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ARE THE MILLENIALS LESS CAR-ORIENTED ? LITERATURE REVIEW AND EMPIRICAL FINDINGS

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1. INTRODUCTION

Generation effects play a key role in shaping long-term trends in travel behaviors, synthetizing a large number of factors operating gradually through generational renewal rather than reaching the whole population at a time. Up to cohorts born in the 70's, the process of generational renewal has made travel behaviors increasingly car-oriented, in relation with higher employment rates, the development of suburban areas, an increasing average income and decreasing vehicle costs. However, empirical findings from recent studies suggest a reversal of this trend within the so-called « generation Y » - sometimes also referred to as « the millenials » - with decreasing licensure, car equipment and car use. These studies also often refer to “young adults”, without necessarily telling whether these so-called new behaviors are caused by a delayed access to car-based mobility, due to new living conditions and economic difficulties, or demonstrate a deeper shift in lifestyles, mental habits and attitudes away from the car. Obviously, this discussion is not without implications to the future of the car and long-term trends in travel demand, as new generations will be majority tomorrow. In this study, we bring a contribution to this debate through a literature review followed by empirical findings, using the French National Unified Base of Local Household Travel Surveys. Given its composition, this database is essentially limited to urban households. Through age-cohort analysis and logistic regression, we try to determine the respective contributions of new living conditions and attitudes to travel behaviors of the millenials. In particular, we try to answer the following research questions:

- Are travel behaviors of young urban millenials different from those of preceding cohorts ?
- Which is the contribution of living conditions to new travel behaviors ?
- Are travel-related opinions of the millenials significantly different from their elders, and do they play a role in explaining travel behaviors ?

Section 2 is dedicated to the literature review about travel behaviors of the millenials. In section 3, we present the main characteristics of the Unified Base of Household Travel Surveys, along with the methodology of analysis, while results are displayed in section 4. Finally, we conclude in section 5, by reminding prominent results before drawing out future research tracks and potential implications.

2. LITERATURE REVIEW

During the last decade, there were many signs of a shift in travel behaviors among young adults, generally consisting in the decline of the car to the benefit of transit, train, walking and cycling. This shift was noticed in many countries – Germany, Great Britain, United States, Australia, Netherlands – and could be captured through a great number of indicators, either about driving license, car availability or car use. For instance, Kuhnimof et al. (2012a,b) showed that car use stopped increasing among young adults from the mid-90's, to the benefit of cycling and transit, the decline being more important for men, making behaviors more multimodal. Declining car use among young adults was also found in the Netherlands (Van den Waard et al., 2013) and the United States (Davis et al., 2012). It sometimes coincided with a decline in total mobility, meaning that it was not always compensated by greater use of other modes, especially in rural areas, where alternatives to the car are limited (Davis et al., 2012 ; Van den Waard et al., 2013).

The decline of auto-mobility for young adults was also about car ownership and licensure. Decreasing driving license access was first recognized in Sweden and Norway (Berg, 2001 ; Ruud and Nordbakke, 2005), before Great Britain (Noble, 2005). After 2010, it also diminished in Australia, North America and Japan, along with a large number of European countries (Davis et al., 2012 ; Sivak and Schoettle, 2012 ; Delbosc and Currie, 2013). Even when holding a driving license, young adults were found to drive less than before (Raimond and Milthorpe, 2010 ; Sivak and Schoettle, 2012). The decline of driving license obviously affected car ownership, which has also been decreasing among young adults, either in Great Britain or Germany (Kuhnimof et al., 2013) for instance. According to some authors, the decline of car use among young adults strongly contributed to the general stagnation of car traffic which was recorded at the national level during the 2000's (Davis et al., 2012 ; Kuhnimof et al., 2013 ; Van den Waard et al., 2013), giving birth to the « peak car » hypothesis.

Some of these research works now also refer to « generation Y », tacitly suggesting that these behaviors could become durable by reflecting a deeper conversion of mental habits and attitudes away from the car, rather than being the simple effect of new living conditions, possibly aggravated by greater economic precariousness. In the last case, indeed, the apparent decline of car-based mobility in generation Y could simply be a temporary delay, that will resorb in the next step of the lifecourse, along with greater travel needs and a higher income for instance. This discussion can be nourished through a review of the different explanations that were given to this phenomenon: while these are many and usually don't allow bringing out a consensus about the main drivers of decreasing car-based mobility among the millenials, authors usually agree that it has to be the outcome of an interaction between a diversity of causes (Delbosc and Currie, 2013).

However, not all explanations are of equal importance, as some of these can be better supported by empirical evidence. The most convincing explanation might be the emergence of new living conditions, given a longer period of

transition towards adulthood, being notably manifested through longer studies, a delayed entrance into the job market, and later family foundation. In parallel, these different stages have become less automatic and more uncertain, in relation with greater economic and relational precariousness (Billari and Liefbroer, 2010). These factors would long tend to maintain less car-dependent lifestyles, given the absence of strong professional and family constraints, thus delaying the need to drive a car. Either for Metz (2013) or Delbosc and Currie (2013), the general delay in the lifecourse appears to be the most important explanation for the reduction of car use among young adults. Being a student or having a part-time job also decreases the probability of holding a license (Noble, 2005 ; Kuhnimof et al., 2012a,b, 2013 ; Kalinowska et al., 2012 ; Delbosc and Currie, 2013), so that longer studies represent a key factor of decreasing car use, by postponing the entrance into the job market. As was shown by Taylor et al. (2012), an increasing proportion of young adults is studying, while in parallel, the number of young professionals has considerably decreased. In addition, as family foundation and young children are proven to be additional cases for passing driving license exams (Delbosc and Currie, 2013), the longer period preceding family foundation and motherhood (Mitchell, 2006 ; Metz, 2013) has become another reason to delay driving (Oakil et al., 2016 ; Hjortol, 2016). However on the other hand, an increasing number of young adults are remaining at their parental home (Cobb-Clark, 2008 ; Mitchell, 2006), which gives them better opportunities to access to a car through their parent's vehicles, the economy of a rent also making additional revenues available to support vehicle costs (Licaj et al., 2012).

Another explanation resides in the increasing economic difficulties encountered by the youth, through lower financial resources, higher unemployment (Berg, 2001 ; Davis et al., 2012 ; Van den Waard et al., 2013) and greater job precariousness, which may have aggravated the effects of general economic background – recession, increasing fuel prices - in this group (Kuhnimof et al., 2012a,b, 2013 ; Kalinowska et al., 2012), thus hindering the access to car-based mobility with respect to its costs, either associated with driving license training (Delbosc and Currie, 2013 ; Licaj et al., 2012), car ownership (Klein and Smart, 2017) or car use (Van den Waard et al., 2013). By the way, economical reasons are frequently mentioned by young adults to explain their (at least) temporary renouncement to passing their driving license exams and owning a vehicle (Berg, 2001 ; Noble, 2005 ; Williams, 2011). Beyond the cost of driving license preparation, several authors also mention their increasing difficulty, following reforms oriented by road safety goals (Noble, 2005 ; Senserrick, 2009 ; Masten et al., 2011 ; Raimond and Milthorpe, 2010). However, the influence of economic drivers is not always quite clear, as the decline of car use among young adults has sometimes preceded the economic crisis (Berg, 2001 ; Davis et al., 2012), and may also affect higher-income groups which are not yet limited by financial resources (Davis et al., 2012 ; Stokes, 2012). In addition, the assessment of resources in the case of young adults is complicated by financial transfers coming from the family (Delbosc and Currie, 2013), though parents may also be affected by increasing economic precarity. Nevertheless, it is likely that greater economic precariousness along with the reinforcement of some other budgetary items such as housing costs (Rougerie et Friggitt, 2010), may have generally contributed to reduce the available income to support

transport-related costs among young adults, thus encouraging them to more severely controlling their budget.

