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The Influences of an Individual's Social Network on the Choice of Travelling by Public Transport

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ABSTRACT: This study concentrates on the role of social networks – through attitudes – on the decision to (not) use public transportation. An integrative theoretical framework is presented from which hypothesis are derived, concentrating on social and psychological processes. Social networks are indicated by social capital and the strength of ties. Attitudes are indicated through using the theory of planned behaviour. The hypotheses are tested by a dataset collected in the United Kingdom. The key findings indicate - after controlling for various control variables - that in order to stimulate an individual to travel by public transport, strong ties have a great direct and indirect influence through attitudes. Furthermore, the choice of transport are proven by the analyses to be influenced by attitudes, which are defined by the mindset towards public transport, and looking up local bus information. Policies, which aim to influence public transport usage through soft policies, should respond to changing mindsets about public transport by reducing the gap between reality and perceptions of a person in case of public transport.

KEYWORDS: public transport, car use, social networks, social capital, strength of ties, attitudes.

Introduction

Last past decades governments try to encourage travelling by public transport, and discourage travelling by car. Especially in the Western world, travelling by car is more common, and public transport less popular. One out of two persons in the European union owns a car and 80 till 90 percent of all passenger kilometers are 'made' by car usage (van Exel & Rietveld, 2009). Environmental problems, e.g. CO₂-rates, force governments to focus on stimulating travelling by public transport and thus act against the future threat of the human environment. The ultimate goal is to maintain a livable world for next generations (Axhausen, 2003; Bertolini, 1999; Matthies, Kuhn & Klöckner, 2002; Beirão & Cabral, 2007; van Exel & Rietveld, 2009; Bamberg et al., 2011). Also, the increase of peak hours in intensity and duration, sometimes resulting in a complete standstill of cars, is of main concern for governments and transport policy makers and a stimulus to increase travelling by public transport (van Exel & Rietveld, 2009). Growing rates in car usage

show that it is obviously not easy for governments to reduce car usage and stimulate public transport. Beirão and Cabral (2007) state that car users have lower perceptions of public transport compared to public transport users, which could indicate that public transport is actually better organized than people's perception of it. To succeed in their goal, governments could benefit of a critical look at the main factors that stimulate people using public transport instead of travelling by car, and how this gap between perceptions and reality of public transport can be declared. Could a false information flow of people in a social network cause this gap? For example, your family do not travel by public transport, so they are likely to discourage the usage. They could share their negative view based on a one-time experience with public transport, thus they deliver a wrong perception. This could create a gap between reality and perceptions of a person.

The main focus of earlier research has been on the combination of public transport towards hard measures of public transport. Hard measures may consist of improvements of infrastructure and management of public transport services, increased costs for car use, and prohibition or rationing car use (Bamberg et al. 2011). However, to increase the amount of public transport (and decrease car use) policy makers nowadays are mainly focused on soft measures; as it has been proven that only hard measures are not effective enough to encourage people to travel by public transport (Bamberg et al. 2011). Soft measures are techniques of information dissemination and persuasion to influence car users to voluntarily switch to sustainable travel modes. A main factor behind this soft measurement could be the social network of an individual. The ignorance of the social dimension (soft measures), results possibly in little empirical literature on the influence of social networks on the individuals travel habits. Leisure travel, for instance visiting ones social network, is the fastest growing 'travel group' in terms of the share of trips and the share of miles travelled (Axhausen, 2003; Bertolini, 2010). This emphasizes the need for information about social networks in relation with the use of public transport.

In 2005 the Swiss Microcensus on Travel Behaviour (Kowald et al. 2010) showed that leisure travel is the highest percentage of all travels (41%) and also the highest rate of kilometres travelled by individuals (44.7%). For many transport planners this kind of travel is something to worry about as these trips are threatening sustainability targets. Thus, social networks may have a great influence, as leisure travel is often focussed on visiting friends or family, and they can encourage or discourage you to travel by public transport. However, how exactly can a social network trigger people to use public transport? Axhausen (2003) explains that the spatial structure of social networks is an important factor, because of information flows, affirmation, prestige and resources in social networks of the traveler. This influences the amount of travel a person makes as

well as the direction. The social network causes the direction of the trip, as it depends on the relatives and friends of an individual where they meet. This will have a direct influence on travel directions: if the place is easily accessible by public transport, the individual could decide to take public transport to the location. The social network of individuals' influences the amount of travel as well, as it depends on the growth of the social network how often an individual will decide to travel for leisure.

This study focuses on social networks: influences of family, friends, colleagues and acquaintances on the choosing patterns of public transport versus car use. Research on transport choices and social networks has been conducted, however, almost no research on the relationship between the two was published. This research aims to make an innovative contribution to existing literature on how public transport can be stimulated through social networks and attitudes. As a second goal we disentangle how these are connected and related to each other.

Chapter 1: Theory and hypothesis

In this chapter, the different factors which influence travelling by public transport will be described; the social network, attitudes, and their control variables.

To define social networks, the theory of social capital will be used to clarify the influence individuals can have on an actor. Furthermore, to fully understand people in social networks having an influence on others, differences will be made between the so-called 'weak and 'strong ties' (Granovetter, 1983). However, there are other factors as well, including attitudes, defined by the theory of planned behavior of Ajzen (1991). Control variables will be described by age, gender, income, household type and previous experiences.

1.1 Social Network

People in a social network can be defined as family, schools attended, sports, social activities, religious and civic affiliations as well as current and previous labour positions of work (Axhausen, 2003). To explain the various factors that affect travel choices through social networks, we first have to declare why social networks actually affect behaviour and the decision making of an individual. These days, overlap between different social networks of one individual is less likely because of spatial dispersion (Axhausen, 2003). This makes it harder to get a clear understanding and discover the way social networks influence behavior (in this case the use or non-use of public transportation). To clarify this understanding, we will observe the social capital of an individual within the social network and the difference in the strength of ties.

