

Factors influencing social satisfaction and loneliness: a path analysis

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HIGHLIGHTS

- Frequency of walking and the percentage of non- western ethnic minorities affect social satisfaction
- Car ownership, very good health and place attachment decrease loneliness
- Personal variables (age, income, household composition and the death of spouse), frequency of cycling and the level of social cohesion affect the number of social interactions
- The number of social interactions and loneliness affect social satisfaction

ABSTRACT

Social networks have increasingly received attention in transportation research. However, more subjective aspects of the social network, such as social satisfaction and loneliness hardly received any attention in travel behavior research, whereas these aspects are very important in shaping quality of life. In this study, a path analysis is used to analyze the relationships between personal characteristics, neighborhood characteristics, travel behavior, social interactions, social satisfaction and loneliness. The analyses are based on data collected in Eindhoven and surrounding towns in the Netherlands in a survey among 177 respondents. Results show relationships between mobility aspects and the social aspects. They indicate that frequency of walking affects social satisfaction, frequency of cycling affects the number of social interactions and car ownership affects loneliness. Regarding the neighborhoods characteristics, interesting results are found as well. The percentage of non-western ethnic minorities in the neighborhood is found to negatively affect social satisfaction, social cohesion is found to affect the number of social interactions and place attachment is found to affect loneliness.

KEYWORDS

Mobility; neighborhood; social interactions; loneliness; social satisfaction; path analysis

1. INTRODUCTION

Loneliness has become a serious health problem (Russell et al., 1978). Being included in a social network and have social opportunities are important aspects that could influence the well-being and happiness of individuals (e.g. Umberson and Montez, 2010; Delmelle et al., 2013). An increased number of academic research analyzed the relationship between mobility factors and the wellbeing of individuals (e.g. Spinney et al., 2009; Nordbakke and Schwanen, 2014; Ettema et al. 2010; Delbosc and Currie, 2011).

In transportation research there has recently been an increased interest in social networks and social activity travel behavior. In a number of studies, mobility factors (e.g. car ownership, walking for transportation and frequency of using transport modes) and demographic factors were found to influence the number of social activities (e.g. Newbold et al., 2005; Farber and Páez, 2009; Van Cauwenberg et al. 2014; Carrasco et al., 2008; Páez and Farber, 2010; Van den berg et al, 2011a; Kemperman et al., 2006). However, these studies focus on the quantity of the social network and social issues such as loneliness and social satisfaction were hardly taken into account.

It is not only the number of social contacts, but mainly the quality that is important to people's wellbeing (Umberson and Montez, 2010). A lower number of social activities does not necessarily mean that people feel lonelier or are less satisfied with their social contacts (Bonsang and Van Soest, 2012; Delmelle et al., 2013) and people with a large social network are not always more satisfied with their social life. People can feel lonely as the consequence of 'life events' (e.g. loss of a spouse, divorce, relocation and marriage) (Von Hippel et al., 2008), that might cause changes in behavior and in the social network of individuals (Wrzus et al., 2013). Moreover, people might be different in terms of preferences or desires for social contact and social interaction because of different outlooks on life or on personality traits (e.g. Nordbakke and Schwanen, 2014). This could also influence the perception of satisfaction with their social life. It is therefore important to focus on subjective feelings of loneliness and social satisfaction in addition to more quantitative measurements of social activities.

Given the background and motivation discussed above, the aim of this study is to analyze the spatial and mobility-related factors that influence loneliness and social satisfaction. The analyses are based on data collected in Eindhoven and surrounding towns in the Netherlands, among 177 respondents. The data are analyzed using path analysis.

The remainder of this paper is structured as follows. The next section reviews the existing literature on the relationships between loneliness, personal characteristics, mobility characteristics and characteristics of the built environment. Section 3 describes the data collection procedure and the sample. In Section 4 the analysis methods and results are addressed. Finally, Section 5 contains the conclusions and a discussion.

2. LITERATURE REVIEW

Loneliness is likely to be an important aspect of aging and a serious health problem (Russell et al., 1978). De Jong Gierveld and Van Tilburg (2010) define loneliness as:

... the subjective evaluation of the situation individuals are involved in, characterized either by a number of relationships with friends and colleagues which is smaller than is considered desirable (social loneliness), as well as situations where the intimacy in confidant relationships one wishes for has not been realized (emotional loneliness).

Loneliness can be the consequence of changes in the social network (e.g. divorce or the loss of a loved one), the lack of a large and diverse network and the absence of children nearby (Von Hippel et al., 2008). Social interactions could increase the feeling of being socially integrated and decrease the feeling of loneliness (Knipscheer et al., 1995).

