

Reconsidering the nature and effects of habits in urban transportation behaviour

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Abstract: This paper adds to the growing empirical evidence on the importance of habits in governing human behaviour, and sheds new light on individual inertia in relation to transportation behaviour. An enriched perspective rooted in Veblenian evolutionary economics (VEE) is used to construct a theoretical framework in order to analyse the processes at play in the formation and reinforcement of habits. The empirical study explores more specifically the synchronic processes strengthening the car-using habit. In addition to underlining the shortcomings of a 'decision theory' perspective to address urban transportation behaviours, we find that synchronic habits can have a significant effect on behavioural inertia. Our results suggest the existence of positive feedback between the development of synchronic habits, qualitative perceptions of driving times and reinforcement of the car-using habit. The paper points out also that the diachronic dimension of habits would constitute another promising domain for further research on behavioural inertia in transportation.

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1. Introduction

Starting with a study by Verplanken et al. (1994), growing empirical evidence in social psychology supports the idea that habits play a major role in transportation behaviour (see, for instance, Aarts et al., 1998; Gärling et al., 2001; Klöckner and Matthies, 2004; Gardner, 2009). The rationale is that transportation behaviour (especially commuting trips) is characterized by a stable context and repeated behaviours.

Several studies acknowledging the power of habit to lead human behaviour have suggested policies and schemes to break patterns in transportation and other activities characterized by inertia (Fujii and Gärling, 2003; Fujii and Kitamura, 2003; Matthies et al., 2006; Verplanken and Wood, 2006; Bamberg, 2007; Eriksson et al., 2008; Schäfer and Bamberg, 2008; Thøgersen and Møller, 2008; Verplanken et al., 2008; Middleton, 2011). However, in a review of measures aimed at reducing car use, Graham-Rowe (2011: 415) finds that ‘the reductions generated by effective, rigorously-evaluated interventions seem to have been relatively modest, and approximately half the interventions evaluated using strong designs were found to be ineffective’. The picture becomes even less rosy when long-term effects are assessed.

This paper aims to provide an enriched perspective on habits using a Veblenian evolutionary economics (VEE) framework to shed new light on individual inertia in transportation behaviour. The rationale for this study is that, to be more effective, policies to change transportation behaviour require a detailed understanding of the habituation processes. The approach to habits proposed by Thorstein Veblen (1857–1929) based on the Pragmatist philosophy and psychology, provides a useful framework to analyse both the *diachronic* and *synchronic* dimensions of habits, and their roles in behavioural inertia. The diachronic perspective focuses on the factors that govern the processes of formation, reinforcement and

change of a given habit; the synchronic dimension deals with the relations such a habit can develop with other habits.

In line with the well-known work by Ouellette and Wood (1998), several scholars confirm that a stable context and repeated behaviour provide a breeding ground for the development of habits.¹ However, this is only one aspect of the diachronic dimension of habits, and refers only to the conditions surrounding the emergence of habit. This leaves crucial questions regarding the nature of habit and the key characteristics of its dynamics. For example, what is the precise link between habit and behaviour? What determines the specific content of a given habit? What are the different modalities of reinforcement of this habit? These and other questions are referred to in presenting our theoretical framework. The empirical part of the paper mainly provides a thorough account of the synchronic dimension of habit, which, to our knowledge, has been mostly overlooked in the literature on transportation.²

It is obvious that recurrent performance of an action that has become habit-based can trigger the concomitant performance of related habits (Middleton, 2011). For instance, the habit of commuting by car is linked trivially to the habit of driving, but may be associated less trivially to other habits, such as listening to music or eating breakfast. Our study assesses the influence of such associated habits on the habit of driving and particularly their role in reinforcing the car-use habit. We questioned a random sample of 124 car users in the metropolitan area of Lyon about several dimensions of their transportation behaviour – especially the activities they perform when driving a car – in order to highlight their habit-based features. We distinguished two groups of car-users based on the frequency of their use of public transport: the first group includes people whose transportation behaviours are

¹ See Danner et al. (2008) for recent findings, notably based on a study on bicycling behaviour.

² Two noteworthy exceptions are the work of Patricia Mokhtarian and colleagues (e.g. Mokhtarian and Salomon, 2001; Handy et al., 2005) which suggests that the act of commuting can be enjoyable, and studies by the Centre for Transport and Society, University of the West of England, on travel time use (Lyons and Urry, 2005; Lyons et al., 2007; Jain, 2011). Among the factors that can make commuting enjoyable are aspects that we refer to as associated practices (e.g. conversing on the phone, listening to music or audio books, looking at the landscape, etc.). Although insightful, these researches depart from our paper in that they are not aimed at assessing specifically the role of those activities in strengthening the habit of driving with which they are associated.

based primarily on using a car; the second group includes people with more diverse transportation behaviour. The results show that the VEE framework offers original and fruitful insights on transportation behaviour and highlight the significance of the synchronic dimension on habits for understanding inertia in transportation behaviour.

The paper is organized as follows. Section 2 describes the theoretical, VEE based framework used to analyse habit-based behaviour. Section 3 presents the data and data collection methods. Sections 4 and 5 respectively present and discuss our results and Section 6 concludes by pointing to some major issues that need to be addressed to extend the research agenda initiated in this paper.

2. Analysing behavioural inertia: the relevance of the Veblenian approach to habits

Spurred by the need to provide a better explanation of behavioural inertia in relation to transportation modes, we propose an interpretative framework that departs from previous theoretical work based on ‘methodological collectivism’ or ‘decision theory’. For several decades these two approaches have dominated the social science literature on human behaviour in general and behavioural inertia in particular. Both approaches have generated major insights, but considering behavioural inertia as the sole expression of the higher forces (‘cultural’, ‘social’ or ‘technological’) that are supposed to determine individual actions and thoughts (i.e. ‘methodological collectivism’), is no more satisfactory than considering that it is a simple problem of choice (i.e. ‘decision theory’).³

Some authors try to go beyond this dualism. However, in our view, these attempts do not develop a framework that is sufficiently comprehensive to contemplate a third way of analysing behavioural inertia. For instance, Kaufmann (2002) and Petit (2003) adopt a

³ Viewing individuals as mainly passive entities has challenged the ability of ‘methodological collectivism’ to explain the way cultural, social or technological structures are formed, reproduced and changed. In contrast, attempts to include habits in the frame of ‘decision theory’ (see notably Becker, 1992) question the very meaning of rational choice, and especially maximizing choice.

Weberian perspective and consider habits as the expression of a certain logic of action (among others), that underpins the meaning the actor assigns them. In this view, an actor's transportation habits are justified and reinforced by other dimensions of his/her way of life and social integration. Our VEE theoretical framework clarifies this synchronic dimension of habits, highlighting its foundations, and integrating it with a general approach to human behaviour.

