Transportation Research Part F 65 (2019) 363–375

Contents lists available at ScienceDirect

Transportation Research Part F

journal homepage: www.elsevier.com/locate/trf

Recreational walking decisions in urban away-from-home environments: The relevance of air quality, noise, traffic, and the natural environment

Kyle S. Bunds [a,b,*], Jonathan M. Casper [a], James A. Hipp [a], Joerg Koenigstorfer [b]

[a] North Carolina State University, United States
[b] Technical University of Munich, Germany

ARTICLE INFO

Article history:
Received 20 December 2018
Received in revised form 5 July 2019
Accepted 2 August 2019

Keywords:
Active transportation
Leisure
Air pollution
Route decision-making
Conjoint analysis

ABSTRACT

Walking is one mode of active transportation that cities around the world promote not only to increase public health, but also to fight climate change. The goal of the present study is to assess the relevance of air quality, noise, green environment, and traffic as well as time and distance considerations on individuals stated walking preferences. In total, 501 US residents participated in an adaptive choice based conjoint study. The following seven attributes were considered (with three levels each): air pollution level, air pollution source, noise level, noise source, natural environment, traffic, as well as walking time and distance. Part-worth utility and relative importance scores were estimated using hierarchical Bayes analyses. Air pollution level was the most important attribute, followed by traffic, noise level, and the natural environment. The findings help identify burdens for walking in urban areas, particularly with regard to air pollution levels and traffic condition (which have a combined relative importance of 41%). Pro-environmentalists select their routes based on both air pollution and noise levels, thus they might be particularly interested in informing themselves about, and monitoring, these attributes. City planners should create opportunities for active routes that offer clean air, some greenery, natural sound, and low traffic, and inform city residents better about these attributes.

Published by Elsevier Ltd.

1. Introduction

According to the Centers for Disease Control and Prevention (CDC), active transportation is an activity that includes "any self-propelled, human-powered mode of transportation" (CDC, 2018). It is not only carbon-neutral, but it is also related to positive health outcomes, explained by increased physical activity (World Health Organization [WHO], 2004). Maintaining a physically active lifestyle is important in mitigating the risks of a range of non-communicable diseases (Lee et al., 2012) and premature death (Ekelund et al., 2016). Physical activity also reduces health care costs (Carlson, Fulton, Pratt, Yang, & Adams, 2015). The WHO (2004) therefore states that, "national and local governments should frame policies and provide incentives to ensure that walking, cycling and other forms of physical activity are accessible" (p. 8).

* Corresponding author at: North Carolina State University, College of Natural Resources, Campus Box 8004, 3028E Biltmore Hall, Raleigh, NC 27695-8004, United States.
E-mail address: Ksbunds@ncsu.edu (K.S. Bunds).

https://doi.org/10.1016/j.trf.2019.08.006
1369-8478/Published by Elsevier Ltd.

Active transportation mainly includes four modes: (1) cycling, (2) use of skateboards, rollerblades, human-powered scooters, and similar tools, (3) use of wheelchairs, and (4) walking. Walking in particular is the most accessible mode of active transportation, given that people are able to walk (i.e., there are no health concerns or disabilities) and the environment allows them to walk (i.e., the built environment lets people walk). However, today's environments—particularly urban settings—are often designed in a way that pedestrians are exposed to poor air quality, noise, non-natural, built-environment features, and traffic. All of these have been linked to negative health outcomes (e.g., Haaland & van den Bosch, 2015; King, Murphy, & McNabola, 2009; Vlachokostas, Achillas, Michailidou, & Moussiopoulos, 2012).

Aside from time and distance (Weinstein Agrawal, Schlossberg, & Irvin, 2008), to date, there is little empirical research that has systematically examined the influence of the above, health-related, combination of factors on individuals' recreational, leisure-time walking route preferences. Recreational walking refers to leisure-time walking, not specific to a utility, such as going to the store or work (see Cutt, Knuiman, & Giles-Corti, 2008). The assessment of people's walking preferences is important, because not the availability of attractive routes, but people's choices will influence whether people actually walk from one place to another in a city.

Research on the determinants of people's walking route preferences in urban contexts is needed, because cities aim to encourage walking, but they largely fail to make more individuals walk more for several reasons (e.g., high availability of cars, use of technological aids, people's migration to suburbs that requires commuting; Brownson, Boehmer, & Luke, 2005). Thus, there is a need to identify the factors that may impact leisure-time walking route choices and assess their relevance for influencing people's intentions to choose a particular route. The present study aims to partially fill this void and assesses the influence of these health-related attributes (air quality, noise, natural environment, and traffic) on intended leisure-time walking routes in urban environments through an adaptive choice based conjoint design.

2. Conceptual background

2.1. Determinants of actual or stated leisure-time walking preferences

Previous studies in the area of leisure-time walking have focused on the influence of the built environment in combination with individual preferences on walking behaviors (mostly self-reports). Durand, Andalib, Dunton, Wolch, and Pentz (2011) reviewed and meta-analyzed 44 empirical studies that have appeared between 2000 and 2009. They looked at walking and other modes of physical activity as outcomes and conclude that diverse housing types, mixed land use, housing density, compact development patterns, and open space are associated with increased levels of leisure-time walking. Another review, conducted by Sugiyama, Neuhaus, Cole, Giles-Corti, and Neville (2012), found that leisure-time walking was influenced less by sidewalks, traffic, and safety, but more by route aesthetics, green space, and street connectivity (see also Ewing & Cervero, 2010; Lee & Moudon, 2004; Owen, Humpel, Leslie, Bauman, & Sallis, 2004; Saelens & Handy, 2008, for earlier reviews).

There is a lack of research considering the combined impact of air quality, noise, green environment, and traffic as well as time and distance considerations on route choice behavior. These factors likely contribute to whether, where, and when individuals walk in urban environments during their leisure time. More importantly, the four factors (air quality, noise, green environment, and traffic) may make people prefer not only the shortest route, but also a route that considers people's health- and environment-related needs. This is particularly relevant to leisure-time pedestrians, because they see, hear, smell, and feel much of the surrounding environment and because health and exercise are one of the major reasons for walking (Handy, 1996). In what follows, we briefly review the contribution of the before mentioned factors to people's route preferences.

2.2. Air quality

Walking is a critical aspect to keeping a healthy lifestyle, but also comes with potential bad air exposure risks (King et al., 2009; Vlachokostas et al., 2012). Exposure to high levels of air pollution has been found to negatively impact human health including an increase in occurrences of asthma (Guarnieri & Balmes, 2014), cardiovascular diseases (Brook et al., 2010), and an increased risk of respiratory mortality (Lelieveld, Evans, Fnais, Giannadaki, & Pozzer, 2015).