In this study, social satisfaction is defined as being satisfied with one's own social contacts and one's social network in general. Most studies on the social network focus on the size and composition of the social network and on the amount of social contact, not on individual's perceptions of loneliness or social satisfaction (Hughes et al., 2004). For instance, Wellman et al. (2005) studied social networks of individuals in the Connected Lives Study and suggest that the size of the network positively influences the number of neighbors in the social network. In addition, Van der Houwen and Kloosterman (2011) suggest that older people, people with high incomes and natives, have more frequent contact with neighbors.

A growing number of studies describe the connection between social networks and travel behavior. Van Cauwenberg et al. (2014) for example, examined the relation between the perceived social environment and walking for transportation. In this study, a relationship was found between walking for transport and social interactions with neighbors. Moreover, Carrasco et al. (2008) analyzed the spatial distribution of social activities and the distances between individuals and their social network members. They suggest that members of the social network who live nearby were seen as supportive social members and that new entrants in the neighborhood have more contacts at a great distance than people who have lived for a long time in the neighborhood.

In addition, Van den Berg et al. (2009) studied the relationships between personal characteristics, characteristics of the built environments and travel behavior mediated by the effect of ICT-use and aspects of the social network. Findings of this study suggest that people who own a car tend to have a larger social network; a car could help to maintain social contacts at a larger distance. Regarding the effect of personal characteristics on the number social interactions, significant effects were found for age, education, work, living with a partner, the presence of children, social network size and club membership (Van den Berg et al., 2009). Moreover, Páez and Farber (2010) analyzed the participation of people with disabilities in leisure activities (e.g. visiting friends, doing exercise or attending events). Demographic variables (e.g. age, gender and household characteristics), mobility disability and the frequency transportation modes that were used, were found to affect the participation in leisure activities.

There is one study in transportation research that aims to predict social satisfaction, as a result of personal characteristics, housing and residential characteristics and transportation variables (Delmelle et al., 2013). Delmelle et al. (2013) defined social satisfaction as the level of satisfaction with one's social life. Respondents were asked to report how satisfied they were with their social contact, ranging from most satisfied (6) to least satisfied (1). Results show that the health status and financial situation of individuals could affect social satisfaction. Regarding mobility, commute time and car ownership were found to affect the satisfaction with social contacts (Delmelle et al., 2013). Delmelle et al. (2013) state the importance of including loneliness and feelings of isolation in research on the relationships of social satisfaction and mobility factors to provide a better insight into the relationships.

Walking is an important factor for social satisfaction. A good walkability improves the health conditions and leads to more spontaneous and intentional social interactions (Glanz, 2011). Leyden (2003) claims that people who are living in a walkable, mixed-use environment are more likely to know their neighbors and are more socially involved. Van Cauwenberg et al. (2014) conclude that people who have more social contacts are more likely to walk for transportation.

Another study in transportation research analyzed the relationship between transport mobility benefits and the perceived quality of life of elderly Canadians (Spinney et al., 2009). This research includes four benefits derived from travel activities namely, psychological benefits, exercise benefits, community helping benefits and community socializing benefits. The domains that were used to measure the quality of life are happiness, life satisfaction, job/ main activity satisfaction, sense of belonging to local community and the time spent alone. Findings of this study suggest that happiness is positively correlated to psychological, exercise and community helping benefits. However, no relation was found between life satisfaction and transport mobility benefits. Respondents who spend more time alone were found to be exposed to fewer benefits (Spinney et al., 2009).

Other studies on social satisfaction have been conducted by social scientists. However, they rarely focus on mobility aspects. For instance, Bonsang and Van Soest (2012) analyzed the determinants of social satisfaction of elderly in eleven countries in Europe. They concluded that income, contact with children and non-professional activities affect the satisfaction with social contacts. Moreover, Helliwell and Putnam (2004) studied which factors influence life satisfaction, happiness and self-assessed health status. Results of this research show that people with high incomes have a higher life satisfaction.

Windsor et al. (2012) claim that residents who live in a neighborhood with a higher level of social cohesion have more social contacts and feel less lonely than residents who live in neighborhoods with low social cohesion. Kolodinsky et al. (2013) found that a sense of community is an important factor for the quality of life. Broese van Groenou et al. (1999) suggest people living in a more homogeneity and high income neighborhood are less lonely. Buffel et al. (2011) found that social characteristics of a neighborhood have an effect on social contact between neighbors, such as a large proportion of non-western ethnic minorities and a large proportion of people with a low-income (Rubenstein and Parmelee, 1992).

Another important factor of the relationship between the living environment and the social network is 'place attachment'. 'Place attachment' can be described as a collection of individual memories and common feelings about a place (Rubenstein and Parmelee, 1992). When people are more attached to their living environment they will, most probably, be more satisfied with their neighbors and have more social interactions with local residents. Studies on place attachment show that characteristics of the built environment affect the attachment to a place (Buffel et al., 2011; Brown and Raymond, 2007; Marney, 2011). For example, Buffel et al. (2011) studied the effect of neighborhood factors on the attachment to the neighborhood. Results suggest that people are more attached to the neighborhood if the neighborhood is proper, green and if there are safe areas, accessible facilities and opportunities for social participation).