The third explanation consists in joint evolutions of transport supply, residential choices and work/studying places of young adults, in particular, the increasing concentration of young adults in dense urban areas of the largest cities (Hjortol, 2016 ; Oakil et al., 2016), characterized by better transport supply, the close proximity of university clusters and highly qualified jobs, functional mixity and lower distances between activities (Lachmann and Brett, 2011 ; Davis et al., 2012 ; Van den Waard et al., 2013). Yet, young adults living in dense urban areas are less licensed than those dwelling in suburban and rural areas (Noble, 2005 ; Raimond and Milthorpe, 2010 ; Licaj et al., 2012 ; Hjortol, 2016 ; Oakil et al., 2016). By the way, the opportunity of ensuring their travel needs otherwise is often mentioned by young adults as an important reason for not driving (Berg, 2001 ; Noble, 2005 ; Williams, 2011). An improved transport during the 90's and 2000's, also has probably contributed to promote new lifestyles and to change travel behaviors, especially as greater facilities were offered to the young, making transit very affordable (Noble, 2005 ; Kuhnimof et al., 2012a,b, 2013 ; Van den Waard et al., 2013).

In contrast with such explanations which are essentially based on new living conditions, other authors allude to a more profound transformation of mental habits and attitudes away from the car. Formerly a symbol of social status and independence (Steg, 2005), the car would have lost part of its attractiveness in generation Y, being dethroned by more up-to-date items coming from the digital world, such as mobile phones and social networks (Cisco, 2011). For a part, this discourse is supported by empirical findings, in particular the analysis of different surveys, which tend to confirm that the car would be less associated with an image of social status, luxury and prestige (Noble, 2005 ; Cornut, 2017 ; Delbosc and Currie, 2014 ; Vincent-Geslin et al., 2017). However, it remains associated with notions of freedom, independence and autonomy (Steg, 2005 ; Noble, 2005 ; Cornut, 2017) as well as with adulthood and maturity (Delbosc and Currie, 2014). Attitudes towards the car would then tend to become more opportunistic, with the car becoming a simple transport mean among others, and its benefits and shortcomings being more systematically compared with alternatives (Vincent-Geslin et al., 2017). However, other studies find that aspirations to drive a car remain strong (Kim, 2014 ; Demoli, 2017) and are still being associated with an image of social prestige (Steg, 2005 ; Van den Waard et al., 2013), while their realization is hindered out by unfavorable economic conditions.

In parallel, some authors suggest that new mobility patterns could be partially driven by greater environmental awareness (Kalinowska et al., 2012 ; Hopkins, 2016). However, there are few empirical findings to support this statement, and other studies *a contrario* demonstrate that new generations are not necessarily more sensitive to environmental concerns, also contesting the validity of the relation between environmental awareness and travel behaviors (Department for Environmental Food and Rural Affairs, 2002 ; Noble, 2005 ; Cornut, 2017).

In the end, there is limited evidence for a significant shift of mental habits away from the car, apart from a tendency to being more opportunistic, which may contribute to explain that young adults delay driving as long as they don't really need it. However, it might also be a consequence of new living conditions and the economy, rather than a real motive for changing behaviors.

To conclude this panorama, information and communication technologies are often considered as a potential motive for changing travel habits. Indeed, though the diffusion of digital innovations was rather general, the millennials have been usually presented as more fond of them. Yet, ICT would favour transit use by increasing the primary utility of travel through allowing young adults to stay connected in order to perform different on-line activities and get real-time information about travel conditions (Davis et al., 2012). In addition, newspaper articles and some research work have suggested that ICT would allow reducing travel needs by substituting virtual networks to direct physical interaction (Choo et al., 2005 ; Williams, 2011 ; Rentziou et al., 2012 ; Sivak and Schoettle, 2012). However, this issue remains partly speculative because of the lack of a clear understanding of the relationship between ICT and travel. Several authors have also pointed out the weakness of these results (Sivak and Schoettle, 2012 ; Le Vine et al., 2013), given the complexity of the interdependencies between ICT and travel (Mokhtarian, 2003 ; Andreev et al., 2010 ; Boyd and Ellison, 2007), which may also include phenomena of complementarity - as ICT may help maintaining some relationships (Delbosc and Currie, 2013) - or induction, as an increasing information about opportunities may generate additional travel (Van den Berg et al., 2009).

All these explanations may finally be reduced to the subject of determining whether travel behaviors of the millennials illustrate a structural shift in mental habits and lifestyles, or simply result from a general delay in the transition process towards adulthood, to be resorbed in a later stage of the lifecourse. This issue is obviously critical to forecasting future travel demand, as new generations will be majority tomorrow (Polzin et al., 2014). While under the second assumption, long-term consequences on transport demand are likely to be limited, they could be of greater importance in the first case, as new behaviors would then tend to be durable. In favor of this last statement, some studies show that habits acquired during the youth tend to persist later on (Bodier, 1996 ; Lyons and Swinbank, 1998), and that the decreasing access to driving license tends to persist at a later stage of the lifecourse in generation Y (Noble, 2005 ; Raimond and Milthorpe, 2010 ; Stokes, 2012 ; Delbosc and Currie, 2013). However, other research works demonstrate that generation Y is simply postponing access to the car until the moment where they really need it (Kim, 2014 ; Garikapati et al., 2016). In addition, we already saw that there was little proof of changing attitudes in generation Y, apart from a tendency to rationalization (Cornut, 2017 ; Demoli, 2017 ; Vincent-Geslin et al., 2017), suggesting that the decline of car use is rather the manifestation of a frustrated desire than the consequence of a personal choice (Licaj et al., 2012 ; Demoli, 2017).

3. DATA AND METHODOLOGY

3.1 The French Unified Base of Local Household Travel Surveys

The analysis relies on the French Unified Base of Local Household Travel Surveys, compiling many surveys realized from 2009 over the French territory, all according to a standardized method designed as CEREMA-Certified Household Surveys (EMC2). Apart from the advantage of methodological unity, the sample is also of important size, which is a factor of greater precision, thus authorizing the study of restricted socio-economic groups and niche markets. More precisely, the database contains three survey types: Household Travel Surveys (EMD), designed for great cities and using a face-to-face protocol, Travel Surveys for Average Cities (EDVM), and Travel Surveys for Large Territories (EDGT), respectively conceived for smaller cities and for suburban and country areas. These are usually less expensive as they are based on a lighter questionnaire while data collection is made by phone. While Household Travel Surveys have been implemented as soon as 1976, survey protocols for less populated/dense areas were introduced only from the 2000's, to satisfy the growing demand from local authorities. As these last survey types remain in minority, the unified sample structure is over-weighting great cities and densely populated areas; as a result, this study should not be considered representative of the whole national territory, but is rather focusing on the behaviors of « young urbans ». The unified base of household travel surveys is structured by vintages, meaning that every year, the base is completed by new surveys, and potentially with extra variables. The vintage 2016, which was used for this research, thus contains only surveys from 2009 to 2016. The database contains several levels, corresponding to different parts of the questionnaire: households, individuals, loops, trips, journeys and opinions. A trip is defined by a purpose, for instance going to work or accompanying children to school. A journey is the use of any motorized mode, for instance transit or the car. A trip may therefore be made up of several journeys, for instance a journey by car to go to the train station, followed by a journey by train to go to work. A loop is made up of all trips between two trips back home. Finally, the opinion component includes answers to a series of questions about general and transport-related issues. The base contains about 210 000 households, 470 000 individuals, 520 000 loops, 1 344 000 trips and 1 051 000 journeys.

3.2 Methodology of analysis

The first part of the study will consist in the age-cohort analysis of different sets of indicators, respectively focusing on car equipment and travel behaviors, living conditions and opinions. Indicators of travel behaviors include : a) the proportion of driving license holders ; b) the proportion of individuals holding a personal car for their home-to-work/studying trips ; c) the proportion of daily car users ; d) the proportion of daily or regular transit users – at least twice a week ; e) the average number of daily trips by car as a driver ; f) the average number of daily trips by car as a passenger ; g) the average number of daily trips by transit ; h) the average number of daily trips by walking and cycling. Indicators for living conditions include : a) the employment rate ; b) the proportion of students ; c) the proportion of singles ; d) the proportion of individuals living in

households with children ; e) the proportion of central city dwellers ; f) the proportion of unemployed ; g) the proportion of individual housing ; h) the proportion of owners.

