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Understanding young people's travel trends and the mediating factors of individual mobility intentions

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Understanding young people's travel trends and the mediating factors of individual mobility intentions

PhD Thesis

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December, 2013

DTU Transport
Department of Transport

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Technical University of Denmark

To my loving parents

Preface

This thesis presents the work done in my PhD study, carried out at the Department of Transport (DTU Transport) at the Technical University of Denmark. I first became acquainted with the field of traffic and transportation psychology during my internship at the predecessor of DTU Transport, The Danish Transport Research Institute, as a MSc. student in 2007. As the institute became integrated with DTU, PhD positions became available which I applied for under the encouragement of Dr Mette Møller. In May 2009, I became a dignified PhD student, working on a part of the project "Drivers and Limits" funded by the Danish Agency for Science Technology and Innovation (Styrelsen for Forskning og Innovation).

I thank my supervisor Dr Mette Møller for being the amazing mentor she is, for the motivation, inspirational discussions, fruitful collaboration and for exceptional understanding and patience. I am forever grateful that our paths crossed.

I would like to thank Dr Sigal Kaplan especially, who never ceased to amaze and inspire me, you have my deepest respect and gratitude for everything.

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Furthermore, I thank Sanne Jacobsen for her assistance with the interviews used for this project, Poul Lyk Sørensen for proofreading the Danish version of the questionnaire used and Ulla Steen Salado-Jimena for proofreading this thesis.

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I express my deepest gratitude to my family and friends, and moreover, to my husband and daughters; Ingi Jarl, Saga Björg and Filippa Borg; with you, this journey has been an adventure on its own, contributing to great personal growth and invaluable experience. I thank you for seeing this through with me, for all your understanding and patience. I look forward to catch up on quality time with you.

I would like to dedicate this thesis to my loving parents, Inga Þorbjörg Steindórsdóttir and Sigurður Mikaelsson, who with their lifelong motivation, support and sacrifices are the ones that truly deserve merit for this work. I thank you with all my loving heart.

<div align="right">Sigrún Birna Sigurðardóttir</div>

Abstract

This PhD thesis presents three complementary studies that aimed to enhance knowledge of young people's longitudinal mobility trends and the factors influencing adolescents' future mobility intentions. First study was an analysis of Danish national travel survey data (TU) from 1995 to 2012. The sample consisted of young people divided into four age groups: 15-19 year old, 20-24 year old, 25-29 year old and 30-34 year old. The analysis explores the development of gender gaps for rural and urban living location. The mobility indicators analysed were; driving licence status, travel mode, distance travelled, number of trips, duration travelled and purpose of trips. The findings show that driving licence holding has increased, in particular for females in urban areas and car accessibility has increased sharply in rural areas. The development licensure rate is somewhat unique as it is in contrast to mainstream trends for many countries. However, since females bear the majority of this increase, it can be seen as sign of increased gender equity as the gender gap is near closed for the groups in question. The gender gaps have narrowed or closed in many cases over the time period explored, but where there is a gender related gap in transport behaviour, the gap progresses across age groups and is different for rural and urban areas. The convergence trends are in line with mainstream trends but there is still a pattern of gendered mobilities observable for the older groups. The findings highlight that gender is still an important subject in transportation research and future development for young people should be monitored closely.

The second study was an internet based survey with the aim to explore a range of mediating factors influencing 15 year old adolescents' intentions to commute by means of car or bicycle in the future. This study employed structural equation modelling (SEM) in order to statistically test the proposed theoretical behavioural framework, which was inspired by the Theory of planned behaviour (TPB) (Ajzen, 1991), the Social cognitive theory (SCT) (Bandura, 1986) and a socio-ecological model (McLeroy et al., 1988). Intentions to commute by car were positively related to car passenger experience, general interest in cars, and car ownership norms, but are negatively related to willingness to accept car restrictions and perceived lack of behavioural control. Intentions to commute by bicycle were related to positive cycling experience, willingness to accept car restrictions, negative attitudes towards cars, and bicycle-oriented future vision, but are negatively related to car ownership norms. Attitudinal constructs are related to individual characteristics, such as gender, residential location, current mode choice to daily activities, and parental travel patterns. The findings reveal that environmental concern has no impact on intentions but mediates willingness to reduce car use in future. The behavioural framework proposed highlights the influences behind the adolescents' intentions from a broad aspect and identifies several distinct targets in domains outside the intra- and interpersonal domains. This distinction gives potential to guide behavioural interventions as it provides both a distinction between levels of intervention and the targets of intervention.

The third study was a qualitative interview study where 50 in-depth interviews were carried out in

order to explore the motivation behind 15 year olds adolescents' intention to obtain a driving licence and to own a car in the future. The interviews were analysed using thematic-analysis to identify the underlying factors shaping the semantic content of the data, to create a data driven conceptual model. Three segments of pre-drivers were identified: car enthusiasts, who would like to be early car users, car pragmatists, who would like to have the license at an early stage and a car at a later stage, and car sceptics, who are late license holders and car users. Among the three groups, the car pragmatists have the highest potential to be affected by policy measures for delaying the driving license and owning a car.

Abstract in Danish

I denne ph.d. afhandling præsenteres resultatet af tre komplementære undersøgelser, der havde til formål at øge kendskabet til unges forventninger til deres fremtidige mobilitetsbehov. Den første undersøgelse var en analyse af data fra den danske transportvane undersøgelse (TU) i perioden 1995-2012. Undersøgelsen omfattede unge mennesker opdelt i fire aldersgrupper: 15-19 år, 20-24 år, 25-29 år og 30-34 år. I analysen blev der set på kønsforskelle og forskelle mellem by og land. De mobilitets indikatorer der blev undersøgt var: besiddelse af kørekort, valg af transport form, afstand, antal rejser, varighed og formål. Resultaterne viser at andelen af kvinder med kørekort er steget i byområderne og flere har fået adgang til bil i landdistrikterne. Stigningen mht. kørekort er overraskende idet det er i modsætning til generelle tendenser i mange andre lande. Da stigningen primært skyldes en stigning blandt kvinder, kan dette vurderes som et tegn på øget ligestilling mellem kønnene. Angående de andre mobilitets indikatorer, er der I perioden sket en generel reduktion i kønsforskel i relation til transportvaner. Denne udvikling er på linje med mainstream tendenser, men der kan stadig observeres et kønnet mobilitetsmønster for de ældre grupper da der er en konsekvent og systematisk forskel med hensyn til turformål særlig i landdistrikter. Undersøgelsens resultater viser, at køn er stadig et vigtigt emne i transport forskning og den fremtidige udvikling for unge bør overvåges nøje.

Den anden undersøgelse er en internet-baseret spørgeskemaundersøgelse. Formålet var at undersøge om en række faktorer påvirker de unges intentioner om at pendle med bil eller cykel senere i livet. Undersøgelsens teoretiske ramme var inspireret af TPB (Ajzen, 1991), SCT (Bandura, 1986) og den socio-økologiske model (McLeroy et al., 1988). Undersøgelsen viste, at intentionen om at pendle i bil var positivt relateret til tidligere positive oplevelser som bil-passager, interesse i biler og sociale normer der understøtter bilejerskab, men negativt relateret til villighed til at acceptere restriktioner på bilkørsel i fremtiden og manglende PBC. Intentioner om at pendle på cykel var positivt relateret til tidligere positive oplevelser som cyklist og vilje til at acceptere bil restriktioner, negativ holdning til biler, cykel-orienteret fremtidsvision og sociale normer der ikke understøtter bilejerskab. Derudover havde individuelle karakteristika såsom køn, bosted, nuværende daglige transportform og forældrenes rejsemønster betydning for de unges intentioner. Resultaterne viser at miljømæssig bekymring ikke har betydning for intentioner men har indflydelse på villighed til at acceptere bil restriktioner i fremtiden. Disse resultater kan med fordel inddrages i adfærdsmæssige interventioner indenfor forskellige domæner.

Den tredje undersøgelse var en kvalitativ interviewundersøgelse hvor 50 dybdegående interviews blev udført for at undersøge 15-årige unges motivation for at få kørekort og eje en bil i fremtiden. Interviewene blev analyseret ved hjælp af en tematisk-analyse for at identificere de underliggende faktorer i det semantiske indhold og oprette en data-drevet konceptuel model. Tre segmenter blev identificeret; bil-entusiaster der gerne vil have både bil og kørekort så hurtigt som muligt, bil-pragmatikere der gerne vil have kørekort tidligt, men først vil have bil på et senere tidspunkt, og bil-skeptikere der, hvis de i det hele taget vil have kørekort og bil, først vil have det på et senere

tidspunkt i livet. Af de tre grupper har bil-pragmatikere det største potentiale for at blive påvirket til at udsættelse erhvervelse af kørekort og bil.

Table of Contents

1 Introduction

Mobility and transport systems are fundamental to modern societies, functioning as vital sections that are central to economic and social activities (Rodrigue et al., 2013). Transport systems enable and shape individuals' mobility through daily activities, enabling productive, practical and hedonic interaction with other members of a network, thereby making up individuals' social network geography (Axhausen, 2008; Hjorthol, 2009). Individual mobility facilitates social and psychological needs that are deemed necessary for social well-being, quality of life, independence and greater life participation (Delbosc, 2012; Spinney et al., 2009; Vella-brodrick & Stanley, 2013). However, society stands before a grand challenge as the current form for individual motorized transportation is unsustainable and contributes heavily to climate change, resulting in adverse environmental and health effects (Woodcock et al., 2007). In Europe, the transport sector is one of the few sectors where there has been an increase in emissions over the last 20 years. Despite technological advantages, the total CO_2 emission from private cars continues to rise, making them the leading source of greenhouse gas emissions after power production (European Commission, 2013). This is consistent with Danish trends (Statistics Denmark, 2008; 2013). This is largely due to globalization, to emerging societal and consumer trends, resulting in growing demand for individual mobility (Chapman, 2007; Schafer et al., 2009). However, the European Union is at the forefront of international efforts and has made the commitment to reduce all emissions by 20% below the 1990 level before 2020 (European Commission, 2013). As the transport sector offers considerable opportunities to reduce greenhouse gas emissions, the need for a paradigm shift toward sustainable mobility has been stressed (Banister, 2008). Individuals can contribute significantly to environmental sustainability by adopting sustainable behaviour patterns (Steg & Vlek, 2009). Furthermore, an increase in sustainable mobility would bring about important economic and social benefits, as it would require substantial investment in infrastructure to have the potential to increase the attractiveness of sustainable mobility. This would result in an overall positive effect on economic growth, in addition to reduce transport disadvantage and transport-related social exclusion by promoting transport equity (Banister, 2007; Greene & Wegener, 1997; Goldman & Gorham, 2006; Lucas, 2012; May, 2013).

The strategies currently available to enhance sustainable mobility are most likely to succeed if they involve a broad range of stakeholders from all levels of society, from the individual traveller to national governments (Banister, 2007). Of the three dimensions sustainable transport policy is concerned with, namely the economic, environmental and social, the social dimension has received far less academic attention than the prior two dimensions, resulting in little attention given to the impact involved for transport policy, practice and policy appraisals (Jones & Lucas, 2012; Geurs et al., 2009). Given that the problems related to car use do not only call for technological solutions but also for social innovations, involving the individual as a participant in the process of change, the social dimension is central for achieving the shift

towards a sustainable future. Hard policy interventions include infrastructure improvements and road pricing measures for travel demand management (TDM), which are considered necessary to be able to achieve car reduction, but they are not sufficient alone to deliver the desired outcome (Gärling & Schuitema 2007). Soft policy measures, such as public transport marketing and travel awareness campaigns, have therefore gained increased interest for their potential to induce sustainable behaviour. There is no consistent definition of soft policy measures, but the objective is to support decisions that are more socially desirable, generally relying on the distribution of information on more sustainable transport choices and persuasion to influence pre-existing perceptions and motivations (Möser & Bamberg, 2008). In order to create effective soft policy methods to facilitate sustainable behavioural change, it is essential to collect scientific knowledge on the influential motivations for different groups in society and for users of different transport modes (Anable, 2005; Bamberg et al., 2011; Hunecke et al., 2007; Möser & Bamberg, 2008; Steg & Vlek, 2009). Psychological concepts like perceptions, values, attitudes, social norms and intentions are central for these purposes. Despite increased interest in social and psychological factors in transport research and its importance for sustainable mobility, studies have mainly involved adult individuals currently driving and focused on the influence of the factors present when the actual decision is made, thereby neglecting the formation of these factors and other populations such as young people and those not driving. As a result, more is known about adults than young people and adolescents. Given the importance of young people as agents of change in a sustainable future, the impact social and psychological factors have on transport-related intentions and behaviour needs to be investigated in greater detail. Such knowledge has the potential to provide soft transport policy measures with valuable theoretical underpinnings (Bamberg et al., 2011; Michie et al., 2011).

1.1   Scope of the PhD project

The PhD project focused on young people in Denmark and examines the development of gender differences on key mobility indicators in addition to explore factors motivating adolescents' behavioural intentions for their future mobility. For these purposes, three complementary studies were conducted with the following aim:

   i)   To explore the development and differences in males and females daily travel pattern in four age groups; 15-19, 20-24, 25-29 and 30-34 year olds, from rural and urban living locations, using national travel survey data from 1995-2012.

   ii)   To explore adolescents' behavioural intentions for commuting in the future by car or bicycle, and to identify mediating factors, using a detailed survey amongst a random sample of 15 year olds adolescents.

   iii)   To gain a deeper understanding of the factors influencing adolescents' behavioural intentions for obtaining a driving licence and owning a car in the future, through a detailed thematic analysis of 50 in-depth interviews.

1.2 Structure of the thesis

This thesis presents the background and motivation of the PhD project, details each study and discusses the main implications drawn from the findings. The thesis is organized as follows:

Chapter 2 introduces the main focus areas of this project, discusses the background and identifies relevant research gaps.

Chapter 3 elaborates on the theoretical frameworks that served as inspiration in the development of the two frameworks proposed in studies 2 and 3.

Chapter 4 describes the aim, measures and main findings for each study conducted in this project.

Chapter 5 contains the discussion, including the implications drawn from the main findings of the project and presents perspectives for future research.

Chapter 6 addresses the strengths and limitations of the studies in this project.

Chapter 7 presents the conclusions of this PhD thesis and highlights the main contribution from each study. The papers from each study are enclosed in the end of this thesis.

2 Background

2.1 Defining sustainable mobility

Sustainable mobility has a broader meaning than sustainable transport but it has no common definition. Several attempts have been made to define the concept in various disciplines which often draw upon the Brundtland definition of sustainable development, defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). It is generally accepted that sustainable mobility is achieved on a set of economical, social and environmental indicators (Steg & Gifford, 2005) but there is not a unified set of indicators agreed upon and the definition of how to measure these indicators varies (Gudmundsson, 2003). Holden and colleagues (2013) interpreted the Brundtland definition of sustainable development within the transport context and have highlighted four key dimensions for sustainable mobility to be promoted and measured by. First the environmental impact of transport activities may not threaten long-term ecological sustainability. Secondly, it should satisfy basic human needs for transport and ensure equal access to affordable and appropriate modes. Thirdly, intra-generational transport equity should be promoted, with equal access across population groups and lastly inter-generational transport equity should be promoted and ensured that future generations will be able to meet their transport needs (Holden et al., 2013). In this thesis, *future sustainable mobility* referrers to the overall impact on these dimensions, but *individual sustainable mobility* is regarded to be a low-carbon mobility pattern which has less environmental impact than current individual car use has, ideally by means of sustainable transport modes such as active transportation or public transportation.

2.2 The importance of young people in the transition towards sustainable future mobility

Adolescence is a critical period for the acquisition of new behaviours as adolescents find themselves in a transitional phase that is marked by rapid personal development, where low self-regulated mobility patterns evolve to a much more flexible and expanded mobility as new motorized transport possibilities become available (Mackay, 1998). In addition to personal psychological development, adolescence is influenced by the ever-changing society or societal challenges and varies by time and space (Mørch, 2006).

Facing the environmental problems accompanying individual motorized transportation, it is alarming that studies exploring young people's intentions towards their future mobility have shown that young people exhibit a strong intention to obtain a driving licence and to own a car in their future (e.g. Baslington, 2009; Collin-Lange & Benediktsson, 2011; Line et al., 2010; Mackay, 1998). Notably, environmental awareness generally does not impact these intentions (Line et al., 2012; Davison et al., 2003) but was found to be an influence on children's intention to own a car in the Netherlands (Kopnina, 2011) and to obtain the driving licence in Sweden

(Forward, 2010). However, as children and young people generally report genuine concern for environmental issues, they are seen as essential agents of sustainable change and there is a growing interest amongst researchers how to utilize their overall potential for a sustainable development, often highlighting the importance of community and social institutions and their role in enhancing awareness (Burns & Percy-Smith, 2013; Kola-Olusanya, 2012; Hadfield-Hill, 2013; Malone, 2013; Renton & Butcher, 2010). However, there still exists is a lack of knowledge regarding the relationship between environmental issues and transportation for young people. On the other hand, environmental issues have been found to be meaningful indicators for adults when it comes to willingness to accept TDM measures, which also relates to the issue of perceived impact on quality of life and overall mobility limitations (Anable et al., 2006; Cao & Mokhtarian, 2005; Eriksson et al., 2006; Nilsson & Küller, 2000; Loukopoulos et al., 2005; Steg & Gifford, 2005; Steg & Vleg, 2009). These matters are important but as Barr and Gilg (2007) point out, policies and campaigns that perceive behavioural change to occur as a result of increased awareness of environmental issues alone, are unlikely to succeed.

Further scrutiny on these matters for young people could identify valuable indicators for sustainable policy to be targeted early, giving young people the flexibility to adjust their subjective expectations of TDM measures in time and hence encourage future voluntary behavioural change. In addition, past studies regarding young people have not detailed the indented timeframe for future behavioural intentions. Individuals who delay the decision to obtain a driving licence will greatly decrease their overall CO_2 emission, but Fujii (2007) found that informing young non-drivers in an experimental group about risks, cost and enjoyment of automobile use, was efficient to delay their decision to obtain a driving licence. However, nothing is reported about their intentions to obtain the licence or the time-frame for those intentions. Delaying licensure would enhance the use of alternative transportation and hence have the potential to delay car dependency. Thus young people have great potential to reshape the established car culture and norms and induce sustainable future mobility (Bamberg, & Schmidt, 2003; Schwanen et al., 2012).

2.3 Drivers of travel behaviour intentions

Attributes from instrumental factors such as the infrastructure, transport provision and accessibility determine behavioural options and hence have a great impact on travel behaviour. However, the relationship is not an exclusively direct one and does not solely determine behaviour (Hunecke et al., 2007; Schwanen & Mokhtarian, 2005). For individual mobility, personal attributes (e.g. cognitive, social, psychological and subjective factors) and socio-demographical factors (e.g. age, gender, and occupation) are highly relevant determinants. However, socio-demographical factors are difficult to influence whereas personal attributes such as psychological factors are much more accessible for behaviour change interventions.

Individuals' age is a critical factor when understanding travel behaviour and mediating influences, as children's' and adolescents' travel behaviour is dependent on an interaction with

parental attributes, intra-household interactions and activity patterns and is therefore not always self-selected (Johansson, 2006; Kamargianni et al., 2012; Lorenc et al., 2008; McDonald, 2008; McMillan, 2005; Mitra, 2012; Yarlagadda & Srinivasan, 2008). In addition, mainstream cultural values, norms and priorities of transport related attitudes are evident in young boys and girls from early childhood (Kingham & Donohoe 2002; Meaton & Kingham, 1998). In the conceptual theory of Travel Socialization (Baslington, 2008), the home, school, peers and the media are identified as main socializing agents, where the parental home bears the strongest influence on the child's knowledge of travel modes and travel mode behaviour, whereas the school, the media, and peer groups are contributory socializers. The theoretical implication of travel socialization is that transport related influences become embedded when learning about cultural associations which then are reinforced by major social institutions (Baslington, 2008). These social agents or institutions have largely been ignored in studies exploring young people's travel behavioural intentions, instead studies have traditionally focused on exploring intentions within the intrapersonal and interpersonal scope of the individual, such as targeted by motivational theories.

The importance of life script events for travel behaviour change and car ownership has been documented for adult samples, and these studies have identified three biographical domains of key events that are transport relevant; *household and family, education and employment* and *residential* biography (Axhausen, 2008; Chatterjee et al., 2013; Clark et al., 2012; Lanzendorf, 2003, 2010; Prillwitz et al., 2006; Scheiner & Holz-Rau, 2013a, 2013b; Scheiner, 2007). Obtaining a driving licence and purchasing a car are treated as key events in individuals' mobility biography, as these are the onset of a behaviour change. Individuals' subjective perception of their mobility related needs in regard to common life script events has been found to be important for the formation of behavioural intentions related to car use (Haustein & Hunecke, 2007). However, there is a lack of research studying the perceived impact life script events have on future mobility intentions for young people. Such studies could furthermore identify segments that are either resistant to or amendable for policy interventions. As demographical and socio-demographical changes over the last 20 years have mainly been manifested in a delay in life script events, exploring these would be highly valuable to improve understanding on travel behavioural intentions and behavioural change.

2.4 Gender as a mediator of mobility patterns

The term 'gendered mobilities' refers to the systematic differences observed in adult males' and females' mobility which often emerges due to discrepancies and inequality; e.g. transportation access, resources, social positions, economic disadvantage, activity patterns and intra-household structure (Lucas, 2012; Polk, 2004; Cresswell & Uteng, 2008). Mobility and transport behaviour are intertwined with the socially constructed gender roles a person takes in a household (Hanson, 2010; Scheiner & Holz-Rau, 2012a), but despite altered gender relations within homes and workplaces, females' lower mobility levels seem to persists in

general (Dobbs, 2007; Hanson, 2010). Studies on adult populations have shown that despite females having increased their mobility much more than males have throughout time, females are less likely to drive and to own a car, they have less daily mobility span and more complex travel patterns, more often taking trips for the purposes of shopping, errands and escorting children (Crane, 2007; Dobbs, 2007; Duchène, 2011; Frändberg & Vilhelmson, 2011; Hamilton, 2005; McDonald, 2008; Nobis & Lenz, 2005; Rosenbloom, 2006; Scheiner et al., 2011; Schwanen et al., 2012). In addition, females are more positive in regard to environmentally friendly transport than males (Rosenbloom, 2006; Polk, 2004).

Compared to adults, gendered mobility patterns for children and adolescents have been far less studied and in the past decade, interest has mainly focused around active travel and independent travel patterns, generally with respect to school journeys (Brown et al., 2008; McDonald, 2012). Accordingly, adolescents have been less studied than school children in this respect (Schoeppe et al., 2013). When it comes to active travel pattern, boys are usually found to be more active because they engage in more vigorous active transport such as cycling, but girls are more likely to be driven and sometimes more likely to engage in moderate active transport such as walking (Cooper et al., 2005; Leslie et al, 2010; McDonald, 2012; McMillan et al., 2006). Boys have been perceived to engage earlier in independent mobility, but recently it has been disputed and argued that rather boys and girls engage in different forms of independent mobility, as girls are more inclined to accompany other peers (Brown et al., 2008). These studies indicate that already in childhood, boys and girls have a different mobility pattern which diverges even further as children acquire more independent mobility styles with age (McDonald, 2012). The reasons have not been fully understood but focus has been on external influences, such as the infrastructure or parental attributes as a major contributory factor (McDonald, 2012; McMillan et al., 2006).

Studies scrutinising children's and adolescents' aggregative travel trends have shown a rise in car use and a decrease in active and independent travel over the past decades, but do not detail on gender issues (Fyhri et al., 2011; Hjorthol & Fyhri, 2009; Marzoughi, 2011; McDonald et al., 2011; Van der Ploeg et al., 2008). However, Mackett (2013) finds in UK, the big shift in favour of the car for the school journey took place between 1985/1986 and 1995/1997 when the levels doubled, but have been fairly stable since. This is important because after decades of growth in transport demand, researchers have recently acknowledged slower rates of growth, stagnation, levelling off or reductions in various measures of car use for some industrialized countries. The phrase 'peak-car' has been employed for this phenomenon and young adults (from 18 years) or 'generation Y' are contributing significantly to this development (Goodwin & Van Dender, 2013; Kuhnimhof et al., 2013). The changes observed include a significant decrease in licence holding, reductions in automobile mileage in daily travel, increases in other modes - predominantly public transport, increased multimodality of those with access to a car, and finally there are some converging trends for the youngest males and females included in these studies, who are around 18-29 years old. Males have reduced their automobile travel

more significantly than females, resulting in similar mobility pattern for this age group (Frändberg & Vilhelmson, 2011; Lucas & Jones, 2009; Millard-Ball & Schipper, 2010; Murray, 2003; Kuhnimhof et al., 2011; Kuhnimhof et al., 2012; Kuhnimhof et al., 2013; Raimond & Milthorpe, 2010; Shults & Williams, 2013; Sivak & Schoettle, 2012a). However, there are several inconsistencies in this development found between countries and contrasts between dense cities and rural areas, in addition, gender differences regarding licence holding have not been fully scrutinized (Goodwin & Van Dender, 2013; Kuhnimhof et al., 2013; Sivak & Schoettle, 2012b).

The reasons behind the peak-car phenomenon are not fully understood and there is a high uncertainty of the endurance of the observed development in males and females travel trends. If these newly identified trends for key mobility indicators will continue to develop universally and turn out to be persistent for the youngest cohorts in the future, they will have great impact on a range of factors, e.g. infrastructure, mode choice, vehicle ownership, safety issues, and last but not least the environmental consequences of travel. Furthermore, it is important to explore gender differences in travel patterns for young people to understand the development during the transition to adulthood and identify possible gender inequalities. Such findings would be valuable for policy aiming to guarantee equal opportunities and accessibility as part of sustainable mobility.

3 Theoretical framework

The most widely applied behavioural model of cognitive factors of car use is Ajzen's (1991) Theory of Planned Behaviour (TPB) (Gardner, 2009). Despite receiving good empirical support (Armitage & Conner, 2001), the TPB is criticised for neglecting the influence of experience and past behaviour that influences the decision to drive (Gardner, 2009; Aarts et al., 1998; Verplanken & Aarts, 1999). Furthermore, the TPB might be too simplistic for studying travel behaviour in the context of climate change (Anable et al., 2006). The predictive capability of studies using TPB has been improved by expanding this theory with additional concepts that are theoretically relevant (Anable, 2005; Brown et al., 2008; Haustein & Hunecke, 2007). Recently, transportation studies interested in children and adolescents have found it useful to employed social and ecological theories to account for influences from several levels on transportation outcomes (Emond & Handy, 2012; Handy et al., 2010; Mitra; 2012; Panter et al., 2010; Robertson-Wilson et al., 2008). For the scope of this PhD project, which aimed to explore adolescents' intentions for their future mobility in the context of climate change, inspiration was sought from social and developmental psychology to build a theoretical framework instead of solely relying on the TPB. By implementing an iterative deductive-inductive procedure, it became possible to attain and identify theoretically grounded data-driven patterns influencing intentions. Largely, the frameworks are based on domains presented in McLeroy and colleagues (1988) socio-ecological model, with concepts from TPB and the Social Cognitive Theory (SCT) (Bandura, 1986) placed into the domains of where relevant.