3. DATA COLLECTION, VARIABLES AND DESCRIPTIVES

The review of the existing literature suggests that personal characteristics, such as age, gender, home ownership, household composition, club membership, health and income/education level, neighborhood characteristics, such as social cohesion and composition of the population, place attachment, as well as mobility characteristics might affect the number of social interactions, loneliness and social satisfaction of individuals. Therefore, to analyze the relationships between these variables, a data collection instrument was designed, consisting of a questionnaire on social satisfaction, loneliness, and personal- and neighborhood characteristics. In addition, the instrument included a two-day social interaction diary to collect data on social activities outside of the household.

Dependent variables

In this study there are three dependent variables, namely the number of social interactions (in the two-day diary), social satisfaction and loneliness, which are expected to affect each other. First, social satisfaction was measured using a created index based on studies by Delmelle et al. (2013) and Bonsang & Van Soest (2010). It is composed of the answers to the following nine questions on respondents’ satisfaction with their social network composition, social network size and their social life in general.

- How satisfied are you with your friends in your social network?
- How satisfied are you with your family in your social network?
- How satisfied are you with your direct neighbors in your social network?
- How satisfied are you with local residents in your social network?
- How satisfied are you with club members in your social network?
- How satisfied are you with colleagues/ fellow students in your social network?
- How satisfied are you with other non-kin in your social network?
- How satisfied are you with the number of members in your social network?
- How satisfied are you with your social life in general?

The questions in this study were measured on a five point Likert scale ranging from very dissatisfied (1) to very satisfied (5). The total score of social satisfaction will be used in the analyses. To verify if each item measures the same, Cronbach’s Alpha is used. The Cronbach’s Alpha for the total score is 0.758, which is high enough to sum the scores for the analyses. Figure 1 shows the distribution of the total score of social satisfaction.

Loneliness was measured using the three- item loneliness scale designed by Hughes et al. (2004). The three items are: “How often do you feel that you lack companionship?”, “How often do you feel left out?” and “How often do you feel isolated from others?”

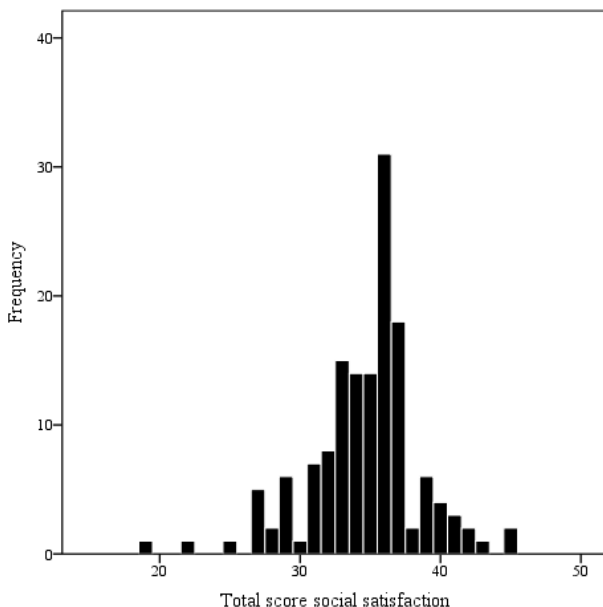


FIGURE 1: Distribution total score social satisfaction

The response categories for these questions were: hardly ever (1), some of the time (2), often (3). In the analyses the total sum score of loneliness is used. The internal consistency of the items is good, with a Cronbach's Alpha of 0.741. Figure 2 shows the distribution of the total score of self-perceived loneliness.