The VEE framework is rooted in a set of theories that explain behavioural inertia from a perspective on the individual that gives analytical and ontological primacy to habit over choice and reason. This perspective was foundational for the evolutionary and institutional economics of Thorstein Veblen, which owes much to the Pragmatist philosophy and psychology of Charles Sanders Peirce (1839–1914), William James (1842–1910) and John Dewey (1859–1952). It is noteworthy that these theses, developed more than a century ago, have experienced a certain revival in social psychology (Ouellette and Wood, 1998; Verplanken et al., 1998; Aarts et al., 1998; Verplanken and Aarts, 1999; Wood and Neal, 2007), and economics (Hodgson, 1997, 2004a, 2004b, 2007, 2010; Brette, 2004, 2006; Maréchal, 2009, 2010). As discussed in depth in Maréchal (2009), there is obvious common ground underlying the notion of habit developed in these different literatures.

In line with this legacy, an important aspect of our VEE framework is that it considers habit not as *behaviour*, but as 'a *propensity* to behave [i.e. to implement specific patterns of action and/or thought] in a particular way in a particular class of situations' (Hodgson, 2010: 4 – original emphasis). Along similar lines, Wood and Neal (2007: 843) assert that 'habits are learned dispositions to repeat past responses'. Verplanken (2006) emphasizes that such a perspective on habits differs from the behaviourist tradition of equating habit with frequent

behaviour.⁴ This confusion between the propensity to behave and the behaviour *per se*, can be compared to the conflation in biology of genotype and phenotype. Avoidance of this confusion is crucial. First, it distinguishes the process of habituation, which generally depends on behaviour repetition, from its outcomes, namely the habit, which may be more or less frequently actualized. Second, defining habits as behaviours makes it difficult to explain how they may be transmitted among individuals, except through strict face-to-face mimicking. Defining habit as a propensity to behave allows consideration of a wide range of mechanisms for its transmission, which may establish institutions, namely 'systems of established and embedded social rules that structure social interactions' (Hodgson, 2007: 96). In other words, such an approach provides a rationale for how social structures emerge from the interactions of individuals and how these social structures in turn may constrain, enable or shape individual behaviours. This perspective, which is based on the idea of mutual constitution in a recursive fashion, has proved insightful for explaining the puzzling efficiency gap in energy consumption (Maréchal, 2010). We claim that it could prove fruitful in the context of transportation issues which are infused with social and structural dimensions. Third, considering habit as propensity keeps open the possibility that the same habit may result in a diversity of actualizations. Rather than determining a specific reaction to a given stimulus, habit may grant the individual a more or less significant degree of freedom to define the content of a response. Although a certain degree of automaticity is regarded as one of the main features of habit (Verplanken, 2006; Maréchal, 2010), '[h]abit is not mere automatic behaviour [...]. Even the most ingrained habits are the objects of recurring mental activity and evaluation' (Hodgson, 1993: 229).

This last position points to the crucial issue of the relations between habit, deliberation, choice and action. Considering habit as the basic unit when analysing behaviour does not deny the individual capacity to make decisions, including strategic choices. On the contrary,

⁴ A view that also occurs in Becker's (1992) approach, as pointed by Hodgson (2004b: 653, 2010: 4).

as William James (1892: 139) already points out, habit is a *sine qua non* of the exercise of intelligence: since ‘habit diminishes the conscious attention with which our acts are performed’, it releases cognitive resources that can be used to cope with original situations and new problems. This argument has been widely acknowledged within Behavioural Economics.⁵ Herbert Simon (1947) explicitly endorses it, leading him to consider that man’s ability to make decision derives from his propensity to develop and follow habits in similar situations. Friedrich August Hayek (1952) adds to the argument, by identifying neural underpinnings to memory. Hayek argues that ‘[t]he mind classifies all in-coming data from the external environment into an appropriate category based on the similarity of the in-coming data with all previously received data’ (Frantz, 2013: 11). These inner processes lead an individual’s past experiences to shape his/her later experiences, perceptions and actions, depending on the activation of different parts of his/her nervous system. Subsequent works in neuroscience and neuroeconomics have corroborated Hayek’s (1952) insights (Festré and Garrouste, 2009: 261-264). In particular it has been shown that ‘everyday consumer behaviour’, such as ‘routine shopping and consuming’, displays features that can be properly observed and analysed at the neural level. For instance, brand loyalty has been interpreted in terms of matching and discounting, two psychological phenomena, which are associated with neurophysiological processes, such as the release of the neurotransmitter dopamine within the reward system, and with the generation of emotional responses (Foxall, 2008: 378). This perspective allows highlighting an important part of habit-based behaviour. Actually this way of entering the cognitive black box of habits to understand their neural underpinnings echoes William James’ (1892) concern who already points out the neurophysiological foundations of habit formation.⁶

⁵ We are grateful to a referee for his/her suggestion to consider the relations between the VEE framework and Behavioural Economics, from Simon and Hayek to Neuroeconomics.

⁶ James (1892: 134) defines habit in the following terms: ‘An acquired habit, from the physiological point of view, is nothing but a new pathway of discharge formed in the brain, by which certain incoming currents ever after tend to escape’. See Twomey (1998) for an extended discussion of how recent results from a number of cognitive sciences are reminiscent of Veblen’s and American pragmatists’ ideas.

However, although consistent to some extent, Neuroeconomics and VEE views on habit are rooted in different approaches. In the main, neuroeconomics has tended so far to interpret habit through the lens of decision theory, as a ‘control system’ competing with other individual’s ‘decision systems’ – i.e. ‘the Pavlovian system’ and ‘the goal-directed system’ – when facing specific situations of choice, such as ‘which road to travel during a commute, or addiction’ (Fehr and Rangel, 2011: 22).⁷ On the contrary, the VEE perspective rests on the principle of continuity, which allows habits to be ‘fused’ with rationality (Kilpinen, 2005: 1). It leads to behaviour being considered as a succession of actions where ‘motives do not precede action because they enter the scene in the middle of ongoing action processes’ (Gronow, 2008: 361). Habitual and intelligent aspects interact during the performance of action (Kilpinen, 2000, 2012). Moreover, habit is seen as the very foundation of rationality since ‘rational choices themselves are always and necessarily reliant on prior habits’ (Hodgson, 2004b: 653). The traditional view of rationality is thus reversed: ‘[i]ts role is to hinder rather than further our action process’ (Kilpinen, 2005: 2), and ‘[i]t is no more action that needs to be explained, it rather is a change in action that demands an explanation’ (ibid: 4). Individuals do not necessarily need incentives/motives to start acting; however opposing habitual ways of acting requires incentives/motives. More generally, the VEE framework puts the process of formation, reinforcement and change of habits at the heart of the research agenda, and allows the principle of continuity in human behaviour to be considered from two complementary viewpoints: the diachronic and synchronic dimensions.