The next section will elaborate on the behavioural and developmental theories that served as a base for the construction of the theoretical and conceptual frameworks in study 2 and 3.

3.1 The Theory of Planned Behaviour

Ajzen's (1991) theory of planned behaviour (TPB) concerns the individual's mediated intention to perform a given behaviour. The *attitude* toward the behaviour, *subjective norm (SN)*, and *perceived behavioural control* (PBC) combined, leads to the formation of a behavioural intention that pre-acquits the actual behaviour. Intentions are assumed to capture the motivational factors that influence behaviour; they are indications of how hard individuals are willing to try and how much effort they plan to exert, in order to perform the behaviour. Importantly, a behavioural intention can only find expression in behaviour if the behaviour in question is under volitional control. Perceived behavioural control acts as a proxy for actual control, thereby affecting behaviour indirectly through the mediating role of intentions. Social norms are regarded to be subjective norms that a person believes to exist in relation to significant others (Ajzen, 1991).

3.2 Social Cognitive Theory

The social cognitive theory (SCT) adopts an agentic perspective to human development,

adaptation and change, and employs a triadic reciprocal causal model to explain how individuals acquire and maintain certain behavioural patterns (Bandura, 1986, 2001). The model has three main determinants; personal factors, behaviour and environmental influences that all interact and influence each other, although not always in equal strength (Bandura, 1989). Outcome expectancies are central determinants of behaviour, i.e. situation-outcome refers to the perception that consequences are determined by the environment and are thus separated from the individuals control, action-outcome relates to the individuals belief that their behaviour is instrumental to the outcome in question, and finally the key concept of self-efficacy is based in the individuals confidence in their own ability to perform the particular behaviour (Bandura, 1989). The SCT highlights the importance of self-efficacy as a mechanism that plays a central role in human agency, because among the types of thoughts that affect action, none is more pervasive than individuals' own judgement of how capable they are to exercise control over events that affect their lives (Bandura, 1989, 1997). In addition, social cognitive theorists believe that individuals acquire a wide range of behaviours, thoughts, and feelings through observing others' behaviour and that making observations is an important part of one's life-span development (Glanz et al, 2002). SCT is mainly used in health sciences to predict behavioural intentions and can also provide the basis for intervention strategies. However, the explained variance of the framework is often only adequate but the central concept of self-efficacy has been highlighted as an instrumental predictor for many behavioural outcomes (Armitage & Conner, 2000).

3.3   Socio-ecological model

Socio-ecological models view the relationship between behaviour and environment as reciprocal and by dividing the social environment into analytical levels or dimensions it is possible to focus attention on specific levels of social influences with the purpose to develop appropriate interventions (Bronfenbrenner, 1979; McLeroy et al., 1988). The socio-ecological model proposed by McLeroy and colleagues (1988) intends to both guide behavioural interventions and to provide a distinction between levels of intervention and the targets of intervention. Their model includes influential factors from five domains. The *intrapersonal domain* includes characteristics of the individual such as knowledge, attitudes, behaviour, self-concept, skills etc. This takes account of the developmental history of the individual. The *interpersonal domain* represents formal and informal social networks and social support systems, including family, work group, and friendship networks. The *institutional domain* refers to social institutions with organizational characteristics, and formal (and informal) rules and regulations for operation. This covers how the organizations are organized and managed which the individual interacts with, including schools (i.e. the form of mediation). The *community domain* signifies the individuals' relationships with organizations, institutions and informal networks within defined boundaries. An important component of community includes what has been called "mediating structures, e.g. schools, organized leisure etc. Lastly, the *policy domain* includes local, state, and national laws and policies.

4 The PhD project

The overall objective of this project was two-folded; to explore past travel trends for young Danes and to broaden the understanding of the social and psychological factors motivating adolescents' transport related intentions for the future. Based on this work, three papers are presented which enhance existing knowledge about young people in the field and have practical implications for future studies and policy makers. For these purposes three complementary studies were performed and each study is described in detail in the following sections. The three papers that were produced from the findings are enclosed last in this thesis.

4.1 Study 1: Longitudinal analysis of gender differences in daily travel pattern

4.1.1 Aim

This analysis specifically explores the longitudinal development of gender differences in daily travel, for four age groups; adolescents (15-19), young adults in their early twenties (20-24), young adults in their late twenties (25-29) and young adults in their early thirties (30-34). Examining these groups allowed for an observation of the development in between males and females during the transition from adolescence to adulthood. Furthermore the analysis differentiates between urban and rural living location.

4.1.2 Data and measurement

The data employed came from the Danish National Travel Survey (Transportvaneundersøgelsen - TU), an interview survey which serves to document the travel behaviour of the Danish population. The survey is conducted on a yearly basis and consists of 24-hour travel diaries collected from a representative sample of the Danish population between 10 and 84 years of age. Data from 1995 to 2003 and from 2007 to 2012 was employed in this study. Paper 1 gives more elaborative information of the survey.

The analysis was processed for each gender, age group and participants living location. Trip purpose was taken into consideration, defined as mandatory (school or work related purpose) or non-mandatory (including shopping, errands, escort, etc.). Additionally, the groups were compared on a range of demographic variables defined as; living with parents or not, presence of own children, occupational status and household car access. The mobility indicators of interest involved; driving licence status, certain trip qualities and mode choice. The trip quality variables include: length travelled in km, time travelled measured in minutes and number of trips taken each day. Mode consisted of four alternatives; car, public transport (PT), walking and biking. Car trips involved both trips taken as a driver and as a passenger. PT involved all bus transport, except hired bus and tourist bus, and all train transport, including S-tog, Metro and regional trains. Walking involved all trips made on foot. Biking referred to trips carried out using only a bicycle.

The statistical analysis involved descriptive analysis, in addition to chi-square tests and t-tests when appropriate.

4.1.3 Main results

The results suggest that in cases where there is a gender-related gap in transport behaviour, the gap progresses with the age groups and is different for rural and urban areas. Regarding driving licence, there is no systematic gender gap in urban areas across all age groups. In rural areas, the gender gap is non-significant for the youngest age group, but is significant for young people in their twenties, with males having a higher licensure rate. Regarding car accessibility (only including those not living with parents), there is no significant gender gap in urban areas, while in rural areas young females in their thirties benefit from a slightly higher car accessibility compared to men. In general there is higher car accessibility in rural areas, with a steep increase over the last five years, particularly for the oldest group.

The gender gap in the number of trips increases with age, with 30-34 year-olds exhibiting the most pronounced systematic gender gap both in rural and urban areas, with females having a much higher number of trips. Regarding the proportion of trips by purpose, the gap is greater for the older age groups and is more pronounced in rural areas. In the youngest group the gender gap progresses and becomes significant by the turn of the century, but in the oldest group it seems persistent over the years. In terms of daily driving distance, the gap has diminished more rapidly in rural than in urban areas, and currently the gap is significant only for the oldest age group in urban areas. The difference in travel time between males and females in urban areas is considerably less than in rural areas where females often travel for longer time. There is no systematic gender difference for the youngest group in neither urban nor rural areas. For the next age group, a systematic difference appears in 2007 with females using more time for their daily transportation but for the two oldest groups the difference in travel time is consistently non-significant across the two decades. Travel time has increased by 10-20% for both males and females across the two decades.

With respect to travel purpose, the two youngest age groups do not exhibit a significant gender difference in the trip proportions by purpose, but the two older groups exhibit a significant difference, with males engaging in more mandatory trips and females engaging in more escort trips. For 25-29 year olds, the difference is only found in rural areas while for 30-34 year olds the difference is both in urban and rural areas. With regard to gender differences in mode choice, for the two younger age groups there was a significant difference in the 1990s with males travelling more by car and females travelling more by non-motorized modes, but the difference has become non-significant in the last few years. For individuals in their late twenties, the difference is significant in the rural areas but not in urban areas, and for the oldest age group there are no significant differences in mode use. Regarding the trip proportion by mode, the difference is more pronounced in rural areas, and it diminishes with the lifecycle progression. Paper 1 describes the results in detail.

4.2 Study 2: Questionnaire study to explore the mediating factors influencing adolescents' intentions for their future mobility

4.2.1 Aim

This study explores adolescents' intentions to commute by car or bicycle as future adults. The aim was to gain an understanding of the motivational factors influencing these intentions, explore gender differences and to understand the role of environmental concern. For these purposes, a comprehensive behavioural framework was designed based on inspiration from the Theory of Planned Behaviour (TPB) (Ajzen, 1991), the Social Cognitive Theory (Bandura, 1986) and the socio-ecological model (McLeroy et al., 1988).

4.2.2 Data and measurement

For this study, a random sample of 15 year olds Danish adolescents was obtained using the assistance of Statistics Denmark. The data was collected by means of a web-based questionnaire, completed by 891 participants, of which 55.4% were females.

The survey contained questions regarding the adolescents' future travel behaviour intentions and explored various social, psychological and cognitive attributes, their current travel pattern and socio-demographical characteristics. The questionnaire is enclosed in the appendix.

Structural Equations Modelling (SEM) was employed to confirm a theoretical framework modelling the adolescents' intentions as a function of the indicators of interest.

4.2.3 Main results

The results supported the proposed behavioural framework. The results show that environmental concern had no significant relationship to future travel behavioural intentions. However, it should be stressed that environmental concern was a significant impact factor on willingness to participate in hypothetical measures to reduce car use in the future. Males showed more general interest in cars and perceived obtaining the driving licence to be easier than females, which in turn showed more environmental concern and had a more severe future vision than males. Furthermore, Individual characteristics were related to the current travel experience, attitudes, norms and future vision of adolescents. Living location was related to less interest in cars and less subjective norm of car ownership.

Positive experience as car passenger had the highest positive relationship to intentions to commute by car in the future, in addition to high subjective norm. Low intentions were related to high willingness to accept limitations of car travel in the future and low perceived behavioural control. Positive cycling experience was also the strongest mediating factor for strong intentions to cycle in the future, as were negative attitudes to the car, high willingness and bicycle friendly future vision. Subjective norm of car ownership was negatively associated to bicycle intentions.

4.3 Study 3: Interview study to understand the mediating factors influencing adolescents intentions to obtain a driving licence and own a car in the future

4.3.1 Aim

The objective of this study was to explore if adolescents' intentions for obtaining a license and to purchase a car in the future varied and if so, to identify the motives and explore the impact of different mediating factors. Furthermore, this study provided an opportunity to gain a deeper understanding of the influences identified in the prior study.

4.3.2 Data and measurement

Through the services of Statistics Denmark, a contact was made with 50 individuals, 25 females and 25 males, all born in 1995 or 15 year old. These participants came from urban and rural areas in the Zealand area in Denmark and had participated in the previous survey.

The interviews were semi-structured and embraced a narrative approach, giving the participants the space and time to reflect on the motives underlying their intentions. The themes related to issues regarding personal attributes regarding past, present and future travel behaviour. The semi structured interview guide can be requested from the author.

Thematic Analysis was applied as the analytical foundation for this study, since it has vast opportunities for concepts of a latent nature and can be used within different theoretical frameworks (Braun & Clarke, 2006). NVivo 10 was employed for data analysis and for structuring the material into meaningful themes.

4.3.3 Main results

There was an evident difference in the time frame of the explored intentions, resulting in three groups being defined. The first group was named *car enthusiasts*, referring to those who had a strong intention to obtain both the licence and the car in the near future. The second group was named *car pragmatics,* indicating their strong consensus of the practical value of having a driving licence, but this group wanted to obtain the driving licence in the near future but did not feel the urge to obtain a car until in the far future. Finally the third group was named *car sceptics*, indicating those who felt that they had no impending need for a licence or a car until possibly in their later future when their situations had changed considerably. Notably there was no apparent gender difference in these groups.

How these groups intend to use a car is also quite different, in general terms the car *enthusiasts* want their own car above everything, giving them travel freedom without anyone interfering with them. The car is highly related to affective and symbolic values and this group generally reports strong influences of existing social norm in favour of car dependency. There are limited barriers perceived for obtaining a car in the future, despite that they say that they are aware of

the financial and environmental costs. The car is not related to a perceived need, but rather associated to be a life script event in itself, or a step closer to adulthood. The *car pragmatics* see the practical attributes that come with a licence and value the ability that comes with it. They feel that it is fine to start with borrowing a car in situations where it is necessary, giving them the opportunity to drive when there is need for it, e.g. when it is bad weather or long distances. Then, using a car would be dependent on the purpose of the trip and when a car is available. For this group, obtaining a car is strongly associated with life script events such as family, children, moving away from the city after education and long distances to work. *The car sceptics* often perceive the car as a liability and imagine that they could manage in the future if they would not have a car at all. The need for obtaining a car is also strongly associated to the perceived need accompanied with life script events. They are bicycle-oriented and have a habit for independent and active transport pattern from early on.

Based on these findings a conceptual model was inductively-deductively created and details the relevance of social and psychological mediating factors common for the three groups. The domains composing the conceptual model are described in paper 3, but in addition they are presented visually in appendix 1 to 5. The colours of the arrows in the figures indicate the strength of the relationship between the mediating factors and the groups, black being the strongest, blue a medium relationship and grey the weakest.

5   Discussion and implications of findings

This PhD project had two overall objectives, both of which aimed to enhance knowledge about young people. First, study 1 explored the longitudinal development and differences in males and females daily travel pattern differentiated by urban and rural living locations. Secondly, two studies were carried out to explore the mediating factors influencing behavioural intentions for future mobility. The main contribution of the PhD project within these two objectives will be discussed in the following sections in line with implications for sustainable policy and future research directions.

5.1   Exploring the development of key mobility indicators

Regarding driving licence status, Denmark is not experiencing a decline for young people but on the contrary there have been rapid increases in licensure amongst females, most noticeable in the three younger groups. From 2007 to 2012 alone the increase was 10.5% for 18-19 year old females but only 5.9% for the males. The increase was only 2.6% for 20-24 year old females in the same period and 1,4% for the males. The overall increase by females has resulted in near elimination of the gender gap, which was observable in the beginning of the period. Rural areas have always had higher share of licensed individuals than urban areas, however, this difference is now narrowing (in 2012 the rural - urban difference was only 1.5% between 20-25 year old females and 1.89% for 25-29 year old males). The upward Danish licence trends are in consensus to trends found for young people in Finland, Israel, The Netherlands, Spain and Switzerland, were the development in licensure for the youngest age groups is somewhat increasing (Sivak & Schoettle, 2012a)[*], but the contribution made by males and females for these countries is unknown. Trends for France and Germany indicate a near stagnation over a long period, and a declining trend for Great Britain and USA has remained stable since 2005 (Kuhnimhof et al., 2012). The Danish trends are in stark contrast to the sharp downward development found in Australia (Delbosc & Currie, 2013), Norway (Hjorthol, 2008; Sivak & Schoettle, 2012a) and Sweden (Kuhnimhof et al., 2012; Sivak & Schoettle, 2012a). Where gender differences have been analysed, the gender gap has narrowed significantly for France, Japan and Great Britain, disappeared altogether in Norway, but reversed for Germany and USA, mostly as a result of decreasing share of males obtaining the licence but stable trends for females (Kuhnimhof et al., 2012). Studies differentiating between the longitudinal development for young males and females in urban and rural areas are generally lacking. But since urban areas often have good transport provision which facilitates individual mobility without a car,

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[*] The increase for these countries can only be estimated from figures presented in the reference and are as follows; Finland: around 30% increase for 18-19 year olds and for 20-29 year olds from 1983-2006, Israel: less than 5% for 16-18 year olds, little over 20% for 19-24 year olds from 1983-2008, The Netherlands: near 20% for 18-19 year olds, no change for 20-24 year olds from 1985-2006, Spain: around 12% for 15-24 year olds from 1999-2009, and Switzerland: less than 15% for 18 year olds, less than 5% for 19 year olds, similar levels for 20-24 year olds from 1984-2005.

living in urban areas is recognized to be a mediating factor contributing to a decrease in mainstream licensure trends for young people (Raimond & Milthorpe, 2010; van der Waard et al., 2013). The countertrend observable for urban areas in this study is concerning but on the other hand, given that females are now obtaining similar levels of licencure as of those of males, this development might be seen as increased gender equity.

Given that changes in licensure is a strong indicator of what to expect of future mobility patterns for the new generations, this increase cannot be considered favourable in regard to sustainable mobility. To counteract this development, policy measures could be applied to support young people to voluntary choose to delay the driving licence. The Danish licensure trends identified are distinctive from the broad international tendency. Thus, young Danes travel trends should be monitored in the future to be able to identify the stability or volatility in travel behaviour for males and females. Future studies should furthermore focus on collecting comparable data to be able to monitor the Danish development in an international setting and to identify the impact of distinctive national attributes such as past and current policy measures and cultural norms.

With regard daily travel pattern and gender differences, Denmark largely follows the mainstream trends with convergence of males and females behaviour (Crane, 2007; Frändberg & Vilhelmson, 2011; Hjorthol, 2008), but where there exists a systematic gender gap on mobility indicators (e.g. for number of trips and trip purpose), they seem to be more prominent with increased age. Living location has considerable impact, as different patterns were observed in the development of the gender gap for urban and rural areas. Car access has increased sharply in recent years for rural areas and for the oldest group in rural areas the gender gap has turned and is now in favour of females. The overall increase in car use for females has near eliminated the gender gap where that was persistent, but gives reason to expect that females will not exhibit a more sustainable travel pattern than those of males in the long run.

Studies have generally not regarded all convergence trends as a positive equity development for adults, given that males and females still exhibit highly gendered mobilities (Crane, 2007; Hanson, 2010; Hjorthol, 2008; Scheiner et al., 2011; Scheiner & Holz-Rau, 2012a). This was the case in this study for the young adults in their early thirties and young adults in their late twenties (only in rural areas), showing that despite similar levels of car use there was a significant difference regarding purpose of trips, with males engaging more often in mandatory trips and females engaging more often in escort activities (in this respect it should be noted that the analysis did not differentiate between who was being escorted). However, males and females did not differ regarding the purpose of trips for other age groups in rural or urban areas. These results regarding trip purpose bear resemblance to those of Scheiner and colleagues (2011) that analysed German longitudinal data and found that there was a persistent gender difference regarding escort trips (which actually widened with time), while

the ratio of trips for mandatory (job) purposes and leisure purposes converged altogether for the genders.

The nature of the travel survey data used in this study does not allow for exploring the intrinsic reasons behind individuals' travel or intra-household relations, therefore it is not possible to explain the differences found for males and females in this study. Nevertheless the findings provide valuable indications about how mobility develops over the transitional phase towards adulthood, especially in early adulthood when males and females adjust to new roles, with household obligations, family and work life. Nevertheless, more work is needed to confirm these indications and possibly the mobility biography approach could be beneficial to understand gendered mobilities further. Importantly, the question remains if the gendered mobilities observed for the older groups in this study are likely to face the same destiny as the licensure trend and fade out with time, or if gendered mobilities will persist due to their link with new adult roles. The latter seems more probable since Denmark is among the highest scorers on the Gender Equity Index (European Institute for Gender Equity, 2013), but this is a subject for future studies. This study did not involve long distant trips or international travel, which are important to be monitored and studied. Frändberg and Vilhelmson (2011) report that despite a reduce in daily mobility and a tendency to delay the driving licence, young Swedes have acquired a more globalized lifestyle with an increase in long distant and international travelling. Therefore their environmental impact might not been reduced after all which has a considerable impact on sustainable future vision. Given that there are somewhat different trends apparent for young Danes, it would be intriguing for future studies to explore this. There is an imperative need for travel trend studies addressing rural and urban differences and the development for various groups in the population, especially for young people. This is important because of the long-term interest in rural accessibility and mobility, in particular with respect to disadvantaged population groups and social inequalities (Nutley, 2005). Lastly, it would be beneficial if means were found to overcome the considerable methodological difficulties to harmonize travel trend data between countries due to differences in data collection and definitions and create measures that would ease international cooperation and meta-analysis in the future. In a growing globalisation such means would be valuable to future research.

5.2   Understanding mediating factors for adolescents future mobility intentions

Study 2 explored the factors motivating adolescents' intention to commute by car or bicycle in the future. A theoretical behavioural framework was proposed and tested, and the findings supported the framework's structure. Based on these results, the third study set out to explore adolescents' intentions for obtaining a license and to purchase a car in the future and to gain a deeper understanding of the influences identified in the prior study. Based on the analysis of the material obtained from study 3, a conceptual framework was proposed. The two frameworks map the influences for the adolescents' intentions. Furthermore, these factors are

related to individual characteristics, such as gender, residential location, current mode choice to daily activities, and parental travel patterns. Behavioural change campaigns that aim to motivate the use of sustainable transportation have the best effect when campaign design is based on a holistic understanding of the target group and when involving the community (Davies, 2012). These frameworks give valuable and specific information about young people and have the potential to guide interventions aimed to induce current and future sustainable individual mobility.

Nearly all participants in study 3 shared strong intentions to obtain a driving licence in the future. Similar results have been found for young people in Sweden (Forward et al., 2010) and in the UK (Baslington, 2009; Line et al., 2010). However, the results from study 3 showed that the adolescents differed in the intended time frame of their intentions and furthermore they did not all share the same view regarding owning a car in the future. Based on the participants' intentions and the mediating factors influencing them, three groups were identified, the car enthusiasts, the car pragmatics and the car sceptics. These groups are identical to Moore's (1991) technology-adoption-lifecycle, which emphasizes the potential of social marketing for successful intervention. These findings suggest that the use of segmentation for understanding mediating factors influencing behavioural intentions is beneficial for identifying amendable subgroups of pre-drivers. Segmentation is based on travellers' attitudes and behaviour and has been employed to identify distinct groups that have the potential to be targeted by social market campaigns to motivate sustainable transport (Anable, 2005; Beirao & Sarsfieldcabral, 2007; Hunecke, et al., 2010; Prillwitz, & Barr, 2011; Shiftan, et al., 2008). This study does not observe actual behaviour and bases this segmentation of young pre-drivers on their self reported intentions and the mediating factors identified, of which many are attitudinal. Therefore, a follow-up on actual behavioural outcome would be valuable. More studies are needed to explore young pre-drivers and moreover, these segments should be explored in a quantitative setting.

Despite being aware of the adverse impact of cars, environmental concern did not impede the adolescents' intentions to obtain a licence and to own a car in the future or change their current use of the car. This has been established by previous studies (Collin-Lange & Benediktsson, 2011; Line et al., 2010; Mackay, 1998). The findings from study 3 suggest however that environmental concern influences preferences concerning their ideal future car and hence their consumer behaviour. Furthermore, personal economical gain and environmentally friendly gain of fuel-efficient cars were closely jointed themes. However, young people in Sweden, in particular females, have increasingly more often mentioned environmental issues as a reason for not wanting a driving licence (Forward et al., 2010) and environmental issues are also found to be of importance for children's attitudes towards cars in the Netherlands (Kopnina, 2011). Possibly this is due to a difference in environmental efficacy, which would be interesting for future studies to explore. Overall, environmental efficacy was weak for all groups in study 3 and mainly associated to socially acceptable behaviour such as

saving energy and water recourses. In addition, many adolescents had difficulty recalling and elaborating on their environmental knowledge, they did not experience global warming to be a serious problem in their community and reported more imminent problems that they were more passionate about. It has been suggested that young people are unconcerned due to lack of knowledge and the intangible effect of climate change (Line et al., 2012). If an individual sees no environmental value in the use of alternative transportation, it will affect their willingness to change their behaviour or intentions negatively (Stern, 2000). This suggests that environmental knowledge needs to be mediated with more affirmative and effective means for young people and awareness throughout the community needs to be supported. Consequently such measures would strengthen environmental efficacy, social and moral norms, and attitudes in a positive way which should have positive overall effect on behaviour.

Of the five factors mediating intentions to commute by car in study 2, males scored significantly higher on two factors; PBC and car interest. Females on the other hand scored higher on environmental concern and had a more environmentally pessimistic future vision. These were two of three factors influencing willingness to participate in limitations on car travel. These gender differences in attitudes are in line with findings for driving adults (e.g. Anable et al, 2006; McCright, 2010; Meinhold & Malkus, 2005; Steg, 2005; Polk, 2004). It has been reported that environmental concern increases individuals' acceptance of TDM measures (e.g. Cao & Mokhtarian, 2005; Eriksson et al., 2006; Loukopoulos et al., 2005; Nilsson & Küller, 2000; Steg et al., 2005). Amongst the three groups identified in study 3 there was a general consensus that it would be better if travel behavioural change would stem from individuals voluntary initiative, instead of being imposed by government. However, when the adolescents were asked of their opinion, mild restrictions were almost always acceptable. Based upon these findings, TDM measures would probably be better accepted as voluntary travel behavioural change programs, providing individuals with the opportunity to implement personalized travel planning in situations where preferable. Such programs have yielded good results although long-term evidence is only newly emerging (Bamberg et al., 2011; Economides, et al., 2012; Stopher et al., 2013; Taylor, 2003). Furthermore, increased environmental awareness in adolescence could result in greater acceptance of TDM measures in adulthood and therefore it would be interesting to follow up on this study.

Study 3 explored the perceived impact on overall quality of life and mobility, if for some reason, the adolescents were not able to obtain the driving licence or own a car. On a group level, the three groups show different predisposition regarding this. The car pragmatics perceived more severe impact in line with coming life events (children, work etc.) but for car sceptics there was a greater degree of openness to adjust and hence they reported the least impact on overall quality of life and mobility. Predisposition and subjective assessment of potential impact TDM measures would bring about on an individual level are important but Steg and Gifford (2005) stress that in order to successfully implement sustainable transport plans, sustainable transport policy should be concerned with how individuals perceive these to affect their quality of life in

current and future generations. Not much is known about how young people assess their quality of life and overall mobility to be affected by limitations and therefore this study offers a valuable contribution to this field.

In study 3, the dynamic relationship with the household, mainly with parents and siblings, was explored. The theoretical foundation from the social-cognitive theory was advantageous, identifying parents and siblings as key role models, shaping the adolescents perceived need for a car. Peers, school and media were found to be considerably less influential. Own family's past and present travel patterns and positive experience were identified as highly influential in the formation the adolescents' intentions, which is coherent with the theory of travel socialization (Baslington, 2008). The adolescents furthermore strongly linked the experienced past behaviour to a purpose in their future (e.g. life events), which was especially evident in regard to intention to buy a car in the future. This is in line with Klöckner and Matthies (2012) findings, which conclude that the influence of travel socialization on behaviour is mediated by psychological constructs such as script based habits (i.e. habits as cognitive structures that store knowledge or information about the decision-making process formed on information about behavioural patterns that stem from socialization). Thereby, the information about appropriate behavioural patterns is linked to certain situations, which furthermore is dependent on the transport provision and infrastructure characteristics experienced in those situations.