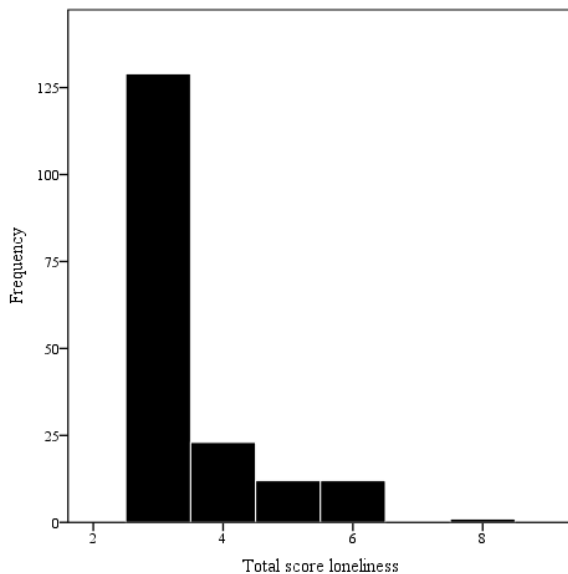


FIGURE 2: Distribution of loneliness

The number of social interactions was collected using a two-day social interaction diary, in which respondents were asked to report their social interactions. This data collection is similar to the study of Van den Berg et al. (2012). Respondents were asked to report all forms of social contacts, such as a joint activity (e.g. sports or going out together), having a conversation (face-to-face, by telephone, through the internet and social media) and sending or receiving an email, letter or text message. Respondents were instructed to report one social interaction for each session of text messages, WhatsApp messages, chat-messages or messages during an internet game. Figure 3 shows the distribution of people where the respondents had a social interaction with in the two reported days.

Independent variables

The personal and household variables age, gender, household composition, employment status, health, income and education level, length of residence in the neighborhood, ethnicity and work status, were all measured in the usual way. Respondents were also asked if they experienced any life events, such as parenthood, divorce or death of a spouse since 2008. In addition, data was collected on mobility. Car ownership was measured asking respondents whether they have access to one or more cars. Frequency of the use of different transportation modes was measured by asking respondents; 'how often do you use each transportation mode'. They could rate this on a seven-point scale, ranging from 'never' (1) to '(almost) every day' (7).

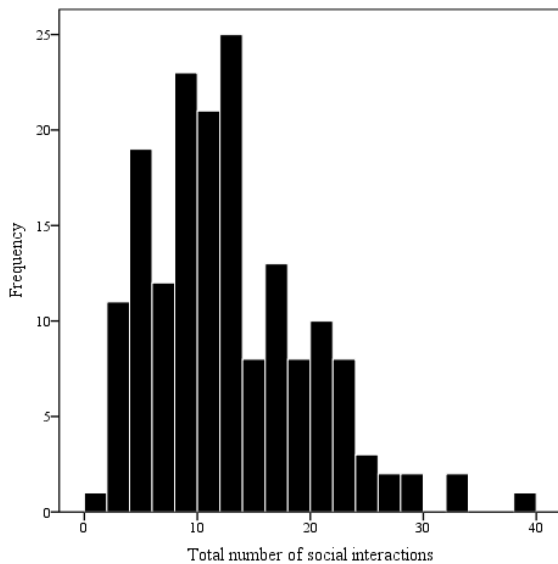


FIGURE 3: Distribution of social interactions

With respect to neighborhood characteristics, place attachment and social cohesion were included in the questionnaire. For this study the 12-item scale of Williams and Roggenbuck (1989) was used to measure place attachment. This 12-item scale contains statements such as ‘I feel that this neighborhood is a part of me’, ‘I am very attached to this neighborhood’, ‘this neighborhood means a lot to me’ and ‘I get more satisfaction out of being in this neighborhood than in another neighborhood’, with the response categories ranging from strongly disagree (1) to strongly agree (5). For measuring social cohesion, the index of Decide (2007) was used. This tool includes the following 7 questions about the perceived social cohesion by respondents and it focuses on the extent to which residents do activities together and the degree of solidarity between residents.

1. How often, in the past six months, did you have a chat with someone from the neighborhood?
2. If you are away from home, is there someone in your neighborhood who looks after your house, for example to make sure that there is no forced entry or give the plants some water?
3. If something important happens in the neighborhood or with a neighbor, is there someone in your neighborhood who will makes you aware of it?
4. Do you feel involved with the people who live in your neighborhood?
5. If there is a sad moment or a sad event in your life, are there local residents who helps and support you?
6. Are there sometimes any neighborhood parties, barbecues or other activities in the neighborhood, for which the whole neighborhood is invited? [IF YES] How often do you go to these parties, barbecues or activities?
7. Have you in the past year collaborated with other local residents to organize something in the neighborhood, for example, to organize a neighborhood party or activity, or to make a neighborhood newspaper [IF YES] How often have you met in the past year with these local residents?

The response categories for these questions were:

Question 1: once a year or less (1), a few times a year (2), a few times each month (3), once a week (4), a few times each week or more (5)

Question 2, 3, 5 and 6: almost never (1), usually (2), sometimes yes / no (3), usually (4), almost always (5)

Question 4: with hardly anyone (1), with most people not (2), with some people yes / no (3), with most people though (4), with almost everyone (5)

Question 7: not collaborated (1), collaborated about once every half a year (2), collaborated about once every three months (3), collaborated about once every two months (4), collaborated about every month or more frequently (5)