Ferrer, Ruiz, and Mars (2015) noted that between 25 and 50% of their sample of Spanish residents considered pollution and smell as a barrier for walking. Koenigstorfer (2018) assessed the influence of informing people about air quality levels, potential ranges, and how this information was presented to them (i.e., with or without the information about the connection between bad air and health risks as well as with or without the traffic light colors red, amber, and green) and the presence of green space on the intended choice to walk further away from traffic-dense roads (but longer distance). When information about both air quality and the levels of air pollution was present (vs. absent), there was a seven times higher likelihood of chooing the 'healthier' route (50.0% [vs. 7.1%] of participants then preferred the path along low-traffic roads). Moudon et al. (2007) also found that air pollution was a negative predictor of route preferences. While the three studies have examined the role of air pollution in leisure time for walking route choice preferences, there is a dearth in examining the importance of air pollution when combined with other health-related considerations.

2.3. Noise

The WHO (2011) identifies noise as another major health concern. High noise levels bother pedestrians, as evidenced by Ferrer et al. (2015; see also Giles-Corti et al., 2005). Exposure to noise, particularly coming from traffic, industry, and construction work, can lead to negative emotions, stress, hearing impairment, cognitive impairment, and reduced quality of life (e.g., headache, dizziness, and fatigue) (Stansfeld, Haines, & Brown, 2000). It also increases the risk of cardiovascular diseases (Babisch, Beule, Schust, Kersten, & Ising, 2005). Although noise was identified as a factor to influence route preferences in Seneviratne and Morrall's (1985) study, few people indicated that the attribute is important to them. To our knowledge, there is no research that systematically considers the influence of noise on stated leisure-time walking route preferences. The present study partially fills this gap and assumes that more noise goes along with lower preferences for walking along a certain route.

2.4. Green space

Urban green space can be defined as "any vegetation found in the urban environment, including parks, open spaces, residential gardens, or street trees" (Kabisch & Haase, 2013, p. 113). Haaland and van den Bosch (2015) report growing evidence that more and more urban green space gets lost due to densification processes in cities around the world. This is despite the fact that city residents (and pedestrians in particular, because their speed of traveling is lower) appreciate the environment that green space provides to them (Burgess, Harrison, & Limb, 1988; Giles-Corti et al., 2005). Kaplan (1995) describes the "restorative" functions of green space: the environment can make people happy and distracts them from their daily life in non-nature settings. In Ferrer's et al. (2015) focus group study, green space elements were deemed important by all focus group participants; they contribute to the aesthetics of the walking experiences. Quantitative research also provides evidence for people's preferences for green space elements. For example, Davies, Laing, Miller, Chen, Horne, Morrice, and Scott's (2002) choice experiment and contingent valuation study in Scotland revealed that green space—particularly trees—had the greatest influence on people's choices among other features (e.g., lighting, paving, and benches) and that people were willing to pay between GB-£ 10.74 and GB-£ 14.57 to change the current situation toward a more natural environment with more trees in cities. Trees also provide shade, an aspect that is appreciated and that correlates positively with walking frequencies (Handy, 1996). The more trees there are, the higher are the odds for walking (Lu, 2018; Sarkar et al., 2015).

2.5. Traffic

Traffic is one feature of the built environment that has been considered in various forms in empirical studies. Previous studies have looked at subjective criteria, objective criteria, or both. We are interested in people's perception of traffic. In Ferrer et al. (2015) study, traffic perception is related to safety (including various sub-categories, such as volume, number of lanes, high intersection density, long crossing waiting times, offensive behaviors of participants, speed of traffic, and crossing at roundabouts or when cars turn). Moudon et al. (2007) found that traffic perception has a negative influence on route preferences (see also Pikora et al., 2006, for an Australian sample). Yet, some studies found a non-significant or even a positive influence on route preferences, most likely because people feel safe near some traffic (Sugiyama et al., 2012).

2.6. Time and distance

The primary considerations for walking are time needed and distance. Weinstein Agrawal et al. (2008) found that US pedestrians were willing to walk an average of 0.5 miles to a rail station. Minimizing the distance was the most important factor influencing their choice of route (see also Seneviratne & Morrall, 1985). Furthermore, Greenwald and Boarnet (2001) found that shorter distances increase the likelihood of individual walking trips for non-work activities. Thus, the present study incorporates time and distance of the walking trip.

The purpose of the present study was to examine what attributes people prioritize while making a choice to take a particular walking route in their leisure time. Specifically, we sought to answer the following research questions: (1) What are the relative importance of air pollution level, air pollution source, noise level, noise source, green environment, traffic, and time and distance for individuals' intended leisure-time walking route preferences? (2) Does a set of sociodemographics, psychographics, and behavioral factors predict the relative importance of the attributes?

3. Materials and methods

3.1. Participants

Individuals were recruited through Amazon Mechanical Turk (MTurk) and paid US-$2 for participation. MTurk is a crowdsourcing online marketplace that provides research participants. Potential issues with MTurk include overreliance on individuals within a high socio-economic status, disproportionately young participants, and female participants (Harms &

DeSimone, 2015). Additionally, it is possible that individuals who are particularly interested in a certain topic participate in the study (here: they may be pre-disposed to walking).

In order to address these concerns, we sought a representative sample based on the 2017 US Census Bureau. Age, income, education level, ethnicity, and employment status were consistent with the Census Bureau. We adapted the stratification of age to eliminate the "below 18 years" category.

Overall, 536 surveys were completed. After data cleaning, we found irregularities (i.e., stylistic response behaviors) in 35 surveys, resulting in 501 surveys utilized in the analysis. On average, it took participants 14 min to complete the survey. Data were collected with approval from university IRB protocol in September 2018.

Participant characteristics are reported in Table 1. The majority of participants were middle age adults with 68.6% of the respondents being between the ages of 25 and 44 years old, male (56.1%), white (62.1%), and had an income of less than US-$50,000 per year. Over half of the participants were married and currently employed. Our sample aligned closely with most recent US Census demographics (United States Census Bureau, n.d.) for age, income, and race, while our data skewed slightly higher than national percentages for males (49.2%). Additionally, related to this study, 87.8% of the respondents indicated that they walk for leisure.

3.2. Attributes of the conjoint study

We employed a cross sectional approach in which participants took a web-based survey. An adaptive choice based conjoint (ACBC) study was set up as part of the survey using Sawtooth Software Lighthouse 9.6.1. The ACBC task assesses the relative importance of attributes by providing participants with varying combinations of attributes and allowing them to choose which combinations they would consider (Huber & Zwerina, 1996; Johnson, Huber, & Bacon, 2003). It is a method used in research examining preferences for park attributes (Veitch et al., 2017), consumer behavior-related variables (Ben-Akiva, McFadden, & Train, 2019), including willingness to pay (Shin, Callow, Dadvar, Lee, & Farkas, 2015), as well as health treatment preferences (Al-Omari, Sim, Croft, & Frisher, 2017).

Table 1
Description of the sample.