Social capital

At first, we will discuss the influence of social capital on the relationship between social networks and the behavior of an individual. Principles of this theory can be found in the work of Emile Durkheim (1983). Other researchers developed his theory, two of them are the sociologist Pierre Bourdieu, and political scientist Robert Putnam. Putnam (1993) describes social capital as the advantage an individual has from mutual trust, social participation and the use of social networks. Unlike financial capital, social capital does not decrease when being used. (Currie & Stanley, 2008). Referring to Coleman (1988), the use of the concept social capital is part of a general theoretical strategy explaining behaviour patterns; taking rational action as a starting point but rejecting the extreme individualistic premises that often come with it.

Bearing in mind the mode of choice, a rational decision can be made by persons themselves about transport choices. However, in the end one will not make a decision totally based on one's own opinion. If more people around you have a clear opinion about something, one will share that opinion more likely. A social network will always have an influence and discourage or encourage a person to go by public transport. The same applies for sharing public transport information; one can be encouraged or discouraged. Public transport information and the use of public transport are positively correlated as proven by earlier research (Farag & Lyons, 2010). According to Coleman (1988), an actor is socialized and action is governed by social norms, rules and obligations. To apply this theory on the use or non-use of public transport, it is expected that if your social capital has a positive attitude towards the public transport information, you will be more pushed towards this attitude (of travelling by public transport). This is due to the social norms, rules and obligations. For example, when your parents always use public transport because of environmental reasons (norm values), you will faster acquire the same opinion and use public transport more likely. The following hypothesis were formed:

Hypothesis 1: *The more often the social capital of an individual recommends the individual to use a public information service, the more often the individual will travel by public transport.*

Hypothesis 2: *The more often the social capital of an individual discourages the individual to use a public transport information service, the more often the individual will not use public transport.*

The strength of ties

The second theory that can elaborate the influences of social networks on the behaviour of an individual is the difference in two specific ties, and can be split up in strong and weak ties (Granovetter, 1983). A strong tie can be classified as a relative or friend, and a weak tie can be for instance, an acquaintance (Granovetter, 1983). Weak ties provide people with access to information and resources beyond those available in their own social circle (Granovetter, 1983). To bring information from one network to another, there is a need for weak ties; as an example if a close social network has no information at all about public transport usage. Strong ties have greater motivation to be of assistance and are typically more easily available (Granovetter, 1983). Relatives and friends (strong ties) will be more of assistance to support an individual with information and making a decision about the use or non-use of the public transport than weak ties. This is due to strong ties being closer to an individual. Research of Brown and Reingen (1987) is based on consumer behaviour and word-of-mouth communication, in comparison towards consumer behaviour. Travelling by public transport and buying tickets, or travelling by car and buying a car, fuel and insurances, can be considered as consumer behaviour. Consumer behaviour can be defined by purchase decisions, and are heavily influenced by opinions and behaviours of friends (Solomon et al., 2013). Word-of-mouth communication could be linked to using soft measures, as was explained in the introduction. Brown and Reingen (1987) have shown in their research that if a consumer is in social relations with both strong and weak ties who are available as potential sources of referral, strong ties are more likely to be activated for the referral flow. Another assumption that is supported in the research of Brown and Reingen (1987) is the assumption that information from strong-tie referral sources is perceived as more influential for the receivers' decision-making than is the information obtained from weak-tie referral sources. This means in terms of travelling by public transport that strong ties will have a greater influence.

So, strong ties could have more power to provide information -positive or negative- to an individual on the information receiving and decision-making process because they are closer to the individual than weak ties. Thus, we assume that strong ties have more influence on an actor. The next hypothesis has been deducted:

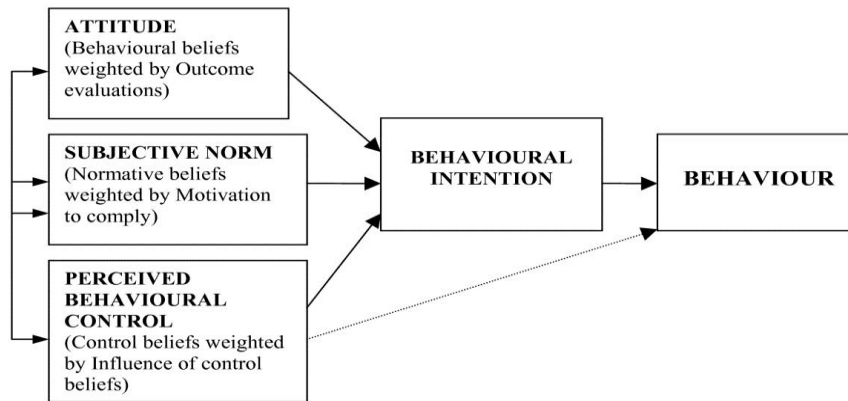
Hypothesis 3: *Strong ties have a greater influence on an individual's decision travelling by public transport, than weak ties.*

1.2 Attitudes

Not only the social network of an individual influences behaviour, like travelling with public transport or not, but also attitudes towards public transport. Attitudes are a psychological view and are analysed using variables such as trust in others, social value orientation, environmental concern and awareness of car use (Heath & Gifford, 2002).

The theory of planned behaviour (TPB) provides a clear view how attitudes affect the choice of travelling by public transport (Ajzen, 1991). Motivational factors are so-called attitudes in the theory of planned behaviour (TPB), which will result in an intention to make use of the public transport. The TPB implies that intentions are the closest antecedents of behaviour, see model 1. These intentions are created by motivational factors that have an influence on the behaviour of a person (Ajzen, 1991). Intentions are indicators of the effort people want to put into getting a certain outcome. E.g, an individual wants to be on time at work and how mode-choice can assist to effectuate this. Ajzen (1991) mentions that the more people want to perceive a certain outcome (the intention), the more likely it is they will perform towards this outcome. The TPB assumes that these factors are determined by beliefs for each factor: normative beliefs for social norms, behavioural beliefs for attitudes and control beliefs for the perceived behavioural control (Heath & Gifford, 2002). Subjective norms can be considered as individual thoughts about reducing environmental damage, but also in how you perceive social pressure. Perceived behavioural control could be explained as having the attitude to behave towards an outcome, but keeping in mind the difficulties and costs of the behaviour.

