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# Exploring the role of public transport service and walking route related factors to identify maximum walking distances to bus stops in the Netherlands

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## ABSTRACT

This paper presents a study regarding the factors affecting the maximum distance travelers are willing to walk to a bus stop. The study focuses on bus services provided at and walking routes towards bus stops. Travelers' evaluations are collected using a stated preference experiment. Based on 7911 evaluations of 879 respondents, a latent class ordered logit model is estimated showing that both bus service and walking route related attributes significantly contribute to the maximum distance travelers are willing to walk from home to a bus stop. The parameter estimates show that the most influential attributes are the bus frequency at the bus stop and the presence of street lighting along the route between home and bus stop. The model also shows that based on the evaluations three different classes of respondents can be distinguished. Membership of a class depends on traveler related characteristics: gender, residential area, and bus use.

## 1. Introduction

In recent years, new methods for defining walking catchment areas of bus stops have arisen, refuting the generally used 300 or 400 m walking distance threshold (Amirah et al., 2021; Chen et al., 2022; Durand et al., 2016; El-Geneidy et al., 2014; Kerr & Ginn, 2003; Mulley et al., 2018; O'Connor & Caulfield, 2018; Stojanovski, 2020; Tennoy et al., 2022; Tsioulianos et al., 2020). All researchers indicate the importance of a good insight into the size of public transport catchment areas. Walking is one of the most commonly used access modes for bus travelers. This is supported by Basheer et al. (2019) showing that at least 40 percent of all public transport journeys in the UK start with a (registered) walking trip. Also, insights of the Dutch National Travel survey show that at least 35 percent of the bus travelers access of a bus stop by foot (CBS, 2022). An accurate catchment area definition can better assist transport operators, urban planners, and real estate developers in enlarging potential ridership for bus public transport and determining attractiveness of areas surrounding public transport stops for living, working, and leisure (Amirah et al., 2021; Efthymiou &

Antoniou, 2013; Givoni & Rietveld, 2007; Siripanih et al., 2019; Zhou et al., 2020). Various studies show that different specifications of public transport catchment areas result in different potentials and attractiveness (Andersen & Landex, 2008; Gutiérrez & Garcia-Palomares, 2008; O'Connor & Caulfield, 2018).

A very important characteristic of public transport catchment areas concerns the (maximum) walking distance that travelers are willing to walk to the public transport stops. Previous studies have presented evidence that there are several factors, apart from distance, that can influence a travelers' willingness to walk to a bus stop (Amirah et al., 2021; Börjesson, 2012; Chidambara, 2019; El-Geneidy et al., 2014; Fillone & Mateo-Barbiano, 2018; Gao et al., 2020; Guo & Ferreira, 2008; Larranaga et al., 2021; Liu et al., 2020; Sukor & Faisal, 2018; Van Soest et al., 2020; Zacharias & Zhao, 2017). Aspects such as bus service and walking routes as well as amenities present at a bus stop are found to be of influence on the maximum distance a traveler is willing to walk to a bus stop (Amirah et al., 2021; Daniels & Mulley, 2013; Mulley et al., 2018; Nassir et al., 2015; O'Connor & Caulfield, 2018). Van Soest et al. (2020) provided an extensive literature overview of 'how far people

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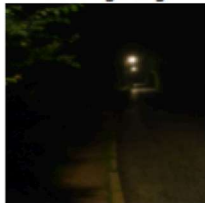

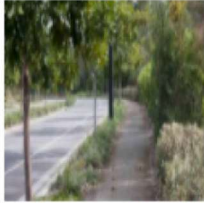







Attributes	Levels		
	Fastest route 10 minutes	20% extra travel time 12 minutes	50% extra travel time 15 minutes
Directness of service	<b>Good lighting</b>  Clear sight on surroundings	<b>Medium lighting</b>  Acceptable sight on surroundings	<b>Poor lighting</b>  Limited sight on surroundings
	<b>Good greenery</b>  Greenery is well maintained	<b>Medium greenery</b>  Greenery is acceptably maintained	<b>Poor greenery</b>  Greenery is unmaintained
Street lighting	<b>High liveliness</b>  Many activities on route, interesting scenery	<b>Moderate liveliness</b>  Some activities on route, mainly residences	<b>Low liveliness</b>  Mostly residential area
	<b>Mostly separated walkways</b>  Pedestrian friendly area, few intersections	<b>Some separated walkways</b>  Dedicated sidewalks, multiple intersections	<b>Few separated walkways</b>  Scarce sidewalks, busy roads
Greenery			
Liveliness			
Separated walkways			

Fig. 1. Explanation of attributes and corresponding attributes levels.

walk to and from public transport in urban areas and what key factors influence this willingness to walk'. They concluded that a large variety of walking distances and walking times have been reported. The distances found are highly context specific and influenced by a wide range of factors that could be categorized as personal, public transport, environmental, and journey related. The results found in the literature were sometimes contrasting. The researchers also concluded that the number of methods to assess the walking distance accurately is still limited. Also, Amirah et al. (2021) concluded that 'answering how far people are willing to walk is very difficult since the distance varies according to the situation either demographic, socioeconomic, or land-use profile'.