Participant Characteristics	N	%
Age (years)		
18–24	77	15.4
25–34	188	37.5
35–44	156	31.1
45 and older	80	16.0
Sex		
Female	220	43.9
Male	281	56.1
Current household income (gross, year)		
Less than $25,000	103	20.6
$25,000–$49,999	162	32.2
$50,000–$74,999	104	20.7
$75,000–$99,999	78	15.5
$100,000–$149,999	34	6.8
$150,000 or more	15	3.0
Prefer not to answer	5	1.0
Ethnicity (or race)		
White	354	62.1
Black or African American	36	6.3
Hispanic or Latino	60	10.5
Asian	88	15.4
Other	24	4.2
Prefer not to answer	8	1.5
Marital status		
Single, never married	188	37.5
Married or domestic partnership	265	52.9
Widowed	6	1.2
Divorced/separated	39	7.8
Prefer not to answer	3	0.6
Currently employed		
No	160	31.9
Yes	341	68.1
Generally walk for leisure		
No	61	12.2
Yes	440	87.8

Attributes were selected using a review of literature and qualitative responses from a previous experimental study examining the influence of knowledge of air pollution on walking route choice (Koenigstorfer, 2018). We employed NVIVO 11 software to inductively create themes. Following analysis of the results, the first and last authors individually coded responses following Braun and Clarke (2006) inductive thematic analysis and presented the codes to the second and third authors. Upon agreement, we created seven attributes with three levels for each attribute.

Time and distance was the first attribute. About 79.9% of the participants stated that time and distance are factors in their decision to choose a particular walking route. It was the most mentioned factor. Time and distance are also noted as an important attribute in the literature (e.g., Weinstein Agrawal et al., 2008). In the present study, time and distance was divided into three attribute levels: 30 min/1.5 miles, 45 min/2.25 miles, and 60 min/3 miles.

Air quality was the second most prevalent response in the qualitative responses with 25.8% mentioning air pollution in relation to their walking route choice. In the present study, air pollution had three attribute levels: low, medium, and high. Individuals also noted sources of air pollution in their responses. Therefore, air pollution source was the third attribute included. In the present study, the three attribute levels for pollution source based on participant responses were: traffic, construction, and industry.

Natural environment was the fourth attribute selected. About 24.3% of the participants mentioned that they consider greenery, green space, trees, and plants when selecting a walking route. This is largely consistent with the literature on green space availability and likeliness to participate in leisure time activities (e.g., Sallis, Floyd, Rodríguez, & Saelens, 2012). The three attribute levels for natural environment were: no plants and trees along the path, some plants and trees along the path, and a lot of plants and trees along the path.

Traffic was the fifth attribute selected. About 5.7% of the participants noted traffic as an important consideration. Previous research (e.g., Broach, Gliebe, & Dill, 2011) has noted traffic to be an important consideration. The following three attribute levels were considered in the present study: no traffic along the route, some traffic along the route, heavy traffic along the route.

Noise was the sixth attribute selected. About 3.6% of the participants mentioned that noise level was an important consideration. In the present study, the three attribute levels for noise were: low, medium, and high. Noise source was prevalent in responses noting noise level and was therefore included as the seventh and last attribute. Three attribute levels for noise source were considered: traffic, people, and construction.

We note that other factors may be relevant too, such as accessibility, safety, familiarity, weather, presence of other people, and built environment characteristics; previous studies have used these attributes, or constructed sets of attributes, or they have used overall indices, such as walkability or sprawl measures (Sugiyama et al., 2012). We considered including safety and crime in the analysis, but did not include it, for parsimony and discriminance reasons. For example, safety has been found to be related to traffic (Weinstein Agrawal et al., 2008). Regarding crime, Appleyard and Ferrell (2017) conducted a literature review and study on the influence of crime on physical activity. They found that some of the feelings regarding crime had to do with safety and security perceptions related to traffic. While future studies may consider crime in a discriminant format—such as differentiating between major violent crimes, major property crimes, and minor crimes (Appleyard & Ferrell, 2017)—this was beyond the scope of this research. Table 2 provides an overview of the attributes.

Table 2
Seven attributes and their levels included in the adaptive choice based conjoint task.

Attribute	Level
Air pollution	Low Medium High
Air pollution source	Traffic Industry factory Construction
Noise level	Low Medium High
Noise source	Traffic People Construction
Natural environment	No plants and trees along the path Some plants and trees along the path A lot of plants and trees along the path
Traffic	No traffic along the route Some traffic along the route Heavy traffic along the route
Time and distance to destination	30 min/1.5 miles 45 min/2.25 miles 60 min/3 miles

3.3. Procedure

Participants first responded to demographic questions as listed in Table 1. After completing them, participants were taken through the ACBC task. The steps are shown in the Appendix A. At the beginning, participants were told that they were walking to an unspecified destination in an unfamiliar city during their leisure time. We chose an unspecified location because previous research suggests that individuals will fall into habit in their route choices and we wanted to eliminate this possibility (Bogers, Viti, & Hoogendoorn, 2005; Heinen, Van Wee, & Maat, 2010; Weinstein Agrawal et al., 2008). They were then asked to 'build your own' item by selecting their preferred level for each of the seven attributes.

Next, participants were given between six and nine screening questions. The number of questions varied based on individual responses. Once the optimum route was found, participants received no more scenarios. Participants were then asked to indicate how likely they would be taking each of four routes that were shown to them. That is, if they might consider a route, they would indicate it as 'a possibility'. If they would not take a particular route, they would mark 'won't work for me'. Depending on the individual responses, participants were asked if there were certain attributes that were either unacceptable or absolute requirement.

This information was used in the last step. Here, participants were given a series of 10 tasks identified from the previous task. They were presented three choices of which they had to choose one. In each choice task, some of the attribute levels would be identical across the three options. In this case, same attribute levels were indicated (to facilitate the identification of differences and similarities between choices). Fig. 1 provides an example for such a choice set.

After the ACBC task, participants filled out a survey with psychographics and behavioral factors. First, participants filled in the revised New Ecological Paradigm Scale (NEP; Dunlap, Van Liere, Mertig, & Jones, 2000). A sample item is the following: "We are approaching the limit of the number of people the Earth can support". The revised NEP was chosen as it measures respondents' pro-environmental worldviews. It has been used extensively in environmental education and related fields (Anderson, 2016). The scale consists of 15 items, anchored at "1 = I strongly disagree" and "5 = I strongly agree" (Cronbach's $\alpha = 0.87$).

Second, we assessed participants' time consciousness ($\alpha = 0.70$). It was measured via eight items taken from Kleijnen, de Ruyter, and Wetzels (2007). A sample item is the following: "I prefer not to be late for appointments". The anchors were: "1 = I totally disagree" and "7 = I totally agree". One item was excluded from the original nine-item scale to increase reliability from 0.63 to 0.70 (item no. 8). Lastly, we assessed height and weight (to calculate body mass index [BMI]) and whether participants regularly walk in their leisure time (1 = yes, 0 = no).

3.4. Data analysis

Two types of parameters were considered in the data analysis: part-worth utilities and average relative importance scores (Orme, 2014). A part-worth utility of an attribute level (i.e., for noise level – low, medium, and high) represents the preference for that attribute level. A higher value indicates a greater preference for that level within the leisure-time walking attribute. For ease of interpretation, these part-worth utilities were zero-centered.