Those that lived in Copenhagen were less interested in cars and reported lower SN of car ownership in study 2. However, living location was not found to systematically impact the participants' intentions in study 3, although a larger sample would be needed to statistically estimate this. More importantly, the perceived transport provision where they expected to live later in life was found to be a mediating factor for their mobility intentions in the future. This future residential self-selection was highly related to individuals' life script events and lifestyle. Policymakers should therefore be concerned about the subjectivity of perceived limitations of the infrastructure and transport provision in general. Furthermore, parental subjectivity is equally important, as it often unnecessarily obstructs active and independent transport amongst their children (Lang et al., 2011), and hence shapes the children's daily transport pattern, experiences, preferences and attitudes. However, this project did not explore the parents' point of view.

The findings imply that adolescents have constructed their own life script based on the cultural life script schemata and accepted gender roles. This is consistent with Bohn (2011) who details how individuals compose and maintain their life scripts from the culturally shared representations of an idealized life. The car pragmatics in particular are a good example of this, they strongly associated the intention to obtain a car with a perceived need accompanied by more distant life script events (e.g. having children and commuting to work). Obtaining a car was ultimately unavoidable due to these events and hence they might already be identified as key events for future travel behaviour change. The findings imply that travel behaviour change

allegedly caused by key events in individuals mobility biography, is dependent on socialization processes occurring long before the actual behaviour. Possibly it could be beneficial to promote a realistic long-term sustainable future vision, giving young people new "guidelines" to adapt their future vision to in good time. Such an alternative future vision could counteract the current link between certain life script events and perceived mobility needs. Alongside such promotion, new alternatives to car ownership should be promoted, where the need for motorized transport would be satisfied due to lack of alternatives in a given situation, instead of being a predefined necessity that comes with a given life situation. The household bears a considerable responsibility for forming the adolescents' future mobility intentions through socialization, and thus has a great opportunity to be utilized as a mediator for sustainable mobility. However, this would mean that the socializing agents would need to obtain a more sustainable mobility in order for a positive socializing effect to occur. Policy should therefore focus holistically on households with children to reduce unfavourable socialization effects in good time.

6 Strengths and limitations

This PhD project included three separate studies which all relied on self-reported data, but employed different methodology. Study 1 employed National travel survey data (TU) which monitors travel trends at the aggregative level, in addition to collect information about socio-demographical factors and socio-economics. The national travel survey employed does not include information about the cognitive determinants underlying the travel behaviour at the disaggregative levels, but studies focusing on conceptual travel behaviour models rely on individual characteristics to explain travel mode choice and activity based travel. Study 2 and 3 make use of data at the disaggregate level, study 2 employed a detailed web based survey and the data was statistically analysed, and study 3 was a qualitative study based on 50 in-depth interviews. This combination of qualitative and quantitative research designs for the purposes of this project was beneficial, as the aggregative data analysis was employed to identify stability and variability in travel behaviour amongst young people. This information guided the construction of a detailed questionnaire that aimed to identify the factors influencing future development. SEM was employed to statistically test a theoretical framework, which can be used to specify and test alternative relationship between stated behavioural intentions and latent constructs (Golob, 2003). As the mediating factors became established, an in-depth interview study followed up on the findings to further understand the formation of the mediating factors beyond their significant influences. Combined, these studies give a detailed picture of the complexities of travel patterns and the factors influencing young people's behavioural intentions for their future mobility.

The primary limitation of the data employed in study 1, is due to methodological improvements in 2006 resulting in a limitation when comparing "new" and "old" data. Therefore it was not possible to perform time-series analysis and instead the analysis focused on changes within each year. The questionnaire survey had about 30% response that contributes to a limitation of representativeness of the data obtained. As for all scales in travel research, the questionnaire was susceptible to social desirability bias as it relied on self-reported measures. However, self-reported behaviour is generally considered reliable (Lajunen & Summala, 2003) and despite applying measures to control for social desirability, the associations between the independent and dependent variables seldom varies (af Wåhlberg, 2010). With regard to study 3, the most prominent concern is that of possible interview bias and social desirability. The analysis checked for internal consistently between the narratives and questionnaire to account for this problem.

7 Conclusion

The existing body of research regarding young people and their importance as drivers of sustainable future mobility is quite small. This PhD project aimed to contribute with much needed knowledge about young people through three complementary studies. First the objective was to explore gender differences in daily mobility trends in urban and rural areas, and secondly to carry out an elaborative quantitative and qualitative analysis of factors motivating adolescents' intentions for their future mobility. An understanding of these issues is a prerequisite for effective intervention design to promote for sustainable individual mobility.

The findings from study 1 highlight that gender issues continue to be an important subject in transportation research. The study identified recent development of several important mobility indicators for young males and females, divided after living location. The findings depict an overall negative development in regard to sustainable mobility goals, giving reasons to believe that there is a considerable effort needed in order to counteract this development. However, since females are responsible for a great deal of this development, systematic gender differences have decreased or eliminated on many mobility indicators giving indications of increased gender equity. On the other hand, males and females still vary in their purpose of trips, which indicates persisting gendered mobility. Unfortunately, the underlying reasons for this development were not possible to explore due to the nature of the data.

The second contribution of this PhD project involves findings from a quantitative questionnaire study and a qualitative in-depth interviews study. A behavioural framework is proposed in each study, based on the theoretical background of TPB, SCT and the socio-ecological model and identifies a wide range of conceptual factors on five domains, which influenced adolescents' intentions for their future mobility. The frameworks can be used to guide the direction of future research, and policy interventions as it provides a distinction between levels of intervention and the targets of intervention (McLeroy et al., 1988).

Furthermore, the interview study identified three segments of pre-drivers, which differed in the intended time frame of their intentions and in the impact of the factors that were explored. Segmentation has been widely used to identify groups that are modifiable to interventions aiming to change established behaviour but this finding identifies that the majority of pre-drivers have the potential to be motivated to delay their behavioural intentions.

Both studies elaborate on the impact and role of environmental concern to mediate the adolescents' intentions for their future mobility intentions. Environmental concern was found to have no statistical impact on intentions to commute by car or bicycle in the future, but it was found to mediate willingness to participate in limitations of the car in the future, which in turn mediates intentions to commute by car or bicycle in the future. Furthermore, environmental concern was not found to relate to the adolescents intentions to obtain a driving licence but rather to mediate their preferences for an environmentally friendly future car. The adolescents

were additionally questioned about the perceived impact for their quality of life and overall mobility if for some reason they were unable to obtain the driving licence and owning a car in the future. The findings show that the three groups report dissimilar views about the perceived impact, and furthermore give indication of which TDM measures would be acceptable to them to reduce the environmental impact accompanied by individual transport.

Lastly, the findings support that the adolescents' intentions for their future mobility are deeply influenced by the dynamic relationship between past experience, socializing effects of the household and social norm. These influences interact and create a cultural life script schemata which guides individuals construction of their own life script and their perceptions of future mobility needs.

Conclusively, it is unlikely that interventions targeting new generations alone will be successful to induce sustainable change. The task at hand to induce a more sustainable mobility is not an easy one and largely calls for a fundamental social change in the community. Social change and sustainable future vision in transportation are interconnected, as transport is both an influence on the nature of social change and reacts to it (Button & Nijkamp, 1997). The success of interventions toward sustainable transport is dependent on the social response to them, as they may require changes in attitudes and behaviours, which at the same time can be in conflict to the changes occurring in the society (Black & Nijkamp, 2002, Steg & Gifford, 2005). Improved knowledge of the drivers of future mobility for young people is therefore imperative for a successful paradigm shift towards sustainable mobility in their future. The findings from this project contribute to a further understanding of young people and the implications drawn from the three studies have the potential to guide future research and provide useful insights for sustainable policy makers.

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9   Appendix

9.1   Appendix 1. Interpersonal domain

The interpersonal domain consists of formal and informal social networks and social support systems, including interactions with family, peers and friends and travel norms within these social networks. Own family's past and present travel patterns, travel subjective norms and perceived obstacles to obtain a licence and owning a car (reflected mainly through financial awareness and a realistic view of the financial cost associated to both), were strongly identified as a motivating factor. Inspired from the SCT, the family's travel pattern is highly important because children learn from observing parents' and older siblings' actual transport related behaviour in particular settings. Furthermore, influences from the family and peers are two of the cornerstones in Baslington's (2008) travel socialization theory, where social norms get transmitted from and embedded in early childhood.
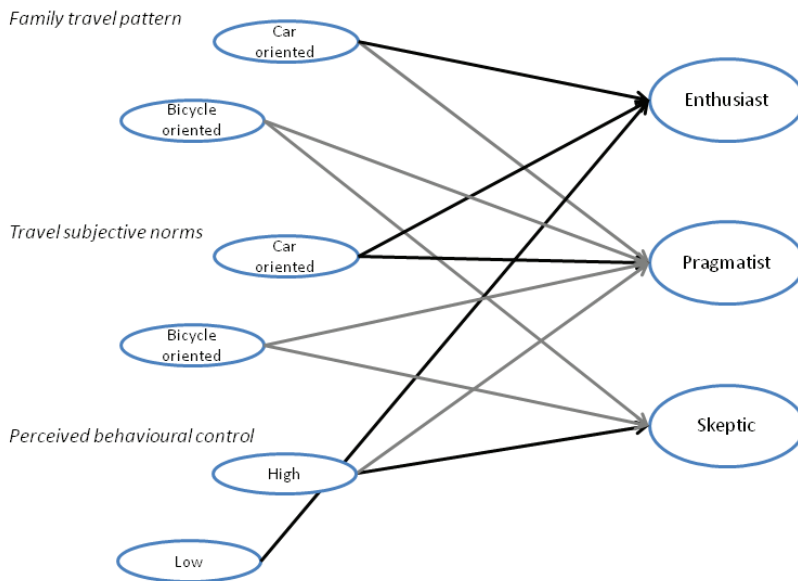
9.2 Appendix 2. Intrapersonal domain

The intrapersonal domain includes individual behaviour, attitudes, self-concepts, perceptions, and developmental history. In this study, the analysis defined several sub-themes of importance, including instrumental, symbolic, affective and relational value associated with having a driver's license and car ownership (e.g. Steg, 2005), travel-related attitudes and experience, general interest in cars and environmental concern.
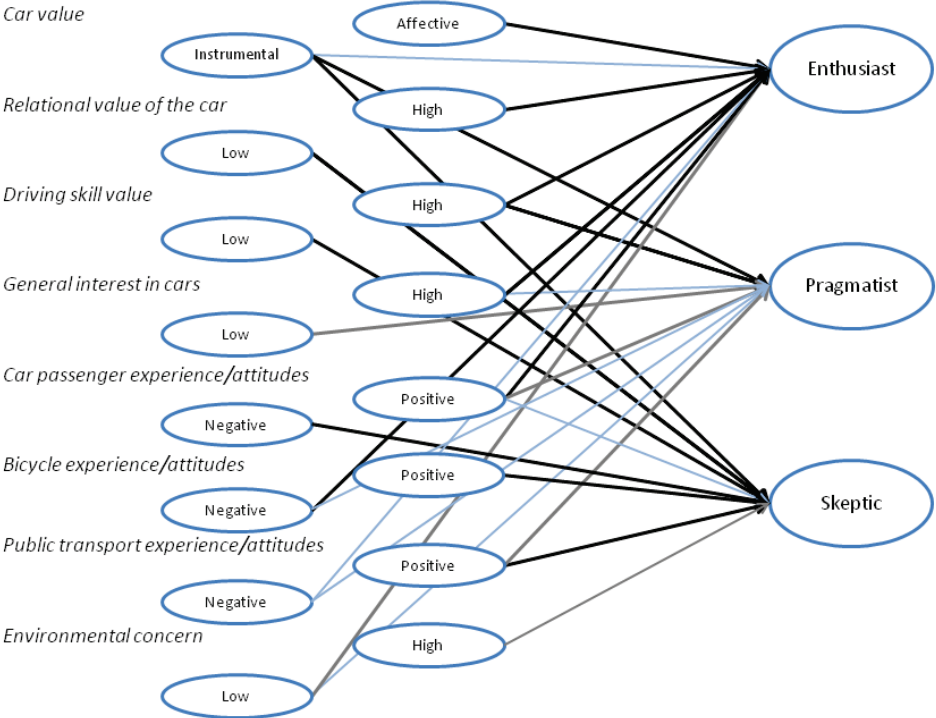
9.3 Appendix 3. Community domain

The community represents the individuals' geographical and social network. In this study, the term community included the individuals' representation and sense of community and sense of expected social roles. Here the adolescents' perceived mobility necessity of obtaining licence and owning a car and the relevance of these events as mobility-related life script events was scrutinized. The three factors within this domain support the concept of mobility biographies as a mediating mobility change.

Community domain

License as a life-script event
Positive
Negative

Car related to life-script events
Near
Distant

Perceived transport provision in future
Poor
Good

Enthusiast
Pragmatist
Skeptic
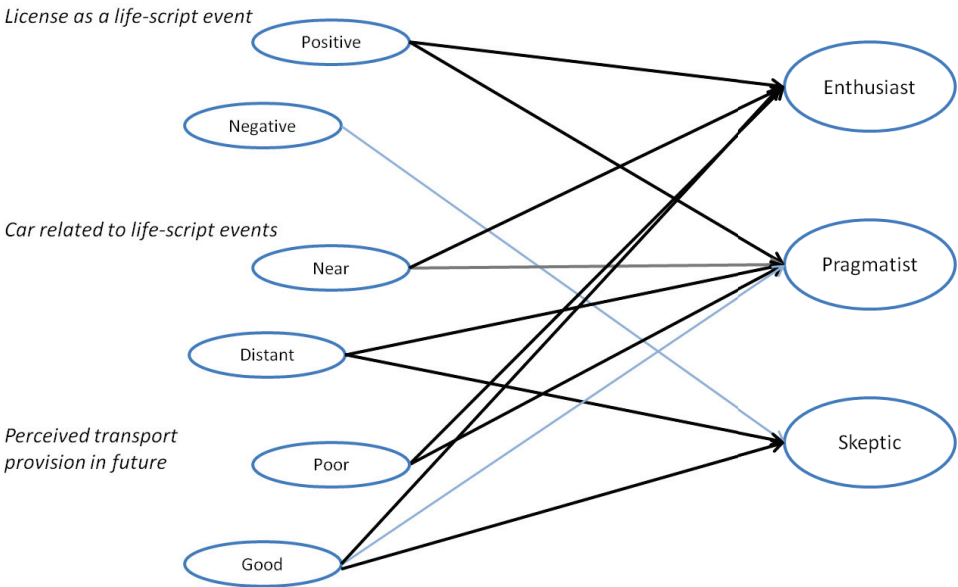
Figure 1.

9.4 Appendix 4. Policy domain

The policy domain refers to the use of policy measures for promoting behavioural change. In this study, the policy domain was investigated from the individual perspective, i.e. the focus was on the perceived environmental efficacy and the effect of car restrictions on the individual's quality of life. These factors bear resemblance with the self-efficacy concept from SCT (Bandura, 1989), with an abstract evaluation of both personal efficacy and of the external factors influencing one's own ability to perform the behaviour.

Policy domain
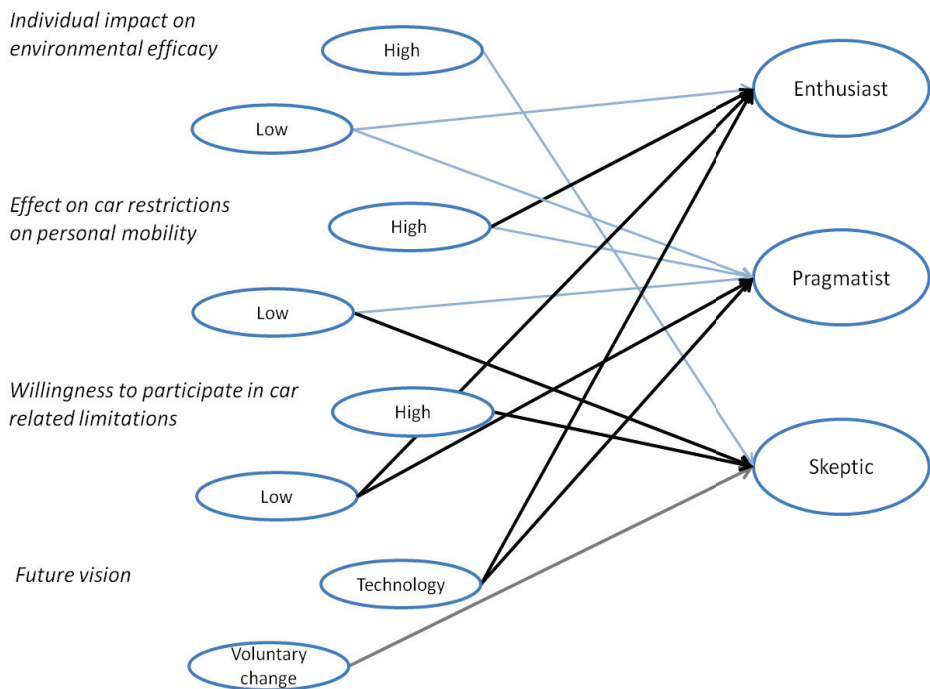
9.5 Appendix 5. Institutional domain

The institutional domain includes the role of organizations or institutions in supporting and promoting behavioural trends and changes. In this study, the considered organizational entities were the media, school programs and government campaigns. In addition, these institutes reflect the school and media agents in Baslington's travel socialization theory (2008).

Institutional domain

Car-oriented influence of media

Influence of bike-to-school campaigns

Influence of environmental school programs
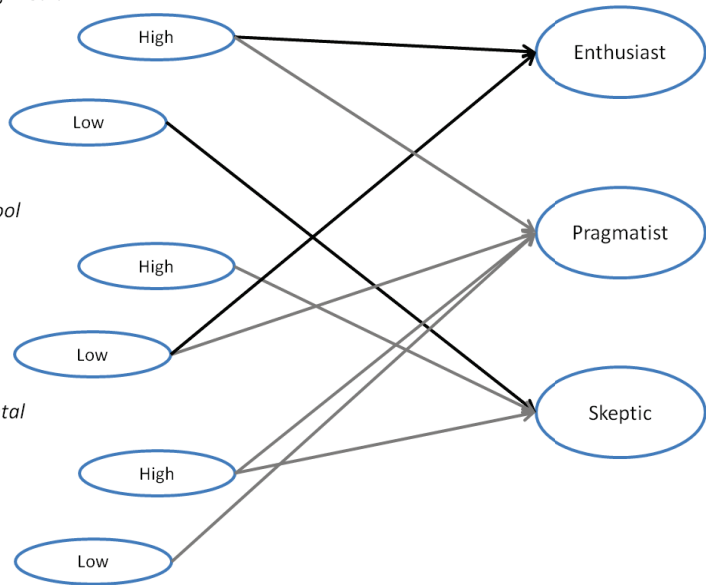
9.6   Appendix 6. Survey questionnaire

1. **Angiv dit køn:**
   a)   Kvinde
   b)   Mand

2. **Angiv postnummer, hvor du bor**

3. **Hvordan er adgangen til følgende, der hvor du bor?**

		Meget dårlig	Dårlig	Hverken eller	God	Meget god
a)	Til offentlige transportmidler	❏	❏	❏	❏	❏
b)	Til gangstier	❏	❏	❏	❏	❏
c)	Til cykelstier	❏	❏	❏	❏	❏

4. **Hvad lægger du vægt på i din daglige transport?**

		Slet ikke vigtigt	Ikke vigtigt	Hverken eller	Vigtigt	Meget vigtigt
a)	At rejsemåden er afslappet	❏	❏	❏	❏	❏
b)	At rejsemåden er sikker	❏	❏	❏	❏	❏
c)	At rejsemåden er pålidelig	❏	❏	❏	❏	❏
d)	At rejsemåden giver dig personlig frihed	❏	❏	❏	❏	❏
e)	At rejsemåden giver dig selvstændighed	❏	❏	❏	❏	❏
f)	At rejsemåden sparer dig tid	❏	❏	❏	❏	❏
g)	At rejseomkostningerne er rimelige	❏	❏	❏	❏	❏
h)	At rejsemåden er spændende	❏	❏	❏	❏	❏
i)	At rejsemåden er fornøjelig	❏	❏	❏	❏	❏
j)	At rejsemåden er sund for dit helbred	❏	❏	❏	❏	❏
k)	At rejsemåden giver dig mulighed for at være social	❏	❏	❏	❏	❏
l)	At rejsemåden giver dig mulighed for at være privat	❏	❏	❏	❏	❏
m)	At rejsemåden giver dig mulighed for at foretage dig andre ting undervejs	❏	❏	❏	❏	❏
n)	At rejsemåden er miljøvenlig	❏	❏	❏	❏	❏

5. **Hvad lægger du vægt på, når du foretager lange rejser?**

		Slet ikke vigtigt	Ikke vigtigt	Hverken eller	Vigtigt	Meget vigtigt
a)	At rejsemåden er afslappet	❏	❏	❏	❏	❏
b)	At rejsemåden er sikker	❏	❏	❏	❏	❏
c)	At rejsemåden er pålidelig	❏	❏	❏	❏	❏
d)	At rejsemåden giver dig personlig frihed	❏	❏	❏	❏	❏
e)	At rejsemåden giver dig selvstændighed	❏	❏	❏	❏	❏
f)	At rejsemåden sparer dig tid	❏	❏	❏	❏	❏
g)	At rejseomkostningerne er rimelige	❏	❏	❏	❏	❏
h)	At rejsemåden er spændende	❏	❏	❏	❏	❏
i)	At rejsemåden er fornøjelig	❏	❏	❏	❏	❏
j)	At rejsemåden er sund for dit helbred	❏	❏	❏	❏	❏
k)	At rejsemåden giver dig mulighed for at	❏	❏	❏	❏	❏

	Meget uenig	Uenig	Hverken eller	Enig	Meget enig
	være social				
l) At rejsemåden giver dig mulighed for at være privat	❏	❏	❏	❏	❏
m) At rejsemåden giver dig mulighed for at foretage dig andre ting undervejs	❏	❏	❏	❏	❏
n) At rejsemåden er miljøvenlig	❏	❏	❏	❏	❏

6. De næste spørgsmål handler om dine holdninger til personbiler. Tænk på dine daglige rejser og sæt kryds ved den valgmulighed der passer bedst til din holdning.

	Meget uenig	Uenig	Hverken eller	Enig	Meget enig	Ikke relevant
a) Jeg kan godt lide at køre i bil til daglig (som passager)	❏	❏	❏	❏	❏	❏
b) Jeg kommer hurtigere frem i bil end med andre transportmidler til mine daglige gøremål	❏	❏	❏	❏	❏	❏
c) Det er nemmest for mig at blive kørt i bil til de steder, jeg skal til	❏	❏	❏	❏	❏	❏
d) Det er stressende at køre i bil i myldretiden	❏	❏	❏	❏	❏	❏
e) Jeg interesserer mig for biler	❏	❏	❏	❏	❏	❏
f) Jeg betragter bilen som en del af den moderne livsstil	❏	❏	❏	❏	❏	❏
g) Jeg ville bruge bilen mindre, hvis adgangen til offentlige transportmidler var bedre	❏	❏	❏	❏	❏	❏
h) Jeg forbinder bilen med personlig frihed	❏	❏	❏	❏	❏	❏
i) Jeg forbinder bilen med forurening, trafikpropper og støj i byerne	❏	❏	❏	❏	❏	❏
j) Ved at begrænse bilkørsel i byerne ville livskvaliteten i byerne forbedres	❏	❏	❏	❏	❏	❏
k) At eje bil giver familier muligheden til at være sammen mere	❏	❏	❏	❏	❏	❏

7. De næste spørgsmål handler om dine holdninger til offentlige transportmidler. Tænk på dine daglige rejser og sæt kryds ved den valgmulighed der passer bedst til din holdning.

	Meget uenig	Uenig	Hverken eller	Enig	Meget enig	Ikke relevant
a) Jeg kan godt lide at benytte offentlige transportmidler til dagligt	❏	❏	❏	❏	❏	❏
b) Jeg kommer hurtigere frem med offentlige transportmidler end med andre transportmidler til mine daglige gøremål	❏	❏	❏	❏	❏	❏
c) Jeg bruger offentlige transportmidler, fordi det er nemmest for mig	❏	❏	❏	❏	❏	❏
d) Det er stressende at køre med offentlige transportmidler i myldretiden	❏	❏	❏	❏	❏	❏
e) Jeg oplever, at mit privatliv bliver begrænset, når jeg bruger offentlige transportmidler	❏	❏	❏	❏	❏	❏
f) Jeg lader ikke dårligt vejr afholde mig fra at bruge offentlige transportmidler	❏	❏	❏	❏	❏	❏
g) Jeg betragter offentlig transport som en del af den moderne livsstil	❏	❏	❏	❏	❏	❏
h) Jeg ville benytte mig mere af offentlige transportmidler, hvis det var gratis for mig	❏	❏	❏	❏	❏	❏

		Meget uenig	Uenig	Hverken eller	Enig	Meget enig	Ikke relevant
i)	Jeg ville benytte mig mere af offentlige transportmidler, hvis adgangen til dem var bedre	❏	❏	❏	❏	❏	❏
j)	Jeg forbinder offentlig transport med personlig frihed	❏	❏	❏	❏	❏	❏
k)	Jeg forbinder busser med forurening, trafikpropper og støj i byerne	❏	❏	❏	❏	❏	❏
l)	Ved at forbedre offentlig transport i byerne ville livskvaliteten i byerne forbedres	❏	❏	❏	❏	❏	❏
m)	At køre med offentlig transport giver familier muligheden til at være sammen mere	❏	❏	❏	❏	❏	❏

8. De næste spørgsmål handler om dine holdninger til cykler og til at gå. Tænk på dine daglige rejser og sæt kryds ved den valgmulighed der passer bedst til din holdning.

		Meget uenig	Uenig	Hverken eller	Enig	Meget enig	Ikke relevant
a)	Jeg kan godt lide at cykle til daglig	❏	❏	❏	❏	❏	❏
b)	Jeg kommer hurtigere frem på cykel end med andre transportmidler til mine daglige gøremål	❏	❏	❏	❏	❏	❏
c)	Når jeg cykler, er det, fordi det er nemmest for mig	❏	❏	❏	❏	❏	❏
d)	Jeg ville cykle mere, hvis adgangen til sikre cykelstier var bedre	❏	❏	❏	❏	❏	❏
e)	Det er stressende at cykle i myldretiden	❏	❏	❏	❏	❏	❏
f)	Jeg lader ikke dårligt vejr afholde mig fra at cykle	❏	❏	❏	❏	❏	❏
g)	Jeg kan godt lide at gå til daglig	❏	❏	❏	❏	❏	❏
h)	Når jeg går, er det, fordi det er den nemmeste måde at nå frem til destinationen	❏	❏	❏	❏	❏	❏
i)	At cykle og gå giver mig personlig frihed	❏	❏	❏	❏	❏	❏
j)	Når jeg cykler eller går til daglig, prøver jeg at benytte rejsen til at motionere	❏	❏	❏	❏	❏	❏
k)	Hvis flere cyklede i byerne i stedet for at køre, ville livskvaliteten i byerne forbedres	❏	❏	❏	❏	❏	❏

9. De næste spørgsmål handler om dine holdninger til knallerter. Tænk på dine daglige rejser og sæt kryds ved den valgmulighed der passer bedst til din holdning.

