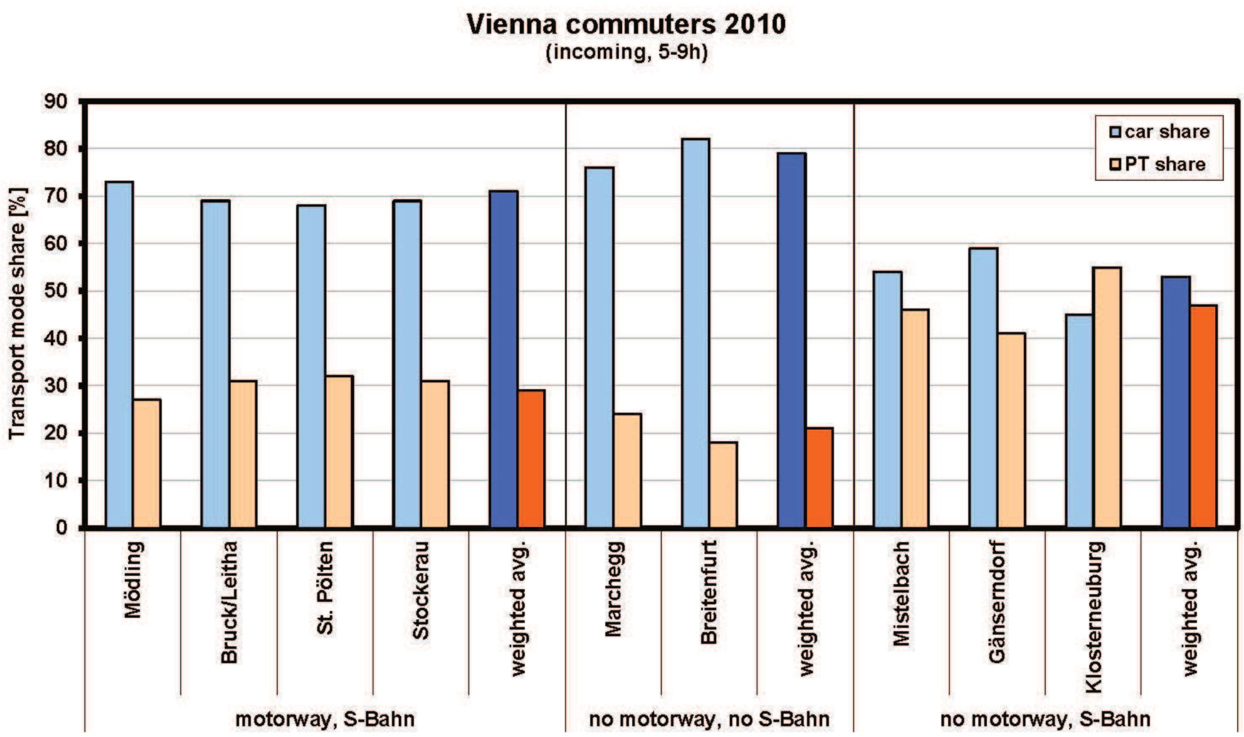

Fig. 4: Modal share along different corridors in/out of Vienna. Data: ÖBB, Statistik Austria.

3.3 Example 3: Parking place pricing and and locations

3.3.1 Effects of parking place pricing

While built environment is an important part of "structures", the monetary duties for usage of public land for mobility purposes are as well. A study (Shoup, 1997) carried out in British cities illustrates the effect of doubling the price of parking on modal share (Fig. 5). Firstly the total number of trips decreased, while secondly a shift by three to 15 percentage points can be observed from car trips to those undertaken by bus, rail and walking.

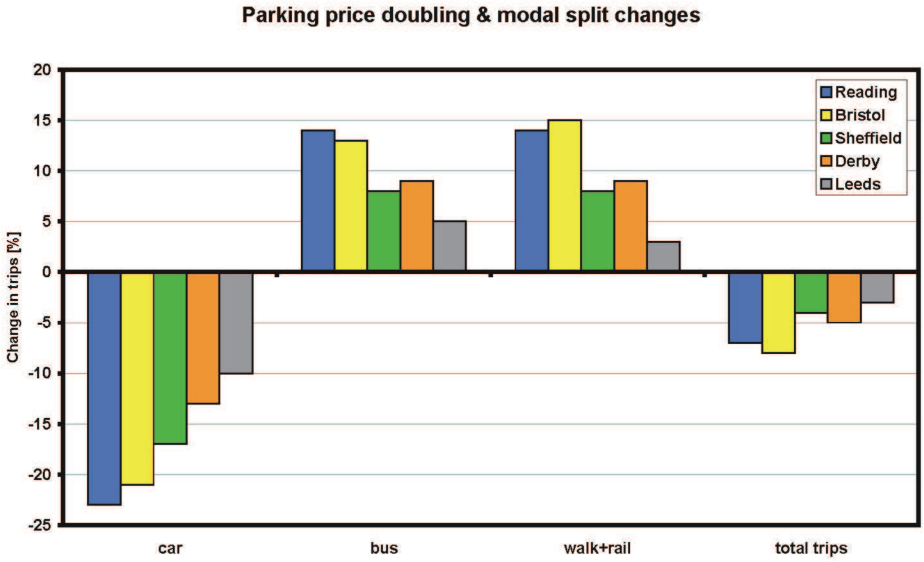

Fig. 5: Impact of parking fees on mobility and mode changes in UK cities. Data: (Shoup, 1997).