Relative importance scores represent the maximum effect that each attribute has on intended choice (with greater importance scores reflecting greater effects on preferences; Orme, 2014). Importance scores are expressed as a percentage and are

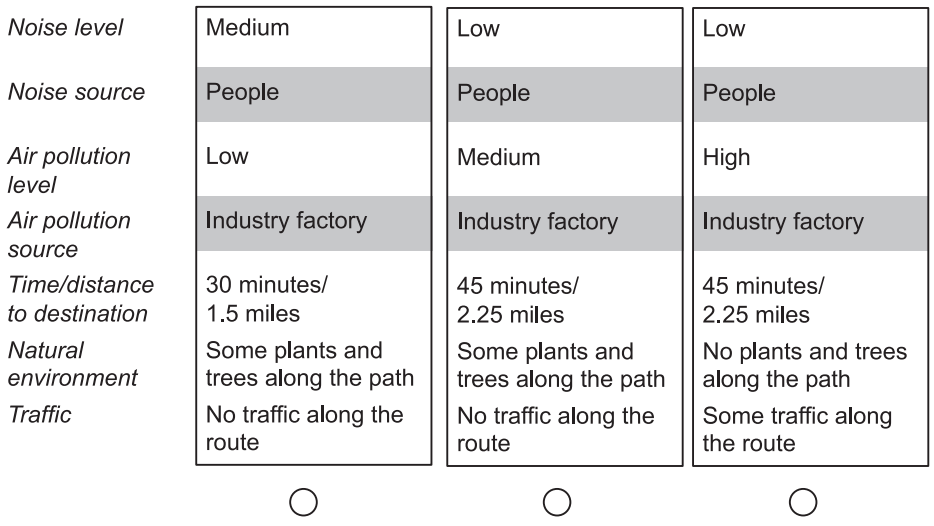

Fig. 1. Example of the choice task as shown to the participants.

directly related to the leisure-time walking attribute ranges (i.e., the difference between the least and most favorable attribute level) that were used in the study.

Individual part-worth utility and importance scores were estimated with hierarchical Bayes analyses, which is considered the best method for choice-based conjoint analyses (Orme, 2014). Preliminary iterations were run until convergence was reached; 40,000 draws were used per participant. For each part-worth utility and importance score, standard errors and confidence intervals (CIs) at the 95% level were calculated to determine significant differences between the levels of each attribute (for part worth utilities) and the different attributes (for importance scores).

The psychographics and behavioral factors were used to explain relative attribute importance scores. We used multiple linear regression analyses with the seven relative attribute importance scores as the dependent variables. The scores were estimated by the hierarchical Bayes analyses on an individual level. As independent variables, we included the following factors: revised NEP, time consciousness, gender (1 = male, 0 = female), age (years), income (levels 1–6; see Table 2), BMI (kg/m^2), and regular walking in leisure time (1 = yes, 0 = no).

4. Results

4.1. Part-worth utilities

Average part-worth utility values within each attribute are displayed in Table 3. The part-worth utilities significantly increased in the expected direction. For example, having low noise level preference (45.85%; 95% CI = 42.62, 49.08) was significantly higher than the medium noise level preference (14.30%; 95% CI = 12.42, 16.18), which was significantly higher than the high noise level preference (−60.15%; 95% CI = −64.00, −56.30). There is no overlap between the CIs. This implies that low noise level was preferred over medium noise level, which in turn was preferred over high noise level.

This directionality was consistently found for other attributes, including: air pollution level, time and distance to destination, natural environment, and traffic. Non-directional attributes included noise source, with people being the most preferred noise source, traffic being the second least preferred, and construction being the least preferred. Non-directional attributes were also found related to air pollution source, with traffic being the most preferred, construction being the second least preferred, and industry factory being the least preferred.

4.2. Relative importance values

Average importance of walking route choice attributes are presented in Fig. 2. Air pollution was the most important attribute and significantly different from all other attributes, including traffic (23.57%; 95% CI = 22.63, 24.50; $t = 9.32$, $p < .001$ compared with traffic). The next most important attributes were traffic (17.42%; 95% CI = 16.52, 18.31), noise level (17.04%; 95% CI = 16.26, 17.82), and the natural environment (16.21%; 95% CI = 15.36, 17.06), which were not significantly different between each other (traffic vs. noise level, $t = 0.63$, $p = .53$; traffic vs. natural environment, $t = 1.92$, $p = .06$, noise

Table 3
Average part-worth utilities of walking route choices for each attribute considered in the ACBC task.

Attribute Category	Attribute Level	Utility	SD	Lower 95% CI	Upper 95% CI
Air pollution level	Low	63.75	49.13	59.45	68.05
	Medium	17.81	26.48	15.50	20.13
	High	−81.56	57.69	−86.62	−6.51
Air pollution source	Traffic	17.88	22.54	15.90	19.85
	Industry factory	−13.08	28.37	−15.56	−10.59
	Construction	−4.80	24.34	−6.93	−2.67
Natural environment	No plants and trees along the path	−53.95	49.56	−58.29	−49.61
	Some plants and trees along the path	17.86	24.18	15.74	19.98
	A lot of plants and trees along the path	36.10	44.21	32.22	39.97
Noise level	Low	45.85	36.87	42.62	49.08
	Medium	14.30	21.47	12.42	16.18
	High	−60.15	43.99	−64.00	−56.30
Noise source	Traffic	−2.72	17.69	−4.27	−1.17
	People	17.04	16.94	15.56	18.52
	Construction	−14.32	16.69	−15.78	−12.86
Time/distance to destination	30 min/1.5 miles	27.49	45.81	23.48	31.50
	45 min/2.25 miles	4.19	23.21	2.16	6.22
	60 min/3 miles	−31.68	44.42	−35.57	−27.79
Traffic	No traffic along the route	33.79	43.07	30.01	37.56
	Some traffic along the route	26.36	29.83	23.74	28.97
	Heavy traffic along the route	−60.14	55.36	−64.99	−55.29

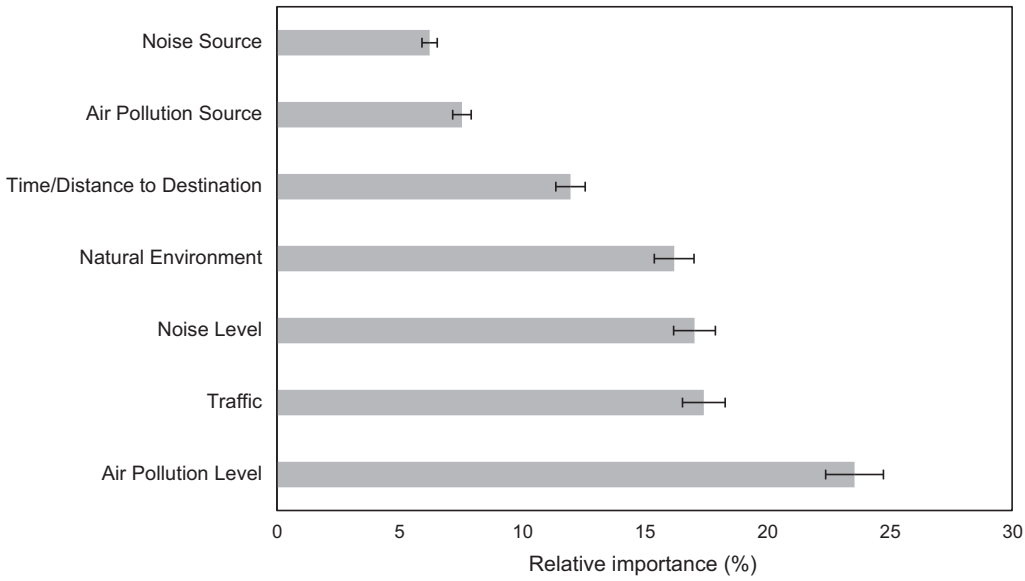

Fig. 2. Average importance of route choice attributes.