From a diachronic viewpoint, one should consider that the characteristics of an individual’s habits, at a given time, are ‘path-dependent’, or dependent on their processes of formation, reinforcement and change. Identifying and analysing these processes is crucial to understand the forming of the individual’s cognitive perceptions, appreciations and normative

⁷ The various approaches in neuroeconomics – in spite of significant discrepancies – are primarily interested in studying choice behaviour (Fumagalli, 2010; Vromen, 2010).

judgments. Indeed, the process of evolution of habits leads to the development of coherent cognitive frames that shape the way individuals interpret the world and make decisions (Dolfsma, 2002). Hodgson and Knudsen (2004: 36) argue that '[a] sequence of similar and repeated behaviors creates in each agent a habitual predilection, which can stimulate a "belief" or "conviction" that a particular behavior is appropriate' and, finally, that these 'stubborn "beliefs" in the appropriateness of an action [...] weigh heavily in the decision-making process of each agent'. There are many types of factors that may combine to shape the habituation processes including factors related to the individual's personal features, and to his/her natural, material and social environment. A significant change in context may create a disturbance to the individual's behaviour, which could promote changes to certain habits and alter his/her 'beliefs' and 'convictions' – see the example given by Hodgson (2003: 166) in relation to transportation behaviour. In these circumstances, the individual's 'rationality' is opened to new information and to some reassessment of his/her habits. Promoting openness and exploiting such 'windows of opportunity' is a major challenge for public policy, which aims at increasing people's receptiveness to economic incentives (Maréchal, 2010). Finally, the individual's social interactions must be considered.⁸ This aspect is related to the crucial issue of institutional evolution, or the process of formation, reinforcement and change of institutions. The current paper does not specifically address institutional issues. Our present concern is to outline our VEE framework and to begin to elaborate on its implications for transportation studies. The rest of the paper is devoted to the personal features of an individual's transportation habits. Exploring these 'simple' features is a first (necessary) step to the study of more intricate issues, such as the dynamic interactions between individual habits and institutions. As Hodgson (2010: 14) argues, '[o]nce habit is seen as the foundation of preferences or beliefs, we can develop an enriched understanding

⁸ For a comprehensive account of the interplay between institutions and the individual's habits and intentions, see Fleetwood (2008) where he discusses the case of labour market. On the importance of this topic for future research in relation to transportation behaviour, see Dugundji et al.'s (2011) guest editorial in the Special Issue on Transportation and Social Interactions in *Transportation Research Part A: Policy and Practice*.

of the interaction between individuals and institutions, including of the causal mechanisms involve’.

To be more precise, our focus is on the synchronic dimension of personal habits. At a given time, an individual’s ingrained habits are more or less interdependent although they may be related to different fields of activity or thought. Veblen (1990: 39) argues that ‘[t]he individual subjected to habituation is each a single individual agent, and whatever affects him in any one line of activity, therefore, necessarily affects him in some degree in all his various activities’.⁹ We consider this point to be crucial for analysing the strength of a habit. We thus test the synchronic hypothesis that the strength of a habit, especially car-use habit, depends on its relations and degree of consistency with other habits.

3. Material and Methods

Characterizing the nature, manifestation and effects of habits related to commuting behaviour is difficult. Verplanken and Orbell (2003) use the Self-Report Habit Index (SRHI), to open the ‘blackbox’ of habits and study their automaticity. Following the work of John Bargh (1994), automaticity displays four distinct features or the ‘four horsemen of automaticity’: lack of control; lack of awareness; efficiency (i.e. economizing on cognitive resources that can be used for other purposes); and lack of intention. Verplanken and Orbell (2003) provide evidence of the existence – to an extent – of the first three features, which can serve to distinguish the ‘strength’ of different habits. Regarding unintentionality, this requires some qualification: if habits can become ‘counterintentional’ (Verplanken and Faes, 1999), the fact that they must be functional (i.e. in line with other on-going actions and beliefs) makes them intentional to some degree (Polites, 2005), which means that habits cannot be reduced to pure automatism or reflex-type behaviour.

⁹ One can also consider the synchronic viewpoint at the institutional level. As Veblen (1915: 374) asserts, ‘the cultural scheme [i.e. the institutional system] is, after all, a single one, comprising many interlocking elements, no one of which can be greatly disturbed without disturbing the working of all the rest’. While having important implications for transportation issues, these aspects are beyond our current concern.

Although insightful and helpful for empirical investigation of the strength of habits, Verplanken and Orbell's SRHI is a rather 'static' and 'discrete' approach that needs to be complemented by some characterization of 'dynamic' (namely diachronic) and 'systemic' (namely synchronic) features. Also, the degree of automaticity of a habit is not equivalent to its 'strength'. Starting from the definition of habits in Hodgson (2010), we assess the strength of habits through the relation between particular classes of situations and the implementation of specific patterns of behaviour. Strength of habits, e.g. the strength of the car-use habit, encompasses both *intensity* and *scope*. Intensity refers to the frequency with which a specific pattern of behaviour is activated in a given set of situations. For instance, the frequency of using the individual's own car to travel between home and work is a measure of the strength (intensity) of his/her car-use habit. Scope refers to the variety of types of situations (e.g. work commuting, grocery shopping, family visits, etc.) when a specific pattern of behaviour (e.g. using the car) is commonly activated.

It is also important to stress that empirical analysis of the notion of habits entails risk of methodological bias, especially because many surveys put the respondent in the position of decision-maker (Røe, 2000; Petit, 2003). Respondents trapped within the researcher's decision theory framework have to justify their so-called choices and apply transportation mode choices to hypothetical situations. This can make habits appear incidental determinants of daily mobility patterns, or reduce them to the outcome of some choice, which is inconsistent with our view of habits discussed in Section 2.