In order to understand the attitudes of an individual towards the use or non-use of public transport, we have to understand the behavioural beliefs. To stimulate travelling by public transport it is necessary to understand the underlying patterns of travel behaviour (Beirao & Cabral, 2007). Nowadays, the car is the most attractive mode of transport. Arguments as speed, comfort, convenience and freedom are well known. This implies that in order to make public transport more attractive, it needs to adjust the service in order to get the same attractiveness. However as said by Beirao and Cabral (2007), it is hard and complex to identify a set of relevant attitudes. To measure perceptions about transport it is important to understand the reasons not using public transport. For instance, how these individuals would feel if they had to use public transport, and what would make them switch to alternative modes (Beirao & Cabral, 2007). This could be a factor, for example, in what way people mind using public transport (or not), and if they mind looking up transport information. This leads to the following hypotheses.



Model 1: *Theory of planned behaviour* (Ajzen, 1991)

Hypothesis 4: *People who do not mind travelling by public transport will be more likely to use public transport*

Hypothesis 5: *People who do not mind looking up public transport information will be more likely use public transport*

1.3 The influences of social network on attitude

The relation between social network, mode-choice as well as the relation of attitude on mode-choice have been discussed. However, not only a direct relationship of social network on the travelling individual exists, moreover an indirect connection exists between social networks, attitude and the travelling individual. This will be discussed now.

The relationship between social capital and attitude

As discussed, the use of the concept social capital means to take rational action as a starting point but rejecting the extreme individualistic premises that often comes with it (Coleman, 1988). Social capital can stimulate or discourage a person to act in a certain way. Attitudes are one part of the theory of planned behaviour, besides the theory includes two other dimensions. Social norms can be used to explain the relationship between social capital and attitude.

As the theory of planned behaviour of Ajzen (1991) describes, a behavioural intention (to use or not use public transport) is partly decided by social norm. This social norm can be seen as social pressure. Social pressure are expectations of other individuals around (one's own social network), who will approve or disapprove your performance of the behaviour (Bamberg et al., 2011). Pressure from your social network in case of travelling by public transport can be felt

through e.g. strong environmental reasons or car status. Environmental reasons will force individuals to use public transport. High car status within a network will people make use the car more (Steg, 2005). Consequently, this means that the more your social network encourages or discourages you to travel by public transport, it will change your attitude towards travelling by public transport or not. Through encouragement from your social network you will use public transport more often, whereas by discouragement not.

Hypothesis 6: People, who are more encouraged by social capital to travel by public transport, will have a positive attitude toward travelling by public transport.

Hypothesis 7: People, who are more discouraged by social capital to travel by public transport, will have a negative attitude toward travelling by public transport.

The relationship between the strength of ties and attitude

As stated before a strong tie can be classified as a relative or friend, and a weak tie can be defined as an acquaintance. Weak ties provide people with access to information and resources beyond those available in their own social circle (Granovetter, 1983). Strong ties (relatives and friends) will be more of assistance to support an individual with information and making a decision about the use or non-use of the public transport than weak ties will. So, if an individual has certain thoughts about travelling by the public transport, strong ties will have a greater influence on that thoughts, which will in the end resulting in a certain behaviour; the travelling or non-travelling by public transport.

Hypothesis 8: *Strong ties will have a greater influence on the attitude of an individual (in case of travelling by public transport), than weak ties will.*

1.4 Control variables

Besides the social network and attitudes, other influences on an individual's mode choice do exist; socio-demographic factors (age, gender, income), type of household and previous experiences. All these factors are related to differences in public transport usage (Bamberg et al., 2007; Heath & Gifford, 2002; Redman, et al., 2012),

Age

Age is an important factor, bearing in mind the age of 18 to get a driver's license; younger people are forced to use the public transport. Hensher & Reyes (2000) proved that non-work related trip chains (visiting a friend or going to the cinema) have been characterised by increasing utility as age increases. They state that elderly persons enjoy non-work related trip chains more. In a study of

Steg (2005) proved the group of persons using public transport most often are older than 50. They also state that people who are younger than 30 come directly after and the group less often are between 30 and 50. Respondent of an average and younger age, valued the affective of car use more strongly, than older people do (Steg, 2005).

Gender

Gender is an important indicator talking about the use of public transport, perhaps mostly because of the status of having a car. Steg (2005) also discusses the difference in gender in using the public transport. Men link, more often than women do, a car with some sort of status. Male drivers found it of mayor importance for their self-expression, thus explaining the fact that 73% of the car drivers were male (Steg, 2005). According to Matthies, Kuhn and Klöckner, (2002), there are three possible explanations why women use more ecological travel options then men do: restricted access to a car, a stronger feeling for environmental issues in every day behavior and weaker car habits. This fits research outcome, that men use their care more often also confirms that men use the car more often, and women public transport (Hamilton & Jenkins, 2000; Nordlund & Garvil, 2003). Hamilton & Jenkins (2000) mention that women represent the majority of the public transport market. So, women's needs and issues are of key relevance for planners and decision makers.

Income

The higher the income of an individual is, the sooner one can afford a car. In a study of Beirao and Cabral (2007) they mentioned that respondents with low income and difficulties in affording a car are not likely to stop using it, mainly because owning a car is a big achievement. This supports research of Kenyon, Lyons and Rafferty (2002): 'an individual can be excluded without being poor and can be poor without being excluded'. They point at the fact that 'poor' people can feel excluded when they do not own a car: they attach more value on having a car than an average income person. Paulley et al., (2006) mention that there is no doubt when income increases the amount of travel increases as well. Although, there is also evidence that the lengths of trips increase by more income. People with a low income use public transport less on short distances, than people with an average income, because they could also go for a walk to the supermarket. On longer-distance trips, 'average' or 'rich' individuals would choose public transport more often, because they can spend a larger proportion of their income. To conclude, people with a higher income are expected to use public transport more often than people with a lower income.

What type of household do you live in?

