Are multimodals more likely to change their travel behaviour? A cross-sectional analysis to explore the theoretical link between multimodality and the intention to change mode choice

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A B S T R A C T

Existing research suggests that being more multimodal (i.e. the use of more than one transport mode within a given period of time) increases the likelihood of changing travel behaviour over time. However, alternative explanations may have contributed to these findings. Many well-known psychological theories state that the actual demonstration of a behaviour is preceded by an intention to demonstrate this behaviour. Therefore, one essential step towards the determination of a causal relationship between multimodality and behaviour change is to investigate whether multimodality increases *the intention* to change.

This paper explored to what extent multimodality was associated with the intention to change the level of cycling, walking, car use, and train use. Our findings showed that the more multimodal individuals were, the more likely they intended to decrease their car use. However, most associations between multimodality and the intention to change mode choice were non-significant. This could be interpreted to mean that there is no relationship between multimodality and the intention to change. However, the significant findings for car use, and the direction of most (non-significant) associations in our analyses were intuitive. Therefore, our analyses are not conclusive on whether or not the level of multimodality is associated with the intention to change and actual behavioural change. Additional research will be necessary to test the proposed link between multimodality and behavioural change. Three lines of additional research that focus on associations between multimodality and behavioural change, multimodality and the intention to change behaviour, and variability and stability of individual behaviour over time, respectively, are particularly important.

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1. Introduction

Transport has negative consequences on our health, the environment and urban liveability. In particular, the dominance of the car in the transport system may contribute to this. Policies have aimed to generate a modal shift away from the car

with initiatives that include subsidies, improving the facilities for active travel and public transport, and restrictive car access. Recently, increased policy attention has been placed on encouraging a partial shift instead of a full modal shift (EC, 2014).

In the scientific debate, the mixed use of different transport modes—referred to as multimodality, the use of more than one transport mode within a given period of time—has recently gained increased attention (e.g. Jones & Clarke, 1988; Huff & Hanson, 1986; Kuhnimhof, 2009; Nobis, 2007; Buehler & Hamre, 2015; Heinen & Chatterjee, 2015; Susilo & Axhausen, 2014; Kroesen, 2014). Despite the fact that the number of studies on multimodality is still small, various topics have been addressed. The majority of studies have either focused on the prevalence of multimodality in a geographical area such as a country (e.g. Nobis, 2007; Buehler & Hamre, 2015; Heinen & Mattioli, 2017), or have tried to identify the predictors of multimodality (e.g. Heinen & Chatterjee, 2015; Susilo & Axhausen, 2014; Kroesen, 2014; Molin, Mokhtarian, & Kroesen, 2016).

However, few studies have investigated whether variability may be a predictor *itself* of behavioural change. Two studies (Kroesen, 2014; Heinen & Ogilvie, 2016) have explicitly addressed this. Kroesen (2014) investigated the predictors of transitions between data-driven travel behaviour clusters and showed that individuals who used multiple modes compared to those that relied on one mode had a higher likelihood of changing from one travel behaviour cluster to another over time. Heinen and Ogilvie (2016) tested whether individuals who were more multimodal in their mode choice before an intervention were more likely to change their share of trips made entirely by car, partially by active travel and partially by public transport when facing an intervention. They concluded that a higher level of multimodality at baseline was significantly associated with changes in all mode shares. More importantly, they also found a significant interaction effect between the exposure to an intervention and multimodality for an increase in active travel and a decrease in car use, implying that individuals who had more variable behaviour at baseline were more receptive to the intervention.

Despite the fact that these results provide an indication that the level of multimodality may be a predictor of travel behaviour change, two other mechanisms may also explain these findings, both of which are related to the possibility that the predictor and outcome may not be independent. First, changes in travel behaviour and variability in travel behaviour cannot always be easily separated, and measured changes may, in part, be a result of variability. A 'change in travel behaviour' refers in here to a shift towards or away from a given mode of transport over time. Variability refers to the level of variation in modes of transport used by an individual within a certain period. Second, statistical coupling (Gilthorpe, 2011) may be present between the measures of interest (change in travel behaviour on the one hand and group membership or baseline level of multimodality on the other). The first mechanism relates to the measurement of the variables, whereas the second relates to the mathematical calculation. Both mechanisms may result in the measurement of a significant association between multimodality and change in travel behaviour, even if such an association is not present in reality (i.e. a type-1 error).

One essential step towards a better understanding the relationship between multimodality and changes in travel behaviour is to investigate the relationship between multimodality and the intention to change. Many well-known psychological theories state that the actual demonstration of a behaviour is preceded by an intention to show this behaviour (e.g. theories such as: the theory of planned behaviour (Ajzen, 1991) and the theory of reasoned action (Fishbein & Ajzen, 2010)). Theories and models based on stages of change (e.g. Prochaska, DiClemente, & Norcross, 1992; Prochaska & Velicer, 1997) also include the contemplation of new behaviour before experimentation with new behaviour. Therefore, if variability predicts the intention to change, this would offer support to the notion that previous findings are not statistical artefacts, but rather that these findings support the proposed conceptualisation (i.e. that those with higher levels of variability may be more open to change).

This study explores the association between multimodality and the intention to change mode choice. Using data collected in the Netherlands in 2015, we explored these associations between multimodality and the intention to change the level of cycling, walking, car use, and public transport use. The remainder of this paper is organised as follows. First, a short overview of the existing literature is provided, followed by a discussion of the methods. Section 4 will present the results of our analyses, which will be discussed in Section 5. A short conclusion of the research is provided in Section 6.

2. Literature review

This section will discuss three aspects of multimodality: the measurement of multimodality, predictors of multimodality, and, finally, to what extent multimodality predicts changes in travel behaviour. The focus of this paper is this last aspect, but a discussion of the wider context of the topic in the scientific research helps to understand the phenomenon, provides a perspective to how multimodality is distributed over the population, and illustrates the complexities of measuring multimodality.

2.1. Measurements of multimodality

The topic of variability of travel behaviour and multimodality (mode choice variability) specifically has received attention in the travel behaviour research literature over the past few decades. Multimodality is, broadly speaking, defined in three ways. The first definition method used to investigate multimodality is to define the use of modes in different predefined groups, such as multimodal car, monomodal car, and multimodal active travel groups (e.g. Nobis, 2007; Buehler & Hamre, 2015). The second measure is based on data-driven groups (e.g. Kroesen, 2014), whereas the third method of multimodality