The study of Van Soest et al. (2020) did not cover the effect of different public transport (PT) services and the willingness to walk of non-public transport users. The effect of PT service on the willingness to walk is investigated in more detail by O'Connor and Caulfield (2018) who looked at differences between various types of public transport; metro, light rail, and quality bus. Also Daniels and Mulley (2013) looked at details of public transport supply: train, bus, and school bus. Sarker et al. (2020) looked at differences in actual walking times in relation bus, tram, U-bahn, and S-bahn use. A more specific look at PT services is

provided by Larranga et al. (2021) who looked at the following public transport service features: headway, capacity, and connectivity. They found that headway was the most influential feature in the context of maximum walking distance. Nassir et al. (2015) investigated transit passenger choices of access stop and concluded that the choice not only depends on attributes of the transit path such as travel time of the fastest path and number of transfers, but also depends on attributes of the departure stop such as frequency of routes, type(s) of modality, and walk time from origin location and stop. Similar to previous studies, they only looked at PT-users. Several previous studies insist on investigating the preferences of non-PT users regarding service frequency, access and egress, time and cost of public transport to stimulate public transport use (Krizek & El-Geneidy, 2007; Ramos et al., 2019).

No specific information of non-PT users was found. Several studies focused on the size and composition of the catchment area only without looking at users and/or non-users (Amirah et al., 2021; Andersen & Landex, 2008; Börjesson, 2012; Chen et al., 2022; Kerr & Ginn, 2003; Mulley et al., 2018; Stojanovski, 2020). Studies that include the demand side of public transport mainly focus on users of different public transport systems: bus/bus rapid transit (Larranga et al., 2021; Tsioulianos

### Stop-service-route combinations (1/9)

Imagine that you leave from your home to make a trip by bus.

The bus will take you to the location of your choice, the fastest route will take 10 minutes.

However, the fastest route is not always available. So, some alternatives will offer an increase in travel time

You have the choice to walk to the bus stop, or choose another mode of transport.

\*Please look at the combination described below and indicate the maximum distance that would be acceptable for you to walk from your home to that bus stop or, if you would rather not walk and choose another mode of transport.

Theme	Combination
Bus service provided	One departure every hour
	Fastest route
Walking route	Poor street lighting
	Low greenery
	Low liveliness
	Few separated walkways

400m corresponds with about 5 minutes of walking (for a healthy person)

Choose one of the following answers

100 m

300 m

500 m

700 m

I would not walk

Fig. 2. Example of an evaluation task.

**Table 1**  
Personal characteristics of the respondents (N=879).

Attribute	Levels	Sample		CBS*
		Frequency	Percentage	Percentage
Gender	Female	438	49.8	50.6
	Male	441	50.2	49.4
Age	45 years or younger	225	25.6	43.3
	46–60 years	396	45.1	26.5
	61 years or older	258	29.4	30.3
Educational level	Primary, High, and Trade school	239	27.2	27.3
	Bachelor degree	391	44.5	32.7
	Master/PhD degree	249	28.3	40.0
Drivers' license	Yes	851	96.8	79.7
	No	28	3.2	20.3
Residential location	Highly urbanized	501	57.0	55.7
	Medium urbanized	167	19.0	15.3
	Lowly urbanized	211	24.0	29.0
Physical limitations	No	879	100.0	-
	Yes	0	0.0	-
Travel by bus	Never	458	52.1	50.9
	At least sometimes	421	47.9	49.1

\*based on the 2020 Dutch National Travel Survey (N=13.8 million; 18 years and older)

et al., 2020), tram/metro/light rail (Chidambara, 2019; Liu et al., 2020; Zacharias & Zhao, 2017), train/high speed train (Givoni & Rietveld, 2007) or a mix of public transport systems (Daniels & Mulley, 2013; Durand et al., 2016; El-Geneidy et al., 2014; Fillone & Mateo-Barbiano, 2018; Gao et al., 2020; Gutiérrez & Garcia-Palomares, 2008; O'Connor & Caulfield, 2018; Tennoy et al., 2022; Sarker et al., 2020). Only a few studies pay attention to non-transit users or non-regular users. Guo & Ferreira (2008) stated in their conclusions that 'for the non-transit users the total transfer inconvenience might be even higher because they normally have more negative perceptions of transfers than current

riders'. Dell'Olio et al. (2011) show several differences in wishes regarding service quality of actual bus users and potential bus users. It appeared that bus users most value waiting time, cleanliness, and comfort, while non-bus users give higher importance to waiting time, journey time, and level of occupancy. In the study of Sukor and Faisal (2018) attention is paid to differences in willingness to walk between regular and non-regular bus users. When looking at travelers' transport mode choice decisions, it is important to consider various attributes of all available transport modes including service reliability and frequency of public transport (e.g. Beirão & Cabral, 2007; Redman et al., 2013).

