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Investigating car users' attitudes to climate change using multiple correspondence analysis

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ABSTRACT

In recent years climate change and environmental issues have attracted worldwide attention and local, regional and national authorities, as well as policy makers, have accelerated their efforts to identify suitable emission reduction policies and measures. According to the UK Department for Transport, around a quarter of domestic carbon dioxide and other greenhouse gas emissions can be attributed to transport. Therefore, the UK Government has mandated reductions of 67% by 2050 over 2010 levels. This paper investigates car users' attitudes to and awareness of climate change to gain further understanding of how those attitudes relate to their travel behaviour. A comprehensive analysis of the British Social Attitude Survey (BSA) datasets of 2011 and 2014 was achieved by using a multi-faceted analytical approach which included Exploratory Factor Analysis (EFA), Multiple Correspondence Analysis (MCA), Hierarchical Cluster analysis (HCA) and Multinomial Logistic Regression (MLR). The dimension reduction process by means of the EFA has resulted in three main factors: "*traffic awareness*", "*perceptions and actions,* and "*environmentally sensitive*". The HCA and MCA resulted in seven clusters that were based on car users socio–demographic and travel behaviour variables. The outcomes from the EFA, MCA and HCA were analysed further using MLR methods to investigate respondents' perceptions in greater depth and to relate them to their travel behaviour. These were used as main variables in the MLR analysis. Although 81% of respondents agreed that human actions are partly responsible for climate change impact as per the initial descriptive analysis, the MLR analysis revealed that the group described as 'middle-aged males and females in full time employment' and 'older-aged males in retirement' in 2014 exhibited an increased likelihood of holding a positive attitude towards "*perceptions and actions*" regarding climate change than the similarly described cohort in 2011. Intervention mechanisms to encourage mode shift to sustainable modes would be more likely to achieve success if tailored to this group.

1. Introduction

Transport is considered a driver for economic growth given its role in moving people and goods across regions and cities (DfT, 2014), yet transport is also a major source of greenhouse gas emissions. The transport sector was responsible for 14% of global greenhouse gas emissions in 2010 and accounted for approximately 23% of energy-related emissions (SKTP, 2016). Emissions from transport have increased rapidly regardless of some significant CO_2 reduction measures implemented to different degrees across the world. Low carbon transportation systems offer significant mitigation potential, enhancing growth in traffic and development of areas and regions while reducing economic, environmental and social costs. SKTP (2016) emphasized that transportation and mobility are essential to sustainable development and went on to recommend that municipal governments, local and regional authorities need to be proactive in initiating sustainable transport systems when setting a vision for reducing carbon.

With the approval of the Climate Change Act 2008, the UK became the first country in the world to set up a long-term target for reducing greenhouse gas emissions (GHG); for example, at least 80% reductions by 2050 over 1990 levels (NIRS, 2000). While changes to the climate can occur due to natural processes, the effect of man-made GHG is responsible for recent upward shifts in global temperatures and transport use plays a major role.

In 2012, 21% of the UK domestic GHG were due to road transport (DfT, 2014). This higher share means that no climate action plan can be successful without the inclusion of transport plans. A reduction in vehicle kilometres travelled by motorised vehicles, by delivering a modal shift towards sustainable modes, is necessary to meet the carbon target (DfT, 2009). Undoubtedly the growth in car ownership, demand for personal mobility and traffic congestion generates negative impacts on the environment (Susilo et al., 2012). Several policies and interventions such as Travel Demand Management, also called Mobility Management, have been introduced in the UK and overseas over recent years to minimise travel-related impacts on society and the environment. The emphasis on these policies has been changing significantly in recent years with particular attention being paid to environmental aspects (Tight et al., 2005; Chapman, 2007; Marsden and Rye, 2010).

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As a result, the modal shift towards sustainable alternatives, including cycling and walking as well as public transportation, gained more attention in recent policy proposals in the UK (DfT, 2012). Under the Local Transport Plans (LTP) initiatives, the Local Authorities (LA) in the UK work towards achieving emission reduction targets by promoting public transport alternatives, supporting the market for low carbon transport and encouraging travellers to move from fuel-hungry vehicles to low carbon vehicles (DfT, 2012). Increasing awareness and nurturing an understanding of climate change and its effect on each individual in our society is a great challenge. On the other hand, it is questionable whether raising awareness alone would be sufficient to change travel behaviour. Previous research brings mixed responses to this question: for example, Anable et al. (2006a); Susilo et al. (2012); and Ho et al. (2017), and this will be discussed in Section 2.

Whilst previous studies examined the effect of travel behaviour, attitudes, the connection between them and their relevance to mode choice decisions, there is a lack of research in the area of travel attitudes and their relation to the environment. This study has considered the influence of travel attitudes on travel behaviour and whether or not travellers take into account climate change and environmental issues when making their mode choices, with particular attention to car users. Given that travel by car is the least sustainable compared to the other modes, as well as the damage it causes to the environment, this study focuses on car users. Due to the convenience, privacy and comfort that cars offer to travellers, influencing behaviour change is a challenging task. For this reason, it is vital to explore and identify the groups of car users who are most likely to change mode to sustainable modes. This will provide very useful information to local authorities (LAs), as future policies and marketing campaigns can then be tailored to relevant car user groups.