level vs. natural environment, $t = 1.41$, $p = .19$) but as a group were significantly higher than all other attributes ($t = 4.35$, $p < .001$) with the exception of air pollution. Time and distance (11.98%; 95% CI = 11.10, 12.87) was the fifth rated most important attribute, air pollution source (7.55%; 95% CI = 7.04, 8.05) was the sixth most important, and noise source (6.23%; 95% CI = 5.92, 6.55) was the least important attribute. All these attributes differ significantly in their importance (t's > 2.0, p's < 0.05).

4.3. Regression analyses

The results of the multiple linear regression analyses are shown in Table 4. The predictors explained between 2 and 8% in the variance of the relative attribute importance scores. Higher scores on the revised NEP were positively related to relative importance of air pollution level and natural environment; and negatively related to importance of time and distance, air pollution source, and noise source. Time consciousness was not a significant predictor of any of the relative importance scores. Males (vs. females) put more emphasis on noise level and less emphasis on traffic. Increased age was positively related to the importance of air pollution level; and negatively related to noise source. While income and BMI did not have significant effects, people who regularly walk during leisure time value air pollution source and noise source more than people who do not walk regularly during leisure time.

5. Discussion

The results of the present study with US residents showed that good air quality, low traffic, and little noise, as well as green space increased individuals' preferences for leisure-time walking in urban settings. While no previous studies have looked at these factors in combination, the results are revealing, particularly with regard to the relevance of air pollution and noise levels. The current study makes the following contributions: it reveals (1) the relative importance of the attributes considered in the study, with a focus on attributes that promote health and prevent diseases; (2) the part-worth utilities of different levels within the attributes; particularly in regard to air quality and noise attributes, the sources were taken into account and found to be relevant; and (3) the importance of individuals' ecological worldview (captured via the revised NEP) as well as sociodemographics and behavioral factors for the relative attribute importance scores. In what follows, we describe the main contributions of this research.

5.1. Theoretical implications

First, the present study adds to the findings from previous qualitative studies that showed that a mix of variables influences individuals' walking route preferences (e.g., Ferrer et al., 2015). The qualitative nature of these studies did not allow the researchers to estimate the relative importance of the various attributes. However, such assessment is needed, as these attributes can have negative health consequences to different degrees (Kaplan, 1995; Lelieveld et al., 2015; Lopez, Mathers, Ezzati, Jamison, & Murray, 2006; Stansfeld et al., 2000). Thus, the knowledge about whether, and how, individuals take the

Table 4
Predictors of the relative importance of each of the leisure-time walking attributes.

Dependent Variable / Independent Variable	Air Pollution Level			Traffic			Noise Level			Natural Environment			Time and Distance			Air Pollution Source			Noise Source		
	B	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*
Revised New Ecological Paradigm Scale	**1.87**	**0.70**	**.008**	0.38	0.67	.57	0.69	0.58	.23	**1.67**	**0.63**	**.009**	**−2.55**	**0.65**	**<.001**	**−1.05**	**0.37**	**.005**	**−1.01**	**0.23**	**<.001**
Time consciousness	0.60	0.56	.29	−0.29	0.53	.58	0.69	0.46	.14	0.20	0.51	.70	−0.76	0.52	.14	−0.24	0.30	.42	−0.18	0.18	.33
Male gender	−0.45	1.00	.65	**−2.58**	**0.95**	**.007**	**3.48**	**0.82**	**<.001**	0.73	0.90	.42	−1.24	0.93	.19	−0.30	0.53	.96	0.08	0.33	.80
Age	**0.07**	**0.04**	**.05**	0.00	0.03	.99	0.02	0.30	.57	0.04	0.03	.25	−0.06	0.03	.07	−0.04	0.02	.06	**−0.03**	**0.01**	**.01**
Income	0.01	0.35	.97	−0.09	0.33	.78	−0.12	0.29	.68	−0.07	0.32	.83	0.21	0.32	.51	0.06	0.19	.75	−0.01	0.11	.96
Body mass index	−0.07	0.08	.40	0.09	0.08	.24	0.09	0.07	.18	−0.08	0.07	.26	0.01	0.07	.94	−0.05	0.04	.25	0.02	0.03	.55
Regular walking in leisure time	0.11	1.46	.94	−2.68	1.40	.06	−1.01	1.21	.40	1.04	1.33	.44	−0.59	1.37	.67	**2.09**	**0.78**	**.008**	**1.05**	**0.48**	**.03**
R^2		0.04			0.03			0.04			0.02			0.05			0.05			0.08	

Notes. Significant predictors are shown in bold.

attributes into account when making walking route decisions increases our understanding of how these decisions can consequently be influenced to increase health at an individual and societal level, and to fight climate change.

The results showed that the provision of information about air quality level, traffic, noise level, and the natural environment had the greatest influence among the attributes that were considered in the present study. There was a clear preference for low air pollution levels as the attribute with the highest importance. These findings corroborate and extend Moudon et al.'s (2007) and Koenigstorfer's (2018) research suggesting that air pollution is a barrier to walking. After air pollution, there was a cluster of attributes that all had similar importance. The combination of traffic, noise, and natural environment are equally important – more so than time and distance as well as the sources of air pollution and noise. Thus, previous claims that distance and time are dominant factors (e.g., Greenwald & Boarnet, 2001) may only hold true in situations in which people are (or perceive to be) uninformed, or forget, about air quality, traffic, and noise conditions, as well as the presence (vs. absence) of green environment. Also, one may have assumed that people might prefer some traffic due to safety concerns (Sugiyama et al., 2012), but we found that the participants preferred no traffic. Thus, the perception of traffic may have changed with increasing health and environmental literacy of city residents.

Second, the results of the present study highlight factors that have largely been neglected in empirical studies on route preferences: air quality and noise. This is despite the fact that both factors have a great effect on pedestrians' health (e.g., King et al., 2009). As assumed, the present study showed that worse air and more noise goes along with lower preferences. This is in agreement with previous studies (Koenigstorfer, 2018). While Seneviratne and Morrall's (1985) early study revealed that noise is not of importance, our research showed that it is important today, and is in fact the third most important attribute considered in our study, in terms of relative importance. The findings on the sources for bad air and noise provide further insights into how these two environmental factors influence people's decision-making processes for walking: people prefer air pollution from industry factory and noise from construction least, while air pollution from traffic and noise from people is mostly tolerated.