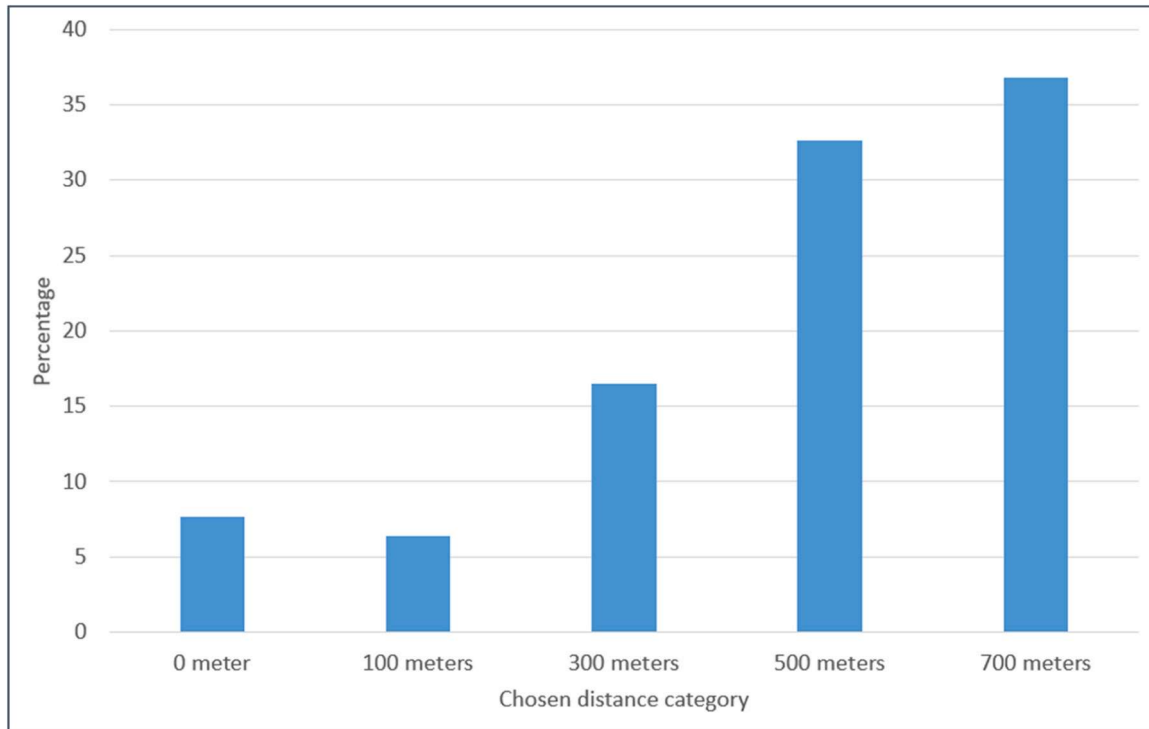


Fig. 3. Overview of choices made by respondents.

**Table 2**  
Estimation results of latent class linear regression model.

Attributes	Levels	Class 1	Class 2	Class 3
Thresholds	$\mu_0$ , separating 0 & 100	0.0000	0.0000	0.0000
	$\mu_1$ , separating 100 & 300	0.2653	1.0109	0.3862
	$\mu_2$ , separating 300 & 500	0.7794	2.7965	2.5838
	$\mu_3$ , separating 500 & 700	1.7713	4.2706	6.2095
Constant		<b>4.2484</b>	<b>1.5401</b>	<b>4.6403</b>
Public Transport Service Frequency	Once per hour	<b>-0.6030</b>	<b>-0.2755</b>	<b>-0.4140</b>
	Twice per hour	<b>0.3133</b>	-0.0126	0.0122
	<i>Six per hour**</i>	<i>0.2897</i>	<i>0.2881</i>	<i>0.4018</i>
Directness	Fastest	0.1432	<b>0.2827</b>	<b>0.4398</b>
	Plus 20 percent	0.1379	-0.0330	-0.0088
	<i>Plus 50 percent</i>	<i>-0.2811</i>	<i>-0.2497</i>	<i>-0.4310</i>
Walking Route Street Lighting	Poor	<b>-0.6300</b>	<b>-0.4650</b>	<b>-0.5801</b>
	Medium	0.0371	-0.0107	0.0710
	<i>Good</i>	<i>0.5929</i>	<i>0.4757</i>	<i>0.5091</i>
Greenery	Poor	0.1778	<b>-0.1021</b>	<b>-0.1922</b>
	Medium	-0.1476	-0.0693	-0.0347
	<i>Good</i>	<i>-0.0302</i>	<i>0.1714</i>	<i>0.2269</i>
Liveliness	Low	<b>-0.3474</b>	<b>-0.2629</b>	<b>-0.2815</b>
	Moderate	-0.1988	<b>-0.1955</b>	-0.0910
	<i>High</i>	<i>0.5462</i>	<i>0.4584</i>	<i>0.3725</i>
Separated Walkways	Few	<b>-0.4085</b>	<b>-0.3843</b>	<b>-0.3812</b>
	Some	0.1582	<b>0.1150</b>	-0.0177
	Mostly	0.2503	0.2693	0.3635
Class probabilities		0.306	0.302	0.392
Number of respondents (based on highest class probability)		267	262	350
Goodness of fit				
Final Log-likelihood value ( $LL_f$ )		-8001.8095		
Equal share Log-likelihood value ( $LL_e$ )		-12,732.2633		
Likelihood Ration statistic $[-2(LL_e - LL_f)]$		9460.9076		
Chi square test value (50 degrees-of-freedom)		67.50		
McFadden's Pseudo R-square: $1 - (LL_f/LL_e)$		0.372		
Adjusted McFadden's R-square		0.375		