Accordingly, we developed an original method that combines qualitative and quantitative elements in order to identify some habit-based features of transportation behaviour. In the first step of our empirical study, 15 regular car-users were asked to describe, explain and comment on their daily car journeys. Information was collected at the end of each journey over seven consecutive days, using voice recorders, followed by in-depth interviews with

respondents. This first step, which echoes to some extent Middleton's (2011) and Earl's (2012) experiential approaches, informed a questionnaire to identify recurring or unexpected elements.¹⁰

In the second stage we conducted a questionnaire survey on a random sample in December 2010 involving 124 respondents who declared using their cars 'at least several times a week' and having a close-to-home access to public transportation. The survey was conducted during four periods of two hours in four main squares in Villeurbanne. Residents of Villeurbanne were chosen to be survey respondents. Villeurbanne is the second (in terms of population) city in the metropolitan area of Lyon (142 552 inhabitants in 2008) and forms a continuous urban area with the city of Lyon within a ring road. The average distance from home to the public transportation system for the survey sample was 110m, providing respondents with a convenient alternative to private car use. This allowed examination of the importance of inertia in daily transport behaviours in a urban context. In addition to general information on the respondents (see Table 1), this survey was designed to identify their places of residence and work, their most frequent journeys, their behaviours associated with driving, their frequency of weekly use of other transportation modes than private car, their feelings of constraint or choice associated with the transportation modes used, and to collect their qualitative judgments about alternative solutions. Most frequent journey by car included 31% direct commuting trips, 30% shopping trips, and 31% leisure and free-time activities.

¹⁰ Middleton (2011) explores the experiential dimensions of habits of urban pedestrian mobility, on the basis of interview and diary data. Earl's (2012) approach is quite different, in that it rests on the introspection of the researcher himself, in order to develop a long term diachronic perspective on car-purchasing behaviour.

Variables	n	Freq
<i>Gender</i>		
F	51	41,13%
M	73	58,87%
<i>Age</i>		
[18-24]	28	22,58%
[25-34]	31	25,00%
[35-44]	23	18,55%
[45-54]	18	14,52%
[55-64]	12	9,68%
>64	12	9,68%
<i>Educational level</i>		
Secondary School	18	14,52%
A-level	29	23,39%
2-year technical or university degree	22	17,74%
BA	26	20,97%
MA and higher degree	29	23,39%
<i>Socio professional groups</i>		
Artisans, shopkeepers and company managers	9	7,26%
Administrators and managers, higher grade professionals	11	8,87%
Intermediate-grade professionals & non-manual employees	52	41,94%
Workers	7	5,65%
Others, no activity	10	8,06%
Students	24	19,35%
Retired	11	8,87%
<i>Number of children living in the respondent's household</i>		
No children	85	68,55%
One child	18	14,52%
Two children	16	12,90%
Three children and more	5	4,03%
<i>Occupancy status</i>		
Tenants	86	69,35%
Owners	34	27,42%
Others (company accommodation ...)	4	3,23%

Table 1. Descriptive statistics

4. Results

Several quantitative surveys show that modal share and traffic in the metropolitan area of Lyon remained stable between 1995 and 2007 despite major improvements to public transport, especially since 2000 (Hubert, 2009; UrbaLyon, 2011). Although the number of car journeys declined between 1995 and 2007, their average length increased. In contrast to the projections of policy makers, car use continues to be significant and has become more

complex as car drivers globally tend to integrate more activities per journey (Buhler, 2010). The survey results presented here constitute the core of our research to develop a better understanding of relative behavioural inertia in daily transportation modes, especially car-use, in the metropolitan area of Lyon. We assess the relations between degree of behavioural inertia, strength of the car-use habit, and the characteristics of other habits associated with driving.

We formulated a series of questions to test several hypotheses with respect to potential theoretical explanations for observed inertia in modal behaviours. These explanations mirror two of the three classes of theories referred to in Section 2, that behavioural inertia can be considered the result of rational choice or habits as defined in the VEE perspective. Many analytic and forecasting models used for transportation planning and in academic research, build on cost-benefit analyses to predict behaviours, using the variables time and cost in a generalized cost analysis. This refers to a conception of universal rationality. The first set of survey results assesses the relevance of this cost and time approach to analyse transportation behaviours. Participants were asked to estimate the time and monetary costs involved in their most frequent car journeys and the equivalent costs of alternative public transport. This allows us to compare reported estimations with objectified values and identify the proportion of the population giving an accurate estimation for either alternative.¹¹

For the variable time, a huge majority (96%) were unable to provide both an accurate (i.e. within a 20% margin of error) estimation of the time required for their most frequent journeys by car and of the time required for the same journey using public transport, whether they already experienced it or not (see Table 2).

¹¹ Objectified journey times were estimated using information provided on the websites 'www.mappy.com' for car journeys and 'www.tcl.fr' for public transport journeys, taking into account traffic conditions at the same time on the same day.

		Most frequent journey by car				%
		Over-estimated (more than 20% difference)	Well-estimated (less than 20% difference)	Under- estimated (more than 20% difference)	No estimation	
Public Transport alternative for the same journey	Over-estimated (more than 20% difference)	15 (12%)	4 (3%)	5 (4%)	0	(19%)
	Well-estimated (less than 20% difference)	7 (6%)	5 (4%)	6 (5%)	0	(15%)
	Under-estimated (more than 20% difference)	23 (19%)	21 (17%)	34 (27%)	3 (2%)	(65%)
	No estimation	0	1 (1%)	0	0	(1%)
%		(37%)	(25%)	(36%)	(2%)	

Table 2. Assessment of travel times for an individual's most frequent journey by car and for public transport alternative

These results tend to discard the idea that individuals take account of objective time issues and choose on this basis to use their cars for their most frequent trips. Our results are coherent with the findings of other studies which highlight the discrepancies between perceived time and real time, due to a diversity of biases in time perception (Kaufmann, 2002; Li, 2003; Parthasarathi, Levinson and Hochmair, 2013). Since perception of time is highly subjective, it is essential to look at the other component in rational choice, namely the associated financial costs. Respondents were asked to assess the monthly costs of their most frequent car journeys, and then were asked about what these included. A small minority (16%) were unable to answer the question. More than two-thirds of respondents (71%) referred only to fuel costs.¹² In line with the results of Beirão and Cabral (2007), it thus appears that the cost of travel is unlikely to be the main reason for observed inertia in

¹² Based on his own experience, Earl (2012: 1070-1071) presents several cases where people are likely to misestimate or disregard the real costs of car ownership and use.

transportation behaviour. Our results support the idea that people do not necessarily resort to a choice scheme based on comparing alternative times and costs, as assumed by decision theory.

To test the role of habits in transportation mode behaviours, we partitioned the survey population into two subsamples, considering the respondents' frequency of use of public transportation services. The first sub-sample, 'PT+', includes 38 people who use public transportation services more than once a week, in addition to using their car. Sub-sample 'PT-' includes 86 people who rarely use public transport (i.e. once a week maximum). Our segmentation criterion allows us to classify car-drivers according to the strength of their car-use habit, assuming that both samples experience similar classes of situations.¹³ This means that the PT+ group habits could be interpreted in two ways. It may be that PT+ drivers use their personal cars and public transport alternately for a particular type of trips (e.g. commuting) while PT- drivers (almost) always use their personal cars in the same class of situations and/or that PT+ drivers always use public transport for a certain type of trips which PT- drivers usually accomplish by car. Differences in the strength of the car-use habit between PT+ and PT- drivers may rest on the intensity of the habit (first case) and/or on the scope of the habit (second case). Whatever the case, PT- drivers are considered to have a stronger car-use habit than PT+ drivers.