Lastly, the study showed that the revised NEP scale as well as sociodemographics and behavioral factors predict relative attribute importance scores, while time consciousness was not relevant. The findings thus contribute to our standing how favorable attribute perceptions can be influenced, and what potential target group differences are. In regards to psychometrics, some attributes seem to be more important for more pro-environmental respondents. Those scoring higher on the revised NEP scale care more about low levels of air pollution and noise. If non-pro-environmental, the attributes are less influential on their route choice. Finally, regarding demographics, the previous finding that gender and age interact with features of the built environment in regard to preferences (Durand et al., 2011) is supported by the present research. For example, the relative importance scores for air pollution are not affected by gender, but noise levels are, with males putting a higher emphasis on noise levels. Regarding age, for older adults, noise source is less a concern as long as it is low.

5.2. Public policy implications

Worldwide, the percentage of people who live in cities will increase from 50% in 2010 to nearly 70% by 2050 (UN, 2013). As relayed by Mehdipanah et al. (2015), urban renewal projects are an important part of the continued efforts to keep up with the growing populations in cities globally. However, the authors argue that these projects often exclude health considerations and are, in fact, associated with poor health conditions. The current study is important to consider for urban planners when engaging in urban renewal interventions. Particularly, in the US, we found that people privilege healthy air and greenery while avoiding heavy traffic and noisy areas. Thus, urban planners should create opportunities for active walking routes between urban destinations that offer clean air, some greenery, natural sound, and low traffic.

5.3. Limitations and outlook

The study has notable limitations. Other factors that may influence leisure-time walking route preferences were excluded from the conjoint analysis, for reasons of parsimony and practicability. Factors such as access and safety, which are considered as basic needs according to Alfonzo (2005) and the presence of others when walking (Cao, Handy, & Mokhtarian, 2006) may be taken into account additionally in future studies.

Furthermore, the hypothetical scenario used in the present study did not state a specific location; it indicated that the participant was in an unfamiliar city going to a particular point without much detail. This has the advantage that familiarity with the shown route (Guo & Loo, 2013) did not influence the results. We phrased it this way in an effort to mitigate bias from known routes, a feeling of time constraint, everyday pressures of life, and in order to focus on understanding what health-related factors were the most important. Given this, we caution suggesting that this might apply to all leisure time walking behaviors. Rather this was a first step to understand what makes individuals choose a particular walking route. Future research should carefully consider examining actual behaviors when individuals are presented with real-time information. For example, it is now possible to see an overall air pollution rating on various websites (e.g., Airnow.com; Breezometer.com; Waqi.info). Will a high air pollution rating make individuals change their route choice? To increase external validity, real-life contexts and behaviors should be considered in future studies.

Conjoint analyses are limited in the sense that the variation of the attribute levels is rather small when using text descriptors. In the present study, three levels were presented for each attribute. This may simplify the richness of the environment for pedestrians. Another limitation concerns the fact that the study did not specify the three levels of the attributes further

(e.g., by providing detailed descriptions). This creates variance in the perception about the different levels that were presented to participants. Future research may use more detailed, standardized descriptors, eventually in combination with stimuli (e.g., photos, movies, virtual reality tools) that better capture sensations based on the five senses: bad air can be smelled and affects eye sight; the green environment can be felt; noise can be heard; etc. One may thus assume that these verbal descriptors are limited in regard to allowing participants to feel and act as if they were in the hypothetical situation. Lastly, given the abstract nature of the prompt, the research findings cannot suggest whether or not individuals will prioritize factors such as the level of air pollution in real-life leisure time scenarios. Future research may consider revealed (but not stated) preferences in empirical studies.

6. Conclusions

The purpose of the study was to assess the relative importance of air quality, noise, green space, traffic, and time and distance to destination on intended leisure-time walking routes in urban environments. Participants favored low air pollution over high, low noise over high, more trees than not, and avoided heavy traffic. Air pollution levels being found to be the most important attribute is a relevant finding, given the prevalence of air pollution in major urban settings. Pro-environmentalists selected their routes based on both air pollution and noise levels, thus they might be particularly interested in informing themselves about, and monitoring, these attributes. The findings have important implications for various stakeholders, such as city planners, public health representatives, and institutions for consumer protection. With this research, we contribute to a better understanding of how individuals form leisure-time walking intentions: it is not only time and distance that matters, but the health-promoting aspects of the environment matter too.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Appendix A. Steps of the ACBC task

Step 1: Introduction text

We are interested in what factors influence your walking route preferences. In general, people make choices based upon time and distance considerations, noise considerations, air pollution considerations, as well as what the natural environment looks like and what the traffic looks like. However, we don't know the degree to which these features are important to you. Therefore, on the following pages, we ask what features you like, and what features you don't like. When responding to the questions, please assume that your walk in your leisure time is in an unspecified city, and you act just as you would normally.

Step 2: Build your own example

Please select the features you would be most likely to consider when you walk in your leisure time in an unspecified city. For each feature, state your preferred level.

(The information presented in Table 2 was presented to the participants and they had the option to choose one of three levels for each attribute.)

Step 3: Possible route choice

Here are a few routes you might like to take when you walk in an unknown city during your leisure time. For each one, indicate whether it is a possibility or not (i.e., whether or not you would actually consider this route).

(The information presented in Fig. 1 was presented to the participants, with two notable differences. First, they selected either "a possibility" or "won't work for me" for all routes. Second, not three, but four routes were presented to them.)

Step 4: Screener question for totally unacceptable characteristics

We've noticed that you've avoided [attribute] with certain characteristics shown below. Would any of these features be totally unacceptable? If so, mark the one feature that is most unacceptable, so we can just focus on [attributes] that meet your needs.

(Levels of attributes were presented to the participants and they were asked to select one of them, or select the option "none of these is totally unacceptable".)

Step 5: Screen question for attributes one 'must have' on her/his route

We don't want to jump to conclusions, but we've noticed that you've selected [attribute] with certain characteristics shown below. If any of these is an absolute requirement, it would be helpful to know. If so, please check the one most important feature, so we can just focus on [attributes] that meet your needs.

(Levels of attributes were presented to the participants and they were asked to select one of them, or select the option "none of these is an absolute requirement".)

Step 6 (last step): Choice Tasks

See Fig. 1.

References

Alfonzo, M. (2005). To walk or not to walk: The hierarchy of walking needs. *Environment and Behavior, 37*(6), 808–836. https://doi.org/10.1177/0013916504274016.

Al-Omari, B., Sim, J., Croft, P., & Frisher, M. (2017). Generating individual patient preferences for the treatment of osteoarthritis using Adaptive Choice-Based Conjoint (ACBC) Analysis. *Rheumatology and Therapy, 4*(1), 167–182. https://doi.org/10.1007/s40744-017-0056-4.

Anderson, R. C. (2016). *Berkshire encyclopedia of sustainability*. London: Berkshire Publishing Group.

Appleyard, B. S., & Ferrell, C. E. (2017). The Influence of crime on active & sustainable travel: New geo-statistical methods and theories for understanding crime and mode choice. *Journal of Transport & Health, 6*, 516–529. https://doi.org/10.1016/j.jth.2017.04.002.