\***Bold** means significant at the confident level of 95 percent or higher level;

\*\**Italic* refers to part-worth utility of reference level

For the reasons mentioned above, the aim of this study is to investigate possible factors that influence travelers' willingness to walk, to create a better understanding of catchment area definition. Moreover, this study aims to provide insights into various factors that influence the maximum distances people are willing to walk to bus related public transport. In the current study the focus is put on willingness to walk (demand side) and factors (routes and service quality) that are directly modifiable by urban or transport planning authorities as suggested by Van Soest et al. (2020). With respect to walkability, Van Soest et al. (2020) also found that improving walkability at the micro level to increase the distances people are willing to walk. For urban planners, the results of this study can help to define the service level of and the route design around bus stops in combination with the estimation of potential public transport user covering both actual and potential bus users. Based on generated potentials policy makers can decide where to locate bus stops (Dell'Olio et al., 2011; Krizek & El-Geneidy, 2007; Taplin & Sun, 2020).

The remainder of this paper is organized as follows. First, the adopted research method will be explained. To investigate the preferences from both users and non-users, a stated preference experiment is selected. This data collection method uses hypothetical alternatives that can be evaluated by both users and non-users (Ramos et al., 2019). In addition, the method give full control over selected attributes and the number of choice tasks shown to respondents. This section is followed by a brief description of the data collection and the composition of the sample. The preferences are analyzed using a latent class linear

regression model. After identifying existing classes, the classes are connected to personal characteristics using a multinomial logistic regression model. The paper ends with the conclusions and recommendations for practice and future research.

## 2. Research approach

A stated preference experiment is designed in order to investigate the importance of various factors in relation to the maximum distances people are willing to walk to bus stops (Hensher et al., 2015). In general, revealed and stated preference experiments in combination with discrete choice models are often used to set up a utility based accessibility metric using (dis)utility as base of travelers' decision making processes (Guzman et al., 2023). Based on findings in the literature, the following attributes were investigated in more detail: frequency of bus service (once per hour, twice per hour, six times per hour), directness of bus service, street lighting, greenery, liveliness, and presence of footways. It is assumed that both public transport users and non-users are familiar with the attributes bus service and directness of bus route as these attributes are considered as comparable with other types of service provisions like frequency of mail delivery and directness of car or bicycle routes. Fig. 1 presents the attribute levels of five of the attributes and it also shows the way these levels are defined and explained in the online questionnaire.

The selected attributes and corresponding attribute levels are combined into bus service-walking route combinations (see Fig. 3). A set of