		Meget uenig	Uenig	Hverken eller	Enig	Meget enig	Ikke relevant
a)	Jeg kan godt lide at køre med knallert til daglig	❏	❏	❏	❏	❏	❏
b)	Jeg føler, at jeg kan komme hurtigere frem på knallert end med andre transportmidler til mine daglige gøremål	❏	❏	❏	❏	❏	❏
c)	Det er stressende at køre på knallert i myldretiden	❏	❏	❏	❏	❏	❏
d)	Jeg ville køre på knallert oftere, hvis adgangen til sikre stier var bedre	❏	❏	❏	❏	❏	❏
e)	Hvis jeg brugte knallert, ville det være fordi det er nemmest for mig til at komme til de steder jeg skal til	❏	❏	❏	❏	❏	❏
f)	Jeg ville ikke lade dårligt vejr afholde mig fra	❏	❏	❏	❏	❏	❏

	at køre på knallert					
g)	Jeg forbinder knallerten med personlig frihed	❑	❑	❑	❑	❑	❑
h)	Jeg interesserer mig for knallerter	❑	❑	❑	❑	❑	❑

10. I hvilken grad vil du mene, at følgende transportmidler er miljøbelastende?

		Slet ikke	I ringe grad	I nogen grad	I høj grad	I meget høj grad
a)	Biler	❑	❑	❑	❑	❑
b)	Busser	❑	❑	❑	❑	❑
c)	Tog	❑	❑	❑	❑	❑
d)	Knallerter	❑	❑	❑	❑	❑
e)	Motorcykler	❑	❑	❑	❑	❑
f)	Fly	❑	❑	❑	❑	❑
g)	Cykler	❑	❑	❑	❑	❑

11. Hvor enig er du i følgende:

		Meget uenig	Uenig	Hverken eller	Enig	Meget enig	Ved ikke	Ikke relevant
a)	Jeg er meget fleksibel, når det drejer sig om at vælge transportmiddel til mine daglige rejser	❑	❑	❑	❑	❑	❑	❑
b)	Jeg bruger stort set den samme transportmiddel til daglig uafhængigt af destinationen	❑	❑	❑	❑	❑	❑	❑
c)	Min familie bruger mere bilen af vane end på grund af behov	❑	❑	❑	❑	❑	❑	❑
d)	Hvis min familie ikke havde bil, ville det genere os meget	❑	❑	❑	❑	❑	❑	❑
e)	Jeg kunne godt klare mig uden bil/uden at blive transporteret i bil i hverdagen	❑	❑	❑	❑	❑	❑	❑

12. Hvem bor du sammen med i den husstand du bor i nu (eller opholder dig mest i)? Kryds ved alle de muligheder der passer.
- a) Mor
- b) Far
- c) Stedmor
- d) Stedfar
- e) Bedstefar
- f) Bedstemor
- g) Værge
- h) Søskende
- i) Andre, hvem?

_____
___

13. Hvor mange over 18 år er der i husstanden?

14. Hvor mange under 18 år er der i husstanden (inklusive dig selv)?

15. Hvor mange i din husstand har kørekort til bil?

16. Hvor mange biler er der til rådighed i din husstand?
a) 0
b) 1
c) 2
d) 3
e) 4
f) 5+

17. Hvor mange i din husstand har knallertbevis og/eller motorcykelkørekort (udover dig)?

18. Har du knallertbevis?
1.	Ja
2.	Nej

19. Hvor mange knallerter og/eller motorcykler er der til rådighed i din husstand?
a) 0
b) 1
c) 2
d) 3
e) 4
f) 5+

20. Har du en brugbar knallert?
    a) Ja
    b) Nej

21. Har du en brugbar cykel?
    a) Ja
    b) Nej

22. Har du månedskort til offentlige transportmidler?
a) Ja
b) Nej

23. Hvem plejer at betale for din transport?
a) Du selv (fx. med din løn eller lommepenge)
b) Forældre/stedforældre/værge
c) Andre

24. Nu er jeg interesseret i at få at vide, hvor tit de voksne i dit hjem bruger forskellige transportmidler til og fra arbejde. Sæt et kryds ved hvert enkelt transportmiddel. Hvis der er en mor/stedmor/kvindelig værge i din husstand, hvor tit benytter denne person følgende transportmidler til og fra arbejde?

	Næsten aldrig/Aldrig	Sjældent	Hverken eller	Ofte	Næsten altid/Altid	Ikke relevant
a) Bil, som chauffør	❏	❏	❏	❏	❏	❏
b) Bil, som passager	❏	❏	❏	❏	❏	❏
c) Offentlige transportmidler	❏	❏	❏	❏	❏	❏
d) Knallert eller motorcykel	❏	❏	❏	❏	❏	❏
e) Cykel	❏	❏	❏	❏	❏	❏
f) Gang	❏	❏	❏	❏	❏	❏

25. Hvis der er en far/stedfar/mandlig værge i din husstand, hvor tit benytter denne person følgende transportmidler til og fra arbejde?

	Næsten aldrig/Aldrig	Sjældent	Hverken eller	Ofte	Næsten altid/Altid	Ikke relevant
a) Bil, som chauffør	❑	❑	❑	❑	❑	❑
b) Bil, som passager	❑	❑	❑	❑	❑	❑
c) Offentlige transportmidler	❑	❑	❑	❑	❑	❑
d) Knallert eller motorcykel	❑	❑	❑	❑	❑	❑
e) Cykel	❑	❑	❑	❑	❑	❑
f) Gang	❑	❑	❑	❑	❑	❑

26. Går du i skole nu?

a) Ja
b) Nej

27. Angiv navnet på den skole, du går på nu:

28. Hvor langt er der fra dit hjem til din skole (i km)?

29. Hvor tit benytter du følgende transportmidler til og fra skole? Venligst sæt et kryds ved hvert transportmiddel.

	Næsten aldrig/Aldrig	Sjældent	Hverken eller	Ofte	Næsten altid/Altid
a) Bil	❑	❑	❑	❑	❑
b) Offentlige transportmidler	❑	❑	❑	❑	❑
c) Knallert	❑	❑	❑	❑	❑
d) Cykel	❑	❑	❑	❑	❑
e) Gang	❑	❑	❑	❑	❑

30. Hvem bestemmer, hvordan du transporterer dig til skole?
a) Du selv
b) Forældre/stedforældre/værge
c) Andre

31. Hvis du hellere ville transportere dig på anden vis til skole, hvilket transportmiddel ville du selv vælge?
a) Bil
b) Offentlig transport
c) Knallert
d) Cykel
e) Gå
f) Andet
g) Jeg er tilfreds med min nuværende transport

32. Deltager du regelmæssigt i fritidsaktiviteter?
a) Ja
b) Nej

33. Beskriv kort hvilke:

34. Hvor tit benytter du følgende transportmidler til og fra fritidsaktiviteter? Venligst sæt et kryds ved hvert transportmiddel.

	Næsten aldrig/Aldrig	Sjældent	Hverken eller	Ofte	Næsten altid/Altid
a) Bil	❑	❑	❑	❑	❑
b) Offentlige transportmidler	❑	❑	❑	❑	❑
c) Knallert	❑	❑	❑	❑	❑
d) Cykel	❑	❑	❑	❑	❑
e) Gang	❑	❑	❑	❑	❑

35. Hvem bestemmer, hvordan du transporterer dig til dine fritidsaktiviteter?
a) Du selv
b) Forældre/stedforældre/værge
c) Andre

36. Hvis du hellere ville transportere dig på anden vis til fritidsaktiviteter hvilket transportmiddel ville du selv vælge?
a) Bil
b) Offentlig transport
c) Knallert
d) Cykel
e) Gå
f) Andet
g) Jeg er tilfreds med min nuværende transport

37. Hvordan vil du helst transportere dig til og fra arbejde i fremtiden?
a) Bil
b) Offentlig transport
c) Knallert
d) Motorcykel
e) Cykel
f) Gå
g) Andet

38. Hvordan vil du helst transportere dig til og fra fritidsaktiviteter i fremtiden?
a) Bil
b) Offentlig transport
c) Knallert
d) Motorcykel
e) Cykel
f) Gå
g) Andet

39. Nu vil jeg bede dig om at sammenligne dine kammeraters transportmønster med dit eget transportmønster.

	Meget mindre end de	Mindre end de	Lige så meget som de	Mere end de	Meget mere end de
a) Du bliver transporteret i bil	❑	❑	❑	❑	❑
b) Du bruger offentlige transportmidler	❑	❑	❑	❑	❑
c) Du bruger knallert	❑	❑	❑	❑	❑
d) Du cykler	❑	❑	❑	❑	❑
e) Du går	❑	❑	❑	❑	❑
f) Du rejser til udlandet	❑	❑	❑	❑	❑

g) Du rejser omkring i Danmark	❏	❏	❏	❏	❏

40. Hvor mange gange i 2010 rejste du til udlandet?

41. Hvor mange gange i 2010 var du på ferierejser i Danmark?

42. Hvor ofte forventer du at rejse til udlandet i 2011?

43. Hvor mange gange forventer du at tage på ferierejser i Danmark i 2011?

44. Hvor enig er du i følgende:

		Meget uenig	Uenig	Hverken eller	Enig	Meget enig	Ved ikke
a)	Det moderne liv kræver, at man kan rejse til alle steder i verden	❏	❏	❏	❏	❏	❏
b)	Alle har ret til at rejse så meget de vil til alle steder i verden	❏	❏	❏	❏	❏	❏
c)	Jeg kan godt lide at rejse til udlandet	❏	❏	❏	❏	❏	❏
d)	Det er en del af ens personlige udvikling at rejse og opleve verden	❏	❏	❏	❏	❏	❏
e)	Man kan nemt holde ferie i Danmark uden bil	❏	❏	❏	❏	❏	❏
f)	Jeg beundrer dem, som rejser meget rundt i verden	❏	❏	❏	❏	❏	❏
g)	Det føles ikke som en rigtig sommerferie uden at man har været i udlandet	❏	❏	❏	❏	❏	❏
h)	Jeg kan godt lide at rejse omkring Danmark	❏	❏	❏	❏	❏	❏

45. Hvis der er en mor/stedmor/kvindelig værge i din husstand, angiv denne persons højeste uddannelse:
a) 9./10. klasse
b) Gymnasium/HF
c) Teknisk skole/Handelsskole
d) Seminarium (lærer eller pædagog)
e) Bachelor på Universitet
f) Kandidat på Universitet
g) Anden uddannelse
h) Ikke relevant

46. Hvis der er en far/stedfar/mandlig værge i din husstand, angiv denne persons højeste uddannelse:
a) 9./10. klasse
b) Gymnasium/HF
c) Teknisk skole/Handelsskole
d) Seminarium (lærer eller pædagog)
e) Bachelor på Universitet
f) Kandidat på Universitet
g) Anden uddannelse
h) Ikke relevant

47. Angiv din egen forventede højeste uddannelse:
a) 9./10. klasse
b) Gymnasium/HF
c) Teknisk skole/Handelsskole

d) Seminarium (lærer eller pædagog)
e) Bachelor på Universitet
f) Kandidat på Universitet
g) Ved ikke
h) Anden uddannelse, skriv hvilken

48. De næste spørgsmål refererer blandt andet til, hvordan du nu tror, det vil være at køre selv. (Mobilitet refererer til dit eget transportmønster. Hvordan du plejer at transportere dig mellem forskellige geografiske steder). Hvor enig er du i følgende:

	Meget uenig	Uenig	Hverken uenig eller enig	Enig	Meget enig
a) Jeg tror, jeg vil blive en god bilist	❏	❏	❏	❏	❏
b) Jeg tror, det vil være svært for mig at bestå køreprøven	❏	❏	❏	❏	❏
c) Jeg tror, det vil være stressende at køre selv	❏	❏	❏	❏	❏
d) Jeg tror, det bliver fornøjeligt at køre selv	❏	❏	❏	❏	❏
e) Jeg tror, det vil være farligt for mig at køre selv	❏	❏	❏	❏	❏
f) Jeg tror, udgifterne til kørekortet vil forhindre mig i at tage det	❏	❏	❏	❏	❏
g) Jeg tror, det vil give mig øget personlig frihed at køre selv	❏	❏	❏	❏	❏
h) Jeg tror, det vil blive nemmere at komme rundt til daglig, når man kan køre selv	❏	❏	❏	❏	❏
i) Jeg synes, det er vigtigt at have kørekort, selvom jeg muligvis ikke kommer til at køre ret meget til daglig	❏	❏	❏	❏	❏
j) Hvis jeg i fremtiden kun brugte offentlige transportmidler til daglig, ville jeg føle, at det ville begrænse min mobilitet	❏	❏	❏	❏	❏
k) At få sin egen bil er et led i at blive voksen	❏	❏	❏	❏	❏
l) Samfundet forventer, at man har kørekort, når man er voksen	❏	❏	❏	❏	❏
m) Hverdagens travlhed gør det besværligt for børnefamilier ikke at have bil	❏	❏	❏	❏	❏
n) De fleste af mine venner forventer at tage kørekort	❏	❏	❏	❏	❏
o) Folk, som betyder meget for mig, synes, jeg skal tage kørekort	❏	❏	❏	❏	❏
p) Folk, som betyder meget for mig, ville støtte mig, hvis jeg besluttede ikke at tage kørekort	❏	❏	❏	❏	❏

49. I hvilken grad forventer du at:

	Slet ikke	I ringe grad	I nogen grad	I høj grad	I meget høj grad
a) Tage kørekort til bil	❏	❏	❏	❏	❏
b) Tage knallertbevis	❏	❏	❏	❏	❏
c) Eje en bil i fremtiden	❏	❏	❏	❏	❏

50. Hvor tit gør du følgende:

	Næsten aldrig	Sjældent	Hverken eller	Ofte	Næsten altid
a) Vælger økologiske produkter	❏	❏	❏	❏	❏

	Meget uenig	Uenig	Hverken eller	Enig	Meget enig
b) Sorterer dit affald	❏	❏	❏	❏	❏
c) Sparer på vand (fx når du tager bad)	❏	❏	❏	❏	❏
d) Sparer på strøm (fx slukker lyset og fjernsynet, når du forlader dit værelse)	❏	❏	❏	❏	❏
e) Vælger miljøvenlige transportmidler	❏	❏	❏	❏	❏
f) Går op i dyrevelfærd	❏	❏	❏	❏	❏
g) Køber genbrugsvarer	❏	❏	❏	❏	❏
h) Genbruger selv	❏	❏	❏	❏	❏

51. Hvor enig er du i følgende:

	Meget uenig	Uenig	Hverken eller	Enig	Meget enig
a) Jeg er bekymret for miljøet	❏	❏	❏	❏	❏
b) Bekymringerne om klimaændringerne er overdrevne	❏	❏	❏	❏	❏
c) Det føles godt at opføre sig miljøansvarligt	❏	❏	❏	❏	❏
d) Jeg vil helst vælge miljøvenlige transportmidler til mine daglige rejser	❏	❏	❏	❏	❏
e) Jeg føler, at mit bidrag er vigtigt, når jeg opfører mig miljøansvarligt	❏	❏	❏	❏	❏
f) Jeg tror ikke, at min adfærd ændrer noget i forhold til klimaændringerne	❏	❏	❏	❏	❏
g) Jeg kan forklare andre, hvad klimaændringerne handler om	❏	❏	❏	❏	❏
h) Mit kendskab til klimaændringerne påvirker mit valg af transportmiddel	❏	❏	❏	❏	❏
i) Hjemme hos mig opfører vi os miljøvenlige	❏	❏	❏	❏	❏
j) Min skole opfordrer til miljøansvarlig adfærd	❏	❏	❏	❏	❏
k) Mine venner går op i miljøansvarlighed	❏	❏	❏	❏	❏
l) Informationer fra forskellige medier har påvirket mig til at opføre mig mere miljøansvarligt	❏	❏	❏	❏	❏

52. Hvor alvorligt tror du, at følgende er i Danmark:

	Slet ikke alvorligt	Lidt alvorligt	Alvorligt	Meget alvorligt
a) Luftforurening	❏	❏	❏	❏
b) Vandforurening	❏	❏	❏	❏
c) Overbefolkning	❏	❏	❏	❏
d) Skovrydning	❏	❏	❏	❏
e) Global opvarmning	❏	❏	❏	❏
f) Jordforurening	❏	❏	❏	❏

53. Hvor alvorligt tror du, at følgende er i verden:

	Slet ikke alvorligt	Lidt alvorligt	Alvorligt	Meget alvorligt
a) Luftforurening	❏	❏	❏	❏
b) Vandforurening	❏	❏	❏	❏
c) Overbefolkning	❏	❏	❏	❏
d) Skovrydning	❏	❏	❏	❏
e) Global opvarmning	❏	❏	❏	❏
f) Jordforurening	❏	❏	❏	❏

54. I hvilket omfang føler du, at du er medskyldig i miljøproblemerne

	Slet ikke	I ringe grad	I nogen grad	I høj grad	I meget høj grad
a) I Danmark	❏	❏	❏	❏	❏
b) I verden	❏	❏	❏	❏	❏

55. Hvor vigtige er følgende værdier for dig som grundholdning i dit liv? Sæt et kryds i hver linje.

	Slet ikke vigtigt	Ikke vigtigt	Hverken eller	Vigtigt	Meget vigtigt
a) At have et spændende liv (et liv med stimulerende oplevelser)	❏	❏	❏	❏	❏
b) At have et varieret liv (et liv med udfordringer og forandringer)	❏	❏	❏	❏	❏
c) At være nysgerrig (udforske)	❏	❏	❏	❏	❏
d) At udvise selvdisciplin (modstå fristelser)	❏	❏	❏	❏	❏
e) At have tryghed og stabilitet i livet (sikkerhed)	❏	❏	❏	❏	❏
f) At vise respekt for traditioner	❏	❏	❏	❏	❏
g) At være rig (eje materielle ting)	❏	❏	❏	❏	❏
h) At have et fornøjeligt liv (lave sjove ting)	❏	❏	❏	❏	❏
i) At opnå succes (nå dine mål)	❏	❏	❏	❏	❏
j) At beskytte miljøet (bevare miljøet)	❏	❏	❏	❏	❏
k) At samfundet er retfærdigt (rette op på uretfærdigheder)	❏	❏	❏	❏	❏

56. Hvis alle var enige om, at det var nødvendigt at reducere personlig bilkørsel for at bekæmpe klimaændringerne, hvor villig ville du være til at acceptere følgende:

	Slet ikke acceptabelt	Ikke acceptabelt	Hverken eller	Acceptabelt	Meget acceptabelt
a) At du først kunne tage kørekort når du er 21 år	❏	❏	❏	❏	❏
b) At hastighedsgrænsen på motorvejene blev sænket til 90 km i timen	❏	❏	❏	❏	❏
c) At kun el-biler måtte køre i byerne	❏	❏	❏	❏	❏
d) At det blev lovbestemt, at alle borgere fik tildelt en drivhusgaskvote og måtte købe supplerende kvote i tilfælde af overskridelse	❏	❏	❏	❏	❏
e) At al bilkørsel blev forbudt i byerne	❏	❏	❏	❏	❏
f) At flyverejser blev begrænset til et bestemt antal kilometer pr. person pr. år	❏	❏	❏	❏	❏
g) At bilrejser blev begrænset til et bestemt antal kilometer pr. person pr. år	❏	❏	❏	❏	❏
h) At der blev indført strengere krav til hvem, der måtte tage kørekort	❏	❏	❏	❏	❏
i) At du i højere grad skulle bruge offentlige transportmidler i stedet for bil	❏	❏	❏	❏	❏
j) At der blev opkrævet vejafgifter på motorvejene	❏	❏	❏	❏	❏
k) At priser på benzin, dieselolie og personbiler blev forhøjet	❏	❏	❏	❏	❏
l) At biler kun måtte ejes i fællesskab, således at man måtte bestille en bil, når man havde brug for den (delebilordning)	❏	❏	❏	❏	❏

57. Hvis privat bilkørsel bliver begrænset i fremtiden hvor sandsynligt tror du, at de begrænsninger som tidligere er nævnt, ville påvirke:

	Slet ikke	Ikke	Hverken	Sandsynligt	Meget

		sandsynligt	sandsynligt	eller		sandsynligt
a)	Din mobilitet	❏	❏	❏	❏	❏
b)	Din livskvalitet	❏	❏	❏	❏	❏

58. Tænk på din fremtidige tilværelse når du er blevet voksen og har et arbejde. Hvor sandsynligt tror du, at følgende bliver:

		Slet ikke sandsynligt	Ikke sandsynligt	Hverken eller	Sandsynligt	Meget sandsynligt
a)	At det bliver gratis for alle elever, lærlinge og studerende at bruge offentlige transportmidler, for at få flere til at bruge disse	❏	❏	❏	❏	❏
b)	Fremtiden vil byde på teknologiske løsninger af klimaproblemerne, så det ikke vil blive nødvendigt for mig at reducere min bilkørsel	❏	❏	❏	❏	❏
c)	Trafiktætheden i byerne bliver værre på grund af flere biler	❏	❏	❏	❏	❏
d)	Luftforureningen bliver til et større sundhedsproblem i byerne	❏	❏	❏	❏	❏
e)	Offentlige transportmidler bliver forbedret og lettere tilgængelige	❏	❏	❏	❏	❏
f)	Jeg bliver mere miljøbevidst og tænker i højere grad på andre transportmuligheder end privatbilen til mine rejser	❏	❏	❏	❏	❏
g)	Effekten af den globale opvarmning bliver et større problem	❏	❏	❏	❏	❏
h)	Det bliver den danske regering ansvar at beslutte, hvilke metoder der skal anvendes i Danmark for at løse de miljømæssige problemer, som bilkørslen skaber	❏	❏	❏	❏	❏
i)	Det bliver EU´s ansvar at beslutte, hvilke metoder der skal anvendes i Danmark for at løse de miljømæssige problemer, som bilkørslen skaber	❏	❏	❏	❏	❏
j)	Alle får lov til at køre et ubegrænset antal kilometer i fremtiden uden restriktioner	❏	❏	❏	❏	❏
k)	Bilkørsel bliver forbudt i byerne	❏	❏	❏	❏	❏
l)	Kun el-biler bliver tilladt i Danmark	❏	❏	❏	❏	❏
m)	Flere vælger at cykle til daglig	❏	❏	❏	❏	❏
n)	Forholdene for cyklister bliver bedre	❏	❏	❏	❏	❏
o)	Offentlig transport bliver trendy	❏	❏	❏	❏	❏
p)	Det bliver betragtet som mangel på miljøansvarlighed at køre i bil i stedet for at benytte mere miljøvenlig transport	❏	❏	❏	❏	❏

59. Hvis du har bemærkninger til spørgeskemaet eller til dine svar, kan du anføre dine kommentarer her:

Til sidst vil jeg bede dig anføre din e-mail adresse, hvis du har lyst til at deltage i lodtrækningen om et af ti gavekort til iTunes Store til en værdi af 150 kr. Vinderne får gavekortet tilsendt via e-mail kort efter undersøgelsens afslutning. Din e-mail adresse bliver adskilt fra dine svar for at sikre din anonymitet.

9.7 Appendix 7. Interview guide

Interview–15 guide		
Tema:		**Emne:**
DEMOGRAPHY/SITUATION		Bopæl, område (by/land)
		Familiesituation
		Transportmidler i husstanden (bil, cykel, knallert etc.)
		Hvad laver de (skole type)
AKTUEL DAGLIG TRANSPORT		<u>Fx til skole, arbejde og fritidsaktiviteter</u>
1)	Dem selv	Hvilke aktiviteter, hvor langt, faste aftaler…
2)	Familie	Hvilke transportmidler bliver brugt og årsagerne hvorfor (hvad påvirker beslutningen og hvem tager beslutningen).
3)	Venner	Hvad synes de om deres nuværende transport (tilfredse, vane, eller har de lyst til at ændre noget til dagligt)
AKTUEL LÆNGERE TRANSPORT		<u>Fx sommerferie, udflugt, lange rejser</u>
1)	Dem selv	Hvilke transportmidler bliver brugt og årsagerne hvorfor (hvad påvirker beslutningen og hvem tager beslutningen).
2)	Familie	Hvad synes de om deres nuværende transport (tilfredse, vane, eller har de lyst til at ændre noget til dagligt)
TIDLIGERE DAGLIG TRANSPORT		Fx <u>Børnehave</u>, skole, fritidsaktiviteter, venner, familie etc.
1)	Dem selv	Ændringer i rejsevaner, hvad skyldes det (alder, afstand, økonomi etc.)
2)	Familie	Hvad betyder disse ændringer for dem selv og for familien
3)	Venner	Er der lyst til at bruge andre muligheder
		<u>Gode og dårlige minder med familie/venner</u>
		Alle transportmidler, især biler (både til dagligt og lange rejser)
		<u>Udviklingsmæssigt</u>
		Vane, fleksibilitet, selvstændighed, livstil
		Selvstændigt mobilitetsmønster (hos de unge og søskende, ligner deres rejsevaner, har forældrene opfodret dem forskelligt).
		Bliver hentet/bragt til dagligt, fester etc.
		Rejsevaner hos venner og brug af transport med venner (PT, cykler, fremtidsbrug af bil)
HOLDNING		<u>Alle transportmidler</u>
1)	Dem selv	Holdning, interesser, livsstil
2)	Familie	Erfaring, oplevelse, årsager

		Hvad betyder bilen/offentlige transportmidler for en/familien/venner
3)	Venner	(normalt, luksus, nødvendigt…)
INTENTIONER		Kørekort
1)	Dem selv	Har du planer om at tage kørekortet i fremtiden?
2)	Familie	Hvornår vil du helst tage det?
3)	Venner	Hvorfor er det vigtigt for dig?
		Er det noget der står i vejen for at du kan tage det?
		Fordele og ulemper
		Eje bil
		Har du planer om at eje din egen bil i fremtiden
		Hvorfor ville det være vigtigt for dig?
		Er det noget der kunne stå i vejen for at du kunne eje en bil?
		Fordele og ulemper
		Andre muligheder (delebil, taxa, leje bil…)
		Socialisation
		Har du søskende der har kørekort? Hvad tror du at har påvirket deres beslutning?
		Nærmeste venners planer/diskussioner
		Diskussioner/deltagelse i familiens beslutninger ang. transport
		Økonomi og kendskab til drift og priser
		Eget transport behøv i fremtiden og livssituation
		Betyder det meget hvilken slags bil man kører?
		Samfundets rolle/pres/livstil
MEDIA		Film, reklamer, dokumentar, top gear…
		Påvirket af media - hvad kan du huske?
		Er det realistisk billede som medierne viser?
		Hvilken slags bil har du lyst til at eje? Hvorfor?
MILJØBEVIDSTHED		Miljøbevidsthed, adfærd, holdning, kendskab
1)	Dem selv	Kendskab om klimaændringer/den globale opvarmning/miljøbevidsthed
2)	Familie	Tror du at din adfærd gør en forskel?
3)	Venner	Hvor har du fået din viden om det fra?
4)	Andre	Har transport betydning for miljø, tænker de på det
		Har det påvirket dine tanker om bilen?
		Har det påvirket din adfærd/beslutninger om transportmåde til dine rejser?
		Socialisation
		Adfærd og holdninger i familien, venner, samfundet, skole, media

SKOLE	
	Skolens rolle, indvirkning
	Aktiv transport, kampagner,
	Undervisning om miljø
FREMTIDENS TRANSPORT	Deres eget liv, samfundet generelt (om et par år + om 10-20 år)
	Hvordan forestiller de sig at transporten generelt vil være
	Hvordan forestiller de egen transport i fremtiden (mere/mindre
	Hvilke transportmidler, hvilke behov begrund)
	Virtuel mobilitet
WILLINGNESS	I forhold til klimaproblemer og transport
	Hvad kunne der gøres i kampen mod klimaændringer/mindske forurening/mindske trafikken på vejene
	Hvem skal tage disse beslutninger (folket selv, kommunen, regeringen, EU)
	Hvad ville der tage til at få dig til at bruge bilen mindre
MOBILITET & LIVSKVALITAET	I fremtiden som voksen
	Hvad vil det betyde for dig hvis du ikke fik taget kørekortet?
	Hvad vil det betyde for dig hvis du ikke ville eje en bil?