3.3.2 Effects of parking place location

Another interesting investigation, carried out by the Vienna University of Technology (Emberger and Knoflacher, 1995), shows the relation between car mode choice and distance to/from the parking place for the city of Vienna. (see Fig 6).

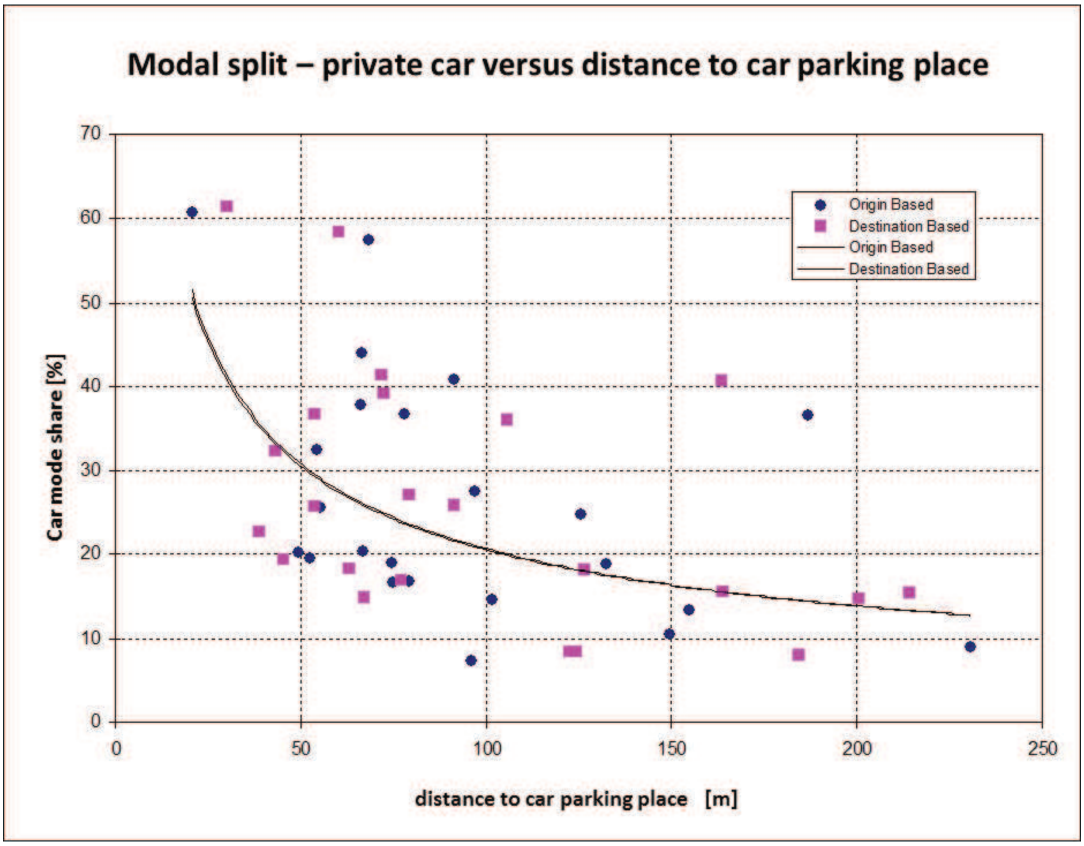

Fig 6: Private car mode choice in relation to parking distance in Vienna (Emberger and Knoflacher, 1995). Data: household surveys of 1986 and 1992.

On the x-axis of Fig. 6 one can see the distances from parking place either from/to the trip's origin or destination. Every dot represents the average distance for one of Vienna's 23 districts. Clearly visible is the average distance of less than 250 meters. The majority of Viennese inhabitants park their car less than 100 meters away either from their home or from their destination. By contrast, the average distance to the next public transport stop in Vienna is about 250 to 300 meters, which is – internationally seen – a very good value. On the y-axis the modal split value for car use in the corresponding district for all trips in the data sample is plotted.

As can be seen in Fig 6, the percentage of car usage in Vienna decreases with increasing car parking distance from/to origin/destination. When a car parking place is located close to the origin/destination, the car mode share is well above 30 %. In cases where the car parking place is further away – say 200 meters – less than 20 % are using the car anymore. This empirical evidence strongly indicates that the distance to/from the parking space has a strong influence on the mode choice (especially in an urban context like Vienna).

