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# Hybrid choice model to disentangle the effect of awareness from attitudes: Application test of soft measures in medium size city

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### ABSTRACT

The need to reduce private vehicle use has led to the development of soft measures aimed at re-educating car users through information processes that raise their awareness about the benefits of environmentally friendly modes, encouraging them to voluntarily change their travel choice behaviour (level of services characteristics being equal). It has been observed that these measures can produce enduring changes, being the result of mindful decisions. It is important then to try and understand what contributes to shape individuals' preferences in order to be able to define the best policy for fostering changes toward more pro-environmental modes.

The objective of this work is to provide empirical evidence of the effect of awareness and individual attitudes on the switch from car driver to more sustainable modes such as Park and Ride. In particular we attempt to discriminate the effect of awareness due to the information provided in a Stated Preference experiment from the effect of individuals' attitudes toward stress and social norms with respect to sustainable transport modes. The case study refers to the implementation of a Voluntary Travel Behaviour Change programme in Cagliari (Italy), carried out with the purpose of promoting the use of the light rail in Park and Ride mode.

To account for all these effects in the choice between car and Park and Ride we estimate a Hybrid Choice Model where the discrete choice structure allows us to estimate the effect of awareness of environment and stress, while the latent structure allows us to estimate the effect of the latent effect of norms and attitudes toward environment and stress.

The results from this case study show that the more people consider the information about stress useful, the more they tend to behave sustainably, suggesting the importance of reporting feedback about stress in the personalised travel plan to promote sustainable mobility. Interestingly, the information about pollution has instead less impact in shifting behaviour toward sustainable modes.

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## 1. Introduction

Road traffic is now the main culprit of air pollution in urban areas, due to the emissions of the combustion products of fuels and their subsequent chemical transformation, as well as to the evaporation of unburned hydrocarbons. Transport accounts for 25% of CO<sub>2</sub> emitted globally, and is also one of the few sectors where emissions have continued to grow, oil consumption between 1973 and 2010 increasing by 110% (Iea, 2011) and CO<sub>2</sub> by 44%. (IEA, 2009; Banister et al., 2012). Several actions and measures have been developed to try to mitigate harmful

emissions. These mostly refer to vehicles technology (greater efficiency both in terms of consumption and production of polluting emissions), type of fuel (biofuel, hydrogen, and electricity), economic tools and institutional controls (pricing policies, incentives, taxes, etc.) information and communication technologies (ICT). Although powerful, these measures have not been proved to be sufficient to solve the problem (Schwanen and Lucas, 2011).

As a consequence, in recent years, research has increasingly focused the attention on measures and policies that affect individuals' behaviour and in particular what motivates individuals' decisions. Providing information is the measure most used to promote behaviour change (Abrahamse and Matthies, 2012). As reported by Ampt, 2003 "A person who has an attitude that suggests that it would be consistent for him or her to use the car

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less cannot bring about behaviour change if that person does not know how to change". It has been observed that measures that increase individuals' awareness can produce enduring changes, being the result of mindful decisions. This is at the basis of the concept of "Soft Measures", also referred to as "Voluntary Travel Behaviour Change" (VTBC) programmes (Ampt, 2003) or "Smarter Choices" (Cairns et al., 2004), i.e. programmes aimed at motivating the voluntary reduction of car use. VTBC programmes provide information typically on: a) the negative (mainly environmental) effects of current behaviour and b) how individuals can change their current behaviour to mitigate the negative effects.

As opposed to supply side or hard measures, where policy approaches aimed at changing mode share revolve around time and cost, soft measures act on private sphere attributes. In particular, not only on how a person perceives the choice context and hence its structural attributes but also on attitudes and on the propensity to behave in a certain way. Indeed soft measures rely on the knowledge, demonstrated by numerous researchers, that an objective analysis of the choice context and its characteristics (time and cost) does not always suffice to evoke change in travel behaviour, if a person is not properly informed or made aware of the most beneficial alternative for him-herself or for society as a whole.

These measures were in fact devised with a view to overcoming some of the shortcomings of the traditional approaches to understanding travel behaviour and behaviour change. Theoretically speaking, the classical engineering approach (structural/hard measures) to travel behaviour research, the result of standard microeconomic theory and the paradigm of rational man, has, over time, been combined with theoretical models from social psychology and behaviour economics. The purpose of this was to enhance the predictive ability of economic theory by providing more psychologically plausible foundations.