Data collection procedure

The aim was to collect a second wave of social interaction diaries from the respondents that took part in the study by Van den Berg et al. (2012) in 2008. In 2008, addresses were randomly selected in a number of neighborhoods in Eindhoven and surrounding towns (Nuenen, Gerwen, Geldrop, Son en Breugel, Liempde, Nijnsel and Sint Oedenrode). Out of the 747 useful diaries collected in 2008, 523 addresses of the respondents were known and these respondents were personally approached at their home. From the 523 respondents who were approached, 215 (41%) accepted a diary. Out of these accepted diaries, 141 useful diaries were returned. This gives an overall response of 27%. To obtain a larger sample, 47 new addresses were selected in a number of neighborhoods in Eindhoven, which consisted of acquaintances' addresses and some randomly selected addresses. Out of these addresses, 36 useful diaries returned. This resulted in a total of 177 useful diaries. Respondents were asked to keep the diary for two days to collect information about social interactions.

Sample characteristics

Table 1 shows the basic sample characteristics. The sample of this research is compared to the population of the Netherlands (CBS, 2012). As can be seen, the sample is not completely representative of the Dutch population. Women (62%) are overrepresented in the sample. Because women may spend more time at home, it is more likely that they would answer the door. Secondly, the sample contains a high percentage of people with an age between 40 and 80 years compared to the Dutch population. This might be caused by the fact that the same respondents who participated in the study by Van den Berg et al. (2012) in 2008, were asked if they were willing to participate again in this research. Therefore, the age groups have shifted.

In addition, people living without a partner, with or without children, are underrepresented in this sample. This is probably due to the high percentage of people aged between 40 and 80 years. The sample contains a high percentage of people with a higher education. This is probably due to the fact that people with a higher education are more willing to participate in a survey.

TABLE 1: Basic sample characteristics (N=177)

	Sample (N)	Sample (%)	Netherlands (%)
<i>Gender</i>			
Male	68	38	50
Female	109	62	50
<i>Age</i>			
Age (<40 years)	28	16	48
Age (40-65 years)	86	49	36
Age (>65 years)	63	35	16
<i>Household composition</i>			
One person household	23	13	37
Couple without children	80	45	29
Couple with children	64	36	27
Single parent family and other	10	6	7
<i>Income</i>			
Low income (< €3000 net/month)	96	54	71
High income (> €3000 net/month)	72	41	29
(Missing)	13	7	
<i>Education</i>			
Primary education	34	19	29
Secondary education	54	31	43
Higher education	89	50	28

Table 2 shows the dependent and independent variables that are used in the analyses. Regarding mobility, the sample contains a high percentage of households that own a car. The sample contains people who are quite mobile. Most respondents cycle and walk several times a week. Moreover, 50% of the respondents walk (almost) every day and 42% of the respondents cycle (almost) every day. This can be related to the fact that 88% of the respondents in the sample are not hindered by health problems when travelling. In addition, most respondents rate their health status as good (47%), very good (20%) or even excellent (15%). These percentages are somewhat high, considering the high percentage of elderly in the sample. Of the 177 respondents, 169 respondents reported a total of 2070 social interactions in two days. Therefore, the average number of social interactions per respondent in two days is 12.25, with a standard deviation of 6.94. The mean of social interactions was used for the eight respondents who only filled in the questionnaire or kept the diary for only 1 day.

In this study, it is assumed that social satisfaction is an interval variable. The total score of social satisfaction will be used in the analyses. The mean total score of social satisfaction is 34.63, with a standard deviation of 3.93. The mean on a five point Likert scale is 3.8. As can be seen, the mean score of self-rated loneliness is 3.50, with a standard deviation of 0.95. The score of loneliness is not normally distributed: most respondents hardly ever feel lonely and some of the respondents sometimes feel lonely. Nevertheless, in the analyses, loneliness is considered to be an interval variable.

TABLE 2: Endogenous and explanatory variables considered in the analysis (N=177)

	Mean	St. Dev.
<u>Endogenous variables</u>		
# Social interactions	12.25	6.94
Social satisfaction	34.63	3.93
Loneliness	3.50	0.95
<u>Explanatory variables</u>		
<i>Personal characteristics</i>		
Older than 65 years (dummy)	0.34	0.47
Low income (< €2000 net/month) (dummy)	0.23	0.42
Death of a spouse in the last 6 years (dummy)	0.06	0.23
Couple with children in household (dummy)	0.36	0.48
Couple without children in household (dummy)	0.45	0.50
Very good health (dummy)	0.35	0.48
<i>Mobility characteristics</i>		
One or more cars in household (dummy)	0.90	0.30
Frequency of walking	6.05	1.40
Frequency of cycling	5.63	1.88
<i>Neighborhood characteristics</i>		
Place attachment	38.56	7.37
Social cohesion	22.98	5.60
% Non-Western ethnic minorities	11.80	7.12

4. METHODS AND RESULTS

In order to simultaneously analyze the effects of the independent variables on the dependent variables, as well as the relationships between the dependent variables, a path analysis is used. The model was estimated using the statistical software package LISREL (Jöreskog and Sörbom, 2008). Although not all variables are normally distributed, we used the maximum likelihood method to estimate the models, which may cause some bias in the standard errors and goodness-of-fit estimates.