Finally, we build up a set of indicators for opinion, starting from answers to the questionnaire, which includes a series of questions about : a) the importance of road safety, noise, pollution, transit, walking, cycling, parking and traffic issues ; b) whether people agree, disagree, or have no opinion, with respect to the following given statements : one should keep on building car parks ; the bicycle in town is the future ; in town using a car is necessary ; restricting car use in town is hindering economic activity ; one should keep on developing transit, even if it means disturbing car drivers ; to improve traffic, car use should be restricted in town ; illegal parking should be more severely punished ; c) the choice of adjectives to qualify travel modes – car, transit and cycling – from a series of 44 which may be either positive – for instance quick, cheap, practical, ecological, safe, comfortable - or negative - slow, expensive, unpractical, polluting, dangerous, uncomfortable. The corresponding information is gathered through a restricted set of indicators built up of score variables, respectively for : a) the importance of alternatives to the car ; b) the importance of car externalities (noise, pollution...) ; c) the importance of traffic efficiency (parking and congestion issues) ; d) the score of statements favourable to the car ; e) the score of statements hostile to the car ; f) the score of every mode – car, transit, cycling – based on the adjectives used to design them. Score variables are then constructed the following way :

- The importance of alternatives was augmented from one point every time a given alternative was considered important. For instance, if an individual judged as important transit, walking and cycling, he was attributed three points. If an alternative was regarded as unimportant, the importance variable was not augmented. If no opinion was expressed, the importance variable was augmented from 0.5. The same method was applied for the importance of car externalities and traffic efficiency ;
- The score variable for pro-car statements was augmented from one point every time an individual agreed with them, and diminished from one point every time he disagreed. The score is unchanged by neutral opinions. The same method was applied to statements hostile to the car ;
- The general score of a mode based on adjectives to design it is finally calculated by attributing the value +1 to a positive adjective, -1 to a negative one, and zero when no opinion was given. However, different weights were attributed to adjectives depending on their rank, as the adjectives first quoted may contribute more to the general image of a given mode than those cited only in second or third rank. Therefore, the first quoted adjective was attributed a weight 1, the second 1/2, and the third 1/3.

However, not all individuals were asked about transport-related opinions, but only about 110 000, forcing us to restrict the sample size within the scope of our study, with respect to the initial sample. Cohorts were constructed using five-year birthdate intervals, resulting in eighteen cohorts, from 1908-15 to

1995-99. In the same way, age was split into five-year intervals, from 16-20 to more than 95, resulting in eighteen age groups. Given the low number of survey waves, only three periods of observation can be estimated for every cohort. The existence of generation effects can be deduced from the comparison of successive cohorts for the same age group, while the general profile of an indicator for successive cohorts gives an indication about age effects, apart from possible period effects which can be highlighted through the existence of simultaneous change across cohorts despite the fact behaviors are observed for different age groups.

The second part is dedicated to travel behavior modelling, out of variables for living conditions and opinions. In particular, we try to assess whether these variables can account for differences between cohorts and age groups. Through logistic regression procedures, we model the three following indicators: personal car availability, daily driving and regular transit use. Model specification is classical and based on utility functions with a logistic distribution of error terms:

$U_i^* = \alpha + \beta X_i + \delta_i$, $i=1\dots N$, for binary logistic regression models.

In this notation, U_i^* stands for latent utility of personal car availability, daily driving or regular transit use, while α is an intercept representing the absolute preference for the event, with respect to the reference case. β represents the marginal increase in the utility of the event resulting from a unit increase in X_i , where X_i are exogenous variables. Model estimation is performed through maximum likelihood. Models are then used to simulate age cohort profiles for travel behavior indicators, which are then compared with observations.

4. RESULTS

4.1 Age cohort analysis

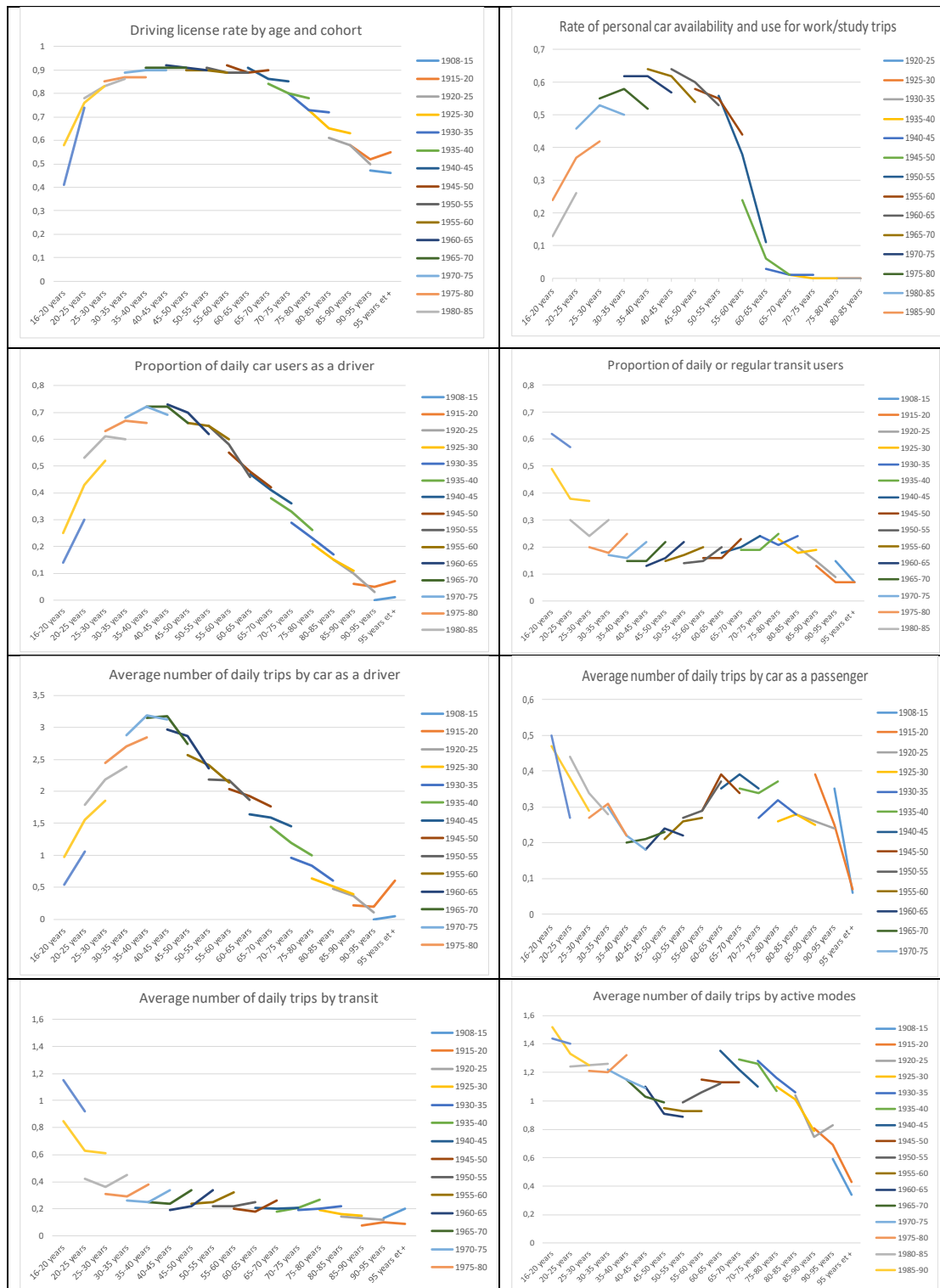


Figure 1 : Indicators of travel behavior by age and cohort

Source : French Unified Base of Household Travel Surveys

Age-cohort analysis shows that driving license rates have increased across generations born before 1950, before remaining stable thereafter. Access to driving license is also characterized by the existence of age effects with licensure increasing until 40, where it tends to level off at the constant level of 90 % across all cohorts, which then tend to merge into a single profile, indicating the lack of significant generation effects. Cohorts born after 1980 are no exception to this rule, only a slight decrease of licensure being noticed in cohort 1975-80. The access to driving license also tends to become slightly more gradual. Finally, differences in licensure between cohorts are slender, suggesting that access to driving license is still considered a necessity by the vast majority of young adults, included young urbans.