Correlation tests show no specific link of this habit strength with age, gender, educational level, number of children, occupancy status or employment location (see Table 3). These usual socio-economic variables are weakly correlated with the strength of car-use habit (i.e. being part of PT- group). What seems to have an influence on the strength of car-use habit, however, is the fact of having a professional activity. This would tend to support the idea developed in Shove et al. (2007) that time-constrained schedules (e.g. having to conform to

¹³ Bearing in mind the broad definition of the main classes of situations considered here (i.e. direct commuting trips, shopping trips, leisure or free-time trips), this is a weak hypothesis.

widespread institutional arrangements regarding working hours) provide a favourable context for the formation of habits. This line of argument is reinforced by an even more (statistically) significant result from Table 3 which shows that the 'feeling of having no choice' for transport mode is strongly correlated with the fact of belonging to the PT- group. Obviously, one must be very cautious in treating such a result linked to a statement that is inherently subjective (i.e. it is but a *feeling*). Nevertheless, taken together with the influence of having a professional activity,¹⁴ it does suggest that 'constrained' car-drivers tend to display stronger car-use habits. This important result is further discussed in Section 5 in connection with other insights from the empirical survey.

As expected, differences in the strength of the car-use habit also correspond to significant differences in the patterns of transportation behaviour. Table 3 shows that, on average, PT- drivers use their personal cars more frequently and for longer journeys than PT+ drivers. This result leads us to examine the links between car-use habit strength and differences in the respective behaviours of the two sub-groups associated directly with driving.

¹⁴ Coupling both arguments is compatible with our data since, within the PT- group, 81% of people that declare a 'feeling of having no choice for the transport mode' have a professional activity (compared with a proportion of 69.76% in the PT- group as a whole and 50% in the PT+ group).

	PT+ (N=38) (mean)	PT- (N=86) (mean)	Chi-square test
Gender (% of women)	52.63%	36.05%	n.s. (p=0.08)
Age (years)	40.16	36.81	n.s. (p=0.14)
Educational level (years after the high-school diploma)	2.31	1.79	n.s. (p=0.77)
People with a professional activity	50%	69.76%	* (p=0.035)
Household with children	26.31%	33.72%	n.s. (p=0.41)
Number of children in the household	0.47	0.57	n.s. (p=0.68)
Occupancy status (% of tenants)	63.15%	70.93%	n.s. (p=0.18)
Working downtown	73.91%	82.43%	n.s. (p=0.66)
Number of journeys per week by car	4.25	6.77	*** (p=0.002)
Time spent in car per week	73 min.	133 min.	*** (p=0.004)
Feeling of having no choice for their transport mode	5.26%	24.41%	*** (p=0.003)

Table 3. Characterisation of two groups of people according to the strength of car-use habit

The reported coefficients are estimated with a multinomial logit with random effects. The significance thresholds are respectively 0.5%(***), 1%(**) and 5%(*).

We hypothesized that the development of habits during car journeys might play a role in strengthening the car-use habit. Some of the literature on transportation (Mokhtarian and Salomon, 2001) indicates that daily journeys are increasingly used for a series of activities (phoning, texting, chatting, etc.). This trend is based on growing use of communication technology and less clear boundaries between family life and work and leisure activities (Urry, 2000; Laurier, 2004). Investigating these ‘associated behaviours’ provides a better picture of the lived experience of a car journey. The first qualitative step in our protocol (based on in-action voice recordings) identified 13 different recurring associated behaviours mentioned in Table 4. We asked participants to the quantitative survey to estimate the frequency of each according to: ‘always’, ‘often’, ‘rarely’, ‘never’. Respondents had space to indicate additional associated behaviours. Two respondents reported the respective actions

of 'singing' and 'eating while driving'. This suggests that, in the main, our list included relevant behaviours.

The first effect identified is the weak influence of gender, social category and age on the nature and frequency of the 13 associated behaviours. In contrast, we found a statistically significant correlation between belonging to one of the two sub-groups (i.e. PT+ versus PT-) and the nature of these associated behaviours. Although respondents from the PT- group reported on average performing a higher number of associated behaviours (5.70 to 4.92 for the PT+ group) this result remains non-significative. Beyond these quantitative aspects we explore the hypothesis of specific learning effects for the PT- group in their daily driving. To test this hypothesis further, we examine the qualitative features of the associated behaviours. Table 4 shows that some associated behaviours are more frequent in the PT- group than the PT+ group. Most of the associated behaviours in this category (i.e. 'texting', 'phoning' and 'talking to passengers') require at least one hand to be free, focused cognitive resources, and/or speech.

			Always + Often	Rarely + never	Chi-square test
Associated practices more frequent in the PT- group	Reading or re-reading documents	PT+	0 [0%]	38 [100%]	p = 0.177
		PT-	4 [5%]	82 [95%]	n.s.
	Writing a message / SMS	PT+	1 [3%]	37 [97%]	p = 0.017
		PT-	16 [19%]	70 [81%]	*
	Phoning	PT+	4 [11%]	34 [89%]	p = 0.033
		PT-	24 [28%]	62 [72%]	*
	Talking to passengers	PT+	27 [71%]	11 [29%]	p = 0.030
		PT-	75 [87%]	11 [13%]	*
Smoking a cigarette	PT+	7 [18%]	31 [82%]	p = 0.212	
	PT-	25 [29%]	61 [71%]	n.s.	
Combing again your hair / redoing your make-up	PT+	1 [3%]	37 [97%]	p = 0.140	
	PT-	9 [10%]	77 [90%]	n.s.	
Looking at passers-by	PT+	15 [39%]	23 [61%]	p = 0.187	
	PT-	45 [52%]	41 [48%]	n.s.	
Associated practices more frequent in the PT+ group	Listening to music	PT+	34 [89%]	4 [11%]	p = 0.402
		PT-	72 [84%]	14 [16%]	n.s.
	Listening to a particular radio broadcast	PT+	19 [50%]	19 [50%]	p = 0.811
		PT-	41 [48%]	45 [52%]	n.s.
	Thinking about your job / your studies	PT+	19 [50%]	19 [50%]	p = 0.905
		PT-	42 [49%]	44 [51%]	n.s.
	Thinking about your daily-life organization	PT+	26 [68%]	12 [32%]	p = 0.914
		PT-	58 [67%]	28 [33%]	n.s.
	Thinking of nothing special	PT+	16 [42%]	22 [58%]	p = 0.92
		PT-	24 [28%]	62 [72%]	n.s.
Looking at the city / the landscapes	PT+	21 [55%]	17 [45%]	p = 0.762	
	PT-	45 [52%]	41 [48%]	n.s.	