The type of household you live in can influence the choice of travel mode. For example: travelling

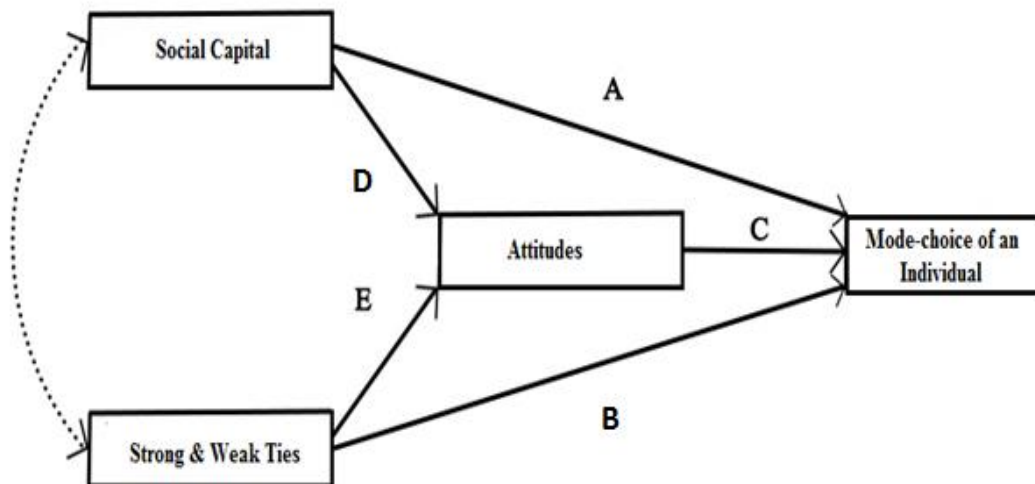
by car is relatively cheaper for two or more people, than for one individual only, because petrol costs can be shared by more people, and costs of insurances as well. Travelling by public transport means one has to buy a ticket for every single person. Dieleman, Dijst & Burghouwt (2002) confirm the influences of household types on the travel mode selection. Households with children use public transport less often than one-person households. The presence of children is seen as the most important indicator. So, type of household is an important indicator.

Previous experiences

Negative experiences will trigger persons less to use public transport again. Beirão & Cabral (2007) proved that strong negative reactions often arise from previous experiences. These reactions from previous experiences do not only influence the individual, but also their social network. Negative word-of-mouth communication, also appears to strongly discourage subsequent use.

1.5 Final model and an overview of the hypotheses

Based on the different theories and hypotheses that have been derived the next model can be deducted:



Model 2: *The influences of social network (defined by social capital and strength of ties) and attitudes as mediated effect on travelling behaviour of an individual.*

We summarize different paths with corresponding hypotheses:

Path A: The influences of Social Capital on the Mode-choice of an Individual

Hypothesis 1:*The more often the social capital of an individual recommends the individual to use a public information service, the more often the individual will travel by public transport.*

Hypothesis 2:*The more often the social capital of an individual discourages the individual to use a public transport information service, the more often the individual will not use public transport.*

Path B: The influences of Social Capital on the Attitudes of an Individual

Hypothesis 3:*Strong ties have a greater influence on an individual's decision travelling by public transport, than weak ties have.*

Path C: The influences of Attitudes on the Mode-choice of an Individual

Hypothesis 4:*People who don't mind looking up public transport information will be more likely to use public transport.*

Hypothesis 5:*People who don't mind travelling by public transport will be more likely to use public transport.*

Path D: The influences of Strong and Weak Ties on the Mode-choice of an Individual

Hypothesis 6:*People, who are more encouraged by social capital to travel by public transport, will have a positive attitude toward travelling by public transport.*

Hypothesis 7:*People, who are more discouraged by social capital to travel by public transport, will have a negative attitude toward travelling by public transport.*

Path E: The influences of Strong & Weak Ties on Attitudes

Hypothesis 8:*Strong ties will have a greater influence on the attitude of an individual (in case of travelling by public transport), than weak ties have.*

Chapter 2: Data collection

2.1 Explaining data and variables

To get an understanding about the main problem; ‘encouraging the use of public transport’ the *Travel information survey* will be used. This survey provides insight in the travel behaviour of an individual. The survey has been used in two different cities in the United Kingdom (due to the guarantee of anonymity the cities cannot be mentioned). The surveys are finally combined to analyse different cohorts (Farag, & Lyons, 2010).

The survey is designed and piloted in October 2007, and is divided into different parts: individuals travel behaviour, public transport information, making an uncertain journey: what would you do and general questions about yourself. The survey took approximately twenty minutes. The survey was sent in the beginning of December 2007 to 10.000 people. Selection took place via the municipalities’ population administration, and a post card has been sent as a reminder, two weeks after receiving the survey. The survey could also be filled in online, but only 6% of the respondents filled in the survey online. Respondents who filled in the survey could win prizes; the first prize was £500, there were 3 runner up prizes (£150) and another 10 prizes of £50. Only one person (aged over 18) per household was allowed to answer the survey. The overall respond rate was 13% (n = 1327).

Discussing the representativeness of the sample; the sample is compared with census data for the two cities. The sample has an over-representation -ranging between 5% and 9%- of older persons, females, high-educated people, and individuals who have access to at least one car in their household. 55% is female, the average age is 48, and around two-third of the respondents are from Bristol (n = 642). Half of the respondents have a full-time job; the other half of the respondents is mostly retired or is working part-time. Approximately half of the respondents have an academic degree; a high level of education, while 36% have a net household income per month of more than £2500; which is indicated as a high income.

2.2 Dependent variables

The dependent variable is ‘making use of public transport’. In the travel information survey the question: ‘*How often do you normally travel using the following types of transport?*’ was used. Mode-choices were: car or van (as driver), car or van (as passenger), train, coach, bus, tram and other. The following answer categories were used: (1) 3 days a week or more, (2) at least once a week, (3) at least once every 2 weeks, (4) at least once a month, (5) at least once every 3 months, (7) less often or never. To get the dependent variable only the variable ‘bus’ will be used, because

the frequencies of people travelling by other kinds of public transport were divided unequally, especially by the first 3 categories. This will result in a distorted view of the final results. The missing values for people travelling by bus will be deleted and also for all other independent and control variables.