Results are very different when it comes to personal car availability for home-to-work/study trips. First of all, the general lifecourse profile of personal car equipment displays increasing equipment until 45, followed by decline thereafter, the maximum rate being observed for cohort 1960-75, between 35 and 50. Apart from age effects, a clear generational effect is emerging, with constantly decreasing equipment rates from cohort 1965-70. This result implies, in particular, that this phenomenon isn't limited to the millenials, but has in fact began as soon as generation X. However, it tends to accelerate from cohort 1975-80 and even more from cohort 1985-90. Generation Y is therefore characterized by the acceleration of demotorization among young urbans.

By then considered indicators of car use, we see that the proportion of daily drivers is increasing until the age of 45, before falling down in the second part of the lifecourse. Though the proportion of daily car users among urban dwellers is generally quite homogeneous across cohorts, a decline can be noticed in generation Y, with an acceleration in cohorts born after 1985. By contrast, the proportion of regular transit users is decreasing until 45-50, slightly comes back to growth until 75, before falling down in the end. Apart from living conditions – residential location of young adults, household composition, job status - the decline of transit use over the lifecourse could also express the modification of preferences resulting from cumulative learning effects - with the accustomance to higher levels of comfort through the car, for instance. Finally, there is an important generational effect which is specific to the millenials, with an acceleration in cohorts born after 1985.

Regarding indicators of daily trip frequency by transport mode, we see that the average number of trips by car as a driver increases until 45, before decreasing in the second part of the lifecourse. Strong generation effects are noticeable across cohorts born after 1975, with a constant decrease of the average number of daily trips by car as a driver from a cohort to another. As for personal car availability, this trend towards declining car use has thus began before generation Y, but this time with no acceleration in cohorts born after 1985, suggesting that the decrease in daily driving to work/study was compensated by an increasing mobility for other purposes. In parallel, the average number of transit trips has increased in cohorts born after 1980, with a strong acceleration in cohorts born after 1985. By contrast, all cohorts tend to merge into a single

profile when it comes to the average trip frequency by car as a passenger and by active modes - walking and cycling - suggesting the lack of significant generation effects. Daily trip frequency by car as a passenger and by active modes tend to present similar lifecourse profiles, characterized by decrease until 45, recovery between 45 and 70, and decline in the end.

Finally, the most striking change in travel behaviors of young urban millennials is the massive shift from driving to transit, especially in cohorts born after 1985. However, despite an acceleration among the millennials, this process had already began in generation X. This transition goes along with trends towards demotorization, while practices of car as a passenger and active modes tend to remain stable. Yet, young urban millennials pass driving license exams as much as their elders, suggesting a rationalization of behaviors, where driving license is still perceived as an insurance for mobility, but driving is delayed as long as young adults do not really need it. Transit use was also probably reinforced due to a period effect, which could be related either to the delayed effects of the economic crisis or to greater traffic and parking difficulties. The shift from driving to transit among urban millennials could result from new living conditions, for instance related to longer studies, a delayed entrance into the job market, their increasing concentration in dense urban areas, and later family foundation. But it could also be the consequence of changing opinions and attitudes towards the car, for instance related to greater environmental awareness. In order to disentangle the respective contributions of these potential orders of causality to new travel behaviors, we now proceed to age-cohort analysis for the corresponding variable sets.

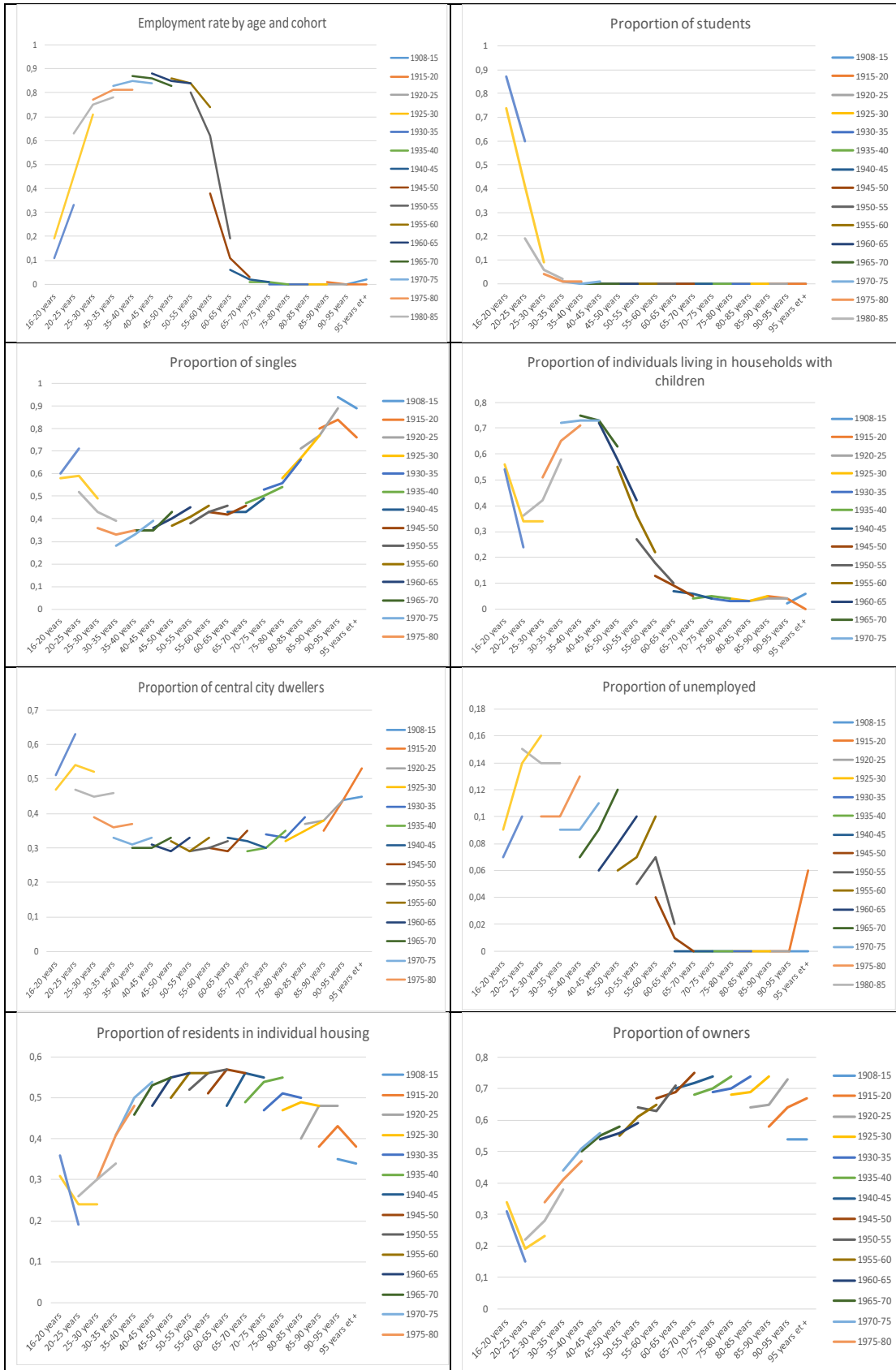


Figure 2 : Indicators of living conditions by age and cohort

Source : French Unified Base of Household Travel Surveys

After a steady growth in generations born before 1960 - in relation with the massive entrance of women into the workforce after the war - the employment rate decreased across all cohorts born after 1965. However, the most important decline occurred in cohorts born after 1985, especially before 25, along with a strong growth in the population of students. In addition, the unemployment rate has constantly increased across all cohorts born after 1945, as well as over the period of observation, probably due to the effects of the economic crisis. While the rise of unemployment is a long-run structural trend, the increasing number of students was specific to cohorts born after 1985. As a result, the number of working adults has considerably reduced before 25 in these cohorts, in relation with longer studies and higher unemployment rates. In parallel, an increasing proportion of adults are living alone before 35 across all cohorts born after 1980, while the proportion of adults having children has strongly decreased across cohorts born after 1975. Regarding geographical and housing-related factors, the most striking evolution was the tremendous increase in the concentration of young adults living in central cities in cohorts born after 1975, which might be an essential reason for the increasing use of transit, given the dramatic gap in transit supply and transit accessibility between central cities and the remaining urban areas. The increasing concentration of young adults in central cities may largely contribute to explain demotorization by making car equipment unnecessary, unless residential choices of generation Y were self-induced by prior travel plans. Finally, while the proportion of individual housing has not changed much, the proportion of owners fell down, a result which is consistent with longer studies and delayed family foundation as these evolutions also lead to differ settlement plans.