The overarching aim of the research reported in this paper is to investigate car users' attitudes to climate change and to explore whether attitudes change over time. This research makes several important contributions in the theoretical and practical domains by focussing on attitudes and perceptions of car users towards climate change. The data used for this research were from the British Social Attitude Survey (BSA), predominantly categorical and, therefore, careful attention was given to setting up the methodological approach for data analysis and modelling. A multi-faceted four steps approach to the analysis was adopted to systematically analyse categorical variables.

This paper begins in Section 2 with a critical review of previous research to investigate the connection between transport and climate change, followed by research questions in Section 3. In Section 4 the data used for this study are described. Next, attention is directed to research methods used in this study, covering factor analysis, MCA, cluster formation, and finally logistic regression modelling in Section 5. Section 6 presents the results of the data analysis and the research findings are discussed. Finally, in Section 7, the paper draws conclusions and makes recommendations. The specific application of MCA to transform and cluster categorical data in this analysis is novel.

2. Previous research

This section highlights previous studies which have quantified the challenges, attitudes to climate change and travel behaviour and how policy might be used to influence behaviour.

2.1. Transport and climate change: What are the challenges?

The “Stern Review” on the Economics of Climate Change emphasized the need for immediate action to alleviate GHG, as the benefits of bold, early action considerably outweigh the costs if delayed (Stern, 2006). Accordingly, the total cost of climate change was estimated to be equal to a drop of at least 5% of global gross domestic product each year if no further action is taken. Thus, climate change is one of the biggest challenges that we face today. Car use, road freight and aviation are seen to be the major contributors to GHG (Chapman, 2007).

Waterson et al. (2003) identified a significant modal shift to public transport as an option to reduce CO_2 emissions from road transport and ‘zero-carbon’ alternatives, such as walking and cycling, are worthy alternatives. However, it was acknowledged that changing attitudes concerning dependency on private transport will be a great challenge. In the UK, a quarter of all car trips were short distance journeys under two miles (Mackett, 2000). Such short trips can easily be made in a more sustainable way by walking or cycling by a high proportion of the population. Ryley (2001) stated that 89% of drivers surveyed agreed with the statement, “I would find it very difficult to adjust my lifestyle to being without a car”. This indicates that behavioural change is a big challenge as society has largely become overdependent on car use.

In order to achieve the GHG targets from the transport standpoint, behavioural change brought about by suitable policies will be vital (Chapman, 2007). Integrating transport policy and social psychology were recognised as important to help drivers move away from their cars (Stradling et al., 2000) onto more sustainable transport modes. While technological solutions offer ways to achieve the targets attached to climate change over the longer term, there is a pressing need to achieve change in short-term behaviour and travel habits through current policies (Anable, 2005; Boardman, 2005; Chapman, 2007).

2.2. Travellers attitudes to climate change: Do they influence behavioural change?

People fail to achieve anticipated behavioural changes if they have no beliefs or perception. Perception leads to attitude which ultimately influences behaviour. On the other hand, travel behaviour is not only influenced by people's preferences but also as a result of compromising many other factors including those relating to individuals, households and socio-demographics (Curtis and Headicar, 1997; Susilo et al., 2012; Susilo and Cats, 2014). Schade and Schlag (2003) found that there were positive associations among acceptability of urban transport pricing approaches with social norms, personal effect potentials and perceived effectiveness. Besides that, Beirão and Cabral (2007) and Shiftan et al. (2008) examined the relationship between mode choices and travellers' attitudes, and found that potential users were attracted to the services that can accommodate travellers' needs such as punctuality and reliability.

The researchers paid particular attention to the habit of using a car as it is fundamental to understanding this mode choice behaviour (Anable, 2005; Susilo et al., 2012; Susilo and Cats, 2014; Ho et al., 2015). Psychology should be considered when studying the propensity to switch travel mode choice as environment issues and concerns and car dependency is increasing (Anable, 2005). Thus, promoting sustainable transport, such as encouraging walking and cycling, requires raising awareness of available sustainable mobility services, including public transport, with emphasis on key aspects such as accessibility constraints, basic safety and security, convenience and cost, enjoyment, and habit, all of which were identified as important by Schneider (2013). Whilst, Nkurunziza et al. (2012) and Li et al. (2013) demonstrated that bicycle commuting, in particular, is strongly related to personal motivation and attitudes.

Some people think that they must change their behaviour to use more sustainable alternatives, whereas others do not. However, in a study by Susilo et al. (2012) almost all agreed that other people were required to change their actions to guarantee a sustainable future rather than take action themselves. Travellers are aware of environmental problems, but their interpretations do not necessarily match their travel behaviour (Tertoolen et al., 1998; Anable et al., 2006b). According to Anable et al. (2006b), there are certain car-owner groups of travellers whose environmental concerns, as well as sense of responsibility, are greater than others. This suggests that there is potential for mode choice behaviour change. A recent study by Ho et al. (2015) clearly pointed out the need to provide information to travellers, such as the benefits of