



# Beliefs about energy, a factor in daily ecological mobility?



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## ABSTRACT

The central question is to ascertain whether general energy beliefs have any influence on transport mode choice. These beliefs are explored and determined by using one short open question. Based on an alternative approach of free associations instead of a standardised scale of behaviour, this question is included in a quantitative survey and allows us to obtain meaningful words. These exploratory results show first that beliefs about energy can be considered as general representations like a cost, a power or even an environmental issue. These beliefs are included in a logit model of mode choice that also considers more conventional factors representing socio-demographic characteristics, socio-economic aspects, as well as territorial structure and function. The final results demonstrate that energy beliefs influence mode choice if they include an environmental component, which expresses the negative effects of energy. The effects of these beliefs nonetheless are smaller than those of situational constraints.

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## 1. Introduction

Nowadays, energy has pervaded every aspect of western lifestyle. Facing it every day, individuals develop energy beliefs which cannot be separated from forms of energy currently used; this is particularly true when we consider the role played by the burning of fossil fuels in climatic change or the deteriorating health of populations (GIEC, 2007). Nevertheless these energy beliefs also refer to concrete inputs about the evolution of mankind: for instance, energy makes it possible to increase the speed of walking. In other words, energy is one of the foundations of the industrial and transport revolution, which improved the quality of life. These new sources require infrastructures, consumers or other actors (Rumpala, 2013), and impact our lifestyle and our comfort (Chappels and Shove, 2005).

The present article therefore focuses on the influence of these energy beliefs on the use of transport modes covering the distance from home to work. In transportation research, economic theories related to behaviour have always dominated psychological ones (Handy et al., 2005). The economics-oriented literature focuses on the instrumental characteristics of modes (cost, time, security, ...) as the main determinants of modal choice behaviours, whereas other works have stressed the importance of attitudes, social norms

and affect in understanding modal behaviour (Lois and Lopez-Saez, 2009; Bamberg et al., 2007; Steg, 2005; Ellaway et al., 2003). Different studies have shown that ecologically-oriented behaviour is strongly linked to favourable attitudes towards the environment (Maloney and Ward, 1973; Hamid and Cheng, 1995; Walton et al., 2004). Behaviour may reflect the individual's awareness of the damage of western lifestyle on the environment.

Our approach to the potential influence of energy beliefs on modal behaviour belongs neither to a completely economic nor to a totally psychological perspective but a combination of both and tests simultaneously variables belonging to these disciplinary fields as well as to time geography. So the role and weight of beliefs about energy with respect to the mode choice are analysed by considering the multi-dimensional range of factors associated with this choice (De Witte et al., 2013). The above literature review on the choice of modes of transport shows that socio-demographic and socio-economic characteristics of individuals and households (gender, age, education, car ownership, type and size of household, income), structural characteristics of the territory studied (density, mixed housing types, accessibility), beliefs (car safety, environmental conscience) and travel time of individuals influence the use of modes of transport.

To the best of our knowledge, these energy beliefs in their broadest meaning have never been tested in this type of modelling. Our approach relies on the one hand on a necessarily exploratory theoretical basis in terms of characterisation of beliefs, and on the other hand on an assessment of the influence of these beliefs confronted with various factors influencing travel mode

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behaviours. The following section discusses our theoretical approach completed by empirical evidences that will be used in our own analysis. The third section details our data collection based on a survey originating from a specific population, the cross-border workers of Luxembourg. The fourth section focuses on the creation of the energy variables based on the semantic fields from the survey. The fifth section details the results of the logit model of mode choice distinguishing between the use of public transport (PT) and private car. The last section is devoted to conclusion and discussion.

## 2. Theoretical discussion and empirical statements

The mode choice behaviour is the result of a combination of factors for which there is no real consensus about their causality or their order of importance (Schwanen and Lucas, 2011). Various theories and disciplines can be called upon, such as economic rationality, theories developed in (social) psychology, in the field of time geography (Hägerstrand, 1970; Lenntorp, 1976) or more recently the new mobilities paradigm (Cairns et al., 2014). The first two types of approaches will be discussed in the next paragraphs. Each type is completed by empirical statements based on the literature and included in our own analysis.

### 2.1. Utility theory: classical model and factors

Popular because of its useful and powerful techniques, the rational choice approach assumes that people makes a comparative judgement of different modal alternatives and choose the one which maximises their utility or the one which provides them with the highest benefit (Ben-Akiva and Lerman, 1985). Many models have already been used, but in our case study concerning cross-border workers in Luxembourg (Schmitz et al., 2012), we still assume an elementary binary logit model. Its interpretation is fundamentally based on the odds ratio attached to each dummy variable (De Palma and Thisse, 1987), which means the chance of taking PT increases/decreases when the individual is part of this modality compared to the reference category, taking the car.