10 The papers

Declaration of conflicting interests:

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of the articles.

Paper 1

Gender differences in the travel behaviour of adolescents and young adults in Denmark

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Abstract

This study explores longitudinal trends in the travel behaviour of adolescents and young adults in Denmark in terms of mode choice (i.e., car, public transport, bicycle, walk), kilometres travelled, travel time, number of trips, and driving license holding. The analysis explores gender differences in travel behaviour for four age groups: adolescents (15-19), young adults in their early twenties (20-24), young adults in their late twenties (25-29) and young adults in their early thirties (30-34). The data are obtained from the Danish National Travel Survey (TU) between the years 1995 and 2009. The results suggest that in Denmark, in cases where there is a gender-related gap in transport behaviour, the gap progresses across age groups and is different for rural and urban areas. Regarding the number of trips and the proportion of trips by purpose, the gap is greater for the older age groups and is more pronounced in rural areas. Regarding the travel distance, the gap over time diminished more rapidly in rural than in urban areas, and currently the gap is significant only for the oldest age group in urban areas. Regarding the trip proportion by mode, the difference is more pronounced in rural areas, and it diminishes with the lifecycle progression.

1. Introduction

Gender equity is considered as a fundamental value of the European Union that is essential for continuing growth (European Institute for Gender Equality, 2013). Within this framework, monitoring the gender gap in travel across time is important in understanding the ability of men and female to equally benefit from transport provision. On the one hand, transport provision facilitates economic growth and social participation and increases the opportunity space for employment, networking and leisure. On the other hand, transport is associated with the relatively high burden of monetary costs and time depletion at the individual level, and negative environmental and health externalities at the societal level (Jones and Lucas, 2012). The existence of a gap between the travel patterns of men and female has been established by extensive research since the late 1970's, and while the gender gap is decreasing with respect to automobile use and miles travelled due to a higher involvement of female in the workforce (Rosenbloom, 2006), gender differences persist. Female still have shorter commuting distances (Crane, 2007) and engage in extensive child chauffeuring with respect to men (Yarlagadda and Srinivasan, 2008; Scheiner and Holz-Rau, 2012; Siren and Haustein, 2013). On the bright side, female are more inclined to use sustainable transport modes relative to men (Polk, 2003).

This study analyses the gap in the travel of young men and female in urban and rural areas. In particular, this study provides information regarding two key research issues recently raised by Rosenbloom (2006). The first question concerns expanding the knowledge about the gender gap in the travel patterns of young adults. The importance of this question is twofold. Firstly, changing societal trends towards higher involvement of female in the workforce, the widespread phenomenon of dual-earner and dual-career households, and changes in household composition

induce changes in the travel of today's young female in comparison with previous decades (Rosenbloom, 2006). Secondly, studies have shown that while in some countries car dependence is growing, in many OECD countries 'generation Y' sets new trends in reducing car travel and dependency, and increasing multi-modality and the use of sustainable modes (Kuhnimhof et al., 2012; Sivak and Schoettle, 2012; Frändberg and Vilhelmson, 2011). These trends may have an important impact on female's travel patterns and the gender travel gap in terms of individual benefits and societal impact. This study focuses on investigating whether the gender gap related to the role of female as workers and household members with respect to the task allocation in the household, or is already formed in the transition from adolescence to adulthood. The question is raised because while for adults travel gender differences persist despite converging trends in male and female travel, for children travel the evidence is inconclusive, for example with respect to active modes to school (McDonald, 2012). The second question concerns identifying gender differences in travel associated with land use and community designs with different transport options. In the current study, the question concerns the gender gap in travel opportunities and burden in rural versus urban areas. Differentiating between urban and rural areas in the analysis of gender-related gap in travel trends is important because of the long-term interest in rural accessibility and mobility, in particular with respect to disadvantaged population groups due to deeper social inequalities (Nutley, 2005). To answer these questions, the current study explores longitudinal trends in the travel behaviour of adolescents and young adults in Denmark, which along with Sweden and Finland scores the highest on the Gender Equality Index among 27 European Union member states (European Institute for Gender Equality, 2013). While much of the previous research on the gender gap in travel focused on highly car-oriented nations such as the United States (e.g., Hanson and Johnston, 1985; Gordon et al., 1989; Rosenbloom, 2006; Crane, 2007), exploring the gender travel gap in Scandinavia can serve as an outer-marker for reducing the gap between males and females while also promoting sustainable transport (Carlsson-Kanyama and Lindén, 1999; Polk, 2003). The investigated travel trends are car accessibility and driver's license holding, daily trips, daily travel distance and time, mode choice, trip purpose and the commuting time and distance. The analysis explores gender differences in travel behaviour for four age groups: adolescents (15-19), young adults in their early twenties (20-24), young adults in their late twenties (25-29) and young adults in their early thirties (30-34). These groups allow observing the changes in the gender gap related to travel behaviour in the transition from adolescence to adulthood. The Danish Rural Development Index (RDI) served to differentiate rural from urban areas. The travel data are obtained from the Danish National Travel Survey between the years 1994 and 2012.

2. Data

The data source for the analysis is the Danish National Travel Survey (Transportvaneundersøgelsen - TU). The survey is conducted on a yearly basis from 1992 (apart from a short discontinuation between the years 2004 and 2006) and consists of 24-hour travel diaries collected from a

representative sample of the Danish population between 10 and 84 years of age. The travel diary, completed on a randomly assigned day, elicits information regarding activity purpose, location and duration, and the trip description includes primary and secondary trip purposes, joint versus solo trips, intermediate stops, travel modes, travel distance and in-vehicle and out-of-vehicle travel time. The diary is accompanied by questions regarding socio-demographical and socio-economical information such as age, gender, education, employment status, income, household structure (i.e., residence with parents, marital status and the presence of children in the household), residential location, driver's license holding and car ownership. Christensen (2013) provides a detailed description of the survey.

The current study focuses on adolescents and young adults and therefore the sample includes only respondents between 15 and 34 years of age. The considered travel modes are cars, motorcycles, public transport (including buses and trains), bicycle and walk. The trip purposes are aggregated to mandatory activities, shopping activities, escort activities and other non-mandatory activities. Trips by air and maritime transport and by heavy vehicles are not considered because of the interest in land-transport trips conducted by non-professional drivers. The sample size, after excluding non-relevant trips, outlier records, and records with missing values included between 2,200-4,800 observations per year representing around 110,000-120,000 young adults per year. The number of yearly trips in the sample ranges between 7,400 and 16,100 trips representing between 3,677,000-4,484,900 yearly trips. The Danish Rural Development Index (RDI) served for differentiating rural from urban communities. The index includes 14 equally weighted criteria including population density, proportion of rural areas in the jurisdiction, employment supply and population share employed in agriculture, share of children and elderly population, share of highly-skilled workers, accessibility to motorways and job supply, and taxation per capita (Danish Ministry of Food, Agriculture and Fisheries, 2011).

3. Results

3.1. Driver's licence holding and car accessibility

Figure 1 and 2 present the driver's license holding and car accessibility, respectively, for the four age groups in rural and urban areas over time. Car accessibility refers only to young adults that do not reside with their parents. Pearson's chi-square tests have been conducted to assess the significance of the gender difference at each year. Across both genders, the driver's license holding and car accessibility are higher in rural areas versus urban areas. The last five years have witnessed a steep increase in car accessibility in rural areas, in particular for young adults in their thirties. In rural areas, the share of driver's license holders is below 40% for the youngest age group, but exceeds 80% people in their twenties and approaches 99% for people in their thirties. In urban areas, the shares are about 10% lower. In rural areas, a gender gap is non-significant for the youngest age group. For people in their twenties in rural areas, the gap became non-significant

in the beginning of the millennium, and reappeared in the last four years. For people in their thirties, only the last three years are characterized by a significant gender gap, but because the share of driver's license holders is above 95% the gap has no practical implication. Regarding driver's license holding in urban areas, since 2003 there is no statistically significant gender gap. Adolescent girls 15-19 years old were the first to close the gap already in 1997, followed by young female in their twenties in 2001, while a further two-year delay is associated with the older age groups. In rural areas, for young adults in their early twenties there is no systematic gender gap in car accessibility, while for young adults in their early thirties a significant gap appeared in the first decade of the millennium with higher car accessibility for female. In urban areas, there is no significant gender gap in car accessibility in any of the age groups.
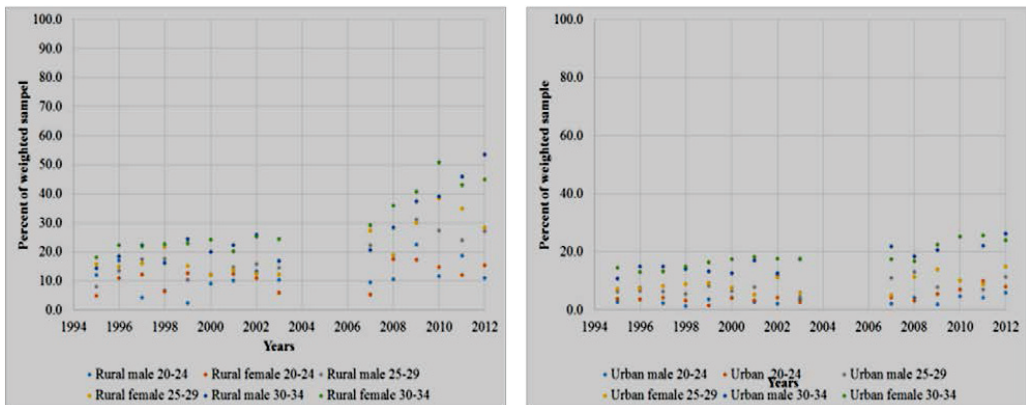
Fig 1. Driver's license holding by males and females in rural (left) and urban (right) areas
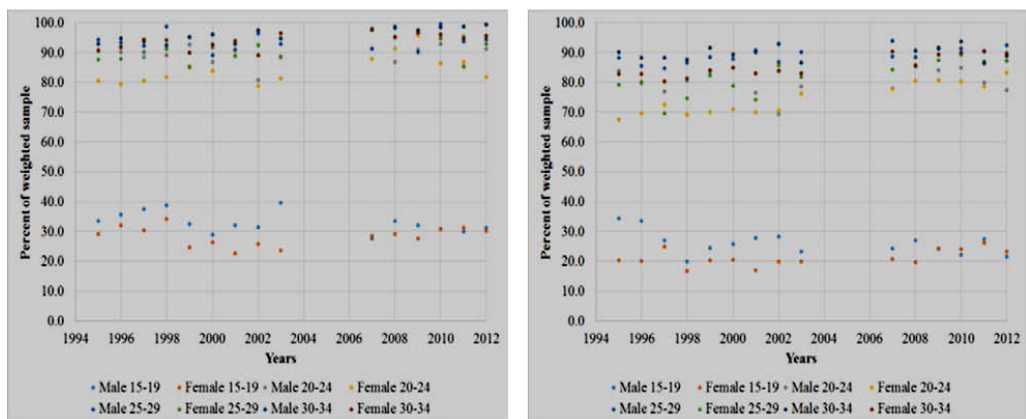
Fig 2. Car accessibility of males and females in rural (left) and urban (right) areas

3.2. Daily trips

Figure 3 presents the gender differences in the total daily trips as the percent difference from the male trips in rural and urban areas for the four age groups
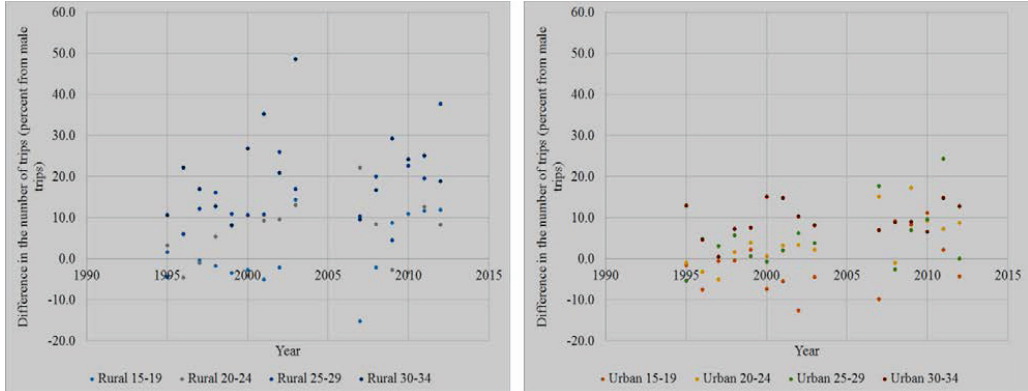

Fig 3. Gender differences in the number of daily trips (percent difference from male trips)

For the youngest age group, during the 1990's the gender gap in the number of trips was not significant. Both in rural and urban areas a gender gap systematically appeared in the first decade of the millennium in 15-19 years females making more trips than males. The gap was significant at the 0.10 significance level until 2009 and 2011 in urban and rural areas, respectively. For 20-24 year-olds, the gap in rural area is non-significant across the two decades. In urban areas, the gender gap was non-significant until 2003, but a systematic gap appears since 2007 with females having a higher number of daily trips. For 25-29 year-olds, in rural areas there is a systematic gender gap over time in the number of trips, with females having a higher number of trips. In urban areas, the gap has been systematically significant only since 2007. The gap is systematically larger in rural areas compared to urban areas. The oldest group of young adults shows the most pronounced systematic gender gap both in rural and urban areas, with females having a much higher number of trips. The gap systematically appears across the two decades, and it is larger in rural areas compared to urban areas. The gap in rural areas is significant at the 0.05 significance level, while the gap in urban areas in some years is only significant at the 0.10 significance level. Table 1 presents Student's t-tests for comparing the means across males and females in each group.

Table1. T-statistics for the comparison between the daily trips of males and females by age and region

Year	Rural 15-19	Urban 15-19	Rural 20-24	Urban 20-24	Rural 25-29	Urban 25-29	Rural 30-34	Urban 30-34
1995	-0.85	1.58	-0.52	0.27	0.66	1.44	-1.65	-2.97
1996	0.06	0.10	0.82	0.88	-0.91	-1.31	-3.62	-1.18
1997	0.28	0.08	0.15	1.37	-1.88	-0.82	-2.69	-0.15
1998	0.71	-0.48	-0.79	-0.46	-2.28	-1.58	-2.12	-1.95
1999	0.48	1.59	-1.16	-0.92	-1.69	-0.19	-1.31	-1.87
2000	0.73	1.15	0.52	-0.15	-1.49	0.17	-4.00	-3.38
2001	0.31	2.75	-1.04	-0.70	-1.37	-0.58	-4.50	-3.30
2002	-1.64	0.66	-1.39	-0.73	-3.12	-1.64	-3.00	-2.17
2003	2.00	1.66	-1.55	-0.45	-1.87	-0.90	-5.43	-1.94
2007	0.31	-1.74	-2.88	-2.90	-1.28	-3.29	-1.24	-1.48
2008	-1.52	-1.71	-1.03	0.22	-2.20	0.55	-2.20	-1.95
2009	-1.89	-2.45	0.38	-3.75	-0.68	-1.66	-4.82	-2.16
2010	-2.21	-0.57	0.59	-2.49	-3.19	-2.54	-3.79	-1.78
2011	-2.13	1.04	-1.64	-1.67	-2.46	-5.17	-3.07	-3.29
2012	-0.01	0.12	-1.03	-1.66	-3.31	-0.01	-2.00	-2.22

3.3. Daily travel distance

Figure 4 presents the gender differences in the total daily distance in rural and urban areas for the four age groups.
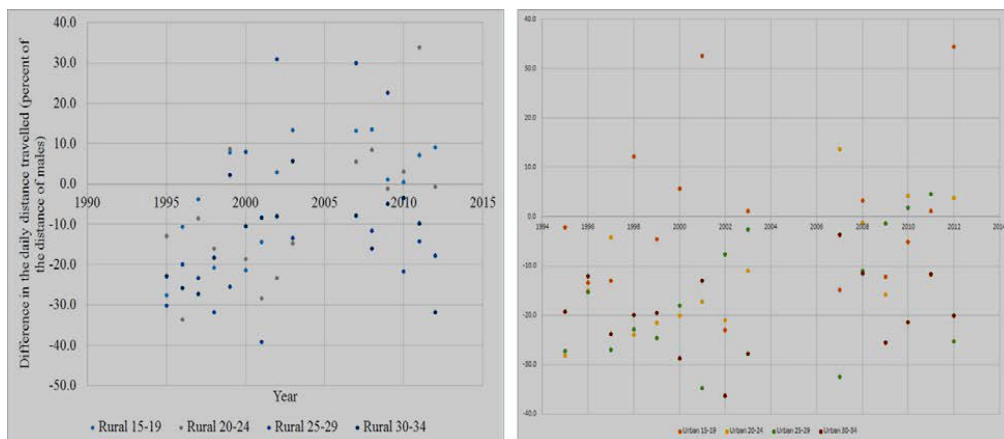

Fig 4. Gender differences in the daily distance travelled

For the youngest age group, the gender gap in the travel distance is non-significant. For 20-24

year-olds in rural areas, the gender gap related to the daily travel distance is non-significant, but in urban areas a significant gender gap systematically occurred in the 1990's with urban females travelling shorter distances. The gap became non-significant since 2003 due to a steady increase in the travel distance of females. For 25-29 year-olds, in rural and urban areas during the 1990's the daily distance travelled by females was significantly shorter, and the difference was significant at the 0.05 level. With the steady increase in the travel distance of young female during this period, the gap became non-significant in 2003. For the oldest age group, in rural areas the travel distance increased over time for both males and females, and because of a greater increase in the travel distance of females, the gender gap became non-significant since the mid-1990. In contrast, in urban areas the travel distance of both males and females in their thirties remained rather steady over the years, with a consistently significant gender gap of roughly 20% shorter daily travel distance for females. The difference is significant at the 0.05 level. Table 2 presents the Student's t-tests for comparing males and females in each group.

Table 2 T-statistics for the comparison between the travel distance of males and females by age and region

Year	Rural 15-19	Urban 15-19	Rural 20-24	Urban 20-24	Rural 25-29	Urban 25-29	Rural 30-34	Urban 30-34
1995	2.14	0.27	0.97	4.22	3.09	4.37	1.95	2.84
1996	0.80	1.32	2.74	1.92	1.80	2.29	2.19	2.00
1997	0.31	1.42	0.68	0.64	1.96	4.17	2.22	3.54
1998	1.57	-1.50	1.34	3.45	2.97	3.33	1.49	2.91
1999	-0.50	0.48	-0.62	2.75	1.88	2.76	-0.18	2.85
2000	1.51	-0.79	1.30	2.25	-0.44	2.45	0.90	3.99
2001	1.15	-3.91	2.23	1.84	3.40	4.45	0.59	1.65
2002	-0.17	1.71	1.28	2.35	-1.84	0.82	0.63	3.65
2003	-0.72	-0.09	0.90	1.08	0.79	0.30	-0.36	3.03
2007	-0.67	1.65	-0.32	-1.56	-1.54	3.21	0.49	0.45
2008	-0.72	-0.28	-0.45	0.11	0.73	1.26	0.98	1.11
2009	-0.07	1.32	0.09	1.76	-1.25	0.20	0.36	3.85
2010	-0.04	0.67	-0.20	-0.63	1.95	-0.24	0.28	3.36
2011	-0.53	-0.15	-1.55	1.13	0.97	-0.54	0.69	1.51
2012	-0.42	-3.92	0.04	-0.32	1.12	2.56	2.00	1.90

3.4. Daily travel time

Figure 5 presents the gender differences in the total daily travel time in rural and urban areas for the four age groups. In urban areas, the difference in travel time between males and females is approximately 10%, which is smaller than the difference of 30-40% in rural areas. For 15-19 year-olds, the gender difference in travel time is non-significant at the 0.10 significance level both in rural and urban areas. For 20-24 year-olds, the gender difference is not significant in rural areas,

but it is systematically significant in urban areas since 2007, with females spending between 10-20% more time in their daily travel. For the group of 25-29 year-olds, the difference between the travel time of males and females is not systematically significant. For the group of 30-34 year-olds the difference in the travel time of males and females is non-significant across the two decades. Table 3 presents Student's t-tests for comparing males and females in each group.
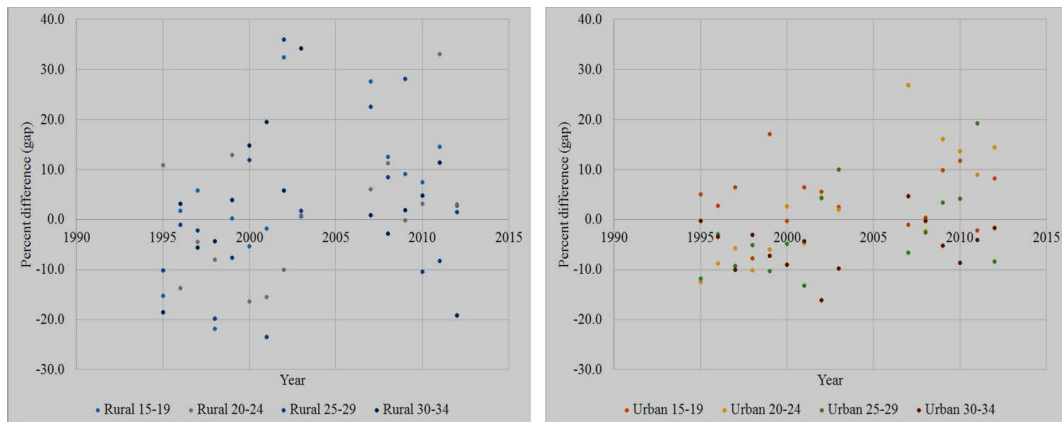

Fig 5. Gender differences in the daily travel time

Table 3 T-statistics for the comparison between the travel time of males and females by age and region

Year	Rural 15-19	Urban 15-19	Rural 20-24	Urban 20-24	Rural 25-29	Urban 25-29	Rural 30-34	Urban 30-34
1995	1.47	-0.33	-0.96	2.11	1.25	2.14	2.26	0.05
1996	-0.16	-0.63	1.39	1.50	0.11	0.49	-0.30	0.64
1997	-0.58	1.06	0.47	0.94	0.24	1.53	0.59	1.71
1998	2.17	-2.08	0.86	1.81	2.22	0.86	0.47	0.50
1999	-0.01	0.03	-1.06	0.98	0.66	1.63	-0.41	1.22
2000	0.50	-0.72	1.46	-0.38	-0.67	0.80	-1.43	1.47
2001	0.17	-0.58	1.57	0.65	2.40	2.34	-1.35	0.65
2002	-2.31	-0.24	0.76	-0.62	-2.71	-0.66	-0.62	2.38
2003	-0.06	0.10	-0.06	-0.24	-0.15	-1.36	-2.89	1.47
2007	-2.04	-0.04	-0.57	-3.26	-1.57	0.88	-0.08	-0.69
2008	-1.01	-1.13	-0.82	0.29	-0.66	0.34	0.22	0.03
2009	-0.98	-1.64	0.02	-2.29	-2.32	-0.52	-0.18	0.95
2010	-0.84	0.35	-0.29	-2.28	1.20	-0.67	-0.56	1.59
2011	-1.48	-1.16	-2.25	-1.26	0.71	-2.57	-1.04	0.68
2012	-0.23	-2.10	-0.25	-1.64	-0.12	1.13	1.45	0.23

3.5. Travel related to activity purposes

Figure 6 presents the gender differences in the trip purposes in rural and urban areas for the four age groups. The youngest age group (15-19 year-olds) does not exhibit a significant difference between males and females. The group of people in their early twenties (20-24 year-olds) does not systematically exhibit a significant difference both in urban areas, although a difference appears in some years in rural areas. For people in their late twenties (25-29 year-olds), the difference between males and females is significant only in rural areas, where males engage in more mandatory activities and females in many more escort activities. The oldest age group (30-34 year-olds) exhibits significant differences with respect to the proportions of trips by purpose, both in rural and urban areas, with the main difference being that males engage in more mandatory activities and females in more escort activities. Table 4 presents the Pearson's chi-square tests for comparing males and females in each group.
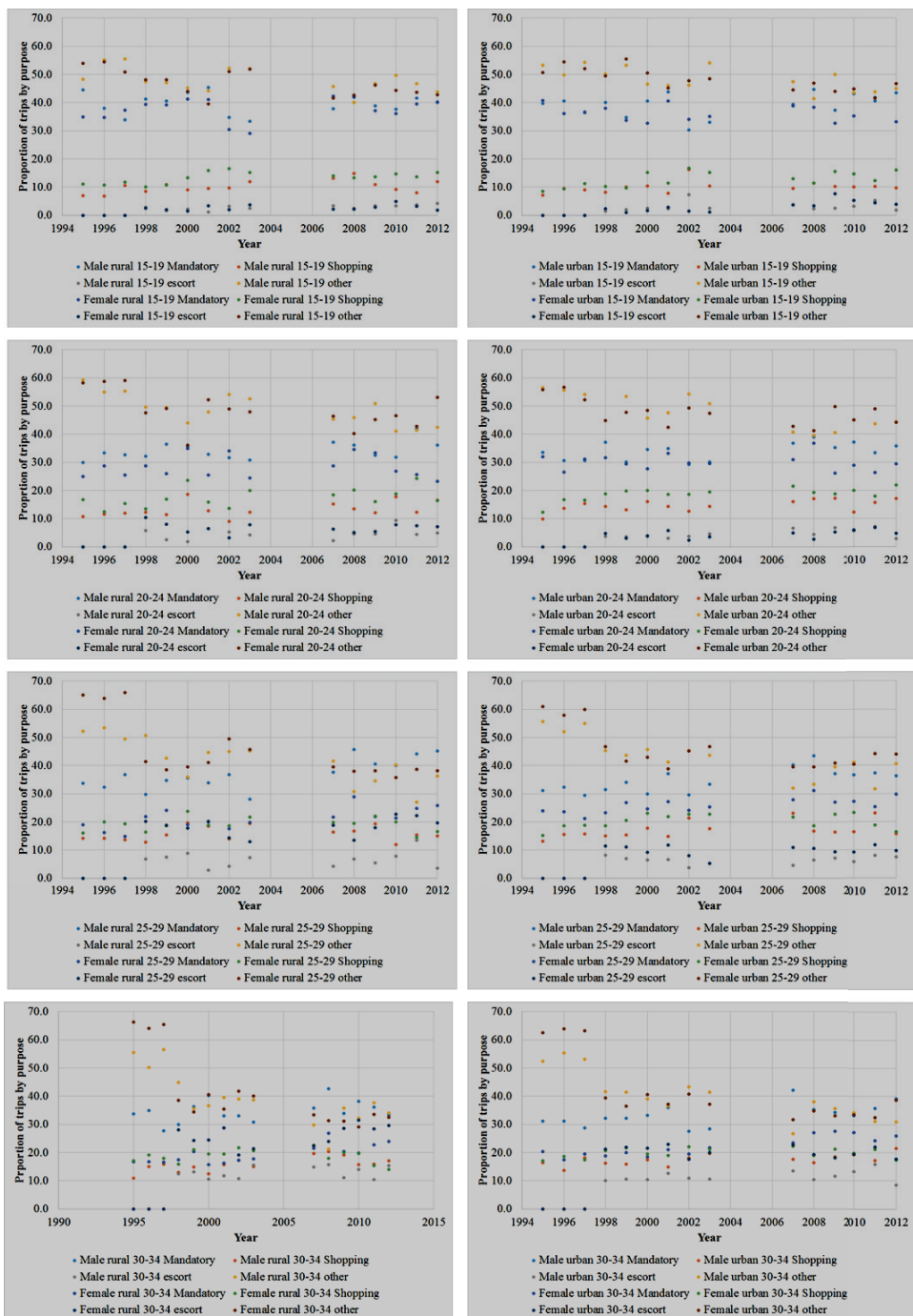
Fig 6. Gender differences in trip purposes