Babisch, W., Beule, B., Schust, M., Kersten, N., & Ising, H. (2005). Traffic noise and risk of myocardial infarction. *Epidemiology, 16*(1), 33–40. https://doi.org/10.1097/01.ede.0000147104.84424.24.

Ben-Akiva, M., McFadden, D., & Train, K. (2019). Foundations of stated preference elicitation: Consumer behavior and choice-based conjoint analysis. *Foundations and Trends in Econometrics, 10*(1–2), 1–144. https://doi.org/10.1561/0800000036.

Bogers, E. A., Viti, F., & Hoogendoorn, S. P. (2005). Joint modeling of advanced travel information service, habit, and learning impacts on route choice by laboratory simulator experiments. *Transportation Research Record, 1926*(1), 189–197. https://doi.org/10.3141/1926-22.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101.

Broach, J., Gliebe, J., & Dill, J. (2011). Bicycle route choice model developed using revealed preference GPS data. *90th Annual Meeting of the Transportation Research Board, Washington, DC, January*.

Brook, R. D., Rajagopalan, S., Pope, C. A., Brook, J. R., Bhatnagar, A., Diez-Roux, A. V., et al (2010). Particulate matter air pollution and cardiovascular disease: An update to the scientific statement from the American Heart Association. *Circulation, 121*(21), 2331–2378. https://doi.org/10.1161/CIR.0b013e3181dbece1.

Brownson, R. C., Boehmer, T. K., & Luke, D. A. (2005). Declining rates of physical activity in the United States: What are the contributors? *Annual Review of Public Health, 26*(1), 421–443. https://doi.org/10.1146/annurev.publhealth.26.021304.144437.

Burgess, J., Harrison, C. M., & Limb, M. (1988). People, parks and the urban green: A study of popular meanings and values for open spaces in the city. *Urban Studies, 25*(6), 455–473. https://doi.org/10.1080/00420988820080631.

Cao, X., Handy, S. L., & Mokhtarian, P. L. (2006). The influences of the built environment and residential self-selection on pedestrian behavior: Evidence from Austin, TX. *Transportation, 33*, 1. https://doi.org/10.1007/s11116-005-7027-2.

Carlson, S. A., Fulton, J. E., Pratt, M., Yang, Z., & Adams, E. K. (2015). Inadequate physical activity and health care expenditures in the United States. *Progress in Cardiovascular Diseases, 57*(4), 315–323. https://doi.org/10.1016/j.pcad.2014.08.002.

CDC (2018). Glossary. Retrieved from https://www.cdc.gov/transportation/glossary.htm.

Cutt, H. E., Knuiman, M. W., & Giles-Corti, B. (2008). Does getting a dog increase recreational walking? *International Journal of Behavioral Nutrition and Physical Activity, 5*(1), 17. https://doi.org/10.1186/1479-5868-5-17.

Davies, A., Laing, R., Miller, D., Chen, W., Horne, P., Morrice, J., & Scott, S. (2002). Streetscapes: Their contribution to wealth creation and quality of life. Retrieved from https://www3.rgu.ac.uk%2Fdownload.cfm%3Fdownloadfile%3DB8DBEE40-B656-11E2-B7610050568D00BF%26typename%3DdmFile%26fieldname%3Dfilename&usg=AOvVaw1lbYXLEuI8M3JyQq9l81Cl.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). New trends in measuring environmental attitudes: Measuring endorsement of the New Ecological Paradigm: A revised NEP scale. *Journal of Social Issues, 56*(3), 425–442. https://doi.org/10.1111/0022-4537.00176.

Durand, C. P., Andalib, M., Dunton, G. F., Wolch, J., & Pentz, M. A. (2011). A systematic review of built environment factors related to physical activity and obesity risk: Implications for smart growth urban planning. *Obesity Reviews, 12*, e173–e182. https://doi.org/10.1111/j.1467-789X.2010.00826.x.

Ekelund, U., Steene-Johannessen, J., Brown, W. J., Fagerland, M. W., Owen, N., Powell, K. E., & Lancet Sedentary Behaviour Working Group (2016). Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *The Lancet, 388*(10051), 1302–1310. https://doi.org/10.1016/S0140-6736(16)30370-1.

Ewing, R., & Cervero, R. (2010). Travel and the built environment. *Journal of the American Planning Association, 76*(3), 265–294. https://doi.org/10.1080/01944361003766766.

Ferrer, S., Ruiz, T., & Mars, L. (2015). A qualitative study on the role of the built environment for short walking trips. *Transportation Research Part F: Traffic Psychology and Behaviour, 33*, 141–160. https://doi.org/10.1016/j.trf.2015.07.014.

Giles-Corti, B., Broomhall, M. H., Knuiman, M., Collins, C., Douglas, K., Ng, K., ... Donovan, R. J. (2005). Increasing walking. How important is distance to, attractiveness and size of public open space? *American Journal of Preventative Medicine, 28*(2S2), 169–176. https://doi.org/10.1016/j.amepre.2004.10.018.

Greenwald, M. J., & Boarnet, M. G. (2001). Built environment as determinant of walking behaviour: Analyzing non-work pedestrian travel in Portland, Oregon. *Transportation Research Record, 1780*, 33–42. https://doi.org/10.3141/1780-05.

Guarnieri, M., & Balmes, J. R. (2014). Outdoor air pollution and asthma. *The Lancet, 383*(9928), 1581–1592. https://doi.org/10.1016/S0140-6736(14)60617-6.

Guo, Z., & Loo, B. P. Y. (2013). Pedestrian environment and route choice: Evidence from New York City and Hong Kong. *Journal of Transport Geography, 28*, 124–136. https://doi.org/10.1016/j.jtrangeo.2012.11.013.

Haaland, C., & van den Bosch, C. K. (2015). Challenges and strategies for urban green-space planning in cities undergoing densification: A review. *Urban Forestry & Urban Greening, 14*(4), 760–771. https://doi.org/10.1016/j.ufug.2015.07.009.

Handy, S. L. (1996). Urban form and pedestrian choice: Study of Austin neighborhoods. *Transportation Research Record, 1552*, 135–144. https://doi.org/10.3141/1552-19.

Harms, P. D., & DeSimone, J. A. (2015). Caution! MTurk workers ahead—Fines doubled. *Industrial and Organizational Psychology, 8*(2), 183–190. https://doi.org/10.1017/iop.2015.23.

Heinen, E., Van Wee, B., & Maat, K. (2010). Commuting by bicycle: An overview of the literature. *Transport Reviews, 30*(1), 59–96. https://doi.org/10.1080/01441640903187001.

Huber, J., & Zwerina, K. (1996). The importance of utility balance in efficient choice designs. *Journal of Marketing Research, 33*(3), 307–317. https://doi.org/10.2307/3152127.

Johnson, R., Huber, J., & Bacon, L. (2003). Adaptive choice based conjoint analysis. Sawtooth Software Research Paper Series. Retrieved from http://www.sawtoothsoftware.com/download/techpap/acbc.pdf.