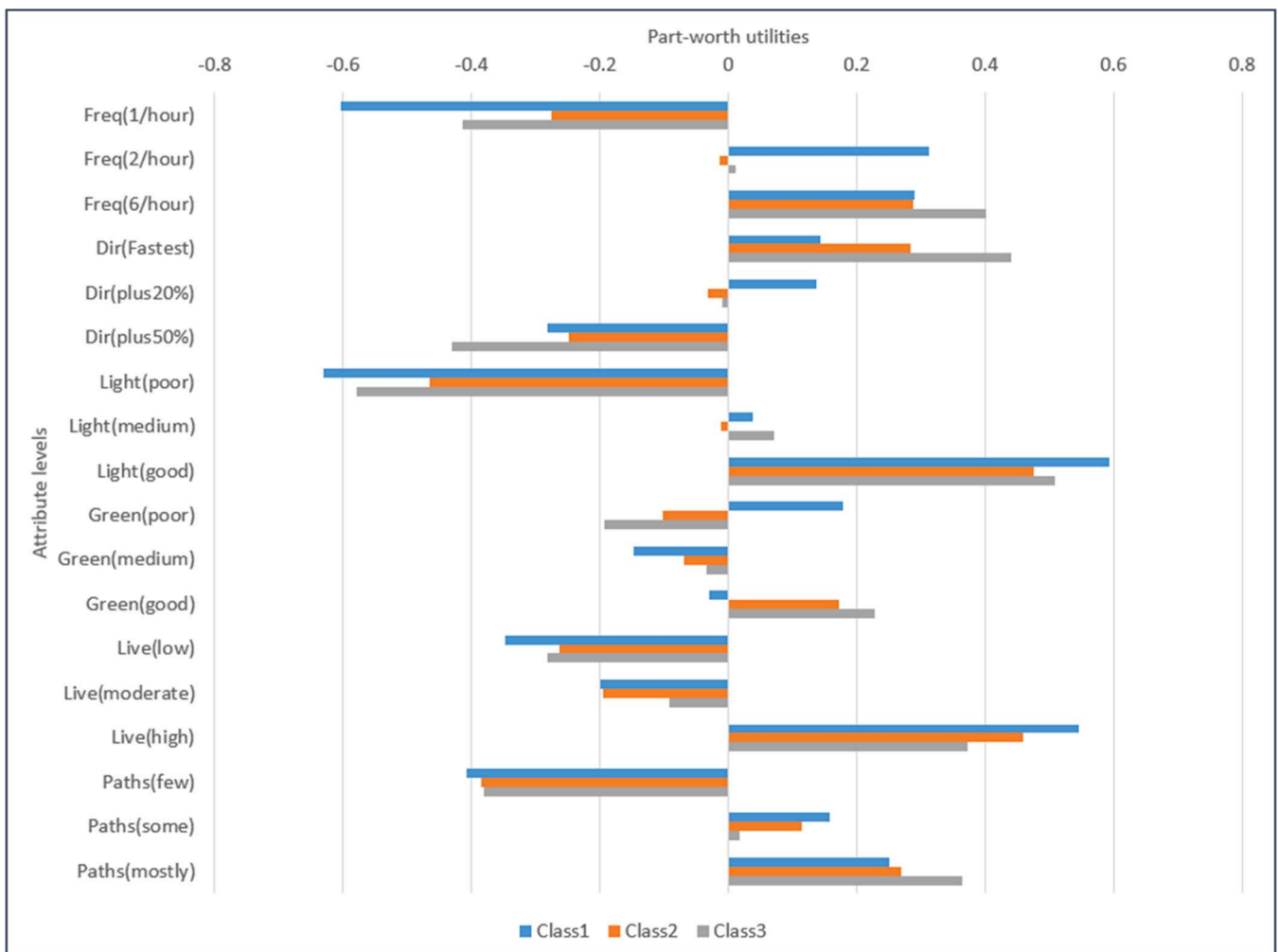


Fig. 4. Part-worth utilities of included attributes.

six attributes with 3 levels each, gives in total 729 possible combinations (full factorial design). By using the [Addelman \(1962\)](#) tables, this large number of combinations can be reduced to 27 combinations, keeping in mind the independency between selected attributes and the optimal balance between attribute levels ([Hensher et al., 2015](#)). Each combination was placed in an evaluation task. The complete evaluation task consisted of a short description of the context (grey block in [Fig. 2](#)), invitation to look at the presented combination of bus service and walking route, and a possibility to make a choice. The respondents were asked to indicate what their maximum walking distance would be given the available bus service and walking route attributes.

Respondents could choose between 5 different answer categories (four distances and one 'no walk' category). The four distance classes are set around the often used distance of 400 m (5 minute walk). Using four classes around the average will stimulate the respondent to consider their preference in terms of shorter/longer than average avoiding over-representation of the average distance in the answers. In addition, some studies pointed to the interval of 300–500 m as average walking distance to bus stops ([El-Geneidy et al., 2014](#); [Tennoy et al., 2022](#)). Each respondent evaluated 9 randomly selected combinations.

The experiment was included in an extensive online questionnaire composed in LimeSurvey ([www.limesurvey.org](http://www.limesurvey.org)). The questionnaire also included questions regarding respondents' experiences with bus use

([ikbaar.nl](http://ikbaar.nl)). The panel consists of people who are interested in all kind of mobility related topics. In total, 879 respondents completed the questionnaire. According to [Orme \(2010\)](#) this number is sufficient for further analyses of stated preference data. Some details of the respondents are presented in [Table 1](#). It appears that for all attributes, the distribution of the respondents over the attribute levels is close to the distribution of the Dutch population.

#### 4. Analyses

The 879 respondents evaluated in total 7911 bus service and walking route combinations. [Fig. 3](#) shows the choices made by the respondents independent from the combinations they evaluated. It appears that most respondents are willing to walk a distance of maximal 500 or 700 m.

