A STATED PREFERENCE SURVEY FOR EVALUATING PEDESTRIANS' EXPECTATIONS ON WALKWAYS

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ABSTRACT

Pedestrian mobility is the oldest form of transport in urban areas. Due to the increase of private vehicles, transport planning has mainly focused on traffic congestion problems, neglecting pedestrian mobility and public transport. Given the current situation of pollution and climate change, walkability is again one of the most important transport modes to achieve urban sustainable mobility in the next future. As reported in the literature, city dwellers are willing to walk to carry out daily activities but complain about the lack of adequate pedestrian infrastructure. For promoting pedestrian mobility, the quality levels of pedestrian paths should be increased. Many researchers suggest methodologies for determining the pedestrian level of service. Among these, some studies consider both path physical characteristics and users' perception about the walkway. Investigating on users' perception represents a good strategy for implementing interventions aimed at increasing the quality of service. In addition to users' perception about the different characteristics of the pedestrian path, it is also necessary to take over the importance that users assign to each aspect.

This work proposes the design of a Stated Preferences survey and the analysis of the preliminary results. A questionnaire was addressed to a sample of 240 pedestrians on a walkway located in the University Campus of Rende (Italy). The aim is recording pedestrians' perception about the characteristics of the path and detecting the choices they would make in a hypothetical scenario. Then, the collected data has been analysed by means of a discrete choice model for assessing the weights assigned by pedestrians to each aspect included in the analysis.

The results have allowed the most relevant pedestrian path aspects for users to be identified. Just on these aspects it is necessary to intervene in order to make pedestrian paths increasingly attractive and to encourage users towards active mobility.

1. INTRODUCTION

Car traffic increasing undermines the quality of life in urban areas. Motorized traffic has grown so much that many important aspects of urban life are inhibited, so that the issue of sustainability has become a fundamental topic.

Promoting walking as an alternative to short trips made by car represents an important strategy to enact sustainability in more densely inhabited areas (Amoroso et al., 2012).

Benefits of increased walking include not only reductions in traffic congestion, air pollution and emissions, but also improvements in public and private health, community relations and positive sense of place, as well as improvements in economic and real estate performance (Hall Ram, 2018a). Walkability can be defined as the extent to which a built environment enables walking (Kelly et al., 2011) and is pedestrian friendly (Gebel et al., 2009; Moura et al., 2017). Some studies emphasize different environmental features that a pedestrian facility has to own, including areas being traversable, compact, safe, as well as the places have to be lively, enhancing sustainable transportation options, and encouraging outdoor exercise and leisure (Forsyth, 2015; Saelens and Handy, 2008; Hall and Ram, 2018b). In this context, it becomes fundamental to investigate on the direct users of the facilities about their perceptions and preferences concerning the service quality characterizing pedestrian environment. The use of pedestrian perceptions to explain the service quality has been less studied (Vallejo-Borda et al., 2020a). The relationship between pedestrian perceptions and service quality is still nascent (Bellizzi et al., 2019; Bivina and Parida, 2019; Jahan et al., 2020; Vallejo-Borda et al., 2020b). These studies are based on the collection of pedestrian perceptions in terms of rating expressed on evaluation scales.

On the other hand, some studies investigate pedestrian perceptions adopting the Stated Preferences (SP) approach, according to which actual or potential users are asked to rate or rank the attractiveness of existing or hypothetical streets (Adkins et al., 2012; Borst et al., 2008; Kaparias et al., 2012; Kelly et al., 2011; Lusk et al., 2018). The importance (utility) of the various service attributes is estimated based on the respondents’ preferences. As an example, some of these studies found that wider sidewalks are generally preferred (Kim et al., 2011; Talavera-Garcia and Soria-Lara, 2015) and lateral separation from traffic increase streets’ attractiveness (Adkins et al., 2012). The presence of trees is appreciated (Lusk et al., 2018; Talavera-Garcia and Soria-Lara, 2015). The existing literature confirms that the SP method is suitable for analysing pedestrian perceptions. SP scenarios are typically presented in text format showing attributes and their levels, but sometimes photos or videos are adopted (Kasrain et al., 2020).