Table 4 Pearson chi-square (p-value) for comparing the proportion of trips by purpose of males and females by age and region

Year	Rural 15-19	Urban 15-19	Rural 20-24	Urban 20-24	Rural 25-29	Urban 25-29	Rural 30-34	Urban 30-34
1995	0.17	0.93	0.24	0.90	0.02	0.47	0.00	0.13
1996	0.48	0.81	0.82	0.75	0.01	0.30	0.00	0.03
1997	0.84	0.89	0.41	0.98	0.00	0.33	0.10	0.17
1998	0.94	0.80	0.24	0.49	0.00	0.22	0.00	0.00
1999	0.99	0.89	0.00	0.25	0.00	0.12	0.00	0.00
2000	0.49	0.22	0.03	0.48	0.00	0.29	0.00	0.00
2001	0.01	0.56	0.44	0.25	0.00	0.02	0.00	0.00
2002	0.13	0.16	0.28	0.30	0.00	0.12	0.00	0.06
2003	0.57	0.32	0.02	0.51	0.07	0.29	0.02	0.01
2007	0.71	0.69	0.01	0.33	0.00	0.00	0.02	0.00
2008	0.94	0.56	0.26	0.76	0.00	0.05	0.00	0.02
2009	0.84	0.00	0.55	0.18	0.00	0.11	0.00	0.14
2010	0.21	0.17	0.61	0.08	0.00	0.07	0.00	0.26
2011	0.21	0.88	0.00	0.48	0.00	0.01	0.00	0.07
2012	0.49	0.03	0.04	0.30	0.00	0.54	0.00	0.00

3.6. Mode choice

Figure 7 presents the gender differences in the trip proportions by mode in rural and urban areas for the four age groups and Table 5 presents the Pearson's chi-square test for comparing males and females in each group. For the two oldest age groups (25-29 year-olds), for both males and females, while the car remains by far the dominant mode in rural areas, the car use is declining in urban areas and the use of non-motorized modes is steadily rising across the investigated time period. Regarding the gender gap, for the youngest age group there was a systematic and significant difference in the trip proportions by mode until 2007, with males conducting a higher share of trips by motorized private modes and females conducting a higher share of trips by bicycle and public transport. The difference is no longer significant in rural areas, although in urban areas a significant difference re-appeared in 2011-2012. For young people in the early twenties (20-24 year-olds) during the 1990s and the beginning of the millennium there was a significant difference in the mode choice, with males conducting more trips by car and females travelling more by bicycle and public transport. The difference became non-significant in rural areas from 2003 and in urban areas from 2007. The difference re-appeared again in rural areas during 2010-2011. For young people in their late twenties (25-29 year-olds), in urban areas there is no significant difference in the proportion of trips by travel mode, while in rural areas there is a systematic and significant difference with males travelling more by car and females more by bicycle. For the oldest age group (30-34 year-olds), there is no significant difference in proportions of trips by travel mode for most of the period investigated.
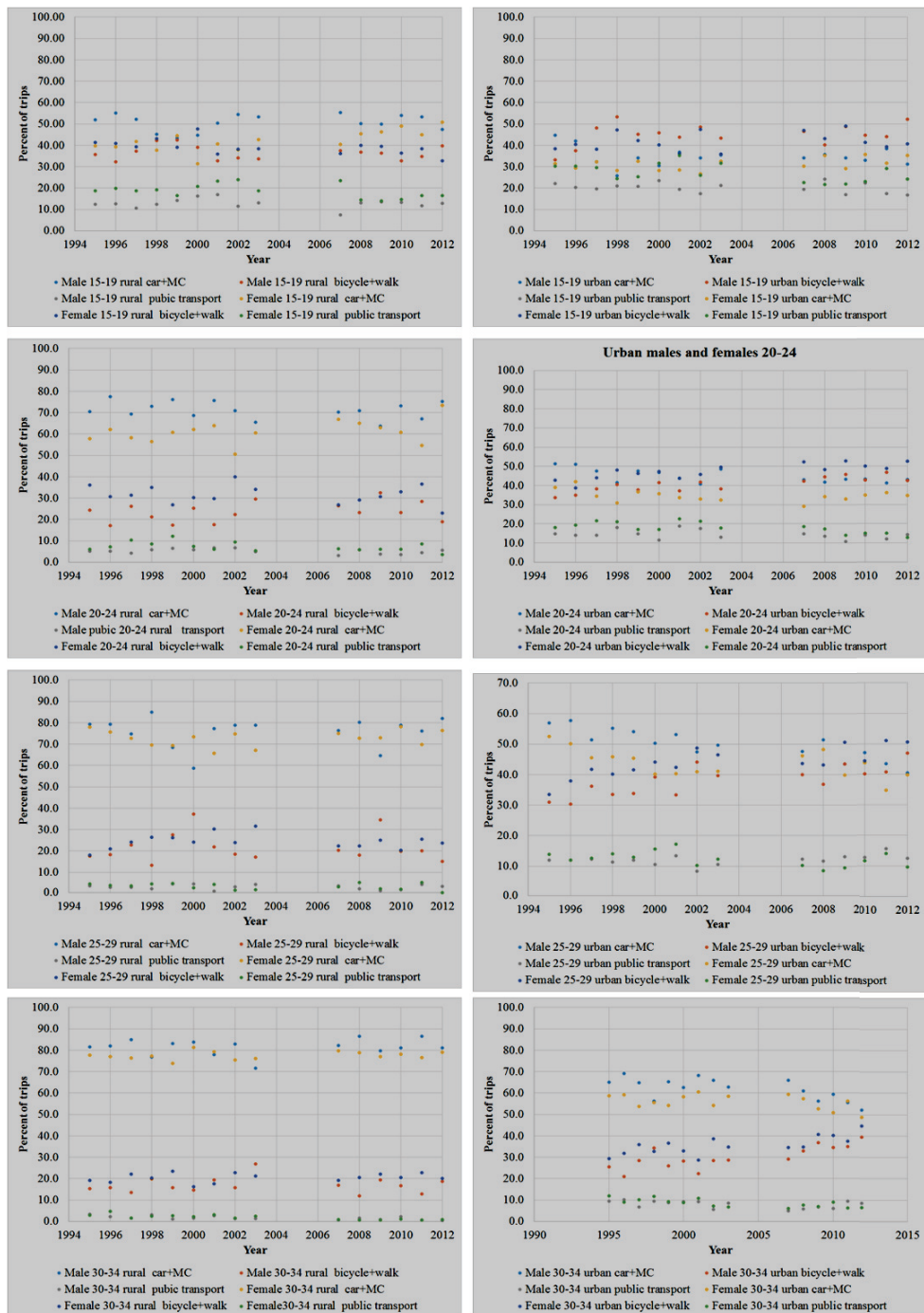
Fig 7. Gender differences in mode choice

Table 5 Pearson's chi-square (p-value) for comparing the mode shares of males and females by age and region

Year	Rural 15-19	Urban 15-19	Rural 20-24	Urban 20-24	Rural 25-29	Urban 25-29	Rural 30-34	Urban 30-34
1995	0.03	0.02	0.02	0.05	0.86	0.64	0.54	0.39
1996	0.00	0.01	0.00	0.12	0.65	0.24	0.18	0.02
1997	0.01	0.03	0.00	0.01	0.87	0.46	0.04	0.05
1998	0.08	0.46	0.00	0.10	0.00	0.17	0.93	0.72
1999	0.71	0.54	0.00	0.09	0.96	0.19	0.03	0.05
2000	0.03	0.16	0.37	0.05	0.01	0.08	0.75	0.59
2001	0.10	0.00	0.01	0.12	0.00	0.04	0.89	0.24
2002	0.00	0.05	0.00	0.25	0.29	0.40	0.14	0.04
2003	0.07	0.04	0.57	0.01	0.00	0.23	0.28	0.38
2007	0.00	0.63	0.21	0.02	0.85	0.70	0.78	0.37
2008	0.64	0.79	0.38	0.26	0.03	0.35	0.02	0.64
2009	0.76	0.33	0.48	0.10	0.08	0.29	0.80	0.73
2010	0.61	0.79	0.02	0.23	0.96	0.67	0.46	0.18
2011	0.17	0.01	0.01	0.49	0.34	0.11	0.01	0.54
2012	0.28	0.04	0.43	0.13	0.02	0.62	0.60	0.50

4. Conclusions

The current study focuses on analysing the gap in the travel of young men and female in urban and rural areas in Denmark in the years 1995-2012. The main research questions concern (i) the change in the gender difference with the lifecycle progression, and (ii) the gender difference in rural and urban areas. The first question is raised because while for adults consistent gender differences in travel are found in the literature, for children the findings are inconclusive. The second question is related to the gender difference considering the availability of different transport options and the socio-economic gap between rural and urban areas.

Results show the following trends in Denmark. In terms of driver's license holding, there is no systematic gender gap in urban areas across all age groups. In rural areas, a gender gap is non-significant for the youngest age group, but is significant for young people in their twenties, with males having a higher licensure rate. The gap is irrelevant for young people in their thirties since almost all have a driving license by this age. Hence, while female exhibit a delay in obtaining the license compared to men, most of them acquire a license by their early thirties. Regarding car accessibility, in urban areas there is no significant gender gap, while in rural areas young female in their thirties enjoy a slightly higher car accessibility compared to men. The gender gap in the number of trips increases with age, with 30-34 year-olds exhibiting the most pronounced systematic gender gap both in rural and urban areas, with females having a much higher number of trips. In terms of daily driving distance, while in the 1990's female young adults have travelled

significantly shorter distances than males, the gap became non-significant since the beginning of the millennium and even earlier in rural areas. The gap remains significant only for 30-34 year-olds in urban areas, with females travelling shorter distances. The difference in travel time between males and females is consistently non-significant across the two decades and it is around 1 hour a day although it has increased by 10-20% for both males and females across the two decades. With respect to travel purpose, the two youngest age groups do not exhibit a significant gender difference in the trip proportions by purpose, but the two older groups exhibit a significant difference, with males engaging in more mandatory trips and females engaging in more escort trips. For 25-29 year-olds, the difference is only in rural areas while for 30-34 year olds the difference is both in urban and rural areas. With respect to gender differences in mode choice, for the two younger age groups there was a significant difference in the 1990s with males travelling more by car and females travelling more by non-motorized modes, but the difference became non-significant in the last few years. For people in their late twenties, the difference is significant in the rural areas but not in urban areas, and for the oldest age group there are no significant differences in mode use.

The results suggest that in Denmark, in cases where there is a gender-related gap in transport behaviour, the gap progresses across age groups and is different for rural and urban areas. Regarding the number of trips and the proportion of trips by purpose, the gap is greater for the older age groups and is more pronounced in rural areas. Regarding the travel distance, the gap over time diminished more rapidly in rural than in urban areas, and currently the gap is significant only for the oldest age group in urban areas. Regarding the trip proportion by mode, the difference is more pronounced in rural areas, and it diminishes with the lifecycle progression.

Acknowledgements

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Paper 2

Understanding adolescents' intentions to commute by car or bicycle as adults

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Abstract

This study focuses on the intentions of adolescents to commute by car or bicycle as adults. The behavioral model is based on intrapersonal and interpersonal constructs from the theory of planned behavior extended to include constructs from the institutional, community and policy domains. Data from a survey among Danish adolescents is analyzed. It is found that car use intentions are related to positive car passenger experience, general interest in cars, and car ownership norms, and are negatively related to willingness to accept car restrictions and perceived lack of behavioral control. Cycling intentions are related to positive cycling experience,

willingness to accept car restrictions, negative attitudes towards cars, and bicycle-oriented future vision, and are negatively related to car ownership norms. Attitudinal constructs are related to individual characteristics, such as gender, residential location, current mode choice to daily activities, and parental travel patterns.

1. Introduction

Understanding the travel intentions of children and adolescents and their related factors is one of the key elements for promoting travel pattern transition in society and predicting future travel behavior. Adolescents are in the initial stages of adopting new travel patterns and developing habits, and hence they are still open to change. Nevertheless, when adolescents become increasingly car reliant, they become less responsive to policies that encourage car use reduction. Additionally, physical activity during adolescence reduces the odds of being physically inactive in adulthood.

Previous studies on future travel intentions, for example by Baslington (2009) and Line et al. (2012), indicate that children and adolescents have developed a car-oriented culture, that they are eager to acquire a driving license and to own a car, and that they show a general resistance to changing these intentions. While the travel intentions of adults have been extensively investigated, little is known about the intentions of children and adolescents. There are few studies that have focused on the perceptions of children and adolescents' attitudes, and those that have, have looked mainly at intentions to obtain a driving license and own a car; they reveal that the majority of children and adolescents intended to do both. The reasons given included positive travel experience as a car passenger, as well as practical (e.g., employment related, convenience, family needs, and travel independence) and psychological reasons (e.g., parental role models, peer group pressure, personal gratification, fascination with cars)[2]. We focus on the intentions of adolescents to drive a car and cycle to work as adults using data from a sample of 15 year-olds in Denmark.

From the conceptual perspective, while previous studies have focused on the intrapersonal and interpersonal domains as influential factors in the formation of the transport intentions of adolescents and children, we employ the broader socio-ecological perspective, thus incorporating factors also from the institutional, community and policy domains. The socio-ecological perspective is particularly important to policy makers for back-casting sustainable and reliable future transport scenarios. The eventual success or failure of future transport scenarios will be determined by the effect of adolescents' vision of future transport environments and acceptance of transport policies on their mode choice intentions. Notably, while some of the factors have been individually identified in previous studies, we assemble them within a comprehensive socio-

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[2] Environmental awareness, however, was found to be a factor limiting children's intention to own a car in the Netherlands (Kopnina, 2011), while it did not significantly influence the same intention among adolescents in Britain (Mackay, 1998).

ecological behavioral framework to understand the intentions of adolescents.

2. Methodology

Our behavioral framework is loosely built upon the theory of planned behavior (TPB) latent constructs (Ajzen, 1991) as its core; see Fig. 1. The combination of behavioral attitudes, subjective norms associated with the behavior, and perceived volitional control associated with the behavior, lead to the formation of behavioral intentions. In general, favorable attitudes and subjective norms towards the behavior and greater perceived ease of conducting the behavior lead to stronger intentions to perform the behavior (Fielding et al., 2008). These intentions will eventually transform into observed behavior, provided the availability of resources and the ability to choose one's own behavior. TPB can also be framed in the wider scope of the socio-ecological model of behavior postulating that the interest in performing an activity is related to factors of intrapersonal (attitudes, skills, knowledge), interpersonal (family, social networks), institutional (formal and informal behavioral rules), community (social, political and geographical context), and public policy (laws, regulations, policies and intervention programs) domains (McLeroy et al., 1988).
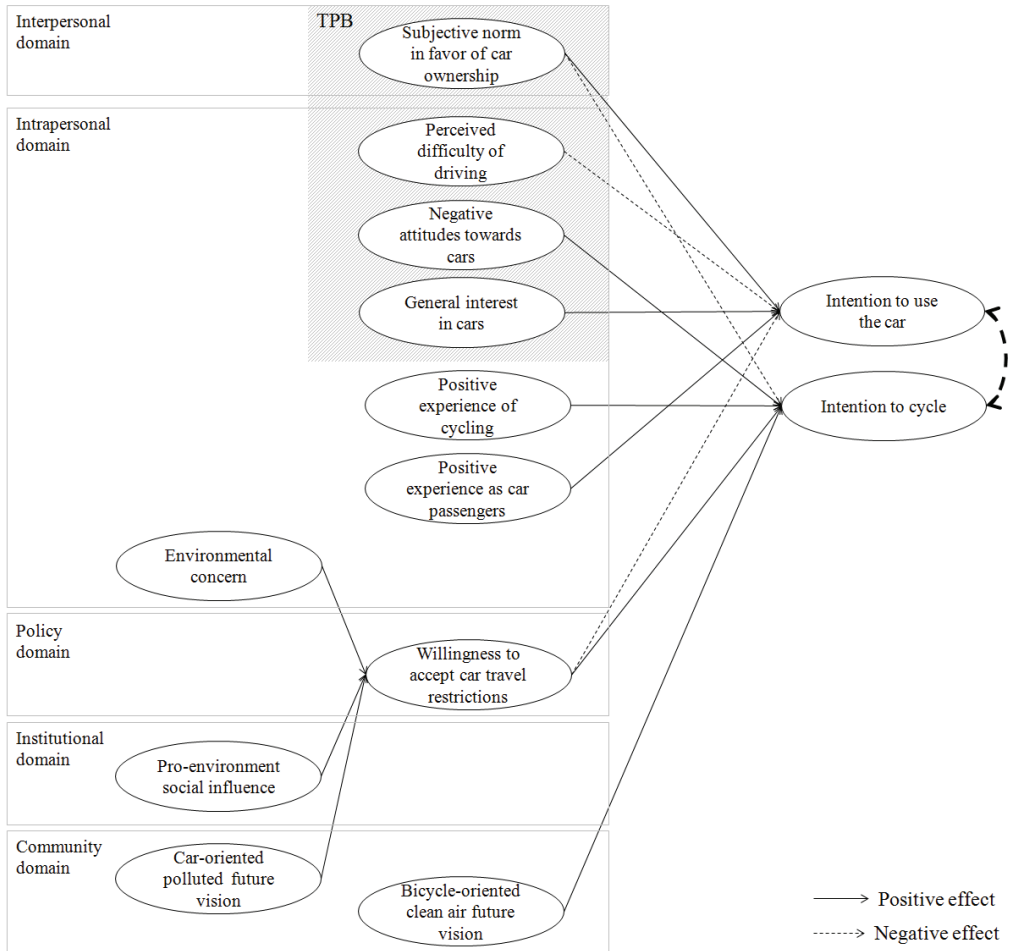
Fig. 1. Behavioral framework

Previous studies have shed some light on the subjective norms shaping children's intentions to obtain a driving license and to own a car. The car is seen as an integral part of growing up and adult life (Mackay, 1998), possibly reflecting the perceived social pressure to own a car as part of a societal car culture at large (Kopnina, 2011). Perceived behavioral control in the context of transport-related intentions can be interpreted as both the amount of choice involved in the action, namely choosing a transport mode on the basis of availability, and the ease of performing an action, for example difficulty of using cars and public transport (Eriksson and Forward, 2011). Here the second interpretation is adopted following findings that fear is associated with children's current mode choice (Line et al., 2010) and fear and stress of driving are related to the dislike of cars (Baslington, 2009). In addition to the TPB latent constructs, we consider other possible constructs potentially associated with the intentions of adolescents, notably including habits,

feelings, peer pressure and social values. Children's own travel experience plays a key role in the formation of their perceived travel options and frequently appeared in their transport related narratives (Baslington, 2009). Positive experience with car travel as a passenger was identified by Kopnina (2011) as a theme related to children's intentions to obtain a license and to own a car in the Netherlands. Here, the role of adolescents' positive experience with both car travel and bicycle travel to school is explored. The attitudes of children and adolescents are determined to a certain extent by their social environment and role models such as their friends, school teachers and the media. Therefore, we considered social influence related to pro-environment behavior of other adolescents, school environmental programs and pro-environment media.

Children and adolescents have been shown to be aware of the negative environmental effects of car use and to recognize their future responsibility for reducing it, although awareness alone is insufficient to discourage future car ownership intentions (Mackay, 1998; Kopnina, 2011). Nevertheless, following evidence that environmental concern manifested through one's own eco-friendly behavior is related to the mode choice of adults (Vredin-Johansson et al., 2006), we investigate the linkage between adolescents' environmental concern and their future mode choice intentions.

Children aged 8–11 are able to engage in high-level visionary future exploration, to recognize future societal needs and to understand their implications for their own present-day attitudes and values (Markley and Burchsted, 1997). Therefore, the hypothesis that adolescents' vision of the future relates to their future mode choice intentions is investigated. The hypothesized visions are a car-oriented future in which air pollution is increasing, and a bicycle-oriented future in which the bicycle infrastructure geographical scope is enlarged.

Finally, the success of policy measures aimed at restricting car use depends to a large extent on people's willingness to accept restrictions on car travel. In line with Boyes and Stanisstreet (1998) and Line et al. (2010), this is hypothesized to be related to children's environmental concerns, the social influence to behave in an environmentally sustainable manner, and the vision of a car-oriented future with increasing air pollution.

The hypothesized behavioral model structure is investigated applying a standard structural equation model (SEM); see Golob (2003). This comprises measurement equations, structural equations linking the latent attitudinal constructs to individual socio-economic characteristics, and structural equations relating the latent attitudinal constructs to adolescents' mode choice intentions in accordance with the path of the hypothesized behavioral model shown in Fig. 1. The parameters of the three sets of equations were estimated simultaneously by using maximum likelihood with Huber–White covariance adjustment (Yuan and Bentler, 2000)[3].

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[3] Standard errors were calculated by adopting the White's (1980) sandwich-based method that produces robust statistics in the presence of non-normality of indicators and categorical variables. Additional to the traditional descriptive measure of chi-square test of absolute model fit, descriptive goodness-of-fit measures

The data were collected by means of a web-based questionnaire containing questions about the intentions of adolescents, their attitudes and perceptions, their current travel pattern and their socio-economic characteristics. Four questions measure adolescents' future travel intentions; these concern an adolescents' intentions to obtain a driving license and to own a car measured on a 5-point Likert scale ranging from highly unlikely to highly likely. In addition, the preferred transport mode to work and leisure activities as future adults was elicited.

The items used to measure TPB latent constructs and additional attitudinal factors are seen in Table 1. General interest in cars is measured by three items referring to the car as a characteristic of modern lifestyle and a facilitator of personal freedom. Negative attitudes to cars are measured by items related to the perceived pollution from motorized transport. Subjective norms are measured by four items referring to the perceived social pressure to obtain a driving license and to own a car. Perceived lack of behavioral control is measured by three items denoting the difficulty of obtaining a driving license, as well as the stress and anxiety associated with driving a car. Positive experience as a car passenger is measured by three items related to the positive feeling associated with riding a car, the short travel time to the destination and the ease of being driven around. Positive cycling experiences are embraced in six items related to the positive feeling associated with cycling, the speed and ease of cycling, the sense of travel independence, cycling in any weather conditions, and the added value of cycling as a healthy exercise activity. Environmental concern is measured in four items related to the positive feeling associated with environmentally responsible behavior, the choice of environmentally friendly transport modes and the general eco-friendly behavior of the family. Three items measure the influence of school programs, friends and media on the adolescents' environmental concern. Future expectations are measured using three items depicting a gloomy car-oriented future vision involving congestion and pollution, and four items depicting a future oriented towards sustainable modes and environmental responsibility. Willingness to accept limitations on travel is defined in nine items about future policy measures that impose limitations on car travel in terms of geographical scope, speed, licensure and costs. All attitudinal items were measured on a 5-point Likert scale.

Table 1 The questionnaire items

Latent factor	Indicator name	Indicator description	5-point Likert scale
General interest in cars	Carinterest	I am interested in cars	Strongly disagree/ strongly agree
	Carmodern	I consider the car as part of the modern lifestyle	
	Carfree	I associate the car with personal freedom	

standardized root mean residual (SRMR) (Bollen, 1989) and the root mean square of approximation (RMSEA) (Browne and Cudeck, 1993) are calculated.