A synthesis of evidence finally suggests that an important transformation of living conditions has contributed to generate a massive shift from driving to transit among urban millennials. The main factor seems to be the decreasing proportion of young professionals, associated with an increasing number of students before 25, as commuting was proved to be a decisive factor of car equipment plans. Longer studies have generalized among French millennials, following the near suppression of selection at university, resulting in a massive shift from work to studies before 25, especially in cohorts born after 1985. Besides, young adults are increasingly concentrated in central cities before 35, where transit supply is much more efficient and appropriate than for the remaining urban areas, while owning and using a car is made more and more difficult by the lack of available space, limited parking supply and increasing congestion. However, the increasing centrality of young adults may also be partially the result from residential self-selection of unlicensed and car-less adults, and from student life, as students often tend to privilege urban life and amenities. However, generational gaps in residential location tend to persist even later on in the lifecourse (35-40), though most adults have then entered the workforce, indicating that other factors come into play. The growing concentration of highly-qualified jobs in dense urban areas might be one of them. Finally, the different stages of family foundation are generally delayed.

The combination of these trends tends to corroborate the thesis of a general delay in the lifecycle, inducing a longer transition towards adulthood.

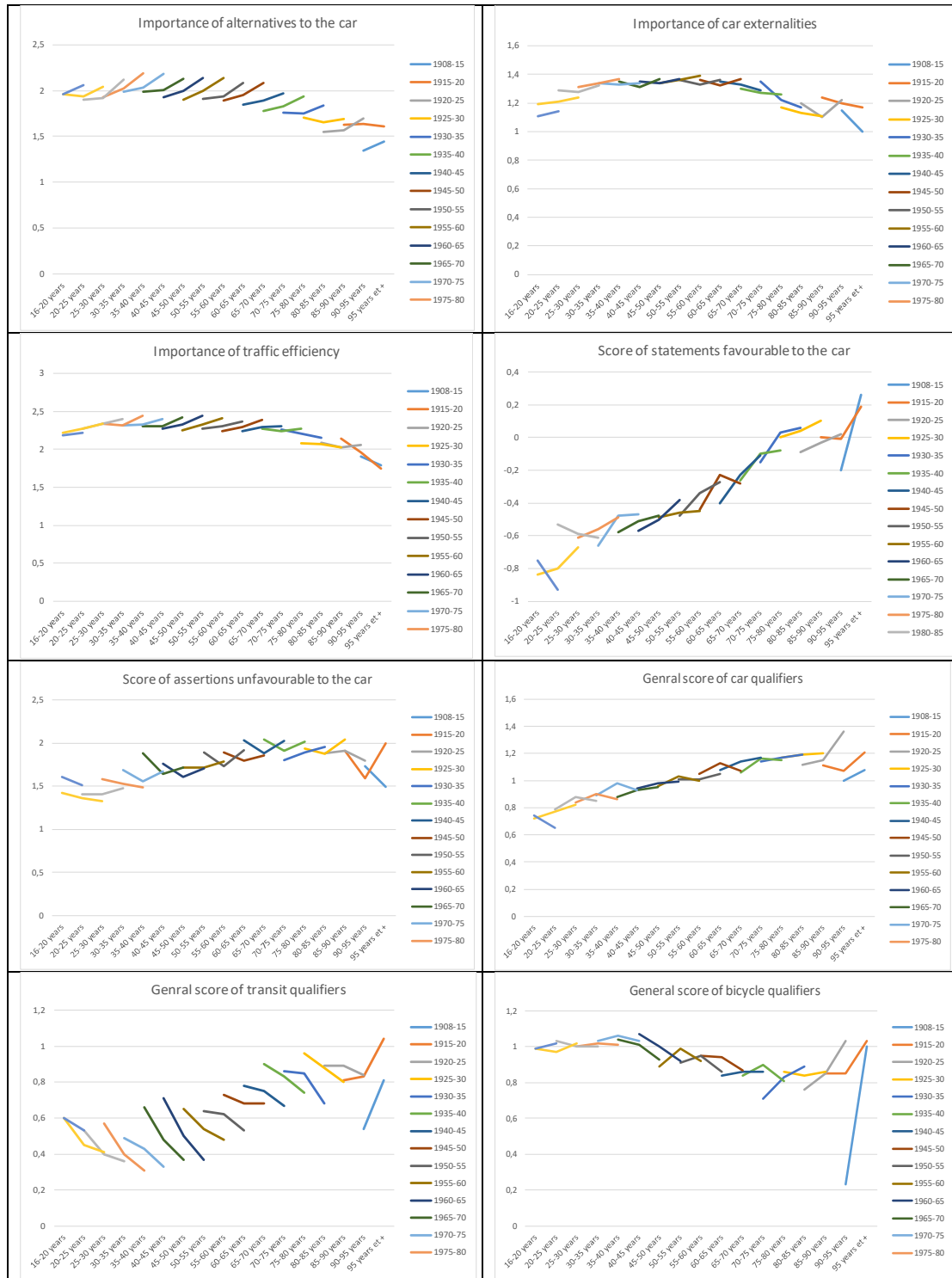


Figure 3 : Synthetic indicators of opinions by age and cohort

Source : French Unified Base of Household Travel Surveys

When it comes to opinion variables, the importance given to alternatives to the car appears to be weakly dependent from age and generation, except in cohorts born before 1945, for which they are considered less important. In particular, no specificity of generation Y is noticeable. On the other hand, a period effect

is applying to all cohorts, with the importance of alternatives to the car increasing over time. It could result either from the increasing difficulties and inefficiency of urban transport - whether it be transit with increasing security issues, malfunctions and disruptions, or road with increasing congestion and parking difficulties – or from the increasing cost of car use, due to higher fuel price levels associated with a lower average income due to the economic crisis.

The perception of car externalities is also rather independent from age and generation. It is not more pronounced in generation Y, where it even seems to go slightly backwards. These results tend to confirm prior findings from the literature about the absence of specific environmental awareness in generation Y, in contradiction with what is often stated by newspaper articles. Only age effects remain, which are nonetheless limited. The awareness of car externalities is very homogeneous between 35 and 70 where it is maximal. The most credible explanation is that individuals in these age groups become more sensitive to these concerns as they are more exposed to them, notably in relation with daily commuting.

Age and generation have no more influence on the sensitivity to traffic efficiency: while cohort effects are unappreciable, age effects are limited to a lower sensitivity to this issue before 30, and after 75. Here again, the degree of awareness to a given issue seems to be directly related to the degree of exposure, suggesting that, beyond the possible influence of opinions on behaviors, there might also be a reverse direction of causality, where transport-related opinions and attitudes are shaped by travel experience and habits. In addition, the sensitivity to this issue has increased over the period of observation, suggesting that traffic and parking difficulties may have aggravated in relation with growing congestion, policies dissuasive to the car and the lack of parking supply.