This paper wants to provide a contribute in the literature of the studies proposing SP experiments for investigating on pedestrian preferences. For facilitating the users in expressing their opinions, we adopted also photos representing the characteristics of the alternative pedestrian environments proposed to the users to make a choice. After a deep study of the literature review, we selected four attributes to introduce in the SP experiment: width of the pedestrian path; pavement of the pedestrian path; equipment present along the pedestrian path; environment where the pedestrian path develops. Interesting findings emerge from the observations of the choice of the various alternatives made by the users. In order to synthetize the findings emerged from the analysis of the preferences expressed by the users, a Multinomial Logit (MNL) model was calibrated.

We found that the environment where the pedestrian path develops is the most important aspects for the users.

The rest of the paper is organized as follows: section 2 explains the design of the SP survey; section 3 describes the methodology and includes the data analysis and the calibration of the MNL model; in the last section the results are discussed and some final remarks are presented.

2. STATED PREFERENCE SURVEY DESIGN

The Stated-Preferences approach is a particular type of survey where two or more hypothetical scenarios are proposed to the interviewee. The interviewee is asked to choose the scenario they prefer most or to rank the scenarios according to their personal level of preference.

The SP survey planned in this work was referred to the detection of the perceived degree of comfort of a pedestrian path. The comfort attributes of a pedestrian path are countless. From the analysis of the literature, four most recurrent attributes have been identified:

- width of the pedestrian path;
- pavement of the pedestrian path;
- equipment present along the pedestrian path;
- environment where the pedestrian path develops.

Each attribute (or variable) varies on two levels or categories. Specifically, the categories relating to the width attribute are narrow path (pedestrians only) and wide path (interference with bicycles, scooters, hoverboards, authorized vehicles). The pavement can be traditional (asphalt, concrete, dirt path) or specific for pedestrian paths (coloured asphalt, rubber, beaten and/or stabilized ground). Along the route there may be more or less equipment, distinguishing between a poorly equipped path (lighting, baskets, benches) or an equipped path (lighting, waste baskets, benches and/or seats, beverage and food distributors, Wi-Fi and charging stations, protection from atmospheric agents).

The environment can be unpleasant (dirt, untreated green spaces, dilapidated building facades, scarce presence of commercial activities) or pleasant (clean, well-kept green spaces, decent building facades, presence of commercial activities).

After establishing the levels of each attribute, hypothetical scenarios were constructed. A scenario is given by a set of level attribute combinations. When all possible scenarios are considered, the survey project takes the name of Full Factorial Design. Specifically, we have considered 4 attributes at 2 levels, for which the Full Factorial Plan consists of 16 scenarios (2^4).
Often the Full Factorial Plan is too numerous or presents irrelevant scenarios, so a reduction in the total number of scenarios is implemented.

The Fractional Factorial Plan is a plan reduced through appropriate exclusions of scenarios in order to lose the least possible amount of information (variance explained) considering only the main effects of the attributes and neglecting some or all interactions. In our case, four scenarios have been eliminated, which correspond to cases in which we have traditional flooring and an equipped path. In fact, an equipped path is not compatible with an ordinary sidewalk with poor quality pavement. In total, twelve scenarios were included in the survey (Table 1).

Once the scenarios have been defined it is necessary to combine them in order to identify the set of choices. The scenarios were combined in pairs, obtaining 64 sets of choices. In this work, a set of choices has been named “card”.

Two combinations were discarded as one scenario was clearly better than the other, in order to avoid too expectable choices.