The evaluations of the respondents are analyzed using a latent class ordered probability model as included in the software NLogit 6.0 ([Econometric Software Inc, 2012](#)). Ordered probability models suit best for variables measured at the ordinal measurement level. In addition, latent class models offer the possibility to investigate in more detail both panel effects and the variation in preferences across groups of respondents ([Greene, 2016](#)). The equations underlying the regular ordered probability model are presented below in [Eq. 1](#) (utility) and 2 (threshold values) ([Greene, 2016](#)).

$$\begin{aligned}
 y_i^* &= \beta' \mathbf{x}_i + \varepsilon_i, \\
 \varepsilon_i &\sim F(\varepsilon_i | \boldsymbol{\theta}), \boldsymbol{\theta} = \text{a vector of parameters}, \\
 E[\varepsilon_i | \mathbf{x}_i] &= 0, \\
 \text{Var}[\varepsilon_i | \mathbf{x}_i] &= 1.
 \end{aligned}
 \tag{1}$$

$$\begin{aligned}
 y_i &= 0 \text{ if } y_i^* \leq \mu_0, \\
 &= 1 \text{ if } \mu_0 < y_i^* \leq \mu_1, \\
 &= 2 \text{ if } \mu_1 < y_i^* \leq \mu_2, \\
 &\dots \\
 &= J \text{ if } y_i^* > \mu_{J-1}.
 \end{aligned}
 \tag{2}$$

(travel frequency, travel purpose, time of day, and travel time), walking (for leisure and for transportation), and evaluations of bus service and walking routes. At the end of the questionnaire some personal information is collected: Residential location, gender, age, income, educational level, daily activity, marital status, possession of driving license, and Family composition. The questionnaire was approved by the Ethical Research Board of Eindhoven University of Technology.

#### 3. Data collection

The invitations for the questionnaire were distributed among the members of the panel 'ZuidLimburg Bereikbaar' ([Where,  
 \$y\_i^\*\$ : latent dependent variable of respondent  \$i\$   
 \$y\_i\$ : observed dependent variable of respondent  \$i\$   
 \$\mathbf{x}\_i\$ : vector of attributes value for respondent  \$i\$   
 \$\beta\$ : vector of parameter values  
 \$\varepsilon\_i\$ : error term for respondent  \$i\$   
 \$\mu\_j\$ : Threshold value of  \$j\$  levels \(showing the separation between levels of  \$y\_i\$ \)](http://www.zuidlimburgere</a></p>
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[Table 2](#) shows the results of the model estimation by means of part-worth utilities. For the estimation of the parameters ( $\beta$ 's), the variables are coded using effect coding: first level ( $x_1=1$  &  $x_2=0$ ), second level

**Table 3**  
Class membership model results with reference Class 1 (N=267).

Characteristics	Levels	Class 2 (N=262)	Class 3 (N=350)
Intercept		<b>-0.978</b>	-0.095
Gender	Female	<b>0.407</b>	<b>0.313</b>
	Male	0	0
Residential	High	<b>0.500</b>	0.196
	Medium	0.353	0.294
	Low	0	0
Travel by bus	Never	<b>0.746</b>	0.108
	Sometimes	0	0
Model fit			
-2Loglikelihood Intercept only model (df=2)		156.146	
-2Loglikelihood Final model (df=10)		125.856	
Chi-Square value		30.290	
Critical Chi-Square value (df=8)		15.51 (sign. <0.001)	

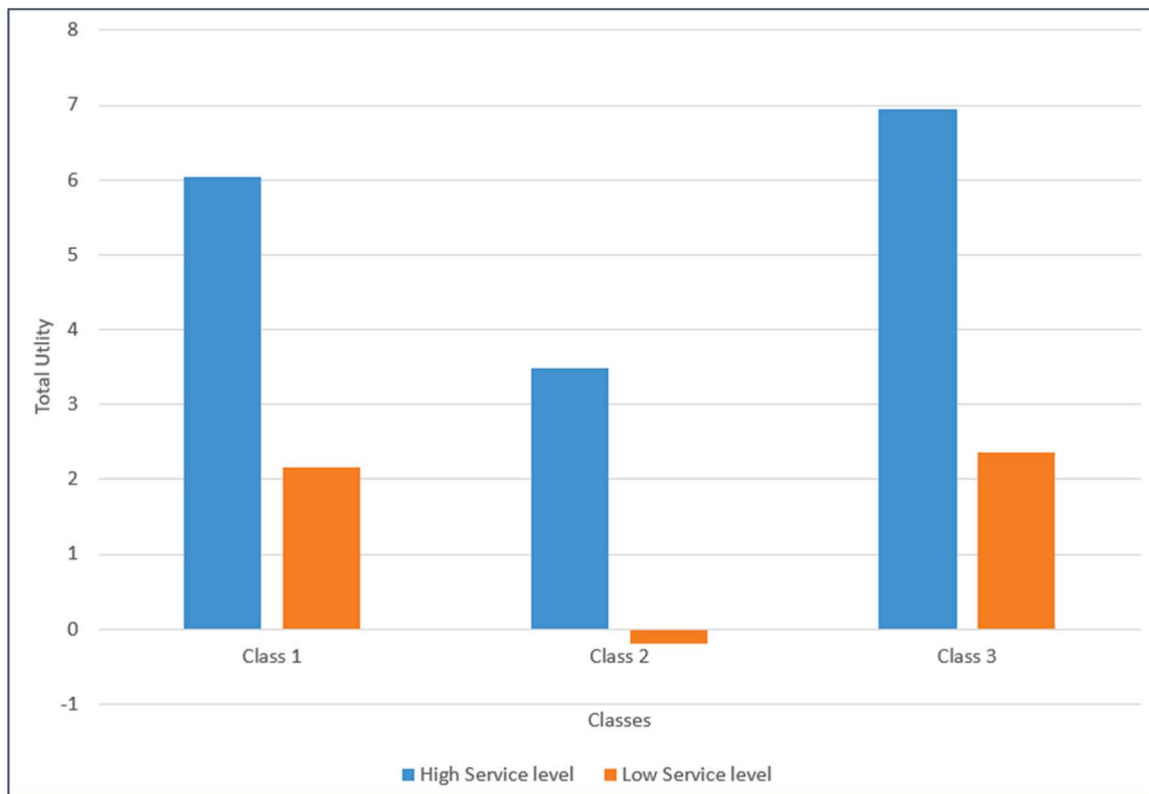
\* **Bold** means significant at the confident level of 90 percent or higher level