The degree of agreement to pro-car statements doesn't show off significant generation effects, but reveals the existence of strong age effects. When ageing, people tend to manifest a higher degree of consentment to pro-car statements, with an acceleration after 65. However paradoxically, the same people also tend - at least until 75 - to agree more with anti-car assertions. However, the degree of consent to anti-car statements tends to increase more slowly than for pro-car assertions. These results may illustrate the combination of two phenomena: first, there might be a conformism bias, implying that with growing age, people would generally give more easily their consent to any given proposition; it could also mean that opinions are becoming less neutral as they are more strongly shaped by acquired experience, so that the elders would more easily identify the respective advantages and shortcomings of any mode. Second, despite a clearer perception of its shortcomings, trade-offs would nonetheless tend to favour more and more the car, given its benefits in terms of comfort, autonomy and efficiency, also in relation with decreasing physical capacities.

We finally come to the image of different modes, based on the choice of adjectives to design them. Again, neither significant cohort effects nor specificity of the millennials can be highlighted, while strong age effects emerge. On the whole, the image of the car is improving over the lifecourse, just like for transit. However, the image of transit has considerably degraded during the period of observation. This particular outcome may have several causes among which increasing insecurity, malfunctions and network saturation in great cities. On the contrary, the image of the bicycle tends to decrease after 50, in relation with the decline of physical capacities and increasing safety concerns. However, the general image of transport modes is improving over the lifecourse, possibly exhausting the existence of an optimistic bias when ageing, related to accumulated assets and an improved social status.

Finally, opinions and attitudes towards different modes do not allow to identify significant generation effects, apart from the importance attributed to alternatives to the car which is lower in cohorts born before World War II. In particular, opinions of generation Y are similar to (those of) their elders. These results tend to confirm the lack of specific environmental awareness of the millennials, consistently with prior findings from the literature. On the contrary, age effects are found and, to a lesser extent, period effects. First of all, individuals are more sensitive to car-related issues such as car efficiency and car externalities in the middle of the lifecourse, when they are more exposed to them in relation with their daily travel experience. In addition, perceptions of transport modes would tend to become more precise over the lifecourse, in relation with accumulated travel experience. Age effects may also reflect different biases either of conformism or optimism. However, opinions would generally tend to become more and more favourable to the car over the lifecourse. Finally, the image of transit has degraded over the period, a result which could reflect the loss of attractiveness and efficiency of this mode.

In the absence of significantly different opinions in generation Y, changing travel behaviors seem to be principally caused by new living conditions, related to a longer and more uncertain transition path towards adulthood, resulting from an interaction between longer studies, a delayed entrance into the workforce, the increasing spatial concentration of young adults in dense urban areas and finally, later settlement and family foundation. In order to look more-in-depth into this issue, we now come to the modelling part, where we estimate travel behavior models with exogenous variables containing both variables for living conditions and opinions. Models are then used to simulate travel indicators, which in turns allows us to estimate the accuracy of their predictions.

4.2 Modelling results

	Personal car availability			Daily driving			Daily or regular transit		
	Estimate	Std-Error	Pr> t	Estimate	Std-Error	Pr> t	Estimate	Std-Error	Pr> t
Intercept	-5.09	0.11	<.0001	NS	NS	0.68	-1.99	0.03	<.0001
1915-20	-1.37	0.16	<.0001	-3.42	0.27	<.0001	NS	NS	0.62
1920-25	NS	NS	0.71	-4.25	0.25	<.0001	NS	NS	0.54
1925-30	NS	NS	0.59	-3.23	0.25	<.0001	NS	NS	0.48
1930-35	NS	NS	0.62	-2.98	0.26	<.0001	NS	NS	0.51
1935-40	NS	NS	0.63	-2.65	0.26	<.0001	NS	NS	0.53
1930-45	NS	NS	0.64	-2.27	0.26	<.0001	NS	NS	0.53
1945-50	NS	NS	0.64	-2.14	0.26	<.0001	NS	NS	0.51
1950-55	NS	NS	0.65	-2.04	0.26	<.0001	NS	NS	0.51
1955-60	NS	NS	0.65	-2.07	0.26	<.0001	NS	NS	0.49
1960-65	NS	NS	0.64	-2.18	0.26	<.0001	NS	NS	0.47
1965-70	NS	NS	0.64	-2.30	0.26	<.0001	NS	NS	0.44
1970-75	NS	NS	0.63	-2.44	0.26	<.0001	NS	NS	0.42
1975-80	NS	NS	0.63	-2.68	0.26	<.0001	NS	NS	0.38
1980-85	NS	NS	0.62	-2.85	0.26	<.0001	NS	NS	0.35
1985-90	NS	NS	0.62	-3.20	0.26	<.0001	NS	NS	0.32
1990-95	NS	NS	0.61	-3.44	0.26	<.0001	NS	NS	0.29
1995-99	NS	NS	0.61	-3.77	0.26	<.0001	NS	NS	0.26
0-16	NS	NS	-	NS	NS	0.29	NS	NS	0.51
16-20	NS	NS	0.59	0.30	0.09	0.001	2.57	0.03	<.0001
20-25	NS	NS	0.58	2.07	0.09	<.0001	1.77	0.03	<.0001
25-30	NS	NS	0.59	2.07	0.09	<.0001	1.48	0.03	<.0001
30-35	NS	NS	0.59	1.93	0.09	<.0001	1.35	0.03	<.0001
35-40	NS	NS	0.60	1.73	0.08	<.0001	1.20	0.03	<.0001
40-45	NS	NS	0.60	1.55	0.08	<.0001	1.10	0.03	<.0001
45-50	NS	NS	0.61	1.35	0.08	<.0001	1.10	0.03	<.0001
50-55	NS	NS	0.62	1.03	0.08	<.0001	1.22	0.03	<.0001
55-60	NS	NS	0.62	0.92	0.08	<.0001	1.32	0.03	<.0001
60-65	NS	NS	0.63	0.82	0.08	<.0001	1.18	0.03	<.0001
65-70	NS	NS	0.65	0.89	0.08	<.0001	1.15	0.03	<.0001
70-75	NS	NS	0.66	0.72	0.08	<.0001	1.29	0.03	<.0001
75-80	NS	NS	0.67	0.53	0.08	<.0001	1.21	0.03	<.0001
80-85	NS	NS	0.83	0.31	0.07	<.0001	1.03	0.03	<.0001
85-90	NS	NS	0.79	NS	NS	0.37	0.48	0.03	<.0001
Employed	3.78	0.004	<.0001	1.44	0.004	<.0001	-0.86	0.004	<.0001
Partner	-0.01	0.003	0.009	0.06	0.003	<.0001	-0.28	0.003	<.0001
Children	0.06	0.003	<.0001	0.10	0.003	<.0001	0.14	0.003	<.0001
Core city	-0.63	0.003	<.0001	-0.77	0.003	<.0001	0.89	0.003	<.0001
House	0.51	0.003	<.0001	0.60	0.003	<.0001	-0.61	0.003	<.0001
Owner	0.45	0.003	<.0001	0.37	0.003	<.0001	-0.20	0.003	<.0001
HTW distance	3.1E-6	4.3E-8	<.0001	1.248E-6	3.05E-8	<.0001	-2.33E-6	4.63E-8	<.0001
Imp_alt	-0.13	0.001	<.0001	-0.17	0.001	<.0001	0.18	0.002	<.0001
Imp_ext	-0.03	0.002	<.0001	-0.06	0.002	<.0001	0.02	0.002	<.0001
Imp_eff	0.15	0.002	<.0001	0.21	0.002	<.0001	-0.15	0.002	<.0001
Fav_car	0.03	0.001	<.0001	0.07	0.001	<.0001	-0.06	0.001	<.0001
Opp_car	-0.06	0.001	<.0001	-0.07	0.001	<.0001	0.06	0.001	<.0001
Score_car	0.27	0.001	<.0001	0.31	0.001	<.0001	-0.18	0.001	<.0001
Score_transit	-0.13	0.001	<.0001	-0.13	0.001	<.0001	0.20	0.001	<.0001
Score_bike	NS	NS	-	-0.01	0.001	<.0001	-0.14	0.001	<.0001