Basic utility models such as our model are represented by a function which integrates variables corresponding to the demographic and socio-economic characteristics of the decision-maker (individuals and/or households), situational constraints as attributes of the origin and/or the destination, and cost factors (monetary, time) related to the attributes of the choice alternatives (Ben-Akiva and Lerman, 1985). Concerning characteristics of the decision-maker, men are more likely to use a private car (Bhat, 1998). Regarding age, there is no real consensus in the literature because different studies focus on very different populations which may or may not include elderly people. As our sample consists only of workers, an increased use of cars will be expected with age (Pucher and Renne, 2003). The effect of the level of education on mode choice is ambiguous. Limtanakool et al. (2006) showed that when commuting consists of long distances, as is the case for cross-border workers of Luxembourg, the use of PT increases with an individual's educational level. This effect will be expected for this variable in our study as well. The presence of children in the household is another variable clearly identified in the literature. Its effect on mode choice leads to an increase in private car use due to the need to accompany children in certain activities with time constraints (Limtanakool et al., 2006). These constraints are all strong as the cross-border workers have long commutes (median = 40 min, see Schmitz et al., 2012) due to a high degree of urban sprawl. This limits the performance of the accessibility of PT (Pirie, 1979). In using an accessibility index, measuring the time differential between PT time and the time taken by a car in rush hour, we

can assume that the better the accessibility of PT, the higher their use by cross-border workers. Moreover, parking availability at the workplace can also impact travel time and time budget. Previous studies indicated that when parking is difficult, the use of PT is more significant (Kaufmann and Guidez, 1996).

For socio-economic variables, income is an important determinant for the use of a private car with positive effect (Hensher and Rose, 2007). Fixed/flexible work hours also influence mode choice. As the PT service usually operates on fixed schedules with different levels of service with respect to normal/peak hours and weekday/weekend periods, most workers with fixed working hours may use PT on working days.

Regarding situational constraints and cost factors, the effect of spatial structure is widely studied in terms of density and functional diversity (Cervero, 2002). However, these variables are generally correlated and can be summarised by the type of commune of residence. In our case, the variable 'urban structure' is split into four types ranging from simple villages to big cities. The expected effect in our modelling is that PT may be more readily available to workers living in a big city than to those living in rural areas.

Beyond the ease-of-use of our model in estimating their coefficients for revealed mode choices, different papers show that all these instrumental variables need to be completed from other conceptual frameworks as psychology (e.g. De Witte et al., 2013).

### 2.2. Socio-psychological factors and the energy beliefs

Psychological factors have already been included in some previous approaches as factors for understanding modal choice (perceptions, experiences, ...). Three main (socio-)psychological theories are used in the field of mode choice behaviour: the theory of planned behaviour (Ajzen, 1991), the theory of interpersonal behaviour (Triandis, 1977) and the theory of norm-activation (Schwartz, 1977). Well compared by Schwanen and Lucas (2011), these theories insist on the different types of beliefs as the deepest roots leading to behaviour.

Usually these beliefs are specifically linked to the focused behaviour. In our model, the first belief factor is directly connected to mobility, and is actually the perception of car safety. Several studies showed its influence on mode choice, which will either be positive or negative depending upon how the car is considered (Hartgen, 1974; Kuppam et al., 1999). Therefore, when cars are considered dangerous, they will be used less than PT. The second belief factor relies on a more general energetic representation which is not directly linked to mode choice. Haustein and Hunecke (2007) showed that general beliefs not directly related to mode choice can impact the latter. This general energy belief can thus potentially be connected to different behaviours, such as buying low energy consumption machines or using less polluting travel modes.

### 2.3. Our work hypothesis

Our hypothesis states that instrumental factors mainly connected to economic theory, individual beliefs connected to psychological theories, and situational factors contribute to mode choice behaviour for the journey to work. As mentioned before, our model incorporates different approximation variables representing sets of factors identified in the literature as having an influence on the choice of mode of transport. However, we argue that the role played by these factors is not similar.

First as reported by Ajzen (1988), the roots of behaviour correspond to beliefs that determine the factors influencing intentions. Intention towards modal behaviour emerge also from general beliefs of an individual who moves beyond a particular behaviour,

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