Table 4. Practices associated with driving according to the strength of car-use habit

The associated behaviours that are more frequent among the PT+ group or are equivalent for both groups – i.e. listening to music, listening to a particular radio broadcast, thinking about one’s job/daily life, thinking of nothing in particular, looking at the city and the

landscape – are passive behaviours, requiring less focused cognitive resources, and show no statistically significant difference.

These results confirm the hypothesis of specific learning effects and possibility of behaviours that require additional cognitive resources for the PT- group.¹⁵ The dexterity (manual dexterity, focused cognitive resources, speech) acquired through these learning processes and frequent journeys enabled this group to integrate a series of associated practices that they correlated with experiencing a 'pleasant' journey. As shown by Gardner and Abraham (2007), the performance of related activities is mentioned by cars users in relation with the idea of a 'personal space'. This private sphere is valued by car users notably as it ensures a 'freedom from observation' thereby allowing them to do things such as 'singing loudly' (Gardner and Abraham, 2007: 192). The car is also experienced as providing opportunities for 'relaxation and quiet contemplation' which may explain some of the puzzling findings of our study that are explained below. Indeed a logistic regression of the occurrence of the adjective 'pleasant'¹⁶ (dependent variable, Table 5) shows that the strength of car-use habit (i.e. PT- or PT+) has a statistically significant impact on perceptions of journey times as 'pleasant', even more than real travel time. Mirroring this important result, Table 6 (see appendix 1) displays the results of the logistic regression for the occurrence of the adjective 'stressful'. Besides real travel time, the only other variable that plays a significant role on perceiving car journeys as being stressful is the fact of belonging to the PT+ group.

¹⁵ Middleton (2011: 2873) points out similar learning effects in case of walking habits, deriving from the everyday practices of urban pedestrians.

¹⁶ Respondents were asked to qualify the time spent during each journey with one or several adjective(s): 'What do you think about the time spent in car during this particular journey?'. Multiple answers were suggested ('long', 'short', 'useless', 'useful', 'pleasant', 'stressful', 'tiring') and the respondents could also suggest another adjective.

Logistic regression of the occurrence of the adjective 'pleasant' to qualify travel time by car (dependent variable)				
Independent variables	Modality	Value	p-value	significance
Age	less than 30	0,42	0,32	n.s.
	31 to 40	(ref)	(ref)	(ref)
	41 to 60	0,31	0,48	n.s.
	more than 61	-1,66	0,08	n.s.
Car-use habit strength	PT+	(ref)	(ref)	(ref)
	PT-	1,09	0,01	**
Company during the journey	with family	(ref)	(ref)	(ref)
	alone	-0,58	0,09	n.s.
	roomates	-0,39	0,64	n.s.
	colleagues	-2,29	0,14	n.s.
Frequency of the journey	friends	-0,20	0,70	n.s.
	rare	-0,07	0,83	n.s.
	daily	(ref)	(ref)	(ref)
Real travel time	more than daily	0,55	0,51	n.s.
	T < 10 min.	(ref)	(ref)	(ref)
	11 min. < T < 20 min.	0,72	0,04	*
	21 min. < T < 30 min.	0,03	0,96	n.s.
	31 min. < T < 40 min.	1,85	0,04	*
	41 min. < T < 60 min.	3,54	0,02	*
	T > 60 min.	0,92	0,15	n.s.

Table 5. Perception of quality of time while driving

The impact of transportation mode behaviours on qualitative perceptions of travel time suggests that associated practices may influence drivers' evaluations. The formation and reinforcement of habits through mono-modal experience of car use (PT-) results in a deeper exploitation of travel time and more positive evaluation of car travel experience which contributes to stronger behavioural inertia.

The results of our study confirm the empirical findings in psycho-sociology and behavioural economics and, as the discussion below shows, are particularly consistent with the VEE framework.

5. Discussion

Habits and perceptions of journeys

Traditional rational choice theory has been challenged by recent empirical findings in behavioural economics (see Gowdy, 2008 or DellaVigna, 2009, for a useful survey). In a world of bounded rationality (Simon, 1947), people are unable to absorb all the information available. They must select among it (Maréchal and Lazaric, 2010; Arena et al., 2012) using filters or cognitive frames (for a discussion see Gronow, 2008). Moreover, individual learning grounded on a personal 'mountain of experience' may lead people facing a complex and evolving environment to 'cling to beliefs they have, sometimes in the face of evidence to the contrary' (Dolfsma, 2002: 681). How people assess the time and costs of their most frequent journeys (see Table 2) suggests that their transportation behaviour does not derive from a well-informed rational economic trade-off between car use and use of public transport services (see also Kaufmann, 2002; Li, 2003; Beirão and Cabral, 2007; Parthasarathi, Levinson and Hochmair, 2013).¹⁷ The information required to assess this trade-off may be available, but it tends to be ignored and people adopt behaviours based on habit.

Various explanations can be proposed to explain this fact. They include the efficiency derived from habit (i.e. developing certain habits allows better management of scarce cognitive resources). Indeed, the possibility that some mental processes become fairly automatic once learned, saves on psychological energy which can be diverted to novel tasks (Egidi, 1992; Bargh and Chartrand, 1999; Kahneman, 2003). Furthermore, in line with the suggestion from de Board (1978) and Bovey and Hede (2001), it appears that behavioural inertia may act as

¹⁷ The results displayed in Table 7 (see appendix 2) show no statistical difference between the PT+ and PT- groups regarding their accuracy in assessing both the costs and the time related to their most frequent journey by car and to its public transport alternative. We can thus not interpret the transportation behaviour profile – i.e. the fact of belonging to one of the two groups – as an indicator of a more or less significant degree of an individual's rationality.