Table 1 : Parameter estimates for models of personal car availability, daily driving and regular transit

Source : French Unified Base of Household Travel Surveys

Regarding personal car availability, age and generation effects happen to be non-significant, while variables for living conditions and opinions are significant at the 5 % level. In particular, there is no residual effect for generation Y when controlling for living conditions and opinions. The most influent variable is the job status, with work strongly increasing the probability of holding a personal car. Then come geographical and housing-related variables, with living in a

central city reducing the probability of holding a car, and occupying a house, being an owner or commuting greater distances increasing it. By contrast, household-related variables – living with a partner, having children – have rather limited influence on personal car equipment. Among attitudinal variables, the most influential is the score of adjectives to design the car, followed by the importance of traffic efficiency, which both tend to be correlated with higher car availability. Conversely, the image of transit and the importance attributed to alternatives are negatively correlated with personal car equipment. By contrast, the degree of consent to pro- and anti-car statements, as well as the importance of car externalities, are much less influential. In general, despite significant effects, attitudinal variables tend to be far less influential than living conditions in explaining personal car equipment. As a result, these look sufficient to explain gaps between cohorts, in particular the strong decline of personal car equipment in generation Y.

When it comes to daily driving, age and cohort effects remain significant, even when controlling for living conditions and attitudinal variables, implying that some unobserved factors of variability play a role in explaining differences according to age and generation. *Ceteris paribus*, the probability of daily driving tends to rise across cohorts until reaching a maximum in cohort 1950-55, then constantly decreases across later cohorts, implying that some unobserved factors contribute to decreasing car use in post-war generations. Everything else being equal, maximum driving occurs among young adults between 20 and 30, while it is decreasing thereafter. This result puts into perspective the apparent preference of young adults for transit, which seems to be in fact principally related to living conditions – lack of professional activity, concentration in central cities, single life – rather than the result of a lower appetite for car use as, everything else being equal, young adults would even tend to drive more than the average. Here again, among living conditions the most influential variable is the employment status, with employment increasing the probability of driving, followed by geographical and housing-related variables, with living in a central city reducing the probability of driving, while living in a house, being an owner and travelling greater distances to work are increasing it. The hierarchy of attitudinal variables is more or less the same than for personal car equipment, with the score of adjectives to design the car being the most influential followed by the importance of traffic efficiency (positive effect), of alternatives to the car – negatively correlated with daily driving – and the score of adjectives to design transit – with a negative correlation to driving. Other attitudinal variables – importance of car externalities, scores of pro- and anti-car statements – are less influential.

Finally, we come to the model for daily and regular transit use. This time generation effects are not significant, while age effects are. *Ceteris paribus*, the probability of regularly using transit decreases until the age of 40-50, then slightly increases until the age of 60, falls down again between 60 and 70, rises up a little before 70 and 75, and decreases constantly thereafter. The general trend is nonetheless of decreasing transit use over the lifecycle. As previously

stated, this result could be the expression of learned experience, with an increasing accustomance to the benefits of the car in terms of comfort, convenience and autonomy, in relation with increasing safety concerns and diminishing physical capacities. Apart from ageing effects, several variables related to living conditions tend to be equally important in explaining regular transit use, including: living in a central city, increasing the probability of using transit; being a worker, having the reverse effect; living in a house, also reducing the probability of using transit. Other variables related to living conditions, though less influent, are not negligible, among which family-related variables - living with a partner, having children - and being an owner, which also tends to reduce the probability of using transit. Among opinion variables, several are of equal importance, including the score of adjectives to design transit, the importance of alternatives to the car – positively influencing transit frequentation – and the score of adjectives to design the car, having the reverse effect. Other attitudinal variables are of almost equal importance, as the importance of traffic efficiency and the image of the bicycle, both negatively affecting transit use. Finally, respective scores of pro- and anti-car statements, as well as environmental concerns, are of little effect on transit use. In general, just like for driving, the influence of opinion variables tends to be of lesser importance than living conditions in arousing the choice to use transit.

As a result, model estimation generally tends to confirm the prevailing influence of living conditions on car equipment and mode choice for daily travel, while opinions, though significant, are of lesser importance. Among variables related to living conditions, the most influent is job status, with working generally being favorable to car use, followed by geographical and housing-related factors, while variables related to household composition have little effect, apart from the choice of using transit which is negatively correlated with living in a family. Among attitudinal variables, the most significant effects are constituted by the scores of adjectives to design different modes, the importance of traffic efficiency, and the importance of alternatives to the car. On the contrary, scores of pro- and anti-car statements, as well as environmental concerns, are weakly influent. This last result tends to confirm previous findings from the literature showing that environmental awareness plays little role in explaining travel behaviors of the millenials. Regarding the importance of attitudinal variables, the major concern remains about the direction of causality between opinions and travel behaviors. Though attitudes may influence behaviors, the reverse proposal may be true in relation with accumulated learning experience, leading either to arouse greater awareness of travel-related issues or to change preferences: for instance, the search for travel efficiency may be a motive for using the car, but in turns, exposure to congestion may raise awareness of transport efficiency issues. In addition, opinions may also respond to a(n unsaid) motive of self-justification, where these are consciously or unconsciously reshaped in order to (ex-post) justify previous choices regarding the way of life which may in fact be the outcome of external constraints : for instance, stated preferences for transit may serve to self-justify a choice by default in the absence of driving license or of sufficient revenues to buy a car.

Coming to age and cohort effects, controlling for living conditions considerably reduces their apparent influence. In particular, they have no remaining significant effect on car equipment decisions, suggesting that living conditions alone are enough to explain age- and cohort-related differences. In addition, generation effects disappear from the model for transit use, which is principally determined by living conditions and age effects. As a result, cohort effects only remain significant in explaining decisions of daily driving. However, one may ask again whether these residual effects might not themselves be explained by unobserved variables which were not included yet into the model, in particular related to economic conditions.