Kabisch, N., & Haase, D. (2013). Green space of European cities revisited for 1990–2006. *Landscape Urban Planning, 110*, 113–122. https://doi.org/10.1016/j.landurbplan.2012.10.017.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*(3), 169–182. https://doi.org/10.1016/0272-4944(95)90001-2.

King, E. A., Murphy, E., & McNabola, A. (2009). Reducing pedestrian exposure to environmental pollutants: A combined noise exposure and air quality analysis approach. *Transportation Research Part D: Transport and Environment, 14*(5), 309–316. https://doi.org/10.1016/j.trd.2009.03.005.

Kleijnen, M., de Ruyter, K., & Wetzels, M. (2007). An assessment of value creation in mobile service delivery and the moderating role of time consciousness. *Journal of Retailing, 83*(1), 33–46. https://doi.org/10.1016/j.jretai.2006.10.004.

Koenigstorfer, J. (2018). Active transportation decision-making against the background of air quality information provision: Walking route preferences of German residents. *Urban Science, 2*(1), 19. https://doi.org/10.3390/urbansci2010019.

Lee, C., & Moudon, A. V. (2004). Physical activity and environment research in the health field: Implications for urban and transportation planning practice and research. *Journal of Planning Literature, 19*(2), 147–181. https://doi.org/10.1177/0885412204267680.

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., & Lancet Physical Activity Series Working Group (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *The Lancet, 380*(9838), 219–229. https://doi.org/10.1016/S0140-6736(12)61031-9.

Lelieveld, J., Evans, J. S., Fnais, M., Giannadaki, D., & Pozzer, A. (2015). The contribution of outdoor air pollution sources to premature mortality on a global scale. *Nature, 525*, 367–371. https://doi.org/10.1038/nature15371.

Lopez, A. D., Mathers, C. D., Ezzati, M., Jamison, D. T., & Murray, C. J. (2006). Global and regional burden of disease and risk factors, 2001: Systematic analysis of population health data. *The Lancet, 367*(9524), 1747–1757. https://doi.org/10.1016/S0140-6736(06)68770-9.

Lu, Y. (2018). The association of urban greenness and walking behavior: Using Google Street View and deep learning techniques to estimate residents' exposure to urban greenness. *International Journal of Environmental Research and Public Health, 15*(8), 1576. https://doi.org/10.3390/ijerph15081576.

Mehdipanah, R., Manzano, A., Borrell, C., Malmusi, D., Rodriguez-Sanz, M., Greenhalgh, J., ... Pawson, R. (2015). Exploring complex causal pathways between urban renewal, health and health inequality using a theory-driven realist approach. *Social Science & Medicine, 124*, 266–274. https://doi.org/10.1016/j.socscimed.2014.11.050.

Moudon, A. V., Lee, C., Cheadle, A. D., Garvin, C., Johnson, D. B., Schmid, T. L., & Weathers, R. D. (2007). Attributes of environments supporting walking. *American Journal of Health Promotion, 21*(5), 448–459. https://doi.org/10.4278/0890-1171-21.5.448.

Orme, B. K. (2014). *Getting started with conjoint analysis: Strategies for product design and pricing research* (3rd ed.). Glendale, CA: Research Publishers LLC.

Owen, N., Humpel, N., Leslie, E., Bauman, A., & Sallis, J. F. (2004). Understanding environmental influences on walking: Review and research agenda. *American Journal of Preventive Medicine, 27*(1), 67–76. https://doi.org/10.1016/j.amepre.2004.03.006.

Pikora, T. J., Gilles-Corti, B., Knuiman, M. W., Bull, F. C., Jamrozik, K., & Donovan, R. J. (2006). Neighborhood environmental factors correlated with walking near home: Using SPACES. *Medicine & Science in Sports & Exercise, 38*(4), 708–714. https://doi.org/10.1249/01.mss.0000210189.64458.f3.

Saelens, B. E., & Handy, S. L. (2008). Built environment correlates of walking: A review. *Medicine & Science in Sports & Exercise, 40*(S7), S550–566. https://doi.org/10.1249/MSS.0b013e31817c67a4.

Sallis, J. F., Floyd, M. F., Rodríguez, D. A., & Saelens, B. E. (2012). Role of built environments in physical activity, obesity, and cardiovascular disease. *Circulation, 125*(5), 729–937. https://doi.org/10.1161/CIRCULATIONAHA.110.969022.

Sarkar, C., Webster, C., Pryor, M., Tang, D., Melbourne, S., Zhang, X., & Jianzheng, L. (2015). Exploring associations between urban green, street design and walking: Results from the Greater London boroughs. *Landscape and Urban Planning, 143*, 112–125. https://doi.org/10.1016/j.landurbplan.2015.06.013.

Seneviratne, P. N., & Morrall, J. F. (1985). Analysis of factors affecting the choice of route of pedestrians. *Transportation Planning and Technology, 10*(2), 147–159. https://doi.org/10.1080/03081068508717309.

Shin, H. S., Callow, M., Dadvar, S., Lee, Y. J., & Farkas, Z. A. (2015). User acceptance and willingness to pay for connected vehicle technologies: Adaptive choice-based conjoint analysis. *Transportation Research Record, 2531*(1), 54–62. https://doi.org/10.3141/2531-07.

Stansfeld, S., Haines, M., & Brown, B. (2000). Noise and health in the urban environment. *Reviews on Environmental Health, 15*(1–2), 43–82. https://doi.org/10.1515/REVEH.2000.15.1-2.43.

Sugiyama, T., Neuhaus, M., Cole, R., Giles-Corti, B., & Neville, O. (2012). Destination and route attributes associated with adults' walking: A review. *Medicine & Science in Sports & Exercise, 44*(7), 1275–1286. https://doi.org/10.1249/MSS.0b013e318247d286.

UN (2013). Sustainable development changes. *World Economic and Social Survey 2013*. Department of Economic and Social Affairs, United Nations Publication.

United States Census Bureau (n.d.) Population. Retrieved from https://www.census.gov/topics/population.html..

Veitch, J., Salmon, J., Deforche, B., Ghekiere, A., Van Cauwenberg, J., Bangay, S., & Timperio, A. (2017). Park attributes that encourage park visitation among adolescents: A conjoint analysis. *Landscape and Urban Planning, 161*, 52–58. https://doi.org/10.1016/j.landurbplan.2016.12.004.

Vlachokostas, C., Achillas, C., Michailidou, A. V., & Moussiopoulos, N. (2012). Measuring combined exposure to environmental pressures in urban areas: An air quality and noise pollution assessment approach. *Environment International, 39*(1), 8–18. https://doi.org/10.1016/j.envint.2011.09.007.

Weinstein Agrawal, A., Schlossberg, M., & Irvin, K. (2008). How far, by which route and why? A spatial analysis of pedestrian preference. *Journal of Urban Design, 13*(1), 81–98. https://doi.org/10.1080/13574800701804074.

WHO (2004). Global strategy on diet, physical activity and health. Retrieved from https://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_english_web.pdf.

WHO (2011). Burden of disease from environmental noise. Retrieved from http://www.who.int/quantifying_ehimpacts/publications/e94888.pdf?ua=1.