Cognitive Dissonance on Sustainable Mobility

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Abstract: This article aims to define sustainable mobility, particularly, reference travel time recognition and its economic and cognitive impact with a particular focus on info-communication. The paper focuses on the social surplus of mobility and its effect on consumer time budget and cognitive recognition of sustainability. Nowadays, the added value of mobility is unquestionable; meanwhile, the increasing amount of information causes cognitive load. Travel time seems to be constant, and different mobility modes have different (environment)mental loads. Therefore, a (environ)mental impact assessment is required. An always-changing environment must lead to an analysis of the effects of rational decisions. The work focused on travel time, as a decision parameter and its impact on (environ)mental load and sustainability.

Keywords: sustainability; travel time; environmental load; rational decision, cognitive mobility

1 Introduction

Recently more and more articles have been dedicated to the analysis of rational transportation decisions [1-4] to understand travel needs. Environmental load is one of the biggest problems in our time, and our knowledge of its consequences are limited and constantly expanding. More and more science, research, and technology are paying attention to possible solutions [5] [6]. The future effects of transport-related pollution are difficult to foresee with enormous certainty, which makes it challenging to analyze the adaptability and preparedness of different technological [7-9] social [10] and economic [11] [12] systems and their effect on the human mind [13] [14].

Meanwhile, continuous technological development provides increasingly effective tools to ensure mobility and provide more extensive services and goods [15]. Travel

time is a frequently studied aspect of rational decision-making [16]. The term "*travel time budget*" is defined by a person's average daily travel time, which seemed to be relatively constant by Mokhtarian and Chen [17]. The assumption is that all travelers have a constant, non-zero travel time budget when they are willing to consume to reach more goods and products. Cognitive processes are several processes that contribute to the formation of thoughts or decisions in our case that are helping the consumer in their mobility-related decisions. Cognition helps obtain information and draw conscious and unconscious conclusions about the world. More and more info communication tools are used nowadays that could load the mental cognitive capacity of consumers. Lots of information are received before the mobility and also during the mobility.

In this article, the author has only analyzed rational decisions about mobility. Understanding the complexity of cognitive processes requires a broad understanding of the human worldview. There is always much information circulating us that allows us to make decisions. This article focuses on travel time and its impact on the environment through mobility. The process of obtaining the information available with our senses and turning it into conclusions or actions is made possible by cognition.

It is turned out that the amount of time is relatively constant over time and space that consumers spend on mobility. The travel time appears to be a universal constant: 1.1-1.3 hours per passenger per day [18] [19] (Figure 1). Crozet found [20] further that due to the theorem of constant travel time budget with enhanced technological innovation, the action radius of the consumer could increase (Figure 2):

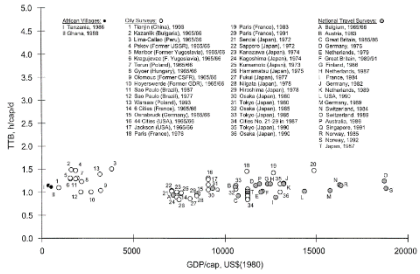

Figure 1
Travel time budget (h/cap/day) in numerous cities and countries throughout the world. Sources: Kloas et al., (1993); GFV, (1987, 1992); Orfeuil and Salomon, (1993); UKDOT, (1994); DMT, (1993); Szalai et al., (1972); Katiyar and Ohta, (1993); USDOT, (1992); Malasek, (1995); Vibe, (1993); Riverson and Carapetis, (1991); EIDF, (1994); FORS, (1988); Metro, (1989); Olszewski et al., (1994); Xiaojiang and Li, (1995).

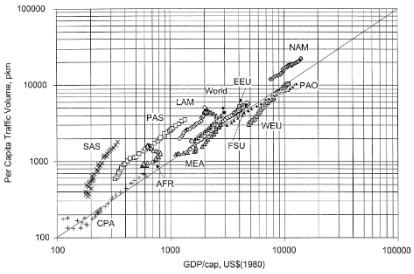

Figure 2
Motorised mobility (car, bus, rail, and aircraft) per capita by world region vs GDP per capita between 1960 and 1990.