a defence mechanism to reduce anxiety and reinforce self-control. ‘Stick-with-what-we-know’-type actions are likely to enhance comfort and security (Lindbladh and Lyttkens, 2002), especially in contexts that require individuals to act under time pressures (Betsch et al., 2004). This line of argumentation is corroborated by some of the main insights from our empirical survey as not only do car-drivers with time-constrained schedules display stronger car-use habits (see Table 3) but the fact of having stronger (weaker) car-use habits increases the likelihood of car journeys being perceived as ‘pleasant’ (‘stressful’) (see Tables 5 and 6). Stronger habits thus seem to indeed provide both a way of handling time pressure and a mechanism to reduce the stress linked to driving. This constitutes a reasonable explanation for an otherwise puzzling result of the survey: the same individuals that more often feel to be highly ‘constrained’ in ‘choosing’ their mode of transportation are also those that find car journeys more ‘pleasant’. Building on the recursive perspective on causation between agency and structure which characterises the VEE framework,¹⁸ this may be interpreted as institutionally-constrained individuals exerting a certain degree of agency through taking advantage of a situation they feel they do not have much grip on. This illustrates how habits may combine with individual ‘reflexivity’ (Davis, 2003; Archer, 2003, 2007).¹⁹ Middleton (2011: 2859) provides examples of such an overlapping process, in emphasizing the importance of ‘specific narratives of everyday urban mobilities [especially pedestrian mobilities]; the significance of how such practices are actually “talked about”; and how these accounts matter in engaging with the experiential dimensions of urban movement’. Habituation thus constitutes the mechanism through which ‘active’ agents – i.e. agents who may ‘undertake instrumental internal conversations’ (Fuller, 2013: 121) – adjust

¹⁸ This perspective can be subsumed as bearing in mind that ‘habits are the constitutive material of institutions’ while the presence of institutions make that ‘accordant habits are further developed and reinforced among the population’ Hodgson (2007: 107).

¹⁹ We thank two anonymous referees for highlighting the benefit of making room for Davis’ (2003) and Archer’s (2003, 2007) approaches to reflexivity in our discussion. Davis (2003: 117-119) makes it clear that the VEE approach to the individual as a socially embedded being is consistent with the acknowledgment of his/her capacity for reflexivity and learning (see also Dolfsma, 2002). Such a view of the individual is necessary to the development of coherent (non arbitrary) structure-agency models. Finally, Fuller (2013) argues convincingly that Archer’s (2003, 2007) analysis of individual reflexivity may articulate with the VEE approach to habit and Davis’ (2003) insights on the ‘relative autonomy’ of individuals.

their cognitive perceptions, matters of appreciation and normative judgements in coherent structures (Lindbladh and Lyttkens, 2002). As our survey suggests, one way this works is through habits enabling cognitive resources to be devoted to the performance of synchronic habits, rendering journeys more pleasant. This binding nature of those strong habits intimately connected with everyday life may be what causes individuals to feel they have no choice or, more likely, that it would be very effortful for them to do otherwise.

Within the VEE perspective, habits thus are not simply an efficient way to save on cognitive resources expended on searching and processing information. Habits intimately shape the way individuals acquire, filter and manage information in accordance with their stubborn 'beliefs' and 'convictions' (Hodgson and Knudsen, 2004: 4).

Performance of habits: one habit triggers another

Our results tend to confirm the synchronic hypothesis that the strength of the habit, in this case car-use, depends on its relations with other habits and the degree of mutual consistency among the various habits. For instance, the habit of driving oneself to work may be associated with other habits, such as supermarket shopping after work (Shove et al., 2007). These habits are mutually strengthening to the extent that the existence of one justifies the existence of the other. This may explain the reluctance to switch to another option such as public transportation even in presence of a convenient service.

Our study focuses on the relations between the habit of car-use and other habits actualized by the driver during a car journey, such as listening to music, phoning or looking at the landscape. These 'small habits', developed to an extent by every individual, may appear trivial especially when considered independently. However, we argue that they become significant when considered jointly, and contribute to shaping the travel experience. This travel experience, in turn, plays a major role in the stability of transportation behaviour thereby strengthening the transportation habit.

Our results show that the more the frequency of their actualization increases, the more the car-use habit and its related synchronic habits (reading documents, writing a message, phoning, and so on) tend to be mutually reinforcing in the sense that one habit triggers the others. Table 4 shows that the people in the PT- group are more likely to perform a set of activities that require particular dexterity. In this respect, our empirical findings are in line with results in psychology on the link between behaviour repetition and strengthening of habits (see Danner et al., 2008 among others). Also, the more actualized the car-use habit is, the more smoothly will its related synchronic habits be performed, leaving space for the memorization of new cognitive skills (Lazaric, 2011). In short, drivers in the PT- group are more prone to being governed by cognitive automatisms enabling combination with additional activities since already established activities (i.e. driving) become more automatic. Finally, our results shed new light on the relations between habits and the pleasure of commuting (Mokhtarian and Salomon, 2001). They show that an increase in the frequency of actualizations of car-use and associated habits positively affects the pleasure derived from travelling (Table 5). Thus, there seems to be a positive feedback between the development of associated habits, more positive perceptions of the travel experience, and a stronger car-use habit.

These results open new avenues for mobility policy. Transportation habits intermingle with and are performed as part of a large set of habits, and cannot be reduced to discrete phenomena that could be targeted and changed independently by public policy. Promoting change in transportation behaviour thus implies acting on various linked factors that underlie the development and strengthening of bundles of everyday life habits. This not only implies taking account of the main habits associated with the trip-chaining phenomenon, such as grocery shopping (Ye et al., 2007), but also ‘smaller habits’, which may play jointly a significant role in shaping people’s convictions and behaviours.²⁰ This leads us to wonder

²⁰ Admittedly, acknowledging the interrelatedness between habits may significantly complicate the design and assessment of public policies. As pointed out by one reviewer, prohibiting smoking in public transport could well constitute an indirect incentive for smokers to continue driving their cars. Conversely, making it illegal to phone or

whether public policies should primarily target car drivers' will to change and their awareness of convenient public transport alternative. According to Bargh and Chartrand (1999), disrupting habit-based behaviours requires setting specific goals, and motivation. Similarly, Pelletier, Lavergne and Sharp (2008) argue that people need to be aware of the drawbacks of current transportation schemes in order, in a second stage, to identify solutions. Having chosen an alternative behaviour, its recurrence could result in the development of new habits. The VEE framework is illuminating and almost reverses this argument by considering that awareness of the drawbacks of current transportation behaviour is a secondary factor in the process of change. The primary factor is the appearance of a disturbance to the current sequence of actions that is sufficiently important to trigger a reassessment of current behaviour. One way to motivate change in transportation, to maintain the intensity of this motivation over time and to make it effective, is to disturb the process of positive feedback between actualization of the car-use habit, actualization of associated habits and more positive perceptions of the travel experience.