In a choice context where time and cost do not vary (i.e. no changes to the transport system), from a policy standpoint soft measures are designed to raise people's awareness as to the available travel alternatives and the environmental impact of travel choice and as a result to change attitudes and evoke inclination to behave differently (Steg and Tertoolen, 1999). The information provided within a soft measure, as well as the quantitative instrumental feedback (time and cost) for showing the personal economic benefits, are combined with feedback about the societal effects concerning the environmental and health spheres (CO<sub>2</sub> and calories burned) as well as stress. Briefly, VTBC programmes aim to combine the traditional behavioural approach with cognitive psychology and persuasion principles.

The objective of the present work is to provide evidences about the effect of awareness after implementation of a soft measure and to understand the relationship between awareness, behaviour, attitudes and norms in the context of mode choice. The research provides a contribution on how to design and develop a VTBC programme to promote a light rail service and on how to study the extent to which each single element of the soft measure contributes to overall awareness. The research also discusses the problem of measuring the effect of information within a SP experiments, contributing to the existing literature in this field (see a recent discussion in Cherchi and Hensher, 2015). Finally, results allow also sketching recommendation for policy makers on the information and feedback that are more effective in promoting sustainable Park & Ride (P & R) travel. The study focuses in particular on the effect that information on pollution and individual stress has on the choice to shift from private car to a more sustainable P & R mode in a medium sized city in Italy.

The promotion campaign was based on the knowledge that the quality of the environment is one of the most important aspects in transport problems and the CO<sub>2</sub> emitted is probably the most

effective (and understandable) measure thereof. However, an earlier VTBC programme named Casteddu Mobility Styles (CMS), the first to be implemented in Italy, revealed that traffic stress was an interesting variable indicated by car drivers. Stress has a very negative health effect on modern society, and the stress caused by traffic conditions is very subtle. Traffic stress may result from the hassles of driving and parking, the potential for unintentional injuries, and pecuniary hardships and inconveniences of vehicle maintenance and purchase (Gee and Takeuchi, 2004). Studies of commuting have identified a number of psychological factors that govern the magnitude of stress response, including control, predictability, time urgency, and impedance (Gottholmseder et al., 2009; Koslowsky, 1997). High levels of traffic congestion may lead to elevated physiological stress and negative effects (Koslowsky et al., 1995). Notwithstanding its importance, to the authors' knowledge, traffic stress has never been considered in transport studies.

The ability to perceive, or to be conscious of something and to react to it (i.e. awareness) can differ from one person to another depending on their psychological stance toward environment and stress. Many studies have accounted for the effect of environmental attitude mainly in mode choice (Paulssen et al., 2014) or in the choice of the fuel-vehicle (Daziano and Bolduc, 2013; Glerum et al., 2013; Jensen et al., 2013). However, other latent effects other than attitude are relevant. In particular, in terms of environmental awareness and the information provided, personal norms measure a very interesting aspect as they evaluate the moral rule (and obligation) that lead individuals to act rightly or wrongly towards the environment. The recent literature reports a couple of examples of the effect of norms in a choice modelling context and how norms stimulate the intention to use public transport and increase actual public transport usage (Zhang et al., 2015) or the intention to switch from the current transport mode to green transport modes (Polydoropoulou et al., 2015).

To account for all these effects in the choice between car and P & R we estimate a Hybrid Choice Model (HCM) where the utility of the modes depends on the awareness of the benefits of environmentally friendly travel in terms of emissions reduction and stress reduction. In particular the discrete choice structure allows us to estimate the effect of the two benefits provided on the mode choice, while the latent structure allows us to estimate the effect of the latent attitudes toward environment and stress. The HCMs include three latent constructs: attitude toward 1) stress perceived and 2) information received about stress and 3) personal norms with respect to sustainable transport modes.

The data used in this work (gathered during a campaign to promote use of the light rail in Cagliari) are: 1) a Stated Preference survey where the information provided is directly included as attributes in the SP tasks presented to the individuals and 2) a questionnaire that includes a set of questions that allow us to evaluate the full Theory of Planned Behaviour (TPB) as described in Ajzen (1991) to measure the latent aspects through items that allow to identify the indicators of the measurement equations in the HCM.

## 2. Case study

The context chosen for the experimental analysis is the corridor that connects Cagliari city centre with the city of Monserrato, in the metropolitan area of Cagliari, where in 2008 a short light rail line, named *Metrocagliari*, went into operation. The *Metrocagliari* is 6.3 km long, has 9 stops and 190 trains a day operate in each direction with 10-min headway. The travel time between the two terminals is 18 min. The corridor carries 150,000 round car trips/day and around 56,000 inhabitants live within 500 m from the 9 stops. Unfortunately up to 2010 only 5000 travellers/day used the

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