Negative attitudes towards cars	Carpollut	I believe that cars pollute the environment	Strongly disagree/ strongly agree
	Buspollut	I believe that buses pollute the environment	
Subjective norm of obtaining a driving license and owning a car	Cargrow	Getting your own car is part of growing up	Strongly disagree/ strongly agree
	Licexpect	Society expects from us to have a driving license as adults	
	Licfriend	Most of my friends are expected to obtain a driving license	
	Licpress	People whom I care about think that I should obtain a driving license	
Perceived difficulty of driving (perceived lack of behavioral control)	Licdiffic	I think it would be difficult for me to pass the driving test	Strongly disagree/ strongly agree
	Drivstress	I think it would be stressful for me to drive	
	Drivdang	I think it would be dangerous for me to drive	
Positive experience as a car passenger	Carlike	I like to drive in a car as a passenger daily	Strongly disagree/ strongly agree
	Carfast	I get faster by car than other modes to my daily activities	
	Careasy	It is the easiest way to be driven to my daily activities	
Positive current cycling experience	Cyclike	I like to ride a cycle on a daily basis	Strongly disagree/ strongly agree
	Cycfast	I will arrive faster by bicycle than by other mode to my daily activities	
	Cyceasy	When I cycle it is because it is the easiest transport mode for me	
	Cycrain	I do not let bad weather stop me from cycling	
	Cycfree	Cycling gives me personal freedom	
	Cycexer	When I bike daily, I try to use the journey to exercise	
Social influence of environmental concern	Envschool	My school encourages environmentally responsible behavior	Strongly disagree/ strongly agree
	Envfreind	My friends are concerned about environmental responsibility	
	Envmedia	The media convinced me to behave in a more environmentally responsible manner	
Environmental concern	Envconc	I am concerned about the environment	Strongly disagree/ strongly agree
	Envgood	It feels good to act in an environmentally responsible manner	
	Envtrans	I prefer to choose environmentally friendly transport modes	
	Envfamil	My family behaves in an environmentally friendly manner	
	Minlicage	The minimum driving license age would be 21 years	Highly

Willingness to accept limitations on car travel	Maxspeed	The speed limit on motorways would be lowered to 90 kph	unacceptable/highly acceptable
	Ghgquota	It would be obligatory to purchase greenhouse gas quotas	
	Bandrive	Driving in city centers would be banned	
	Maxkilom	Car travel would be limited to a certain number of kilometers per person per year	
	Licreq	There would be stricter requirements for taking a driving license	
	Congtoll	Tolls would be collected on motorways	
	Carcosts	The prices of gasoline, diesel and cars would increase	
	Carshare	Cars only were allowed to be jointly owned (car sharing)	
Car-oriented polluted future vision	Congcity	Congestion in cities will be worse because of more cars	Highly unlikely/Highly likely
	Pollutcity	Air pollution will be a major health problem in cities	
	Globwarm	The effect of global warming will be a greater problem	
Bicycle-oriented clean air future vision	Cycmore	More people would choose to cycle on a daily basis	Highly unlikely/Highly likely
	Cycbetter	The conditions for cyclists would be better	
	Drivproh	Driving will be prohibited in cities	
	Envresp	It would seem as a lack of environmental responsibility to drive instead of using more environmentally friendly transport modes	

The questions about adolescents' current travel patterns include the frequency bicycle, walk, public transport, car as a passenger, and motorcycles are used in trips to school and for leisure activities, measured on a 5-point Likert scale ranging from almost never to almost always. Information about parents' commuting patterns is also elicited because travel attitudes of children are largely shaped by interactions with their parents (Kopnina, 2011). Separate questions are dedicated to the mother and father[4] and a differentiation is made between using the car as a driver or a passenger. Demographic characteristics are gender, transit pass holding, household car accessibility, residential location, and the parents' educational level.

There are limitations with the data. The questionnaire focuses on future mode choice travel intentions while neglecting future residential location intentions. Although the two are necessarily related, future residential choice intentions are also determined by socio-ecological constructs.

4 This differentiation is made because the two parental role models may differ in their preferred travel patterns and their influence on a child's current mode choice, possibly due to their different role in escorting activities (Zwerts et al., 2010).

Respondents are also only asked about commuting and leisure trips, while adults conduct many trips for errands; these were omitted because construction of future events in future-oriented mental time travel (FMTT) is related to the episodic memory system that retrieves stored details from experience and recombines them into a representation of the future (Berntsen and Bohn, 2010). Since 15 year-olds are not responsible for running errands, it is plausible to assume that their representation of errand trips is less reliable than their routine trips. Additionally, respondents are asked about their intentions to use single transport modes. Although people increasingly combine cycling and driving with public transport, an approach eliciting intentions regarding a 'main travel mode' is preferred here because respondents are asked to imagine themselves as adults, which is a rather distant future for 15 year-olds, and representation of temporally distant events in FMTT is known to be abstract.

Finally, while a web-based survey is highly advantageous in terms of time and location flexibility, there are challenges concerning sample reliability. To overcome, a random sample of 3025 individuals born in 1995 across Denmark was obtained with the assistance of the Danish Bureau of Statistics. The data collection via internet is seen an adequate survey method among adolescents because 98% of all the households with children have a computer and internet access at home (Danmarks Statistik, 2011). The survey was administered in February 2011 over 3 weeks. An introduction letter was sent to the participants by email, with information about the survey, its purpose and a link to the survey web site. A reminder letter was sent by mail 10 days later. To enhance the response rate, ten €13 shopping vouchers in the iTunes store were raffled among participants who gave their email address upon the completion of the survey.

The questionnaire was completed by 891 of the individuals contacted, of which 55.4% are females. Some 17.3% reside in the Copenhagen metropolitan area, 4.9% in cities of over 100,000 inhabitants, 4.2% with 50,000–100,000 inhabitants, 16.5% with between 20,000 and 50,000 inhabitants, and 11.3% in towns with 10,000–20,000 inhabitants. Of the sample, 38.7% reside in urban communities, 18.8% in intermediate communities, 32.9% in rural communities and 9.6% in peripheral communities as defined by the Danish Rural Development Index (Danish Ministry of Food, Agriculture and Fisheries, 2008). In 17.3% of households at least one parent has a university degree, and 31.3% of adolescents aspire to pursue higher education. In terms of car accessibility, 46.2% has access to one car, 48.0% to two or more and only 5.7% has no access; figures similar to those in the Danish national travel survey for 2010–2011. Some 94.4% has a bicycle in the household, 21.4% a monthly public transport pass, 65.3% perceive access to cycling paths from their home as 'good' or 'very good', and 69.5% assess access to public transport similarly.

Regarding parents' travel pattern, 64.6% of mothers and 68.3% of fathers commute often or always by car as a driver, 27.8% of the mothers and 21.8% of the fathers cycle often or always to work, and 13.0% of the mothers and 11.4% of the fathers commute often or always by public transport, possibly in combination with the bicycle. The adolescents' dominant travel modes to school are cycling and public transport, as 24.0% are often or always driven by car, 32.7% use

often or always public transport, and 49.9% cycle often or always. The adolescents' dominant travel modes to leisure activities are the car and the bicycle, as 46.2% are often or always driven by car, 23.4% use often or always public transport, and 55.1% cycle often or always.

The adolescents' intentions to obtain a driving license and own a car, as well as their intended mode of travel to work and leisure activities in the future are described in Fig. 2.

3. Results

The categorical variables summarized in Table 2 are observable respondent characteristics. Table 3 presents the measurement equations, Table 4 details the structural equations linking the latent factors to adolescents' observable characteristics[5], and Table 5 illustrates the structural equations linking the latent factors according to the hypothesized model structure[6].

The results show gender differences in attitudes towards cars and environmental concern. Male respondents show more general interest in cars and exhibit greater perceived behavioral control, and, on average, perceive obtaining a driving license as easier and driving as less stressful and dangerous than do female respondents. Male also perceive current and future air pollution, global warming, and congestion, as less severe than female respondents. Greater household car accessibility is related to perceived less severe current air pollution, and a lower expectation of air pollution, global warming and congestion in the future, but it is associated with higher perceived lack of behavioral control. Namely, adolescents who have more than one car in the household are more aware of the stress and danger associated with driving.

The place of residence in Copenhagen is negatively related to the general interest in cars and the subjective norm of car ownership. The current travel choice of adolescents to school and leisure activities contributes not only to creating a positive travel experience, but also to shaping their interests, subjective norms, and future vision. Being a car passenger creates a positive experience, with the use of car for leisure activities also increasing general interest in cars and the subjective norm of car ownership, and decreasing the willingness to accept limitations on car use. Cycling to school and leisure activities is associated with a greater positive experience with the mode, with a slightly stronger effect coming from cycling to school. Cycling to school is associated with a higher perceived likelihood of car-oriented air pollution, congestion and global warming in the future while cycling to leisure activities is associated with a higher likelihood of a bicycle-oriented future vision.

The two parents have different roles in shaping the adolescents' travel experience, attitudes and future vision. Having parents who cycle to work regularly is associated with an increase of the adolescents' positive cycling experience. Having mothers who cycle to work regularly is associated with an increase in the negative attitudes towards cars, while having fathers who cycle regularly to work is associated with an increase in the environmental concern and a higher perceived likelihood of a favorable bicycle-oriented future. Having fathers driving regularly to work increases the adolescents' perceived expectation of air pollution, congestion and global warming, while having fathers traveling to work as car passengers is associated with an increase in the subjective

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[5] It also shows that individual characteristics are related to the current travel experience, attitudes, norms and future vision of adolescents.

6 Goodness-of-fit indices reveal that the model fits reasonably well. Also, the RMSEA is 0.067, and the SRMR is 0.072, both within accepted values of 0.08 and 0.10 (Vandenberg and Lance, 2000).

norm of car ownership among the adolescents. Having mothers driving regularly to work is associated with a greater perceived behavioral control, while having mothers traveling to work as car passengers is related to an increase in the positive experience of the adolescents' as car passengers.
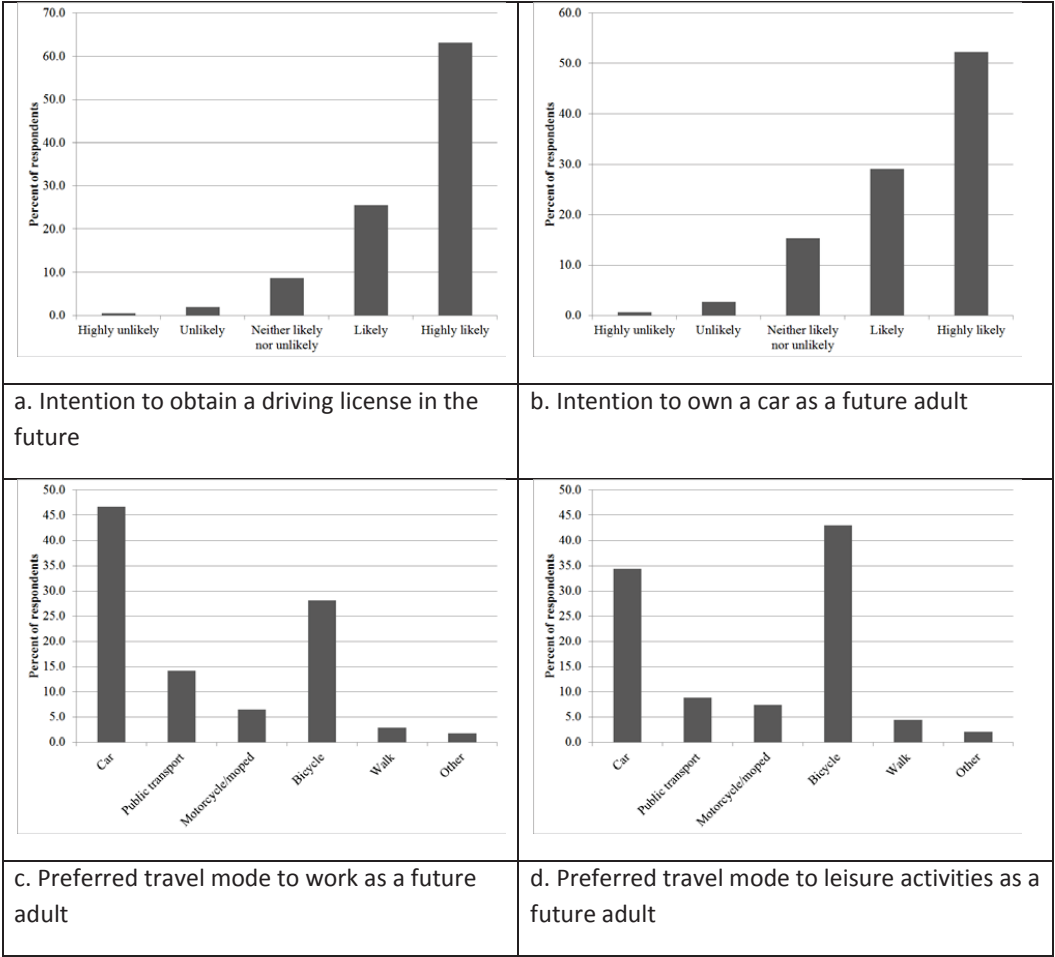

Fig. 2. Respondents future travel intentions

Having mothers with a university degree is positively associated with a higher environmental concern among the adolescents. Having fathers with a university degree is associated with the adolescents' higher positive cycling experience. The adolescents' aspiration to a university degree is associated with an increase in their perceived behavioral control, and with a greater environmental concern. At a lower significance level, it is also associated with an increase in the subjective norm of car ownership and a less positive experience as a car passenger.

Table 5 confirms the hypothesized model structure. The willingness to accept limitations on car travel is positively correlated to a perceived higher probability of air pollution, congestion and global warming in the future, a higher environmental concern, and a greater social influence encouraging environmentally responsible behavior. The intentions to commute by car or by bicycle are negatively correlated, with greater intentions to commute by car implying less intent to commute by bicycle.

Higher intentions of adolescents to commute by car as future adults are related to higher positive experience as car passengers, greater general interest in cars, and higher subjective norms of car ownership. Among these variables, the strongest effect is found for the current positive experience as car passengers. Lower intentions to commute by car as future adults are associated mainly with a higher willingness to accept limitations of car travel and to a lesser extent with lower perceived behavioral control.

Greater intentions of adolescents to cycle to work as future adults are positively related to positive current cycling experience, negative attitudes towards cars, higher willingness to accept limitations on car use, and perceived higher likelihood of bicycle-oriented future vision. Among these factors, the strongest effect is found for the current cycling experience and the willingness to accept restrictions on car use. Adolescents' intentions to cycle to work are negatively associated with a higher subjective norm of car ownership.

Table 2 List of individual characteristics

Variable	Description
Male	Adolescent's gender (1 = male, 0 = female)
Hcars	Number of cars that are accessible to household members (0, 1, 2)
CPHres	Residence in Copenhagen (yes = 1, no = 0)
Mothuniv	Mother has a high education (yes = 1, no = 0)
Fathuniv	Father has a high education (yes = 1, no = 0)
Univasp	Adolescent's aspiration for high education (yes = 1, no = 0)
Carschool	Adolescent going to school by car (often/always = 1, occasionally/rarely/never = 0)
Carleisure	Adolescent going to leisure activities by car (often/always = 1, occasionally/rarely/never = 0)
Cycschool	Adolescent cycling to school (often/always = 1, occasionally/rarely/never = 0)
Cycleisure	Adolescent cycling to leisure activities (often/always = 1, occasionally/rarely/never = 0)
Mothdriv	Dummy variable for the mother driving to work (often/always = 1, occasionally/rarely/never = 0)
Fathdriv	Father driving to work (often/always = 1, occasionally/rarely/never = 0)
Mothpass	Mother commuting as a car passenger (often/always = 1, occasionally/rarely/never = 0)

Fatherpass	Father commuting as a car passenger (often/always = 1, occasionally/rarely/never = 0)
Mothcyc	Mother commuting by bicycle (often/always = 1, occasionally/rarely/never = 0)
Fathcyc	Father commuting by bicycle (often/always = 1, occasionally/rarely/never = 0)

Table 3 Measurement equations

Willingness to accept limitations on car travel			Positive cycling experience			Environmental concern			Subjective norm of car ownership		
Variable	estimate		Variable	Estimate		Variable	estimate		Variable	estimate	
Minlicage	1.000		Cyclike	1.000		Envconc	1.000		Cargrow	1.000	
Maxspeed	0.898	***	Cycfast	0.723	***	Envgood	1.111	***	Licexpect	0.928	***
Ghgquota	0.947	***	Cyceasy	0.739	***	Envtrans	1.056	***	Licfriend	1.074	***
Bandrive	1.049	***	Cycrain	0.749	***	Envfamil	0.705	***	Licpress	1.163	***
Maxkilom	1.033	***	Cycfree	0.681	***						
Licreq	0.775	***	Cycexer	0.440	***						
Congtoll	0.880	***									
Carcosts	1.059	***									
Carshare	0.978	***									

Bicycle-oriented future vision			Car-oriented future vision			Social influence encouraging environmental concern			Perceived lack of behavioral control		
Variable	estimate		Variable	Estimate		Variable	estimate		Variable	estimate	
Cycmore	1.000		Congcity	1.000		Envschool	1.000		Licdiffic	1.000	
Cycbetter	0.998	***	Pollutcity	1.559	***	Envfreind	1.381	***	Drivstress	0.993	***
Drivproh	0.393	***	Globwarm	1.363	***	Envmedia	2.062	***	Drivdang	0.946	***

Positive experience as a car passenger			General interest in cars			Negative attitudes towards cars					
Variable	estimate		Variable	estimate		Variable	estimate				
Carlike	1.000		Carinterest	1.000		Carpollut	1.000				
Carfast	1.440	***	Carmodern	1.066	***	Buspollut	0.753	***			

Careasy	1.413	***	Carfree	1.053	***

Notes: * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 4 Structural equations - effect of socioeconomic characteristics

Willingness to accept limitations on car travel			Positive cycling experience			Environmental concern			Subjective norm of car ownership		
Variable	estimate		Variable	estimate		Variable	estimate		Variable	estimate	
Carleisure	-0.142	***	Fathcyc	0.218	***	Male	-0.202	***	Cphres	-0.181	***
			Fathuniv	-0.195	*	Mothuniv	0.345	***	Carleisure	0.118	**
			Mothcyc	0.142	*	Fathcyc	0.154	*	Fathpass	0.197	***
			Cycschool	0.593	***	Univasp	0.195	***	Univasp	0.094	*
			Cycleisure	0.406	***						

Bicycle-oriented future vision			Car-oriented future vision			Social influence encouraging environmental concern			Percieved lack of behavioral control		
Variable	estimate		Variable	estimate		Variable	estimate		Variable	estimate	
Univasp	0.133	*	Male	-0.107	**	Fathuniv	0.149	**	Male	-0.230	***
Fathcyc	0.249	***	Hcars	-0.126	**				Hcars	0.142	**
Cycleisure	0.176	***	Fathdriv	0.180	***				Mothdriv	-0.177	**
			Cycschool	0.119	**				Univasp	-0.285	***

Positive experience as a car passenger			General interest in cars			Negative attitudes towards cars					
Variable	estimate		Variable	estimate		Variable	estimate				
Carschool	0.233	***	Male	0.337	***	Male	-0.352	***			
Carleisure	0.239	***	Cphres	-0.185	***	Mothcyc	0.152	*			
Mothpass	0.173	***	Carleisure	0.122	**						
Univasp	-0.090	*									

Table 5 Structural equations - hypothesized model structure

Dependent latent variable	Explanatory latent variable	estimate
Willingness to accept limitations on car travel	Environmental concern	0.415***
	Social influence encouraging environmental concern	0.683***
	Car-oriented future vision	0.363***
Intentions to drive to work by car as a future adult	Subjective norm of car ownership	0.370***
	Willingness to accept limitations on car travel	-0.624***
	Perceived lack of behavioral control	-0.254***
	Positive experience as a car passenger	0.811***
	General interest in cars	0.700***
Intentions to cycle to work as a future adult	Positive cycling experience	0.543***
	Negative attitudes towards cars	0.396***
	Subjective norm of car ownership	-0.251***
	Willingness to accept limitations on car travel	0.423***
	Bicycle-oriented future vision	0.275***
Correlation across intentions		
Intentions to drive to work by car as a future adult	Intentions to cycle to work as a future adult	-0.785***

Notes: [*] significant at the 10% level; ^{**} significant at the 5% level; ^{***} significant at the 1% level

4. Conclusions

We deployed a conceptual model framework aimed at understanding the intentions of adolescents to commute by car or bicycle as future adults, as elements towards promoting societal travel pattern transition and understanding the travel behavior of future generations. In line with other studies, more than 80% of the adolescents in our Danish sample stated that they intend to learn to drive and to own a car, with 46.7% and 28.1% saying they would like to drive a car and cycle to work, and with 34.3% and 43.0% saying that they would like to drive a car and cycle for leisure activities. Comparing this with data from the Danish national travel survey shows that 23.7% and 50.6% of the trips to work by young adults in their twenties respectively are conducted by bicycle and car; percentages shifting to 19.4% and 62.7% for the adults in their thirties. These

percentages remain roughly steady until the retirement age. The agreement between the intentions of adolescents and the observed behavior of young adults in their twenties indicates that, when asked about their intentions, adolescents mainly picture themselves as young adults in the third decade of their lives and it seems that car use intentions undergo a change towards higher car use for adults in the following decades of their lives.

Positive travel experience by bicycle, which is shaped by the adolescents' and their parents' use of the bicycle for commuting, is associated with adolescents' greater intentions to cycle to work as adults. Moreover, the belief in a bicycle-oriented future vision is positively correlated with a greater higher intent to cycle to work as future adults. Lesser intentions to commute by car are related to the adolescents' willingness to accept limitations on car use. The willingness to accept such limitations depend on adolescents' environmental concern, but also on their perceived future implications for car travel, social and media influence, and frequent car use to leisure activities. The model shows gender differences in the attitudes towards cars and environmental concern. Specifically, male respondents show more general interest in cars and less environmental concern. Last, residence in Copenhagen, which is characterized by an extensive bicycle infrastructure and a significant share of bicycle trips to work (36%), is negatively correlated with subjective norms of car use and general interest in cars.

Acknowledgements

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Paper 3

'Now or later?' Understanding adolescents' time-frame for their intentions to obtain a driving license and own a car

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Abstract

This study focuses on adolescents' intended time-frame for obtaining a driving license and purchasing a car and proposes a behavioural framework based on the socio-ecological model, comprising intrapersonal, interpersonal, institutional, community and policy domains. Qualitative interviews from a survey among 50 Danish adolescents were analyzed by means of thematic narrative analysis. Three groups were identified: car enthusiasts, who would like to be early car users, car pragmatists, who would like to have the license at an early stage and a car at a later

stage, and car sceptics, who are late license holders and car users. The groups are compatible with Moore's (1991) technology-adoption-lifecycle. Adolescents' vision of their future life script is highly influencing their future transport intention. Among the three groups, the car pragmatists have the highest potential to be affected by policy measures for delaying the driving license and owning a car. Efforts could be directed to promote a less car-oriented future and lay an emphasis on creating a tangible future vision with respect to sustainable transport through planning processes, public involvement and marketing campaigns.

1. Introduction

Car-oriented behaviour and attitudes are shaped from early childhood (Baslington, 2008). When asked about their future intentions, both children and adolescents aged (Baslington, 2009; Kopnina, 2011; Line et al., 2010; Sigurdardottir et al., 2013) indicated their intentions to obtain a driving license and own a car as future adults. These studies focused on the motivating factors to obtain a license and own a car among children and adolescents: positive car travel experience, convenience and travel independence, life script events (e.g., future family, employment needs), and psychological factors (e.g., peer pressure, cars as a status symbol, general interest in cars). While favourable intentions towards car ownership and driver's license often materialize into car-oriented travel already at the driving licensure age (Line et al., 2012), delaying these decisions can lead to higher use of sustainable travel modes, and potential benefits in terms of energy and fuel savings, improved traffic safety, and reduction of pollutants (Sivak & Schoettle, 2012). Positive attitudes of children towards cars are translated into car-oriented behaviour, but not always in early adulthood. Many countries have experienced a substantial decrease in the percentage of young people with a driver's license from their respective age groups has decreased substantially between the 1980s and the New Millennium (Sivak & Schoettle, 2012). Car availability and car use were also lower in the beginning of the millennium than in previous decades in France, Germany, U.K., Norway and the U.S. (Kuhnimhof et al., 2012). While possible reasons suggested for this phenomenon are rising fuel prices, environmental awareness, restrictions on car use, and improved public transport (Kuhnimhof et al., 2012), the factors involved in these recent age-related changes in licensure and car availability have not been investigated (Sivak & Schoettle, 2012).

This study explores the motivation underlying adolescents' intended time-frame for obtaining a license and purchasing a car in Denmark. The data consist of 50 in-depth interviews with 15 year-old adolescents recruited by Statistics Denmark. To explore the motivating factors underlying adolescents' time-frame for obtaining a license and purchasing a car, we employed a broad socio-ecological perspective (McLeroy et al., 1988). Thematic narrative analysis was applied for interpreting the underlying constructs expressed in the narratives towards offering a behavioural framework. Denmark was chosen as a case-study because a recent study from Denmark shows that while 80% of the adolescents stated that they intend to learn to drive and to own a car as

adults, only 47% and 34% stated their intentions to drive a car to work and leisure activities, respectively (Sigurdardottir et al., 2013). Indeed, data from the Danish national travel survey show that the proportion of 18 year-old and 35 year-old Danes who hold a driver's license are, respectively, 65% and 91%, and the proportion of car trips to work is 51% for young adults in their twenties compared to 63% for adults in their thirties. These data are promising in terms of the possibility to delay significantly the driving licensure and car assimilation by the market segment of young adults.

This article is structured as follows. Section 2 elaborates on the methods including the hypothesized behavioural framework, the survey design and the sample characteristics. Section 3 presents the results and section 4 offers concluding remarks.

2. Methods

2.1. Data source

Data consist of 50 in-depth interviews with 15 year-old adolescents recruited by Statistics Denmark from a representative sample of adolescents who participated in a large-scale survey regarding their future travel intentions and agreed to participate in in-depth interviews. The participants included both male and female adolescents from the core, the suburbs and the rural outskirts of the Greater Copenhagen Metropolitan Area. The interviews took place in June and July 2011 and were performed at the participants' location of convenience, were recorded, and lasted on average about 40 minutes. The interviews were semi-structured, and embraced a narrative approach encouraging the participants to share their experiences and thoughts related to their travel behaviour and values following relevant questions. The adolescents described their past travel behaviour as children, their current travel behaviour, and their future intentions to obtain a driving license and to own a car. They described underlying reasons for their intentions, and the impact of these decisions on their perceived future quality of life. The interviews provided the participants the space and time to reflect on the themes and tell stories about the travel patterns of family and friends, their attitudes and values associated with cars and driving, their knowledge from campaigns and school programs related to transport, and their perceived environmental efficacy.

2.2. Thematic narrative analysis

The current study applied thematic-analysis as a tool for pattern recognition across qualitative data. Thematic-analysis has the advantages of high flexibility, ability to generate unanticipated results and suitability to producing valuable data for informed policy decisions (Brown and Clarke, 2006). Two researchers performed the reading separately and then compared the elicited key elements and concepts for consistency. Next, the dataset complexity was reduced and its

manageability was increased by both referring to key questions and identifying key words and concepts. Then, the themes were reviewed for generating a coherent, mutually exclusive, easily identified and interpreted set of themes. The study implemented an iterative inductive-deductive procedure for searching, identifying and reviewing the themes, allowing for attaining data-driven patterns that are theoretically grounded and easily identifiable.

2.3. Behavioural framework

On the basis of the emerging themes in the narratives, a comprehensive behavioural framework was designed on the basis of the socio-ecological model (McLeroy et al., 1988) for analyzing the motivating factors underlying the selected tentative time-frame for obtaining a driving license and purchasing a car. The socio-ecological model framework comprises five thematic domains, namely the intrapersonal, interpersonal, institutional, community, and policy domains. The intrapersonal domain includes individual behaviour, attitudes, self-concepts, perceptions, and developmental history. In this study, the considered sub-themes include travel experience as a car passenger, general interest in cars, instrumental, symbolic, affective and relational value associated with having a driver's license and car ownership (Steg, 2005), financial awareness, and environmental concern. The interpersonal domain includes interactions with family, peers and friends and travel norms within these social networks. In this study, family travel patterns and travel subjective norms were considered. The institutional domain includes the role of organizations or institutions in supporting and promoting behavioural trends and changes. In this study, the considered organizational entities were the media, school programs and government campaigns. The policy domain refers to the use of policy measures for promoting behavioural change. In this study, the policy domain was investigated from the individual perspective, namely the focus was on the perceived environmental efficacy and the effect of car restrictions on the individual's quality of life. The community is the geographical and social network. In this study, the term community related to the social subjective norms, the role of the car in adulthood life, and the perceived transport provision by the authorities.