(Source: [21])

The author formulated the research question of how constant travel time budget and increasing environmental pollution of personal mobility influences the cognitive load? The article is structured as follows: after introducing the constant travel time, the author investigates the (environment)mental load of different transport modes and their role in the constant travel budget theorem. Later the conclusion is being drawn as the more information is available and influencing our life, the larger (environ)mental load is being caused by the technical enhancement.

2 Technological Enhancement and its Effect

Technological development has been unquestionable in the last couple of centuries in mobility. However, with constant travel time theorem, technological development could cause an increase in travelled distance (Figure 3):

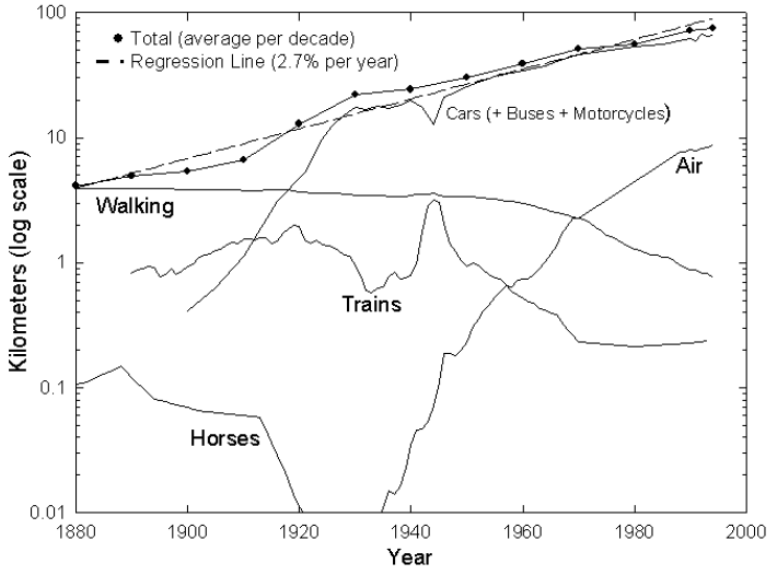

Figure 3
Distance travelled in km per person per day since 1800 in the US
(Source: [22] based on Ausubel J. H., Marchetti C., Meyer P. S.)

As shown in Figure 3, the technological development resulted in 2.7% distance development per year on cumulated integrated moving average per decade per person. Meanwhile, it is also essential to note that these transport modes are still primarily driven by internal combustion engines, burning fossil fuel. Therefore, the constant travel time budget theorem affects increasing travel distance and with technological development also influences environmental pollution [23].

On the other hand, the idea of a constant travel time budget – at least at first glance – contradicts one of the foundations of traditional traffic engineering theory: travel time is a disadvantage that needs to be reduced. The principle of reducing travel times is at the core of many decision-making processes, and almost all models for forecasting local travel needs are based on travel time. It serves to generate revenue from development benefits by saving travel time. It is therefore, essential to understand the cognitive reasons for mobility decisions. From a traffic engineering point-of-view, instead of thinking about decreasing the travel time, the following should be considered: "What are the most attractive goods or services one can achieve with a specific travel time budget?". From this consideration, it can be concluded that as their overall mobility increases (Figure 3), that could increase economic activity. Based on the analysis (Figure 4), it can be stated that an increase in road traffic – that cause environmental pollution – occurred with more significant development in economic activity. That is the cause why the generalized black arrow monotone is decreasing.