Scenario		Width	Pavement	Equipment	Environment
1	a	narrow	traditional	poorly equipped	pleasant
2	b	narrow	traditional	poorly equipped	unpleasant
5	c	narrow	specific	poorly equipped	pleasant
6	d	narrow	specific	poorly equipped	unpleasant
7	e	narrow	specific	equipped	pleasant
8	f	narrow	specific	equipped	unpleasant
9	g	wide	traditional	poorly equipped	pleasant
10	h	wide	traditional	poorly equipped	unpleasant
13	i	wide	specific	poorly equipped	pleasant
14	l	wide	specific	poorly equipped	unpleasant
15	m	wide	specific	equipped	pleasant
16	n	wide	specific	equipped	unpleasant

Table 1 – Fractional Factorial Plan

The interviewee had to administer a block consisting of 8 cards. For each card the interviewee was asked to choose one of the two scenarios. The interviewee's task was facilitated by the inclusion of images relating to the different categories of the attributes considered in the survey form (Figure 1).

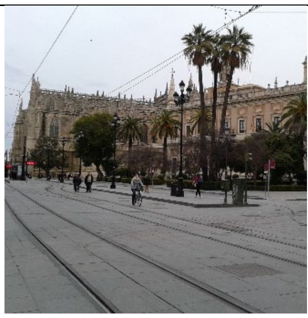
Which of these alternatives would you choose?			
A ☐		B ☐	
Width **Narrow path** (pedestrians only)		Width **Wide path** (interference with bicycles, scooters, hoverboards, authorized vehicles)	
Pavement **Specific for pedestrian paths** (coloured asphalt, rubber, beaten and/or stabilized ground)		Pavement **Traditional** (asphalt, concrete, dirt path)	
Equipment **Poorly equipped path** (lighting, waste baskets, benches)		Equipment **Poorly equipped path** (lighting, waste baskets, benches)	
Environment **Unpleasant** (dirt, untreated green spaces, dilapidated building facades, scarce presence of commercial activities)		Environment **Pleasant** (clean, well-kept green spaces, decent building facades, presence of commercial activities)	

Fig. 1 – Example of card

3. METHODOLOGY

3.1 Data analysis

The survey was carried out in November and December 2019 by interviewing a sample of 240 people along a pedestrian path located in the University Campus of Rende (Italy). The sample is divided almost equally between males (51%) and females (49%). As the survey was carried out on the University campus, most of the interviewees are students (99%) aged 25 or under.
The SP survey made up of 64 cards was divided into 8 blocks each containing 8 cards.

Each pedestrian interviewed answered only one block, so for each block we collected the answers of 30 respondents.

From the preliminary analysis of the data collected, it emerged that for each pair of scenarios where the possibility of choosing between pleasant and unpleasant environment appears, most of the pedestrians have chosen the scenario characterized by pleasant environment. As can be seen from the two bar diagrams in Figure 2, there are few (or even zero for card *ab*) pedestrians who, other things being equal, choose a path with an unpleasant environment.