2.3 Independent variables

Different independent variables will be used to measure aspects influencing use of public transport.

Social Networks

Firstly, we will discuss the social network and the variables of the survey used to measure the connection of social networks towards mode-choice. Social networks were split up into social capital and strong and weak ties. Social capital can be measured by using two questions of the survey: *'Have other people (for example, colleagues, family or friends) ever recommended the use of a particular public transport information service to you'* and *'Have other people (for example, colleagues, family, or friends) ever discouraged the use of a particular public transport information service to you?'*

For the third hypothesis, strong ties can be measured using the next survey question: *'Most of my friends use public transport regularly'*, Answers were given varying in a Likert score from from strongly disagree (1) to strongly agree (7). Weak ties can be measured with the following question of the survey: *'I do not know many people who use public transport regularly'*. Answers were given varying from (1) to (7). The variables were recoded pointed into the same direction.

Attitudes

In order to measure the attitudes of a person towards the use or non-use of public transport we can use different questions of the survey. Attitudes are based on the following question: *'to what extent do you agree or disagree with the following statements?'* Statements used are: *'I like travelling by local bus'* and *'I dislike looking up local bus information.'* People could answer the question varying from (1) strongly disagree to (7) strongly agree. To rank the variables the same, the variables were recoded, and measuring in the same direction

2.4 Control variables

Socio-demographic factors exist out of four dimensions: age, gender, income and household composition. Age is measured in the survey: *'What is your age?'* responded by filling in a number. The second socio-demographic factor is gender, and was measured by: *'Are you'*, answer possibilities: female or male. The third socio-demographic factor on income was measured: *'What*

is the monthly net income of your household (after tax)? If you are sharing a house with non-relatives, please answer for yourself. The available answers were (in pounds): (1) less than 500, (2) 500-1000, (3) 1000-1499, (4) 1500-1999, (5) 2000-2499, (6) 2500-2999, (7) 3000 per month or more, (8) I do not know. The fourth control variable: type of household, is measured: *What type of household do you live in* and could be answered with single, couple, family, shared housing with non-relatives or other (please specify). As a last control variable previous experience, was used: *To what extent do you agree or disagree with the following statements?* The statement that has been used is: *My experience of travelling by local bus is good*. The statements could be answered with a Likert scale from (1) strongly disagree to (7) strongly agree.

Chapter 3: Results

Firstly, the descriptive statistics will be given and discussed. For analysis of the results, model 4 will be used (discussed in subparagraph 1.3). We discuss every influence of the different independent variables separately by means of our model.

3.1 Descriptive statistics.

By analysing this research (effects of social network on the travelling individual), SPSS Statistics (version 22) was used. To get a representative perspective of the dependent variable, missings of the dependent and independent variables have been filtered out. To do so depends of the size of the sample, which is large enough in this study (N=718). After deleting missing variables for each category, new variables have been ‘made’ to define the social network, attitude and public transport. By analysing the results different descriptive variables are used. An overview of the different descriptive statistics can be seen in table 1. This table shows that 18.2% of the respondents travels by bus during 3 days a week or more and 16.4% travels less than once a year (or never). Social capital and attitudes are measured by different variables; in order to find out if the variables can be readdressed into one variable, we checked if they are mutually correlated. Cronbach’s Alpha (table 2) has to be higher than 0.65 to be mutually correlated. This is not the case, which made us decide to keep the variables separate.

Table 2: *Cronbachs alpha (Attitudes and Social Capital)*

	Mean	Variance	Std. Deviation	N of Items	Cronbach’s Alpha
Attitudes	7.2683	9.522	3.08577	2	.289
Social Capital	.3805	.381	.61732	2	.442

Table 1: Descriptive statistics of the dependent, independent and control variables (N= 718).

	N	Minimum	Maximum	Mean	Std. Deviation	%
Bus (PT)						
3 days a week or more	131	-	7	-	-	18,2
At least once a week	86	-	-	-	-	12,0
At least once every 2 weeks	55	-	-	-	-	7,7
At least once a month	82	-	-	-	-	11,4
At least once every 3 months	130	-	-	-	-	18,1
At least once a year	116	-	-	-	-	16,2
Less often or never	118	-	-	-	-	16,4
Social Capital						
Recommendation of other people to go by PT	-	0	1	,2911	,45458	-
Discouragement of other people to go by PT	-	0	1	,1114	,31487	-
Strength of Ties						
Strong Ties	-	1	7	3,1992	1,88827	-
Weak Ties	-	1	7	3,8008	2,09353	-
Attitudes						
I like travelling by local bus	-	1	7	3,7089	1,92037	-
I like looking up local bus information	-	1	7	3,4972	2,11704	-
Control variables						
Man	-	0	1	-	-	40,1
Age	-	18	93	47,7	15,6	
Income	-	-	-	2,0183	,72571	
- Low	165	-	-	-	-	23,0
- Middle	347	-	-	-	-	48,3
- High	206	-	-	-	-	28,7
Household Composition						
- Single	220	-	-	-	-	30,1
- Couple	229	-	-	-	-	34,0
- Family	224	-	-	-	-	30,3
- Shared housing with non-relatives	45	-	-	-	-	5,6
Previous experiences	-	1	7	3,4721	1,95734	-

3.2 Multiple regression

Two different analyses have been set up. At first path A, B and C will be discussed (table 3), with direct influences on social capital, strength of ties and attitudes on mode-choice. Thereafter path D and E, i.e. influences of social capital and the strength of ties on attitudes, are given (table 4). The first and second model of table 3 shows the influence of social capital on mode choice. Secondly, the influence of the strength of ties is shown (model 3 and 4). The fifth model only shows the relation of attitudes on mode-choice of an individual. At last, all factors are added into model 6.