3. Results

The analysis revealed three distinct groups that differ in their intended time-frame for obtaining a license and owning a car and in their motivating factors related to the socio-ecological domains. The groups are compatible with the levels of market penetration in the technology-adoption-lifecycle, described in Figure 1 (Moore, 1999). The first group is composed of *car enthusiasts*, a reduced share of the participants (12%) who exhibit strong intentions to obtain both the license and the car early in the near future, and potentially form the early market among young people who are future car users. The second group is formed by *car pragmatists*, the majority of the participants (70%) who associate practical value with having a driving license in the near future and having a car at a later life stage, and represent the greatest market share of potential young

car users. The last group is made by car *sceptics*, a small share of the participants (18%) who are sceptical regarding their immediate and future need for obtaining a license and having a car and intend to do both at a later life-stage, and contribute to the completion of car assimilation in the market of young car users. The following sections describe the characteristics of the three groups and their underlying motivation for their intended time-frame.

Moore's market adoption-lifecycle curve
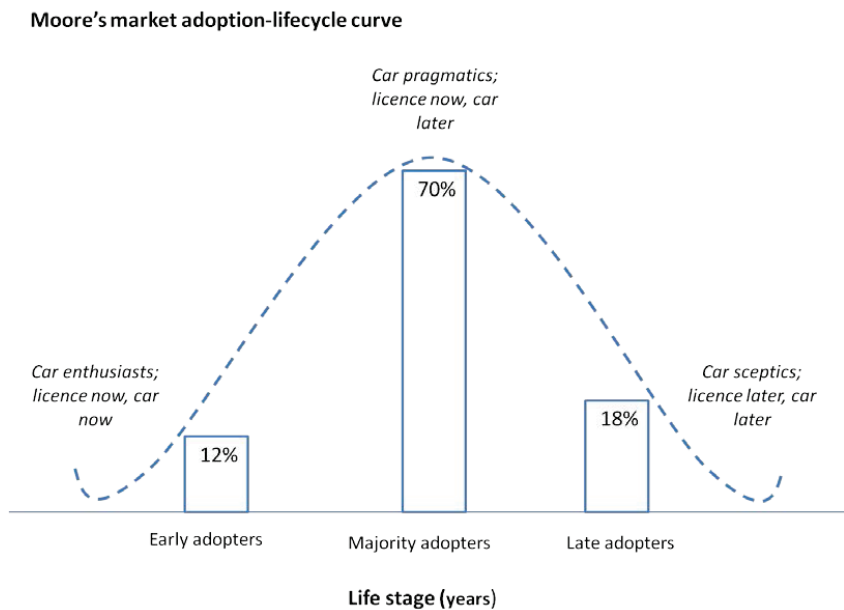
Fig 1. The car adoption life-cycle among young adults.

3.1. Car Enthusiasts

Car enthusiasts have strong intrapersonal motivation for obtaining a license, owning and driving a car as future adults. They exhibit positive attitudes towards cars, they show high interest in cars, and they associate high instrumental, affective, symbolic, and relational value to the cars. Car enthusiasts can identify top gear, expensive and affordable cars by brand and model. The instrumental value of obtaining a driver's license and having a car is related to achieving high-end goals of gaining travel independence and increasing the spatial opportunity space, rather than low-end goals of travelling to reach locations or activities. Nevertheless, car enthusiasts perceive the car as a 'must have', a fundamental need for their life. The affective value of cars is expressed as a positive feeling towards a driver's license as a source of happiness and life opportunities, and as affection for cars and often motorcycles. Car enthusiasts have a clear image of their dream car and detail their preferred brand, model, colour, features and accessories. The symbolic value of the car as a status symbol reflecting financial status, prestige and positive self-image is manifested

through the adolescents' excitement to have expensive, pretty, and new or pimped-up cars. While they have realistic estimates of the financial cost of owning a car and are aware of the air pollution generated by cars, they do not perceive these as barriers to car ownership and are determined to have a car regardless of the cost involved or the air pollution it generates. The relational value of the car is reflected in the value cars have for socializing means. Car enthusiasts are keen to engage in chauffeuring activities for friends and younger siblings, as well as to drive around with others also for long-distance trips and as a stand-alone leisure activity. They have a positive experience as car passengers and they view driving as a stand-alone leisure activity rather than as a mean to arrive from an origin to a destination. They are eager to learn to drive and some have already tried to drive in parking lots or fields.

The family members of car enthusiasts are highly car-oriented, with parents and older siblings encouraging car use both passively and actively. Passive encouragement consists in parents serving as role models and enhancing the adolescents' relational value of the car by driving them around. While not all the parents have a driving license, at least one adult in the household is highly car dependent and uses the car for commuting, shopping, driving to social activities, and chauffeuring the children. Active encouragement entails giving financial support for the driving lessons, often as a reward for non-smoking behaviour, or accumulating savings to be used from the age of 18. In addition, the parents (fathers in particular) actively stimulate interest for cars with broad discussions and own behaviour as many enjoy taking care of cars and repairing them. Older siblings (both male and female) also play a significant role, as many car enthusiasts have older siblings who show a general interest in cars and car repair, have a driving license and have a car available. They chauffeur their younger siblings or drive them around, share their car interest and experience the advantages of being able to drive and the affective value they associate with the cars. Notably, when thinking about their own family in the future, car enthusiasts follow the familiar car-oriented family pattern imagining a household with two cars, and multiple uses for the car including commuting, shopping and chauffeuring children. For the car enthusiasts, obtaining a license at the age of 18 is a strong social norm. Their friends share the same intense interest in cars and together with their friends, car enthusiasts discuss their intentions to obtain a license and the various car brands that they could possess.

The influences of institutional factors, for example school programs that promote health and environmental awareness and non-motorized transport modes, have little effect on this group because of two reasons. Firstly, car enthusiasts show little knowledge about transport related environmental impacts, as they perceive the environmental impacts as intangible and thus of lesser concern. Secondly, car enthusiasts acknowledge that school programs to encourage non-motorized modes are ineffective because of the strong car-oriented norms in their social networks. In contrast to the little effect of pro-environmental school programs, car enthusiasts are very attentive to car advertisements in the media. They remember visual and textual content, mildly criticize the lack of realism related to the car advantages, but perceive them as a good information source and identify with the positive image of cars. Regarding the community and the

policy domains, car enthusiasts believe in low environmental efficacy. They do not believe that people care about the environment and hence they do believe in voluntary behavioural change without government intervention through legislation. They envision a highly technological advanced car-oriented future, were cars will be more environmentally friendly. Some however do not think that cars pollute so much and the focus should be to reduce the pollution from other industrial sectors before focusing on the car industry. Car enthusiasts associate not having a driving license with strong negative emotional impact and perceived lower mobility, limited working opportunities, and reduced quality of life. They have difficulties to imagine their future without a car, although those who mainly associate cars with a high-end instrumental value are willing to borrow or share a car if necessary.

3.2. Car Pragmatists

Car pragmatists have a high intrapersonal motivation for obtaining a license and a moderate intrapersonal motivation for owning a car as future adults. They associate the license with the practical reason of being able to drive, but also with its own stand-alone value as both as an important skill, a status symbol and a stepping stone towards adulthood. Car pragmatists differ in their degree of interest in cars. Many remember top-gear and vintage cars, and can identify a brand with being expensive or affordable. Others say they have little knowledge or interest in cars. Car pragmatists associate aesthetic value to cars rather than high affective value, by describing cars as cool or nice to have, rather than saying that they love cars. Car pragmatists are aware of the symbolic value of the car as a status symbol reflecting financial status, cool lifestyle and own self-image, but they are not attracted to large size, fast or expensive cars and perceive driving those cars negatively (e.g., immodest, foolish). They rather refer to their preferred car as a small, functional, fuel-efficient, safe and reasonably priced family car that suits their needs. While most car pragmatists do not have a preferred brand, a few have a particular car type as a 'dream' car. A few girls refer to small retro cars (e.g., Mini-Cooper, Beetle, Fiat500) with bright colours (i.e., red, green, orange), which they perceive as cute feminine cars. A few boys refer to sport cars or expensive car brands, although recognizing that such dream cars are not realistic. Car pragmatists are aware of the financial burden associated with taking driving lessons and obtaining a license, and the costs related to having a car, in terms of both the purchase price and fuel costs and the need for economic efficiency. In the cases where the older siblings bought a car, car pragmatists consider the financial burden associated with their older siblings' car ownership and the tradeoffs between owning a car and other lifestyle decisions. Car pragmatists associate high instrumental value of obtaining the license and using the car for achieving low-end practical goals of travelling to activities or locations, and high-end goals such as gaining travel independence and increasing the spatial opportunity space. While their travel needs can be accommodated by public transport and cycling, car pragmatists view the car as an important mean of increasing their travel convenience. They consider travel time savings, schedule flexibility, travel time reliability, travel ease and comfort as reasons for choosing the car as a transport mode. Car pragmatists are willing

to use other transport modes dependent on their travel ease and availability in the residential location. In particular, the instrumental value of the car decreases with reduced travel ease for example due to difficulties to find parking, driving stress, need to refuel, and car-related costs. In addition, while car pragmatists accept and accommodate to the extensive chauffeuring by their parents, they perceive obtaining the license as a mean to gain travel freedom and independence as adults by avoiding the need to be driven around. Car pragmatists associate high relational value to the car and identify chauffeuring as part of their role as future caregivers. In particular, some of the car pragmatists associate the need to have a car with the life-script events of having children and the need to transport children. A few adolescents are also keen to share the driving burden of long-distance family trips with their parents and to help them with grocery shopping and driving around their younger siblings.

The family members of car pragmatists are moderately car-oriented, and parents moderately encourage car use both passively and actively by providing a mixed role model comprising both more and less car-oriented lifestyles. Passive encouragement to car use consists generally of one parent being more car-oriented and using the car for short and long trips and for multiple purposes, and the other parent being more flexible in travel choices and using mainly the bicycle and/or public transport. The share of male and female parents as primary car users is similar. In some households, passive encouragement consists of both parents tending towards moderate car use and favouring the use of alternative modes. The reasons provided by the adolescents for the mixed used of transport modes are mostly financial concerns, convenience due to parking scarcity and public transport availability, and to a lesser extent also environmental concerns. The parents discuss car expenses openly or exhibit frustration over fuel prices. Active encouragement to car use consists in parents increasing both the instrumental value of the car as a transport mode and the relational value of the car by chauffeuring children to leisure activities. Most adolescents' cycle to school and the level of chauffeuring differs across families. Some parents engage in extensive chauffeuring upon request and provide the impression that chauffeuring children does not induce any extra effort or detour because "it is on the way". Other parents have clear rules about their willingness to engage in child chauffeuring, mainly during the evening and night, in places with low public transport availability, activities in a relatively long distance from home, and harsh weather. Some parents cooperate with other parents to carpool. Only a few adolescents are largely travel independent. Active encouragement consists also in the parents discussing with their children about obtaining the driving license and offering to pay the driving lessons. Older siblings generally hold a driver's license, but only half who have a license have also a car. Instead, the parents allow the older siblings to borrow the family car on a regular basis, thus encouraging car sharing within the household and making adolescents perceive the family car as widely available for accommodating their future travel needs. Many car pragmatists mention obtaining a license or using the car as a strong subjective norm, often generalizing by using the words " normal", "everyone", "most young people" with respect to obtaining a license and having a car. They believe that most of their friends would like to obtain the driving license once they turn 18 years

old and have a car in the future.

For institutional factors, most car pragmatists say that they only learn a little bit about environmental conservation at school and that they do not remember much about what they have learned, but they recall the focus not being on transport. They mention the need to save energy, reduce pollution from power plants, use renewable energy in power plants, save water, and recycle paper. Most car pragmatists say that they do not know or think much about car-related emissions. When asked specifically about "bike-to-school" programs, car pragmatists remembered such programs in elementary school, and related them to health concerns. A few car pragmatists refer to the information that they learned in school as an 'eye opener' and that they are happy they could make a difference with their own behaviour. Some car pragmatists are affected by car-oriented cultural norms in the media in films, television series, and advertisements.

Regarding the community and policy domains, car pragmatists envision a highly car-oriented future with greater use and higher number of cars. They also hope that in the future cars would become more environmentally friendly through technological advancements. Suggested solutions for reducing transport-related emissions included; investments in electric cars, fuel-efficient cars and alternative fuels. Car pragmatists do not believe in voluntary behavioural change because of the difficulty for people to change their car use habits. They perceive car restrictions as a last resort with a limited value because of the political unacceptability of limiting travel freedom and the central role of cars in people's life. Instead, they suggest encouraging public transport use through improving the coverage, expanding the metro and reducing the fares. They also mention that eventual restrictions should be very mild and allow people to use the car according to their needs. Examples are restricting car ownership to two cars per household, and limiting car use on Saturday or Sunday. Nevertheless, some car pragmatists mentioned that if restrictions would be imposed, they would be flexible and adapt their travel behaviour. When asked directly about the effect of not having a driving license or a car on their quality of life, most car pragmatists perceive that in the short term they can continue to cycle or to use public transport and either are not sure about how it will affect their life, or perceive little to no effect on their quality of life. Some car pragmatists mention that they would be happier to use the car occasionally, so they could stay in shape to avoid the stress of daily car use, while others say using the car would increase their travel freedom, would make their life easier and happier. Nevertheless, car pragmatists perceive the car as essential in the long term and cannot imagine their life without a car, as their quality of life would be reduced if they would not use the car for transporting children or pets, or if they would live in the countryside. Several car pragmatists also compare their life without a car to the social norm or car ownership and believe that the social norm obliges them to have a car in the long term.

3.3. Car Sceptics

Car sceptics have weak intrapersonal motivation for obtaining a license or owning a car as future adults. They are not particularly interested in cars. When asked about reflections of their future car, car sceptics focus on basic practical aspects (i.e., functionality, size, fuel efficiency) rather than aesthetics or accessories. They do not feel the immediate need of having a car because they associate limited instrumental value to the car as a mean to reach activities or locations. They feel that their daily travel needs and their travel independence are accommodated by cycling and public transport, and they perceive the car as a 'safety-net' that occasionally can help with certain distances (e.g., long-distance trips for family visits), purposes (e.g., shopping trips, work-related trips), places (e.g., the countryside), time constraints, and conditions of the available transit service, the cycling infrastructure, and the weather (e.g., 'pouring rain'). Some car sceptics are aware of the value to cars as status symbols representing wealth or cool lifestyle, but associate low importance to it. Rather, they associate a cool lifestyle with other forms of living large including travelling around the world, living abroad or buying a boat. Car sceptics associate limited relational value to the car, as they associate the car with child care and child chauffeuring needs as part of normative family life like car enthusiasts and pragmatists, but also imagine themselves using a cargo-bike for this purpose. Unlike car enthusiasts, they do not consider cars as means of socializing or explicitly prefer to avoid chauffeuring their friends when engaging in joint social activities. Car sceptics are also aware of the negative environmental impact of cars, mainly air pollution, and the financial expenses associated with having a car, mainly fees associated with obtaining the license and fuel expenses. Environmental and financial reasons are key elements in their choice to continue to cycle and use public transport and to delay obtaining the license and owning a car. Car sceptics do not have a particular good experience as car passengers, and with one single exception, they associate car trips with feeling sick or bored, and enduring lack of air and space.

The family members of car sceptics are environment and health-oriented, and talk at home about recycling, focusing on efficient use of resources, engaging in fitness activities and limiting car use because of environmental concerns. The parents and older siblings discourage car use both passively and actively. Passive discouragement consists in the parents serving as role models by making limited use of the car, for example for long-distance family visits and in bad weather. At least one parent commutes by bicycle or train and drives to work only occasionally. The parents engage in very little chauffeuring of children, thus contributing to reducing the adolescents' car use and the associated relational value. Although the parents engage in child chauffeuring for young children, chauffeuring decreases with age and the children are expected to gain more travel independence. Most older siblings (both male and female) of car sceptics cycle as their primary transport mode and exhibit a significant delay in obtaining a license or buying a car. The social networks of car sceptics include friends who mostly cycle, with a minority of them being driven by their parents. Car sceptics do not discuss the possibility of obtaining a license or driving a car with

their friends, and they believe that the majority of their friends have low interest in cars and would not obtain a license or buy a car in their early twenties.

For institutional factors, most car sceptics have some educational programs in their school that promote health and environmental awareness or the use of non-motorized transport modes. They recall key words such as global warming, climate change, and CO_2 emissions, and they are aware of the negative environmental impact of cars in terms of air pollution. They recall particular classes (i.e., geography, biology) and teachers focusing on environmental conservation. Their schools often encourage active transport with programs such as "bike to school week" and not allowing cars to enter the school parking lot. Other car sceptics, however, do not remember much from the school programs, admit that they are not interested in them, or refer to environmental conservation in general rather than in relation to transport in particular. Among the experiences, being a scout and the role of the media as an information provider emerges among car sceptics, although the description of the influence of these programs on their behaviour is minimal and there is disagreement on the effectiveness of these programs.

Regarding the community and the policy domains, car sceptics envision a future in which technological advancements would lead to more environmentally friendly cars such as electric and solar power cars, and in which there will be higher incentives to use public transport because of wider supply and lower fares. Some car sceptics believe that car restrictions should be imposed by legislation, but others oppose them and believe in voluntary behavioural change without government intervention. Car sceptics believe in some environmental efficacy, with individuals being able to contribute to protect the environment. Nevertheless, they believe that a national effort is required for advancing towards a more sustainable future. The possibility of not having a driving license is not associated with negative emotional impact and car sceptics do not perceive that their mobility, opportunities or quality of life would be lower without obtaining a driver's license or having a car. They can very easily imagine themselves using the bicycle and public transport in their daily adult life, including chauffeuring young children with a cargo-bike, but having the driving licence 'just in case'.

4. Conclusions

This study explores the motivation underlying adolescents' intended time-frame for obtaining a license and purchasing a car in Denmark. The analysis revealed three distinct groups that differ in their intended time-frame for obtaining a license and owning a car: *car enthusiasts*, a small share of the participants who exhibit strong intentions to obtain both the license and the car early in the near future, *car pragmatists*, the majority of the participants who intend to obtain a driving license in the near future and to own a car at a later life stage, and *car sceptics* who intend to do both at a later life-stage. The groups and their proportions in the dataset are compatible with Moore's (1991) technology-adoption-lifecycle. The motivating factors of each group were analyzed by applying McLeroy's et al. (1988) socio-ecological model.

Among the three groups, the car pragmatists have the highest potential to be affected by policy measures for delaying the driving license and owning a car. Financial policy measures could be effective for car pragmatists due to their high sensitivity to the financial expenses associated with obtaining the license, purchasing a car, and using a car, their willingness to use alternative transport modes in case that car use restrictions are imposed, and their feeling that life quality in the short term would not be negatively affected in case of lower car use. The high financial concern of car pragmatists supports the suggestion of Kuhnimhof et al. (2012) regarding the importance of fuel prices in the decision to delay car ownership and use. Policy measures related to pedestrian friendly and safe urban design, mixed land-use, and public transport provision, along with car restrictions, could be beneficial for lowering the instrumental value of the car compared to other transport modes and decoupling the car from the perceived opportunity space. Policy measures aimed at increasing the travel independence of adolescents, and the use of sustainable transport modes for both youth independent trips and joint family trips, could also be useful to delay the car use in this group, because car pragmatists are often driven by their parents to activities thus developing higher car dependence. Institutional factors, such as school programs to encourage environmentally sustainable transport behaviour, have a low to negligible effect on all three groups in their current form. The general recall level across the three groups was low, with many adolescents less concerned about sustainable transport in comparison with energy saving or recycling. Further research should be dedicated to increasing the effectiveness of educational programs and national campaigns. Last, all three groups imagine highly car-oriented future, embracing technological solutions and largely rejecting behavioural solutions for increasing transport sustainability. Nevertheless, both car pragmatists and car sceptics show high willingness to alternate between the car, the bicycle and public transport, and to accept mild car use restrictions. Because the envisioned future serves as a beacon for transport decisions and intentions, efforts could be directed to promoting a less car-oriented future and putting an emphasis creating a tangible future vision with respect to sustainable transport through planning processes, public involvement and marketing campaigns.

Acknowledgements

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Appendix 1

Table 1. Example of quotes for the groups on all domains

Domain	Group	Example quotes
Future intentions	Enthusiasts	Angela: "I would like to have car, maybe when I am 18-19 or maybe when I am 20… But it is going to be one of those small old cars that are actually really bad for the environment… But I would like to have car when I am around 18-19 years old….. I have always been driven around and I could very well imagine me trying it out myself …Also in the beginning everybody thinks it is cool that you have gotten your license, that you can drive a car, and of course I can't wait to be able to do it myself…I would like to have an Audi A4 or an Audi R8, I think that is a really cool car, but then again I need to perform better at school so I can have lots of money when I grow up"
	Pragmatists	Suleijma: "I want to take the license when I am 18 but I am not going to drive much, or buy a car now….Now I have a moped license, I can cycle, and now I just need to learn how to drive, and take the driving license, right? Maybe I would like to have a car in the future but not as soon as I get the license"
	Sceptics	Barbara: "Having a car when I grow up? I do not really think much about it... I think there is a long time yet, so I have not even imagined anything about it yet, so I do not know"
Intrapersonal domain	Enthusiasts	Tim: "A car means everything to me…I love cars, I love them, they mean a lot to me…The good thing about cars is that you can drive around, you are sitting inside so if it is raining you do not get wet and it is really - really neat to have car"
	Pragmatists	Rasmus: "What does a car mean…well for me it is only a transport means…exclusively…but there are some that are so quite enthusiastic and that is not quite me. One of my friends says that he wants a Lamborghini that costs 2 million DKK or something, I would rather travel around the globe or something for those 2 millions and then by me a cheap used car"
	Sceptics	Anders: "I don't really know if a car means anything to me. It has always been a safety net so you can always get to places if you really want, for example if it isn't manageable with a bicycle and you can't really take the train, then you can get where you need to go. But actually I don't feel like that, I can self get around and I grew up with the attitude that if you want to go somewhere, then you have to get there yourself. That way you learn to manage on your own"
Interpersonal domain	Enthusiasts	Tim: "My step father has allowed me to drive a mini-digging machine…I have driven it many times….I have tried to drive a car a little bit, I tried it over at Jutland with my real father. He has a small Opel and I just tried to drive back and forth….It wasn't really that much but he has promised me that I can try it again when I come over to his place again"
	Pragmatists	Jette: "Well, my parents prefer that if there is an activity during the evening they would like to know that we are safe so they have no problems driving us and picking us up. I have been picked-up at 02:00 at night quite often. They are just more comfortable with that….we have always done so and if we are going somewhere they have always offered us to be driven, so it is me and my sister that make the decision if we want to drive or take the bus"
	Sceptics	Freja: "We use our car for the necessary things, now the supermarket is just across the street from us so it is not like we use it to shop for groceries and my dad also likes to take walks. So we just use it when it is really necessary, not like we say 'hey let's take a drive somewhere'"
Institutional domain	Enthusiasts	Angela: "Sometimes the car advertisements can be a little exaggerated I think, but they give a picture of the car even though it might not be the most expensive car…they can still be pretty and effective…those old Toyota adds where they had the slogan Today, Tomorrow, Toyota – that is something you will always remember and because it was there for a long time"
	Pragmatists	Mona: "We have learned that it is better to use renewable energy, from wind turbines and hydroelectric power... but about transport? It has been difficult because people came from far away, so I think the schools have not focused on that, it has been more about remembering to turn off the lights and to turn off the computer and perhaps not

		to toast the bread, and things like that. And there have been moments where I thought 'seriously, but okay'"
	Sceptics	*Anders: "We have had a lot about the environment at school, but it's probably because we had a teacher who was very engaged and taught us how to save the environment and I did attend a real environment school... it has probably influenced me to think like a bit more like 'oh alright then I can cycle today' and things like that. Also I save just a little by cycling instead of asking whether I could be driven"*
Community domain	Enthusiasts	*Mohammed: "I am going to have a car as well… an education and then a car… because it is different when you are 18, then you don't want to take the bus to work... It will actually mean a lot if I won't take the driving license, if I am going to work in the transport business and maybe drive a truck... so it all depends on that license... When I have family and all, me and my wife will have a car each… So she can drive to work and I can drive to work and I don't have to drop her off anywhere"*
	Pragmatists	*Dorte: "The need for a car? I don't know, I think that it has something to do with when you get a job and it's simply impossible to take the train, or if you have 3 kids or 10 dogs that you have to transport, not that it's something I think I would have but…but when it's clear that I can't use the train, bicycle or the bus. You can do that with most things. In any case I plan to live in Copenhagen or Roskilde, and there the train goes every five minutes, right?"*
	Sceptics	*Hans: "No I don't think I will take the driving license right away, I think I will wait until I am maybe in my twenties… I don't think that I will need it, anyway from 18 until 20 something I will be going to high school and then to the university, so I can just as well use the public transport… Afterwards, when I get a job, a car might be good, but if I worked close by I would walk or cycle, but the car would still be there, just not used so much… I of course don't know so much about the future, but I am pretty sure that I won't need a driving license any time soon… A car is a really necessary thing to have, if you have to go far. But I would try to use the train, public transport and cycle as much as I could, I would start to focus on that… I would like that the most, but if I will need to have a car because of my work, then it will probably be some kind of an electric car, I hope"*
Policy domain	Enthusiasts	*Kamilla: "They (the government) could for example say that you couldn't drive on Sundays in your car... you could do a lot of things... but then again it could be that somebody had to use his car on Sundays, and yes well then you can't really say that he is not allowed, so I don't quite know if it should be done that way… I don't think I could completely be without a car, I don't think so. Also if you have to go to friends you don't feel like taking the PT every time, if they live far away and you have to change and then it is late in the evening, then it is just good to have your own car. So I don't think I could manage without one, no I wouldn't"*
	Pragmatists	*Nadia: "How can we improve transport? This is a good question. There are of course electric cars, but I do not think that they are far less polluting than petrol cars because using electricity also increases global warming.... so I think it's hard to change it now because I think that people like to have habits, and when they get used to one thing it's hard for people just to change, at least if almost the entire world population that has to do it. Therefore if you're doing a lot of campaigns and stuff, I think that most people will just not care because they think 'it does not affect me' or 'it cannot happen to me' when actually it influences everybody"*
	Sceptics	*Troels: "I don't know if not having a license would influence my life. It could be that I would just say 'well now I don't have a license' and then I would just take the train even though it takes longer time and I might need to change trains, but I don't know, that is something I would figure that out along the way…If I didn't have it before and I haven't experienced it I wouldn't know about it. You can't miss something that you never had…..because then you do not get used to that routine, for example driving to work, but if you get used to other modes I think it would be fine…Then I think that you can easily live without a car."*

DTU Transport performs research and provides education on traffic and transport planning. It advises the Danish Ministry of Transport on infrastructure, economic appraisals, transport policy and road safety and collects data on the transport habits of the population. DTU Transport collaborates with companies on such topics as logistics, public transport and intelligent transport systems.