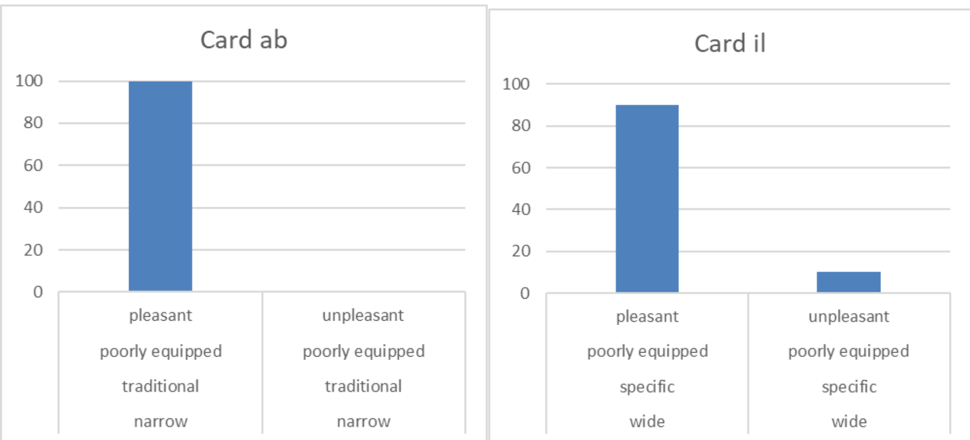


Fig. 2 – SP results: difference between pleasant and unpleasant environment

When comparing scenarios that also have other attributes that may vary in addition to the environment, most users continue to choose scenarios where the environment is pleasant.
For example, observing the card *ad* in Figure 3, it can be seen that the scenario with a pleasant environment and traditional pavement is chosen by 77% of pedestrians, while that with an unpleasant environment and specific pavement only by 23%. In the *af* card, the scenario with a pleasant environment, traditional flooring and poorly equipped path is chosen by 83% of the interviewees, while the scenario with specific flooring, equipped path and unpleasant environment is chosen only by the remaining 17%.

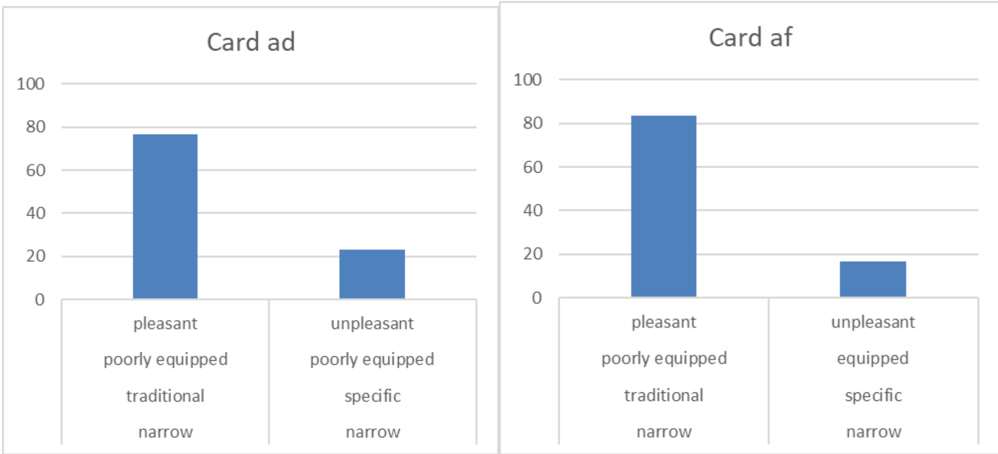


Fig. 3 – SP results: difference between pleasant and unpleasant environment in relation to other attributes

For the cards where two scenarios with the same characteristics are compared, except the pavement, the one preferred by most of the interviewed pedestrians is the scenario with specific pavement. For example, in card *ac* and card *gi* (Figure 4) the scenario with specific pavement was chosen by almost 80% of the interviewed pedestrians. The scenario with specific pavement is the most chosen one even when other attributes such as equipment and width are considered. For example, in Figure 5, in card *ai* the most chosen scenario is that with specific pavement (73%), even if the scenarios are different regarding the width. When the two scenarios differ also in terms of environment, as well as pavement, the most chosen scenario is always the one that presents the pleasant ambient alternative, regardless of the pavement. For example, in card *gl* in Figure 5, the most chosen scenario is the one in which there is traditional pavement and a pleasant environment (93%).