Table 4 shows 'attitude' as dependent factor and social capital as well to detect the strength of ties as the independent (figure 1, path D and E). First, the relationship between social capital and attitude is shown (table 4; model 1 and 2), where model 1 is the relationship between the first determinant of attitude; intercept 1 '*I like travelling by local bus*' and social capital (path D). Model 2 is the relationship between the second determinant of attitude: '*I like looking up local bus information*' and social capital (path D). Secondly, the strength of ties can be seen in table 4 (model 3 and 4). Where model 3 is the relationship between the first determinant of attitude and the strength of ties, and model 4 is the relationship between the second determinant of attitude and the strength of ties (path E). At last, factors will be included (table 4; model 5).

To make the results more comprehensive, different results of table 3 and 4 are shown in figure 3 and 4. Both figures show the influences of social capital, strength of ties and attitudes on the mode-choice of an individual. Figure 3 relates to intercept 1, figure 4 relates to intercept 2.

Direct influences of Social Capital, Strength of Ties and Attitudes on the Mode-choice of an Individual (Path A, B and C)

Direct influences, which are the same for model 6 and model 7, will be explained. First, path A, social capital has a positive influence (both determinants) on mode-choice of an individual, where the discouraging factor has a greater influence ($B = .359$; $p < .05$). Recommendations are negatively correlated ($B = -.229$; $p = .082$). As seen in model 1 and 2, adding attitudes makes both relations stronger. Although, both recommending as well as discouraging people to use public transport information is not found to be significant in model 1. Model 2 shows a significant positive relation between discouragement of the use of public transport information and travelling by local bus. Which is in line with our hypothesis. So, hypothesis 1 can be refuted and hypothesis 2 is assumed by our analysis.

Secondly, influences of strong and weak ties will be discussed in relationship to the mode-choice of an individual (path B). Both determinants have a positive influence. This means that if 'an individual's strong and weak ties' travel by public transport, an individual is more likely to travel

by public transport itself. Both of the determinants that indicate the significance of strength of ties, meanings that an individual is indeed influenced by his or her ties in choosing to travel by public transport. The hypothesis not only assumed an effect of the ties, but also predicted that strong ties will have a greater influence. As can be seen in the figure, stronger ties have a greater influence ($B = .166, p < .001$) than weak ties have ($B = .099, p < .001$), which means that hypothesis 3 can be supported. Although, the influences of strong and weak ties became less after including attitudes.

Lastly, influences of attitudes towards the mode choice of an individual will be discussed (path C). Both determinants have a positive influence, which implies that positive attitudes towards the public transport have a positive effect on travelling by public transport. Both determinants are significant, mindset ($B = .099, p < .01$) and accessing information ($B = .331, p < .001$). Thus, the mode-choice of an individual is determined by his or her attitudes. Hypothesis 4 and 5, that assumed that people who don't mind travelling by public transport or looking up public transport information will be more likely to use the public transport, is confirmed by this analyze.

After including all variables in the model, we can see that the model fits best. The variability in local bus usage is determined 23.4% by social networks, attitudes and the control variables, adjusted $R^2 = .234, F(14, 703) = 16,687, p < .001$.

Table 3: Multiple regression of the direct influences of social capital, strength of ties and attitudes on travelling by public transport

	Model 1 (Path A)	Model 2 (Path A)	Model 3 (Path B)	Model 4 (Path B)	Model 5 (Path C)	Model 6(all factors)
Intercept	2.590***	2.154***	1.573***	1.358***	2.207***	1.347***
Social Capital						
Recommendation	-.152	-.229				-.266
Discouragement	.320	.395*				.272
Strength of Ties						
Strong Ties			.195***	.166***		.160***
Weak Ties			.124***	.099**		.105**
Attitudes						
I like travelling by local bus		.102**		.095**	.099**	.097**
I like looking up local bus information		.335***		.294***	.331***	.298***
Control variables						
Man	-.231	-.240	-.166	-.186	-.240	-.188
Age	8.146E-5	-.005	.004	-.001	-.006	-.001
Low income	1.291***	1.178***	1.147***	1.071***	1.193***	1.068***
Middle income	.521**	.424**	.465**	.386*	.428**	.387*
High income ¹	-	-	-	-	-	-
Single	.020	.032	-.029	-.007	.037	-.015
Couple ²	-	-	-	-	-	-
Family	-.373*	-.348*	-.307	-.295	-.344*	-.301*
Shared housing	-.045	.003	-.335	-.264	-.046	-.211
Previous experiences	.270***	.042	.200***	.008	.037	.013
F & Adjusted R ²	F (10,707) = 11,073*** Adj. R ² = .123	F (12,705) = 16,123*** Adj. R ² = .202	F (10,707) = 15,987*** Adj. R ² = .173	F (12,705) = 19,162*** Adj. R ² = .233	F (10,707) = 18,927*** Adj. R ² = .200	F (14,703) = 16,687*** Adj. R ² = .234

Note. All hypotheses were tested one sides. ¹ High income and ² couple were used as reference category. *** p < .001, ** p < .01, * p < .05. All analyses have been controlled for multicollinearity by tolerance and VIF.

Table 4: Multiple regression of the direct influences of social capital and strength of ties on attitudes. Intercept 1: I like travelling by local bus; intercept 2: I like looking up local bus information.

	Model 1 (Path D)	Model 2 (Path D)	Model 3 (Path E)	Model 4 (Path E)
Intercept 1	2,897***		2,629***	
Intercept 2		,424		-,119
Social Capital				
Recommendation	,075	,208		
Discouraging	-,273	-,141		
Strength of Ties				
Strong Ties			,006	,097**
Weak Ties			,043	,071*
Control variables				
Man	,152	-,018	,168	,017
Age	,002	,014***	,004	,017***
Low income	,477*	,194	,445*	,115
Middle income	,457**	,152	,443**	,124
High income	-	-	-	-
Single	-,088	-,009	-,096	-,042
Couple	-	-	-	-
Family	,064	-,093	,075	-,065
Shared housing	,009	-,146	,005	-,241
Previous experiences	,098**	,653***	,090*	,625***
	F (10,707) = 1.961**	F (10,707) = 48.262***	F (10,707) = 1.987***	F (10,707) = 50.769***
	Adj. R ² = .013	Adj. R ² = .397	Adj. R ² = .014	Adj. R ² = .410

Note. All hypotheses were tested one sides. ¹ High income and ² couple were used as reference category.

