Shedding light on the psychological and behavioral determinants of travel mode choice: A meta-analysis

Pietro Lanzini *, Sana Akbar Khan

Department of Management, Università Ca' Foscari, Cannaregio 873, 30121 Venezia, Italy

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ABSTRACT

Mobility represents a relevant topic from the standpoint of environmental degradation, health-related consequences and social inclusion. Since private mobility is responsible for the greatest share of polluting emissions, it is necessary to gain deeper understanding of the mechanisms underpinning the choice of individuals to use either cars or alternative, environment-friendly transport modes. A meta-analysis on 58 primary studies is conducted to synthesize evidence on the determinants of travel mode choice, as regards both behavioral intentions and actual behaviors. Results suggest that, besides intentions, habits and past use represent the most relevant predictor, followed by constructs referring to the Theory of Planned Behavior framework. Environmental variables, on the other hand, play a relevant role in shaping behavioral intentions while their effect on actual behaviors is negligible, so that a deep intention behavior gap emerges. A moderator analysis is performed to explain the high heterogeneity in the results. Behaviors' operationalization and measurement emerges as the moderator affecting heterogeneity of outcomes the most; trip purpose, sample type and year of the study also show a moderate effect on heterogeneity, while location does not appear to be a relevant moderator.

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1. Introduction

There is wide consensus over the un-sustainability of current mobility patterns, and the need to shift towards new paradigms (Collins & Chambers, 2005; Gardner & Stern, 2008; Stern, 2011). The transport sector is indeed responsible for problems ranging from air pollution and climate change (Oskamp, 2000) to health related issues (Peters et al., 2004), and even to social exclusion/accessibility (Geurs & Van Wee, 2004).

Transportation currently accounts for around 14% of greenhouse gas (GHG) emissions on global scale (IPCC, 2014). In the EU 28, transport in 2013 accounted for 22.2% of GHG emissions, up from 14.9% in 1990 (Eurostat tables[1]). Moreover, unlike other industrial sectors, transport did not reduce emissions although after the peak of 2007 the trend started to change due to increasing oil prices and diminishing activity by freight vehicles as a consequence of the economic downturn. Similarly in the US, transport accounted for 26% of GHG emissions in 2014, with a sensible increase since 1990 (EPA, 2016). Until recently, the environmental impacts of transportation have been an issue affecting western countries. However, emerging economies are experiencing a steady increase so that the contribution to emissions deriving from transport sector is bound to rise over the

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* Corresponding author.
  E-mail address: lanzini@unive.it (P. Lanzini).
[1] Eurostat, European Environment Agency, European Topic Centre on Air and Climate Change http://ec.europa.eu/eurostat/statistics-explained/index.php/Greenhouse_gas_emission_statistics.

next years. China represents a striking example (Gambhir, Lawrence, Tong, & Martinez-Botas, 2015): vehicle sales rose from 2.1 million in 2000 to 23.5 million in 2014 (CAAM, 2015), with private vehicles and freight respectively responsible for 5% and 8% of GHG emissions, and on the increase (Hao, Geng, Li, & Guo, 2015; Hao, Liu, Zhao, Li, & Hang, 2015). India has still low figures as regards private cars (with on the other hand many two-wheeler vehicles), yet it is projected to become the third world's largest automobile market, with a rapid growth especially in the segment of small vehicles (Altenburg, Schamp, & Chaudhary, 2015).

The shift towards sustainable mobility represents a complex issue where various solutions and pathways (either in synergy or in alternative) can be envisaged, encompassing an active role played by different actors and stakeholders. For instance, the automotive industry can propose new or improved technologies capable of curbing the environmental impacts of mobility (e.g., new vehicles such as EVs or the improvement of the efficiency of conventional engines). Local authorities can adopt plans for sustainable mobility in urban areas (like so called SUMPs, Sustainable Urban Mobility Plans) focusing on new infrastructures, improved public transportation or even congestion charges. Policy makers at national and international level can implement standards and regulations to drive the change by means of a top-down approach (e.g., the Fuel Quality Directive, European Commission, 2009). However, citizens represent the key-actor whose involvement is necessary for any sustainable mobility strategy to succeed (Donald, Cooper, & Conchie, 2014): private mobility is a crucial contributor of CO_2 and other pollutants' emissions with detrimental impacts especially in urban areas (Dulal & Akbar, 2013), and psychological drivers of behavioral change proved to be more effective than infrastructural changes in addressing the issue (Hunecke, Haustein, Böhler, & Grischkat, 2010). Indeed, there is growing awareness that transport policies aiming at reducing car use can be accomplished by focusing on the psychological constructs of commuters (Möser & Bamberg, 2008). It is hence necessary to understand the relevance of different drivers capable of spurring the adoption of sustainable mobility patterns.