**Table 4**  
Details of the most positive and most negative alternatives.

Attribute	High Service level	Low Service level
Bus service		
Frequency	Six times per hour	Once per hour
Directness	Fastest route	50 % extra travel time
Walking route		
Street lighting	Good	Poor
Greenery	Good	Poor
Liveliness	High	Low
Separated walkways	Mostly	Few

( $x_1=0$  &  $x_2=1$ ), and third level ( $x_1=-1$  &  $x_2=-1$ ). The coding is used to calculate the part-worth utilities by multiplying the parameter with the x-values ( $\beta_1 * x_1 + \beta_2 * x_2$ ). Overall, the model performs with a final Log-likelihood equal to  $-8011.81$  significantly better than the Log-likelihood of the equal share (or null model),  $-12,732.26$ . The analysis with the latent class model shows that three classes of respondents

can be formed based on the indicated preferences. The three classes cover respectively 31 (Class 1), 30 (Class 2), and 39 (Class 3) percent of the respondents. Based on the median, it appears that on average respondents of Class 1 are willing to walk maximal 700 m. Respondents of Class 2 are willing to walk on average a maximum distance of 100 m. The median maximum distance that respondents of Class 3 are willing to walk is 500 m. When looking to the influence of all attributes (length of the bars in Fig. 3), it appears that respondents of Class 1 are the most sensitive. Some exceptions are the influence of bus frequency (6 times per hours), directness (fastest), greenery (good), and presence of separated foot paths (mostly) where class 3 seems to be more sensitive. The sensitivity levels of respondents of Class 2 lay between the two other classes. Looking at the ranges in part-worth utility covered by the attributes (Fig. 4), it can be concluded that most influential attributes are frequency of bus service and street lighting. At some distance these two attributes are followed by the attributes directness of service, liveliness, and presence of separate walkways. The presence of green is considered