*** p <.001, ** p <0.01, *p <.05. All analyses have been controlled for multicollinearity by tolerance and VIF.

Direct influences of Social Capital and Strength of Ties on the first determinant of attitudes (figure 3, Path D and E)

Direct influence of social capital on attitudes will be discussed, as can be seen in the model: recommendation has a positive, and discouragement a negative effect. So a recommendation in your social network has a positive effect on an individual choice to travel by public transport ($B = .075$, $p = .326$). Discouragement of your social network on travelling by local bus has a negative effect on your attitude towards the choice of public transport ($B = -.273$, $p = .126$). The more people discourage an individual, the more likely it will be to have a positive attitude towards travelling by public transport. We realize that this is not the same direction as the hypothesis did assume. Both determinants are not significant, social capital does not influence how much an individual likes travelling by public transport.

Also the strength of ties influencing someone's attitudes will be discussed. The hypothesis assumed that strong ties would have a greater influence than weak ties on the attitudes of a person. The model shows weak ties having a stronger positive affect ($B = .043$; $p = .122$). Both of the determinants are not significant, so hypothesis 3 cannot be supported, (first intercept of attitude).

Direct influences of Social Capital and Strength of Ties on the second determinant of attitudes (figure 4, Path D and E)

Firstly, the direct influence of social capital on attitudes will be discussed. Recommendation has a positive effect ($B = .208$, $p = .073$), and discouragement a negative effect ($B = -.141$, $p = .246$). Discouragement of your social network of travelling by local bus has a negative effect on your attitude towards the likelihood of going by public transport. Both determinants are not significant, so social capital does not influence how much an individual likes travelling by public transport.

Secondly, the strength of ties influencing someone's attitudes will be discussed. The hypothesis assumed that strong ties have a greater influence than weak ties have on the attitudes of a person. The model shows strong ties having a stronger positive effect ($B = .097$, $p < .01$). Both of the determinants are significant, so hypothesis 3 can be supported for the second determinant of attitudes.

Remarkable, considering both intercepts, is the relationship between the predictor variables and the criterion. Social capital and strong and weak ties accounted for a significant 1.3% and 1.4% of the variability in the mindset towards travelling by local bus. The first intercept on social capital, $R^2 = .013$, $F(10,707) = 1.961$, $p < .001$, on the strength of ties R^2

=.014, $F(10,707) = 1.987$, $p < .001$. On the other hand, social capital and strong and weak ties accounted for 39,7% and 41% of the variability in the way someone minds looking up local bus information. The second intercept on social capital $R^2 = .397$, $F(10,707) = 48.262$, on the strength of ties $R^2 = .410$, $F(10,707) = 50.769$, $p < .001$).

Figure 3: Influences of the social network on the mode-choice of an individual, through attitudes. Attitudes are in this model defined by 'I like travelling with local bus'. ¹ = Recommendation; ² = Discouraging; ³ = Recommendation; ⁴ = Discouraging; ⁵ = I like travelling by local bus; ⁶ = I don't mind looking up local bus information; ⁷ = Strong ties ⁸ = Weak ties; ⁹ = Strong ties; ¹⁰ = Weak ties.

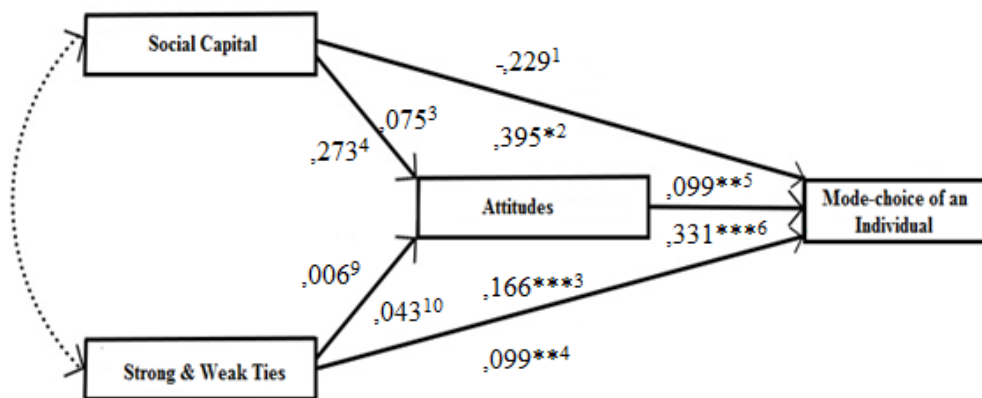
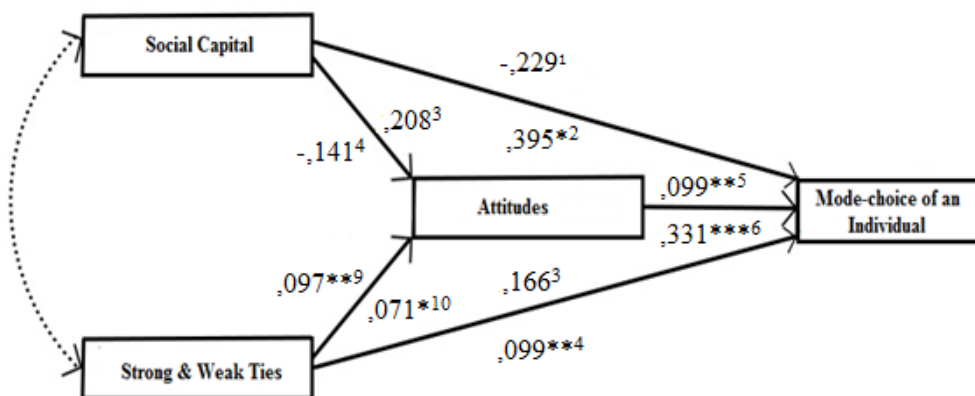


Figure 4: Influences of the social network on the mode-choice of an individual, through attitudes. Attitudes are in this model defined by 'I like looking up local bus information'. ¹ = Recommendation; ² = Discouraging; ³ = Recommendation; ⁴ = Discouraging; ⁵ = I like travelling by local bus; ⁶ = I don't mind looking up local bus information; ⁷ = Strong ties ⁸ = Weak ties; ⁹ = Strong ties; ¹⁰ = Weak ties.