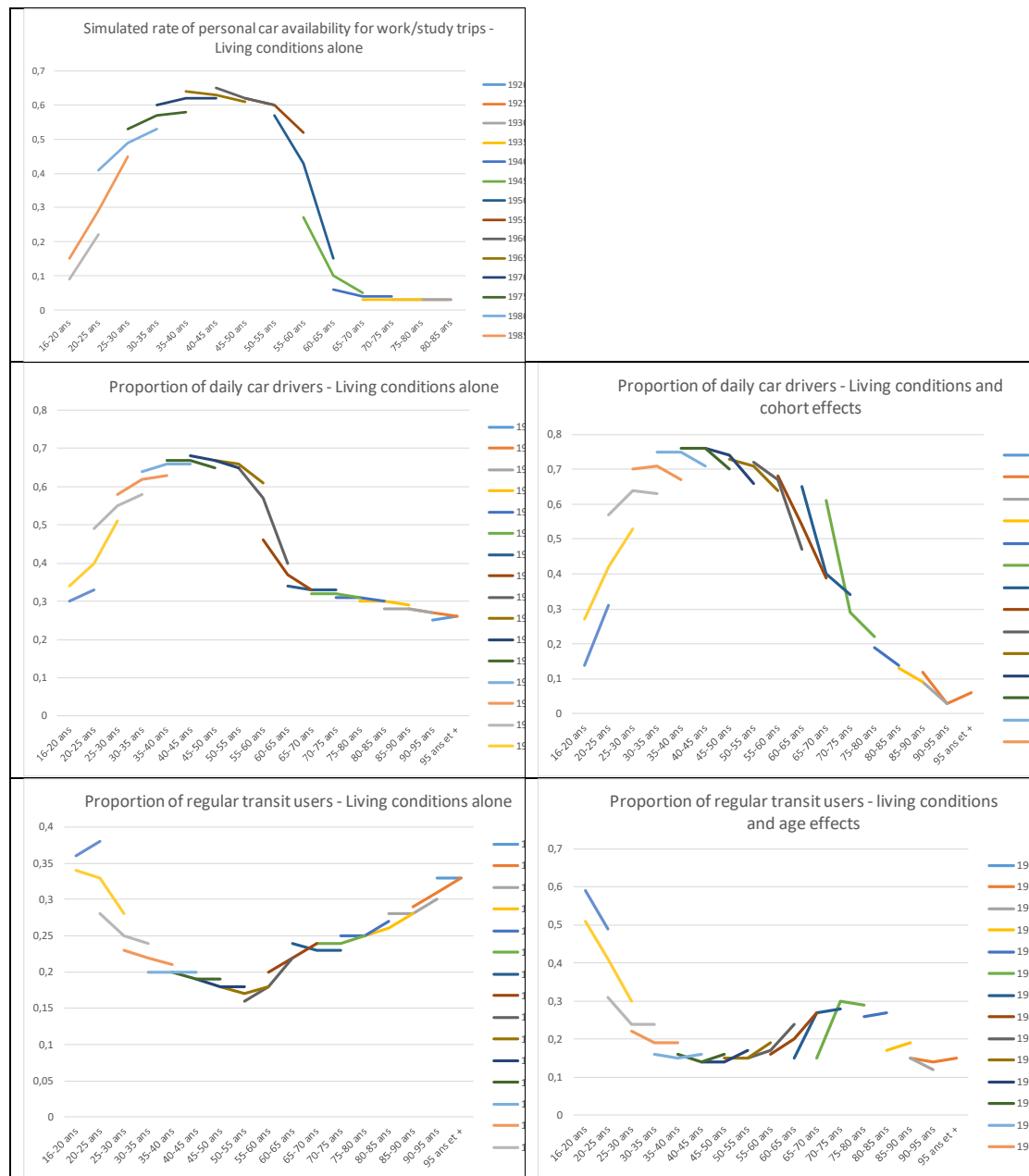


Figure 4 : Simulated travel behaviors by age and cohort – Left : model with living conditions only ; Right : sufficient model

Source : French Unified Base of Household Travel Surveys

We finally simulate indicators of travel behavior using the prior logistic models. We compare the accuracy of predictions according to different models, including either variables related to living conditions, opinions or age and cohort effects, which in turns allow us to identify a « sufficient » model, i.e a model which is sufficient to give good predictions of travel behavior indicators by age and cohort, while adding supplementary variables provides little benefit. For every indicator, the model based on living conditions alone is compared with the « sufficient » model, except in the case of personal car availability, where living conditions alone already allow to give a very good description of personal car availability by age and cohort, while attitudinal variables give little extra benefit. In this case, the model based on living conditions alone is the sufficient model, so that only one outcome was displayed. In particular, the model succeeds in forecasting the decrease of personal car equipment in cohorts born after 1975, with an acceleration in cohorts born after 1985. It seems therefore that the decrease of car equipment can be essentially explained through the greater number of students and decreasing employment rate, the growing concentration of young adults in central cities, and delayed family foundation. However, it fails in explaining the persistence of low car equipment after 25 in cohorts born after 1985, even though millenials have then entranced the labor force. Consequently, other factors might be at stake, possibly the persistence of difficult economic conditions – job precariousness, low wages, housing costs – in the early career, along with increasing traffic and parking difficulties. More or less the same results are found for the diffusion of daily driving though in this case, the model based on living conditions alone is not the sufficient model which also requires to include cohort effects. In particular, cohort effects better account for the persistence of low car availability even though millenials have entered the job market. Finally coming to the last indicator about transit use, living conditions alone only account for half of the difference between age groups, which is better predicted only through the introduction of age effects. However this means that, when controlling for age effects – the decreasing appetite for transit with age – living conditions explain the increasing use of transit by the millenials.

In the end, change in living conditions – which may all be synthetized through the general concept of a longer and more uncertain transition towards adulthood - explains much of travel behavior change among the millenials. By contrast, opinions and attitudes play little role, especially as opinions from the millenials do not differ substantially from (those of) their elders. These results tend to disclaim the regular statement of millenials being less car-oriented. Instead, the way of life has changed, notably in relation with longer studies caused by the quasi-suppression of selection at the entrance of the university within cohorts born after 1985.

CONCLUSION

The generation born between 1980 and 2000, sometimes designed as the millennials or generation Y, shows off different travel behaviors from their elders, with an apparently declining appetite for car to the benefit of transit and active modes. Researchers and experts have imagined different explanations to these trends which, despite their diversity, can be roughly split into two families: the first one assumes a profound transformation of attitudes, aspirations and lifestyles in generation Y, resulting in potentially durable outcomes for mobility over a long-run period, while the second essentially sees a delay caused by a longer transition towards adulthood, possibly aggravated by economic conditions, which should resorb later on in the lifecourse. Through age cohort analysis and logistic regression performed over the French Unified Base of Local Household Travel Surveys, we bring a contribution to this debate by considering the case of French young urban millennials. First, the results confirm that travel behaviors of the millennials differ substantially from their elders, especially for cohorts born after 1985, showing off an important shift from driving to transit, along with lower personal car availability, while the practice of car use as a passenger and active modes tends to remain the same. However, opinions and attitudes of generation Y do not play any role in these trends, as they do not differ substantially from their elders. On the contrary, millennials have experienced significant change in living conditions: in particular, the gradual suppression of selection at the entrance of university has resulted in considerably increasing the number of students within cohorts born after 1985 before twenty-five. In parallel, the proportion of young singles and couples without children has increased, along with the concentration of young adults in central cities. All these trends tend to corroborate the general assumption of a longer phase of transition towards adulthood which, associated with the increasing concentration of highschool establishments and highly qualified jobs in dense urban areas within the largest metropolitan cities, tends to favour less car-dependent lifestyles. In addition, travel behaviors by age and cohort are already quite well predicted through models based on living conditions alone, thus explaining most of age and generation effects. However, they don't explain the persistence of low driving after twenty-five, despite the fact that the millennials have then entered the workforce. Therefore, other factors should be involved, in particular the lack of financial resources, job precariousness and increasing housing costs. Greater parking and traffic difficulties could also play a role in reshaping behaviors, by dissuading millennials to use their car on a daily basis.

Finally, we draw out a few research tracks to deal more in-depth with this issue:

- A deeper analysis of the economic conditions experienced by the youth accross generations is required, to determine their contribution to the decline of car use. Though an income variable was not available in the Unified Base of Household Travel Surveys, it could be simulated through a model estimated from external data, using available information about socio-professional category, employment status and localization.

Whether young adults are still living with their parents should also be accounted for, along with indicators of housing and travel costs for different modes. The prolongation of economic precariousness beyond twenty-five could explain at least partially the persisting decline of car use in this age group ;

- Though logistic regression procedures have established a correlation between opinions and travel behaviors, the direction of causality remains uncertain, given the possibility of learning effects shaping opinions, or of self-justification leading to present ex-post lifestyles as the result of personal preferences. A deeper insight into the interdependencies between behaviors and opinions would be then required to determine the dominant direction of causality, through the implementation of more sophisticated models ;
- For now, the analysis is limited to French urban millennials. However, given the importance of car dependence, a comparison with French young countrymen and suburban adults would be instructive, using another source. In addition, opinions might also be strongly correlated with geographic factors and the degree of education, as France is experiencing multiple economic, social, territorial and cultural gaps.

By showing that travel behavior change in generation Y is rather resulting from living conditions than from a deeper shift in mental habits and attitudes, we may also assume that such change is not necessarily perennial, the transition towards adulthood having simply been delayed among the millennials. At first sight, these results tend to put into perspectives expectations about new generations to reduce car use. On the other hand, the decline of car use should be considered structural if economic precariousness of generation Y was to persist later on in the lifecourse, resulting in the durable impoverishment of new generations. However, in this case, one should also ask himself about the social significance for the decline of car use as it would then represent some kind of « Pyrrhic victory », being obtained only at the price of a general socio-economic regression. Indeed, it couldn't be then really considered as a progress, where the economic footprint of human activity is reduced through technological and organisational improvement, however without undermining the foundations of social cohesion and economic dynamism.

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