**Fig. 5.** Calculated total utilities under highest and lowest service levels.

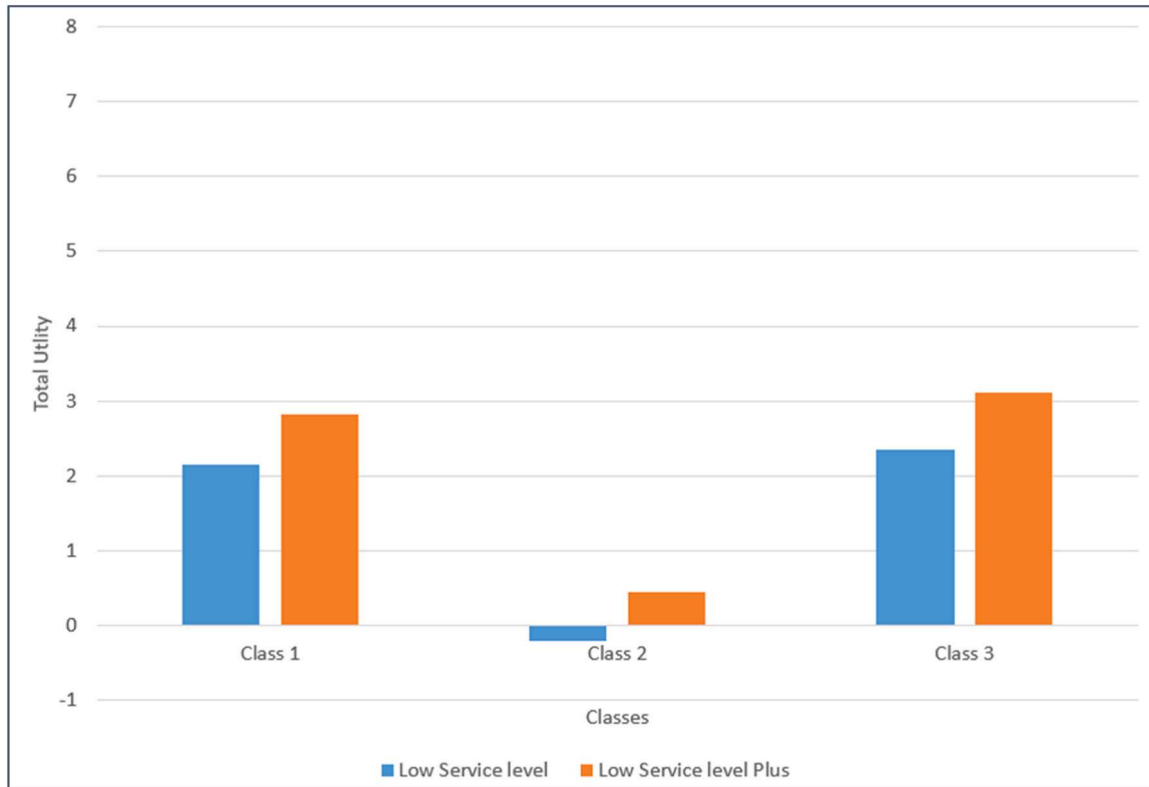


Fig. 6. Calculated total utilities after changing lowest service level.

as least influential.

In addition, the three identified classes based on highest class probability, are connected to the socio-demographic characteristics of the respondents using a multinomial logistic regression analysis. The model estimation results are presented in Table 3. It appears that the probability of belonging to one of the classes depends significantly on gender, residential location, and travel frequency by bus. The parameters show that the probability of being a member of classes 2 and 3 (compared to class 1) is higher for females. The probability of being member of class 2 is also higher for respondents living in medium urbanized areas and never have used the bus.

### 5. Conclusions

This paper presents a study of factors that influence travelers’ willingness to walk a certain distance to bus stops. In a stated choice experiment two bus service and four walking route related attributes are investigated in relation to the maximum distance a traveler is willing to walk to a bus stop. Based on 7911 evaluations of 879 respondents, a latent class linear regression model is estimated showing that both bus service and walking route related attributes significantly contribute to the maximum distance travelers are willing to walk. The parameter estimates show that the most influential attributes are the bus frequency at the bus stop and presence of street lighting along the route between home and bus stop. The model also shows that based on the evaluations three different classes of respondents can be distinguished. Membership of a class depends on traveler related characteristics: gender, residential area, and bus use.

The model can be used for generating the maximum distance classes given the public transport service and walking route available. For example, the highest and lowest service levels can be defined as shown in Table 4. For each group of respondents, the total utility can be calculated using the specifications of bus service and walking route, and the estimated parameters (Fig. 5). Based on the various threshold values

(Table 2), it can be concluded that groups 1 and 3 are willing to walk maximal 700 m when the highest service level is offered. In this case, group 2 is willing to walk maximal 500 m. In the case that the lowest service level is offered, group 1 is still willing to walk maximal 700 m while group 3 is willing to walk maximal 300 m. Group 2 does not want to walk anymore when the lowest possible service is offered.

For public transport planners and urban designers these results show what happens with the catchment areas when the service level at the bus stop and/or the layout of walking routes between origins and bus stops changes. For example, it is possible to get insight into the effect of changing the amount of separated walkways along the routes between origins and destinations. Assuming the lowest service level, Fig. 6 shows for each group of respondents the effects of an increase of the amount of separate walkways from Few to Mostly (Low Service level Plus). This increase results in a change of the catchment areas for groups 2 (from no walking to maximal 100 m) and 3 (from maximal 300 m to maximal 500 m). There is no change in the willingness to walk for group 1 (maximal 700 m). The generated insights could also be used to improve the information provision towards potential travelers and in addition, stimulate more people to walk longer distances to bus stops (Sulikova & Brand, 2022).

Carrying out a stated choice experiment often comes with some limitations to keep the experiment accessible for a variety of respondents and within time and money budgets. These limitation mainly concern the number of attributes included in the experiment and the way attributes and corresponding attribute levels are presented. In future research the following changes could be considered when setting up a new experiment.

- Adding amenities at the bus stop to serve and to attract potential travelers (e.g. Daniels & Mulley, 2013; Kim et al., 2020; Nassir et al., 2015; Shi et al., 2021);

- Extending the experiment with more details of the bus trip such as trip purpose, travel distance/time, and travel destination (e.g. Nassir et al., 2015; Van Soest et al., 2020);
- Exploring possibilities to improve the communication of the different attributes and corresponding attribute levels with respondents by using for example an immersive virtual reality environment (e.g. Mokas et al., 2021);
- Exploring in more detail personal and trip related characteristics underlying the different classes.

### CRedit authorship contribution statement

**Peter van der Waerden:** Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Michiel Burger:** Writing – original draft, Validation, Methodology, Data curation, Conceptualization. **Jaap van der Waerden:** Writing – original draft, Formal analysis, Conceptualization.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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