First, significant effects of personal- and neighborhood characteristics as well as mobility variables on social satisfaction were determined using bivariate analyses. The relationships that were significant at the 0.1 level were entered in the model. Next, the links between explanatory and endogenous variables were added. In addition, the interrelationships between endogenous variables are also added. All links that were not significant at the 0.05 level were then removed stepwise from the model. For instance, gender, homeownership, urban density and club membership were not found to significantly affect any of the dependent variables. The unstandardized coefficients and t-statistics of direct and total effects of the final model that are significant at the 0.1 significance level are shown in Table 3. The total effects are the direct effects plus indirect effects (via a mediating variable). The direct effects of the explanatory variables are shown in Figure 4.

Table 3 shows the goodness-of-fit statistics of the model. The model provides a good fit of the data, if the value of Chi Square divided by the degrees of freedom and the Normed Fit Index are close to 1 (Golob, 2001). The value of RMSEA needs to be (close to) 0; this model results in a RMSEA value of 0.37. In addition, the value of the model's Akaike information criterion (AIC) needs to be close to the value of saturated AIC (Golob, 2001). Overall, Table 3 shows a good fit of the model to the data.

Effects of explanatory variables on the number of social interactions

Seven explanatory variables are found to have a significant effect on the number of social interactions. First, people over 65 years of age are found to have fewer social interactions than people who are younger than 65 years. This is in line with the findings of Van den Berg et al. (2011b). This is probably partly due to the fact that social interactions with colleagues disappear after retirement. Moreover, it might also to a large extent be explained by impaired health and mobility. Elderly are less able to travel for and maintain their social interactions.

Secondly, low income is found to have a negative effect on the number of social interactions. This implies that people with a low income have less social interactions than people with a high income. People with higher incomes are likely to have more resources to maintain their social contacts. Van den Berg et al. (2011b) found that people with a higher income have a larger social network; a larger social network leads probably to a higher number of social interactions. In addition, Van der Houwen and Kloosterman (2011) found that people with high incomes, have more frequently contact with neighbors.

Next, the life event 'death of a spouse' is found to have a negative effect on the number of social interactions. This implies that people, who have lost their spouse in the last 6 years, have fewer social interactions. Results of the study of Wrzus et al. (2013) also suggest that the loss of a spouse decreases the social network.

Regarding household composition, a negative effect on the number of social interactions is found for couples with and without children. The results suggest that people living with a partner with children and people living with a partner without children have fewer social interactions than people living without a partner. This finding is in line with Van den Berg et al. (2011b). People living with a partner probably have less need to have social interactions outside of the household, because they already have many social interactions within the household. Note that social interactions within the household were not reported by the respondents.

In addition, a relationship was found between the number of social interactions and frequency of cycling. This is probably due to the fact that during cycling spontaneous social interactions are more likely to occur than when using a car as transport mode. In addition, it is likely that people who have more social interactions would cycle more frequently. Finally, results show that social cohesion has a positive effect on social interactions. This suggests that people living in a neighborhood with a higher social cohesion level, have more social interactions. This is in line with findings of Windsor et al. (2012). They claim that residents who live in a neighborhood with a higher social cohesion level have more social interactions with neighbors.