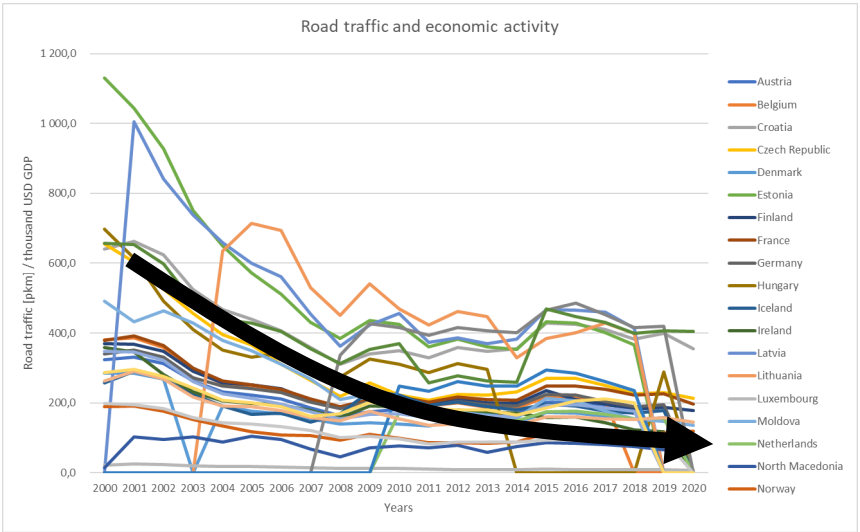

Figure 4

The connection between road transport performance and economic activity

**Please note that Malta and Portugal are missing from the OECD dataset*

People will switch to faster modes of transport to have more options, but that causes more environmental load and more cognitive effort due to the info communication system. The enhanced info-communication system leads to an enormous information load where failure needs to be identified and eliminated to avoid users losing their trust in the available data [24].

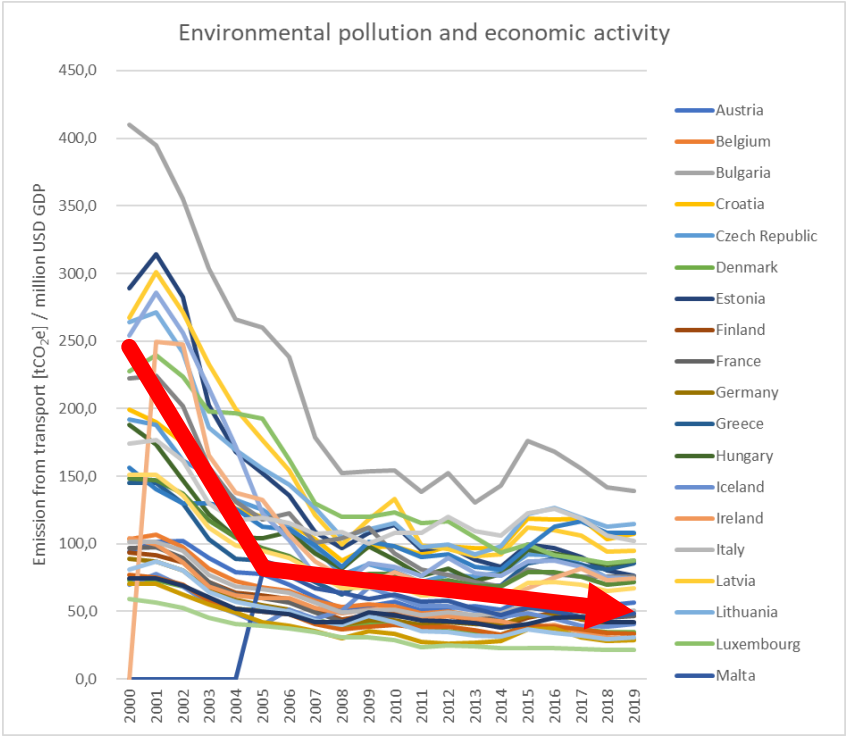

Figure 5

The connection between road transport performance and economic activity

**Please note that Malta and Portugal are missing from the OECD dataset*

Access to information, goods or services can be evaluated from several perspectives, including a particular group, mode, location, or activity. Traditional design often underestimates these factors and ideas and neglects the cognitive load [25].

