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Adoption of alternative fuel vehicles: Influence from neighbors, family and coworkers

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ABSTRACT

During the last years, many governments have set targets for increasing the share of biofuels in the transportation sector. Understanding consumer behavior is essential in designing policies that efficiently increase the uptake of cleaner technologies. In this paper we analyze adopters and non-adopters of alternative fuel vehicles (AFVs). We use diffusion of innovation theory and the established notion that the social system and interpersonal influence play important roles in adoption. Based on a nationwide database of car owners we analyze interpersonal influence on adoption from three social domains: neighbors, family and coworkers. The results point primarily at a neighbor effect in that AFV adoption is more likely if neighbors also have adopted. The results also point at significant effects of interpersonal influence from coworkers and family members but these effects weaken or disappear when income, education level, marriage, age, gender and green party votes are controlled for. The results extend the diffusion of innovation and AFV literature with empirical support for interpersonal influence based on objective data where response bias is not a factor. Implications for further research, environmental and transport policy, and practitioners are discussed.

1. Introduction

With emissions from the transport sector growing more rapidly than other sectors and with an estimated doubling of these emissions by 2050, the transport sector is of key importance in climate change mitigation (Creutzig et al., 2015). As the problems become ever more pressing, alternative technologies that rely less on fossil fuels are being developed and diffused in markets. Alternative fuel vehicles (AFVs) are vehicles that can be fueled by alternatives to fossil gasoline and diesel in part or in full. Among the most common ones today are different types of electric vehicles (i.e., battery-electric, hybrids, and plug-in hybrids) but there are also cars available to consumers that can be fueled by ethanol, biodiesel, biogas and hydrogen. The total environmental impact of the car fleet is likely to decrease if fossil conventional vehicles (CVs) are replaced by AFVs and alternative fuels, by large consumer groups (Rezvani et al., 2015; Schäfer et al., 2009). Thus under-

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standing consumer adoption of new technologies is an important condition for the long-term success of a future less environmentally harmful transport system and for crafting policies to that effect (Axsen and Kurani, 2011; Mau et al., 2008; Ozaki and Sevastyanova, 2011).

In the literature that is developing with the purpose of better understanding consumer adoption of AFVs several frameworks and theoretical models have been used (for comprehensive reviews see Rezvani et al., 2015; Turcksin et al., 2013). For example several studies have highlighted the importance of actual and perceived vehicle attributes using conceptualizations such as perceived relative advantage, compatibility, trialability, observability, and risk (Jansson, 2011; Moons and De Pelsmacker, 2015; Peters and Dütschke, 2014; Petschnig et al., 2014) as well as other related aspects such as vehicle use, fuel consumption, tax incentives and pollution reduction (He et al., 2012; Hidrue et al., 2011; Mannberg et al., 2014). Other studies have looked into attitudinal psychological factors such as values, beliefs, norms and environmental awareness and responsibility, influencing intentions to adopt or actual adoption (Caperello and Kurani, 2011; Egbue and Long, 2012; Jansson et al., 2010). Yet other studies focus on the influence of sociodemographic factors (such as age, gender and education) on the adoption decision (Jansson, 2011; Potoglou and Kanaroglou, 2008, 2007; Ziegler, 2012). Several studies combine factors and also rely on theoretical frameworks (or parts thereof) such as the theory of planned behavior (Egbue and Long, 2012; Lane and Potter, 2007; Moons and De Pelsmacker, 2012), the value-belief-norm-theory (Jansson et al., 2010; Petschnig et al., 2014), and the diffusion of innovation theory (Jansson, 2011; Peters and Dütschke, 2014; Petschnig et al., 2014). In spite of this quickly developing literature, and thus increasing understanding of AFV adoption factors, a detailed understanding of interpersonal influence on the adoption decision is still lacking. This is somewhat surprising given that cars are highly visible products (Jansson, 2011; Johansson-Stenman and Martinsson, 2006) and that marketing theory (Bearden and Etzel, 1982; Buttle, 1998; Chevalier and Mayzlin, 2006; Childers and Rao, 1992), as well as diffusion of innovation theory (Rogers, 2003; Young, 2009), view influence from others as a key factor in consumer behavior. This deficiency in the AFV adoption literature has been noted by others as well. For example, according to Axsen and Kurani (2011), transportation researchers are only beginning to explore interpersonal influence as a driver for adoption. Therefore, although other factors are important for AFV adoption, the focus in this paper is on interpersonal influence.

Although there is a lack of studies on interpersonal influence on AFV adoption, it does not mean that it's a new idea as such. In fact, a fundamental pillar of diffusion of innovation theories is the influence from the social system in one's spatial vicinity (Hägerstrand, 1967; Rogers, 2003, 1962). This effect has sometimes been termed the neighbor effect (Axsen et al., 2009; Mau et al., 2008) and the neighborhood effect (Hägerstrand, 1965; Zhu and Liu, 2013). The few empirical studies that exist have found that potential AFV adopters are more likely to purchase AFVs when exposure to them is high in the surrounding areas (Mau et al., 2008; Zhu and Liu, 2013) proving that the value or utility of these vehicles become higher as more people close by adopt. Axsen and Kurani (2011) also found that most households ranked at least one social interaction as being highly influential of their assessment of the AFV in a demonstration project type setting. From an environmental psychology perspective there are many studies pointing to the importance of interpersonal influence in the form of social and personal norms on AFV adoption (Jansson, 2011; Ozaki and Sevastyanova, 2011; Petschnig et al., 2014). However, these studies generally do not specify from where the social influence comes, just that it is an influential factor in adoption.

In much of the developing literature on interpersonal influence and AFV adoption there is a heavy reliance on consumer reported information using for example interviews in demonstration projects and different types of self-administered questionnaires. Although valuable for understanding the influence of attitudinal factors and previous experiences, relying only on self-report interviews and surveys in researching interpersonal influence runs the risk of the respondents over- or underestimating these types of influences based on what information is currently salient in their minds (i.e., the availability bias, Tversky and Kahneman, 1973). In addition, most studies investigating social normative influence do not explicitly examine from where in the social system this influence comes. This is problematic since good communication strategies rely on segmentation and understanding target groups in order to communicate with the relevant groups regarding new environmental innovations or policies.

The study conducted here aims to overcome the theoretical as well as empirical problems of the extant literature on AFV adoption discussed above. Thus, the main purpose of this paper is to explore how membership in social domains is related to AFV adoption. Although the main focus is on interpersonal influence from three domains (neighbors, family and co-workers), based on the literature, we also control for sociodemographic factors that have been found in previous studies to be important. In addition, instead of relying on self-report data, we use a national database of the entire car owning population in a country. Since the database contains actual, objective data on car ownership, place of residence, family ties, and work location, together with sociodemographic and voting data, we are able to investigate interpersonal influence without asking respondents to remember who influenced them to do what in their adoption decisions. Thus, based on diffusion of innovation theory, and previous survey based studies, we develop a model of interpersonal influence incorporating influence from neighbors, family and co-workers. Using logistic regressions on the data set covering car purchases in 2008 (the year most flex-fuel cars were sold) in Sweden, we test the relationships and also add sociodemographics as controls. We then compare our results with previous research and draw conclusions and implications relevant for researchers, practitioners and policymakers. As such we add a novel perspective of interpersonal influence measured objectively to the insights from previous survey-based adoption studies.