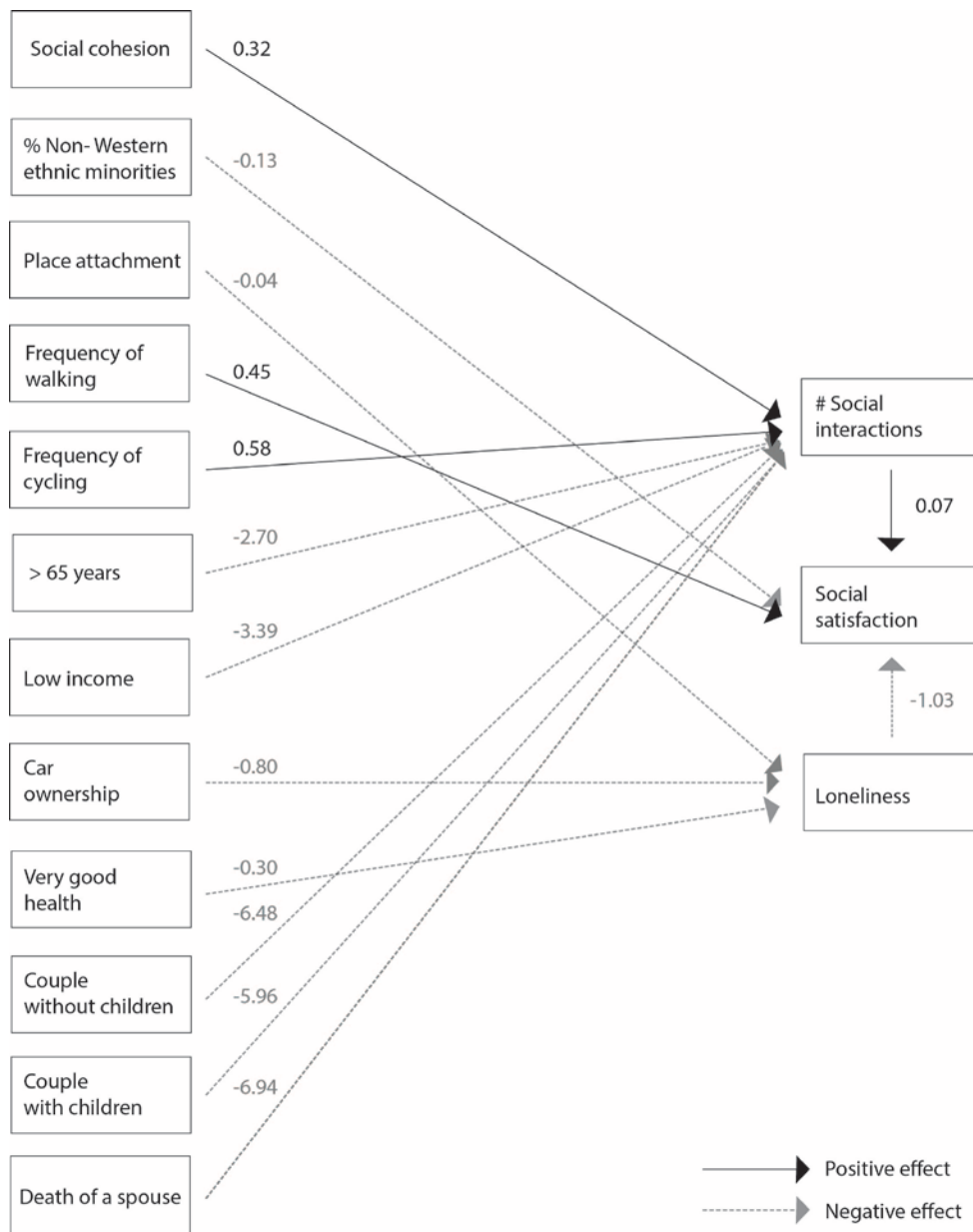


FIGURE 4: Significant effects

TABLE 2: Path analysis model estimates (unstandardized effects)

From	To		Social satisfaction		Loneliness	
	# Social interactions		Direct	Total	Direct	Total
	Direct	Total				
<i>Effects between endogenous variables</i>						
# Social interactions			0.07	0.07		
<i>t statistic</i>			2.03	2.03		
Social satisfaction						
<i>t statistic</i>						
Loneliness			-1.03	-1.03		
<i>t statistic</i>			-4.01	-4.01		
<i>Effects of explanatory variables</i>						
Older than 65 years	-2.70	-2.70		-0.20		
<i>t statistic</i>	-2.24	-2.24		-1.51		
Low income	-3.39	-3.39		-0.25		
<i>t statistic</i>	-2.50	-2.50		-1.58		
Death of a spouse	-6.94	-6.94		-0.51		
<i>t statistic</i>	-3.01	-3.01		-1.68		
Couple with children	-5.96	-5.96		-0.44		
<i>t statistic</i>	-3.34	-3.34		-1.74		
Couple without children	-6.48	-6.48		-0.48		
<i>t statistic</i>	-3.87	-3.87		-1.80		
Very good health				0.31	-0.30	-0.30
<i>t statistic</i>				1.88	-2.13	-2.13
One or more cars in household				0.83	-0.80	-0.80
<i>t statistic</i>				2.68	-3.61	-3.61
Frequency of walking			0.45	0.45		
<i>t statistic</i>			2.57	2.57		
Frequency of cycling	0.58	0.58		0.04		
<i>t statistic</i>	2.17	2.17		1.48		
Place attachment				0.04	-0.04	-0.04
<i>t statistic</i>				2.95	-4.36	-4.36
Social cohesion	0.32	0.32		0.02		
<i>t statistic</i>	3.65	3.65		1.78		
% Non-Western ethnic minorities			-0.13	-0.13		
<i>t statistic</i>			-3.83	-3.83		
<i>Goodness-of-fit of the model</i>						
Degrees of Freedom	23					
Minimum Fit Function Chi Square	17.70					
Chi Square / Degrees of Freedom	0.77					
RMSEA	0.37					
Model AIC	209.25					
Saturated AIC	210.00					
Normed Fit Index	0.97					

Effects of explanatory variables on social satisfaction

First, a relation was found between frequency of walking and social satisfaction. Glanz (2011) found that walking leads to more spontaneous and intentional social interactions. Social satisfaction and loneliness were not included in the study by Glanz (2011). It is likely that the frequency of walking could, as well as the frequency cycling could influence the number of social interactions. However, in this model no significant relationship was found between frequency of walking and the number of social interactions. Moreover, people who are more satisfied with their social life would probably walk more frequently for social contacts.