Chapter 4: Conclusion and discussion

The present study aimed to an innovative contribution towards explaining the role of social network in terms of the travel or non-travel by public transport. Important focuses of governments are the soft measures; governments nowadays are more focused on the soft measures of travelling by public transport (Bamberg et al., 2011). A main factor behind this soft measurement could be the social network of an individual. This has been the focus of this study. The key objectives were to investigate (1) how the social network influences the use or non-use of the public transport, and (2) what kind of role attitudes played in this relationship. The social network has been conducted by social capital and the strength of ties. Explaining social capital, the theory of Durkheim (1983) has been used. Explaining the strength of ties, Granovetter (1983). Additionally, attitudes were measured by using the Theory of Planned Behaviour (Ajzen, 1991). We used *travel information survey* to test the hypothesized relationships in the regression models. The travel information survey provides an insight in the travel behaviour of an individual. The survey has been used in two different cities in the United Kingdom (Frag & Lyons, 2010). This dataset was conducted in 2008. Generalization of this data is doubtful. Certainly for the Netherlands, as two cities in England have been researched, having a different public transport service.

The first set of hypothesis, explaining the effects of social capital on mode-choice, resulted from a theory driven approach conducted by Durkheim (1983) and further developed by others, including Bourdieu (1988) and Putnam (1993). It assumed a direct effect of social capital on the mode-choice of an individual. Social capital is defined by recommendation and discouragement of the social network on the mode-choice. Unfortunately, the two were not highly correlated, and therefore could not combined into one variable. Effects of social capital on encouragement were negatively related, and for discouragement positively. This means that if people encourage someone to go by public transport, someone will have a tendency not to travel by public transport. This is not in line with the hypothesis and not consistent with results of other studies. However, according to the analysis if an individual is discouraged to use travel information services and therefore one does not travel by public transport, this is in line with the hypothesis. Additionally, this is also in line with other studies (Frag & Lyons, 2010).

Two different proxies explained the independent variable social capital. These two different proxies only tell whether an individual ever had a recommendation of a discouragement of their social network about public transport services. This does, however,

not explain how this relationship holds; is this one person only, or few people? Furthermore, it does not conclude anything about what kind of recommendation or discouragement is adequate. Next research respondents should be asked in which way the recommendation/discouragement meant something to the individual. For instance, did the recommendation/discouragement have a strong influence on the decision-making process, or (almost) none.

The third hypothesis included the strength of ties on the influence of travel behaviour, and the theoretical approach of Granovetter (1983) was used. Our hypothesis assumed that stronger ties have a greater influence on an individual travelling by public transport, than weak ties. Results of the analysis are in line with the corresponding hypothesis. In addition, the results are in line with results of other studies that assumed that strong ties have a greater influence on the decision making process of an individual (Granovetter, 1983; Brown & Reingen, 1987). However, the validity is doubtful; strong ties were measured through only 1 determinant, as the same for weak ties. Future research should include more determinants on defining strong and weak ties.

The fourth and fifth hypothesis included the direct effects of attitudes. Attitudes have been theoretical defined by using the theory of Planned Behaviour (Ajzen, 1991). This theory explains the way attitudes, behavioural control and social norms influences the intentions and actual behaviour of a person. Attitudes have been defined by the data in 2 categories; in which way an individual like to go by public transport, and in which way an individual don't mind to look up public transport information. Both of the determinants were positively significant. Which will mean that if a person like to go by public transport, or don't mind to look up public information, they will travel by public transport more often. However, the defining of attitudes has some flaws as well. The conceptualization of attitudes is restricted by the variables available in the dataset. A next research should construct a scale with various scales.

The sixth, seventh and eighth hypotheses, explaining a variation in the use of public transport by social networks, adding attitudes, results from a theory driven approach that combines sociological and psychological measures. Firstly, the sixth and seventh hypotheses will be discussed. The hypotheses were based on the relation between social capital and attitude. As the relation between the two proxies of attitudes was of weak strength, two different variables were used in the analyses. First, recommendations and discouragements were analysed towards in which way an individual likes going by public transport. Secondly, recommendations and discouragements were analysed towards the mindset towards travelling

by local bus and looking up local bus information. Unlike the theory argued, no significant relations can be found between social capital and attitude. This is not in line with research of Bamberg et al. (2007) who emphasizes the issues of the role of personal norms in terms of the decision to travel by public transport.

The last hypotheses (hypotheses 8) explained the way in which the strength of ties is related to attitudes. First, the relation of the strength of ties and the mindset of the travelling individual, after that the second determinant – looking up local bus information-, has been analysed. On the first determinant of attitudes, both were not found significant. However, on the second determinant both results were found to be positive effects and significant. Strong ties had a larger effect on the travel behaviour, which could support our hypotheses. This is in line with different studies (Bamberg et al., 2007; Bamberg et al., 2011).

This study contains some important contributions to the already existing literature in the field of social networks in relation to travelling by public transport. Most importantly, are the findings that can be seen in model 4. Which shows the importance of strong ties above weak ties in the decision making process. Not only the direct influences of the strength of ties on the travelling individual can be seen, subsequently the influences through attitudes on the travelling individual are confirmed as well.

For future research it is important to look in greater depth at the model used. Several limitations in this study can be traced. One of the most doubtful aspects of this study, is the way public transport is defined, namely by local bus. This is caused by too low frequencies in people who often use the train, coach or tram. This makes the reliability of this research apocryphal. In future research, other mode choices have to be included as well.

To conclude, although this research contributes to the understanding of the causes and effects of the social network on travelling by public transport, it also raises a number of questions that should be addressed in future research. Firstly, future research should continue to disentangle how the gap of perceptions in public transport and the reality lead people to the non-use of public transport. Moreover, research should focus on how precisely people influence each other's behavior, and subsequently have a focus on how to influence individuals positively towards public transport usage.

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