3 Cognitive Connections in Mobility

Longer, faster, more often. Simply that is a tendency that describes our mobility pattern, proving that these trends are the basis of our activities. The most important feature that makes the modern lifestyle more attractive than previous forms is the fantastic variety of goods, services, and information [26]. However, in this case, our choice results from a simple combination of several key variables. The income level or Value of travel time, combined with the proposed speeds of different mobility technologies and available information and information pressure, influences the

rational decision. To describe such a complex system, four Descartes coordinate systems were established:

Income or Value of time vs Time Budget [27]

Time budge vs Distance or environmental pollution

Distance or environmental pollution vs Information requirement [28]

Information requirement vs Income or Value of Travel Time

The definition value of travel time, time budget, distance and information requirement cannot be negative; therefore, the 4 Descartes coordinate systems can be merged into one non-conventional Descartes coordinate system. Please note that from origin into every direction, the parameters are increasing. Now let me formulate some basic assumptions:

(i) The constant travel time theorem is valid and based on that, and a red line has been drawn for constant travel time.

(ii) The further one travel, the more significant the air pollution is. Even with the change in transport mode, please consider changing more environmental polluting plane from car, or car from powered two wheelers[1], based on these black dashed lines are drawn.

(iii) The further the travel is, the more information is required (each transport mode has a different parameter level). Based on these blue lines are drawn [29]

(iv) The higher the income or the Value of travel time is, the larger the travel-related information requirement. Based on this yellow dashed line is drawn

[1] more environmental polluting in terms of emission unit per transport performance [$CO2_{e}t$/pkm]

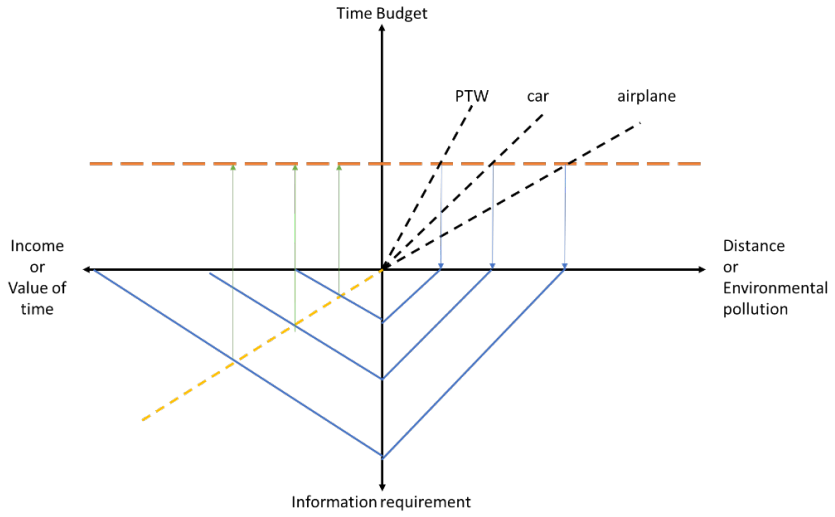

Figure 6
The connection between travel time, pollution, and cognitive activity
(Source: own edition based on [22])

Conclusions

This work was designed to reveal the contradiction between sustainability and mobility, particularly reference travel time recognition and its economic and cognitive impact, focusing on info-communication as a part of decision-making process. The beginning of the paper introduced the constant travel time theory and its cognitive reflection through sustainability. Nowadays, the added value of mobility is unquestionable, although it's role in the decision-making process in not yet fully understood. Meanwhile, the increasing amount of travel-related information causes the cognitive load, and the transportation causes harmful environmental load. As travel time seems constant, different mobility modes have different (environ)mental loads. This study focused on travel time as a decision parameter and its impact on the (environ)mental load.

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