6. Conclusion

This paper is intended to show the usefulness of the VEE perspective on habits, and to complement current analyses of transportation behaviour. The results of our empirical study underline the shortcomings of standard economic approaches that consider urban transportation behaviours as the sole result of a decision process guided by a well-informed assessment of the costs and benefits of various alternatives. This confirms the need to investigate the issue of urban transportation through an alternative conceptual lens. In line with the principle of continuity, applying the VEE framework allowed us to explore the importance of the synchronic dimension of habit for strengthening the car-use habit. Our empirical findings show that synchronic habits can significantly affect behavioural inertia in

send text messages while driving on the ground of a better safety could lead some car-drivers (i.e. those who are very active on social networks) to use public transport.

this regard and should be taken into account by policy-makers targeting urban transportation. For instance, this approach to transportation behaviour suggests a new rationale for the importance of ‘windows of opportunity’ or key events when modal changes are more likely – e.g. following a house move or the birth of a child (Fujii and Gärling, 2003; Stranbridge et al., 2004; Bamberg, 2006, 2007; Rocci, 2007; Schäfer and Bamberg, 2008; Verplanken et al., 2008; Maréchal, 2010; Meissonnier, 2011). Indeed, synchronic habits are found to be partly inactivated during these specific life stages. The underlying thesis is that the most important driver of changes to habits may be disturbances in the current driving experience, including the actualization of habits associated with car-use.

It follows from the conceptual perspective adopted in this paper that there is indeed much more behind a habit than the sole behaviour to which it gives birth. It also comprises the underlying processes which bestow habits a central role in maintaining general coherence of individuals’ perceptions, appreciations, and normative judgements, and allow us to fully grasp their intertwining with institutions. In line with the argument put forth in Schwanen et al. (2012: 527), this intertwining makes that displacing carbon-intensive transportation habits ‘requires changes to “objective conditions”, which are not – or rather not only – infrastructures or pricing structures as most travel behaviour analysts would have it but the customs and institutions that have shaped the habits of body–mind–world assemblages’. Coupling the main results of our survey with the account provided in Pooley et al. (2011: 19), it follows that some of the needed wider societal changes that are relevant for tackling strong car-use habits would be (among others) to increase the flexibility of working hours so that alternative modes ‘could be more easily fitted into a household routine’ and to devise on family welfare policies allowing parents to be ‘less constrained by time commitments’.

Despite some useful findings, the approach adopted in this paper has some limitations which could be addressed in future research. First, our approach to the strength of the car-use

habit is quite crude. It would be useful to develop a tool to measure habit strength more precisely, distinguishing between scope and intensity and taking account of the diversity of types of situations individuals face. Our method could be improved by considering some intermediate stages between strong and weak habits, and the possibility of a continuous rather than a discrete measure of habit strength might be considered. Also, the present study considers only personal car and public transportation services as substitutes for urban transport. The survey did include questions about cycling and walking, but the responses were not significant enough to include in our analysis. A measurement tool for research on transportation should include a more comprehensive approach to modal behaviour, including non-motorized modes.

This paper focuses mainly on the synchronic aspects of habits. A barrier to the development of a comprehensive tool to assess transportation habits is the lack of longitudinal approaches to transportation already underlined by Goodwin et al. (1987). More comprehensive analysis would require a combination of longitudinal and cross-sectional approaches. It should take account of path-dependence effects and habit reinforcement, but avoid confinement in an idiosyncratic conception of the processes at play. Although the specificities of each person's experience of life are likely to play a major role in developing some specific habits (Earl, 2012: 1070), a typology of generic life paths in relation to transportation could be constructed as a necessary next step in research on habits in transportation behaviour. For instance, one cannot consider in the same way people with a strong car-use habit formed after trying all alternatives, with people who commute exclusively by car and have always done so.²¹ The diachronic dimensions of habits should thus be the subject of further work to understand and formulate actions to reduce behavioural inertia in transportation. Such an approach should notably have in view a better understanding of the mechanisms of 'reconstitutive downward causation' from institutions to individuals (Hodgson, 2004b, 2007). Indeed, the impact of low-

²¹ We are grateful to an anonymous reviewer for his/her suggestion to consider Archer's (2003) typology of modes of 'reflexivity' or 'internal conversation' (see Fuller, 2013) as a relevant way of identifying some typical groups of people, the generic life paths of whom are likely to differ from one to the other, with significant implications in terms of mobility habits. Here is a potentially fruitful perspective to explore in further work.

carbon mobility policies also depends on their ability to displace 'the cultural meanings and affective atmospheres associated with cars' and to challenge 'popular connotations of cars with freedom, power, control' (Schwanen et al., 2012: 528). In this case, as in many other fields, it seems essential to put the processes of formation and evolution of habits and institutions at the heart of the social sciences research agenda, as Thorstein Veblen already urged economists to do one century ago.

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Appendix 1

Logistic regression of the occurrence of the adjective 'stressful' to qualify travel time by car (dependent variable)

Independent variables	Modality	Value	p-value	significance
Age	less than 30	(ref)	(ref)	(ref)
	31 to 40	0,54	0,19	n.s.
	41 to 60	-0,73	0,13	n.s.
	more than 61	-0,45	0,46	n.s.
Car-use habit strength	PT+	0,72	0,05	*
	PT-	(ref)	(ref)	(ref)
Company during the journey	with family	0,02	0,96	n.s.
	alone	(ref)	(ref)	(ref)
	roomates	0,27	0,75	n.s.
	colleagues	0,04	0,97	n.s.
	friends	-0,17	0,78	n.s.
Frequency of the journey	rare	-0,50	0,15	n.s.
	daily	(ref)	(ref)	(ref)
	more than daily	-0,24	0,81	n.s.
Real travel time	T < 10 min.	0,73	0,08	n.s.
	11 min. < T < 20 min.	(ref)	(ref)	(ref)
	21 min. < T < 30 min.	1,68	0,003	***
	31 min. < T < 40 min.	0,48	0,66	n.s.
	41 min. < T < 60 min.	0,31	0,86	n.s.
	T > 60 min.	1,01	0,23	n.s.

Table 6. Perception of stress while driving

Appendix 2

Assessment of the monthly costs associated with car use

	'wrong' or no assessment	'correct' assessment (including more than fuel cost)	
PT+	32 [84%]	6 [16%]	Chi-square test n.s. (p = 0,524)
PT-	76 [88%]	10 [12%]	

Assessment of the time required for the most frequent journey by car

	'wrong' or no assessment	'correct' assessment (+/- 20%)	
PT+	30 [79%]	8 [21%]	Chi-square test n.s. (p = 0,499)
PT-	63 [73%]	23 [27%]	

Assessment of the cost of a monthly travel card for public transport

	'wrong' or no assessment	'correct' assessment (+/- 20%)	
PT+	20 [53%]	18 [47%]	Chi-square test n.s. (p = 0,53)
PT-	40 [47%]	46 [53%]	

Assessment of the time required for the most frequent journey using the public transport alternative

	'wrong' or no assessment	'correct' assessment (+/- 20%)	
PT+	34 [89%]	4 [11%]	Chi-square test n.s. (p = 0,402)
PT-	72 [84%]	14 [16%]	

Table 7. Assessment of time and costs according to car-use habit strength