The percentage of non-western ethnic minorities in the neighborhood is found to have a negative effect on social satisfaction. This implies that people living in neighborhood with a higher percentage of non-western ethnic minorities are less satisfied with their social life. Findings of Van der Houwen and Kloosterman (2011) suggest that a large proportion of non-western ethnic minorities has a negative effect on the social contact between neighbors.

Effects of explanatory variables on loneliness

Very good health is found to have a negative effect on loneliness. This implies that people with a very good health are less lonely than people with a good or moderate/bad health. People with health problems are less able to maintain their social network and therefore probably feel lonely more often. Delmelle et al. (2013) found a relationship between health and social satisfaction. However, the variable loneliness was not included in this study.

Regarding mobility, car ownership is found to have a negative effect on loneliness. People who own one or more cars in the household feel less lonely than people who don't own a car. Findings of Delmelle et al. (2013) show a significant effect of car ownership on social satisfaction. A car might help people to maintain their social contacts with members who are living further away. Therefore, they would probably feel less lonely.

As can be seen, place attachment is found to have a negative effect on loneliness. Dallago et al. (2009) suggest that place attachment increases the quality of social contacts with neighbors and the sense of community in the neighborhood. Therefore, people who are more attached to their neighborhood would probably feel less lonely than people who are less attached to their neighborhood.

Effects between the endogenous variables

The number of social interactions is found to have a positive effect on social satisfaction. This implies that people who have more social interactions are more satisfied with their social life. Loneliness has a negative effect on social satisfaction. This indicates that people, who often feel lonely, are less satisfied with their social life. It is notable that no significant effect was found of social satisfaction on loneliness. This indicates that people who are not satisfied with their social life, do not necessarily feel lonelier.

5. CONCLUSIONS AND DISCUSSION

There is a growing interest in social networks and travel behavior. However, social aspects such as loneliness and social satisfaction have received hardly any attention in transportation research. On the other hand, it has been recognized that social satisfaction and loneliness are important aspects of quality of life. The quality of the social network is much more important than the quantity of the social network (Penninx, 2005). A smaller size of the social network

does not mean that people are lonelier and vice versa, people with a large social network are not always more satisfied with their social life.

The aim of this study was to analyze the relationships between social interactions, loneliness, social satisfaction, household characteristics, neighborhood and mobility attributes. Based on data collected in Eindhoven and surrounding towns, a path analysis was performed. The endogenous variables used in this analysis are the number of social interactions, self-rated social satisfaction and self-rated loneliness.

This research has shown that social interactions, feelings of loneliness, personal characteristics as well as the place where people live are important factors in shaping social satisfaction of elderly. However, the sample contains only people from Eindhoven and surroundings. It would be interesting to compare social satisfaction to other cities in the Netherlands or other countries. Also, a larger sample size could give a better insight in the relationships. In addition, more detailed information about travel behavior could strengthen the analysis. Including, for example, public transport travel time and detailed information on travel behavior of the social interactions (e.g. type of location, distance and transport mode) in the model could be relevant.

Another aspect that could be interesting for further research is analyzing changes in characteristics of social interactions (e.g. type, purpose and travel distance) related to new communication modes, such as social media (e.g. Facebook, Twitter, LinkedIn and YouTube) and mobile applications (e.g. WhatsApp, Instagram and Pinterest).

Nevertheless, this study adds more understanding to the relation of social satisfaction and travel behavior, which received hardly any attention in existing literature. The relationships that were found between frequency of walking, frequency of cycling, the number of social interactions and social satisfaction are important for urban planners. Spaces should be created where cycling and walking are encouraged, for example by designing safe streets with good visibility, clearly marked sidewalks and cycle paths, sufficient facilities nearby and substantial open space (Hanibuchi et al., 2012).

In addition, results of this study can contribute to broader concerns of society, such as loneliness and social satisfaction in an ageing population. Results of this study give more insight in the relation between characteristics of the living environment, loneliness and social satisfaction. It shows that the living environment is an important aspect for improving the quality of the social life of individuals. Feeling attached to a neighborhood could diminish feelings of loneliness.

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