The present study focuses on the determinants of travel mode choice and the psychological and behavioral correlates of car vs. non-car use. Since existing literature is not conclusive and different studies reach inconsistent results on the main predictors of (sustainable) mobility, we perform a meta-analysis to synthesize existing quantitative research on the topic. To the knowledge of the authors, only one comprehensive meta-analysis on travel modes has been carried out, based on a 2006 database (Gardner & Abraham, 2008) and representing the starting-point of the present research. Indeed, our study provides a contribution to the ongoing debate by (i) including recent and current research, (ii) broadening the scope of analysis as to encompass further predictors and new perspectives of analysis (which will be described in the methods section) and (iii) investigating possible explanations of the variability across studies, by means of heterogeneity analysis. Our concluding remarks highlight the implications of the results of the meta-analysis, and propose preliminary ideas for future research.

2. Theoretical models

Different theoretical frameworks have been applied to investigate travel mode choice, with different degrees of complexity and predictive capability, the most popular of which is represented by the Theory of Planned Behavior (TPB, Ajzen, 1991). TPB is broad in scope and is not born out of environmental research; however, it is very useful to investigate sustainability related domains, including mobility. The theory holds that intentions are the closest antecedents of behavior and have, in turn, three main predictors: attitudes, subjective norms and perceived behavioral control (PBC). Attitudes represent the personal desirability of a behavior, or the feeling of being more or less favorable towards performing the activity. As regards mobility, I might have a positive attitude towards, say, commuting by means of public transportation because I believe that it is nice to contribute to environmental protection through my daily activities. Subjective norms refer to the social pressure we experience: do people who are relevant to me expect that I adopt a specific behavior? That is, for instance: do I feel pressure from my peers and relevant ones to commute by means of environment-friendly transport modes? PBC has been added to the original framework of the Theory of Reasoned Action (TRA, Fishbein & Ajzen, 1975) as a third predictor of behavioral intentions (and thus behaviors): it accounts for the perceptions of how difficult or easy it is to perform a behavior, representing the answer to speculations that behaviors are not completely under volitional control as originally suggested by TRA. In our example, I might hold positive attitudes and feel social pressure towards sustainable means of commuting, yet I might feel that such behavior is too difficult to adopt, this leading to an attitude-behavior gap (Kollmuss & Agyeman, 2002; Lane & Potter, 2007).

TPB has been adopted by a number of studies analyzing the determinants of travel mode (Harland, Staats, & Wilke, 1999; Klöckner & Matthies, 2009; Lois, Moriano, & Rondinella, 2015; Noblet, Thøgersen, & Teisl, 2014; Nordfjærn, Şimşekoğlu, & Rundmo, 2014; Polk, 2003). Further variables have been included to integrate the original framework, as to increase the explanatory power of the model: for instance, we can here mention habits (Bamberg & Schmidt, 2003; Donald et al., 2014; Verplanken, Aarts, van Knippenberg, & Moonen, 1998), role beliefs (Bamberg & Schmidt, 2003), personal norms (Manstead & Parker, 1995; Parker, Manstead, & Stradling, 1995) and descriptive norms (Donald et al., 2014; Heath & Gifford, 2002). While the predictive capability of TPB proved to be good (Armitage & Conner, 2001; Sutton, 1998), the relative importance of the constructs as antecedents of travel mode choice varies across studies (Gardner & Abraham, 2008).

A second stream of research on transport mode focuses on "feelings of moral obligation to perform or refrain from specific actions" (Schwartz & Howard, 1981, page 191). Such constructs, which have been suggested as a relevant driver of pro-environmental behaviors, have been labeled as personal norms, moral norms or other equivalent formulations (Conner &