Furthermore, it is common sense in transport planning that every trip either made by public transport or car starts/ends with walking. Therefore the distance to (origin) and from (destination) the parking space (car trip) or to/from the public transport stop plays a very important role within the intra-personal mode choice. In other words, it can be said from a systemic point of view that there is no systemic difference between a public transport stop and a car/bike parking place. Both are the interface between walking and motorized (mechanized) means of transport. Although a public transport stop and a parking place resemble each other from a systemic point of view, the treatment in transport planning science was/is completely different (Emberger and Pfaffenbichler, 2017).

For example, looking at the past development of settlement structures reveals that nearly in all cultures and societies car parking places are located as close as possible to the origins (housing) and destinations (shopping centers, office buildings, factories, etc…). This is due to the fact that in nearly all countries guidelines exist, which provide regulations for the provision, number and location of parking places (for an overview of worldwide parking regulation see (Jittrapirom and Emberger, 2011)). These guidelines were developed to avoid car parking in public space but have had the unintended side effect that the distance between car parking places and public transport stops developed in different ways. Car parking places tend to be located as close to trip origins/destinations as possible, whereas public transport stops are allowed, depending on the type of public transport, to be between 300 meters (bus, tram) and 2,000 meters (light rail) away from trip origins/destinations.

Summing it up: the distance to/from a parking place/public transport stop is one of the most important parameters to influence individual mode choice and should therefore be used extensively in transport planning to foster sustainable transport behaviour.

3.4 Example 4: Redefining road space usage

Ljubljana, the capital of the Republic of Slovenia has been undergoing a significant transformation of urban space for the last decade (Lokar, 2015). In Sept. of 2013 the core link of the city's main Slovenska street was transformed from a motorized traffic thoroughfare to a pedestrianised space where city buses are allowed as only motorized guests. The implementation of this closure for private traffic – and concurrent opening for active modes – lead to a general decline in traffic volumes in the adjoining network links. As Fig. 7 shows, only at one road link an increase of traffic loads occurred, while at all other links a decrease of traffic volume took place.

Our selected examples illustrate the efficacy of streetscape design as a means of changing behaviour by changing structures. But decision-makers are still too often impaired by mental barriers too strong to allow for an audacious pursue of consistent streetscape revitalisation. But the internet provides best practise databases for mutual learning and inspiration with a large selection of case studies: for example at http://www.urb-i.com/ some 3,000 before/after pictures of urban streetscape transformations in North and South America, Europe, Asia and Australia can be found. Photos, taken at nearly identical viewpoints (either in-situ or via Google Streetview) illustrate very well the streetscape transformations and make these transformations conceivable in real world situations and with people, where it was not possible yet.

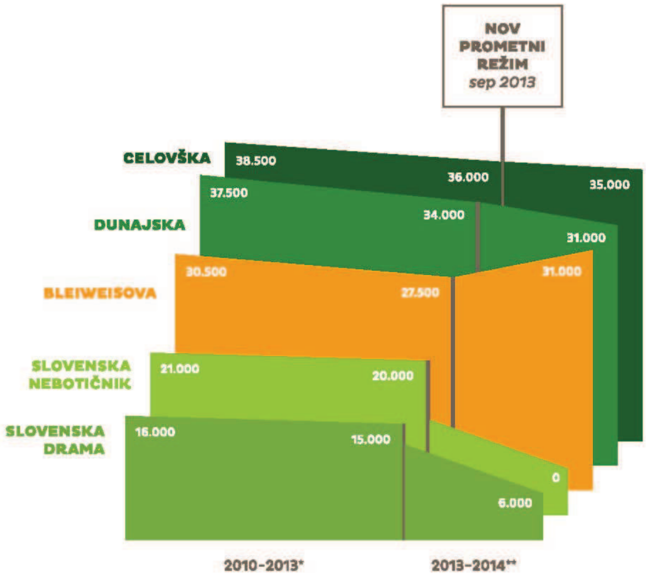

Fig. 7: Impact of central Slovenska street section closure for private car traffic in Sept. of 2013 on average volumes in adjoining street sections. Source: City Administration of Ljubljana. Note: Slovenska's Neboticnik final value of zero should leave no vertical segment.

4 CONCLUSION

In many countries, policy documents on all public administration scales (Emberger, 2017) have put as an important objective a more sustainable transport system on their agenda.

A lot of good streetscape revitalisation projects are already implemented and realized around the world. Unfortunately many more of them exists only on paper because of the (mental) barriers immanent at the responsible authorites. But their fear to reduce traffic capapity through the suggested streetscape redesign have been proven numerous times to be in vain.

In this paper, we have presented four examples of transport system's flexibility. The application of evolutionary-based planning principles to urban streetscape (re)design, either in a deliberate manner or unconsciously, improves the transport system's flexibility and changes the transport system towards sustainability. The visualisation/documentation of implemented streetscape redesigns, as done at http://www.urb-i.com/ is an important repository for all transport planners around the world. We think it is important to make such substantial transport regime changes conceivable (Knoflacher, 2001b) by collecting and making available such good, existing, real life examples to overcome the still existing mental barriers within transport planners, decision makers , media and the general public.

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