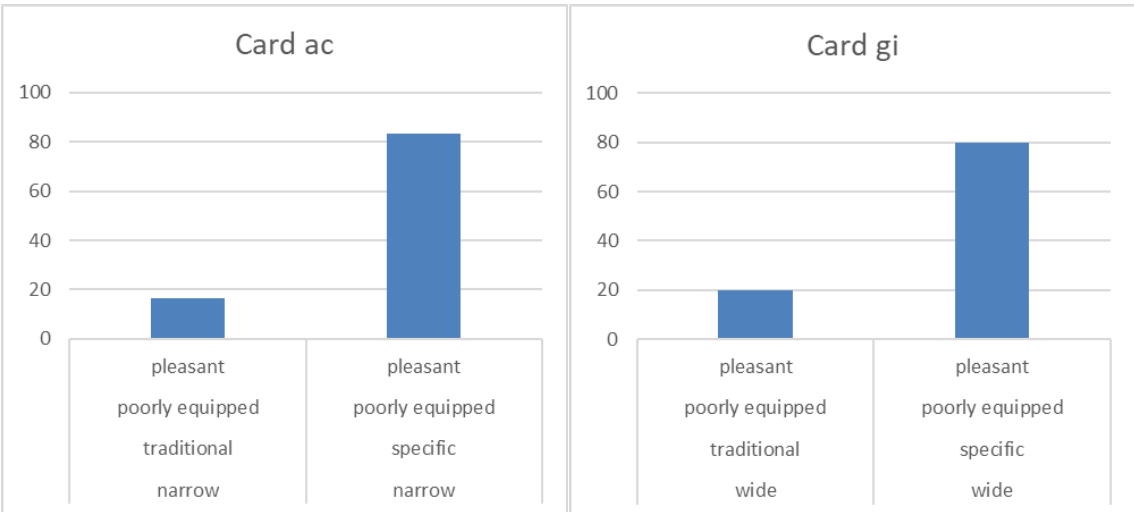


Fig. 4 – SP results: difference between traditional and specific pavement

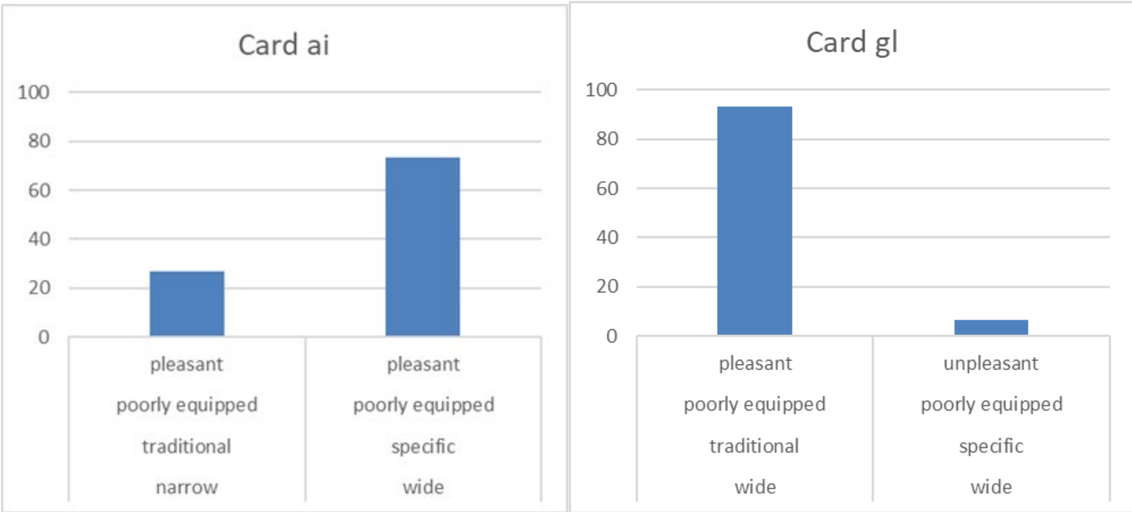


Fig. 5 – SP results: difference between traditional and specific pavement in relation to other attributes

By comparing scenarios with the same characteristics but different equipment (card *ce* in Figure 6), the equipped path is the one chosen by most of the interviewees (about 83%). The equipped path continues to be the most chosen one (80% of the respondents) when the environment is pleasant and when the pavement is specific, as reported in card *gm* (Figure 6). As can be seen from the graphs shown in Figure 7, the width of the path does not seem relevant with respect to the equipment attribute.

The width attribute is the one with the most variability. From the analysis of the results of the survey, it is clear that for some pairs of scenarios the most chosen scenario is the one with the wide path (card *ci* in Figure 8), for others the narrow path (card *ag* in Figure 8).

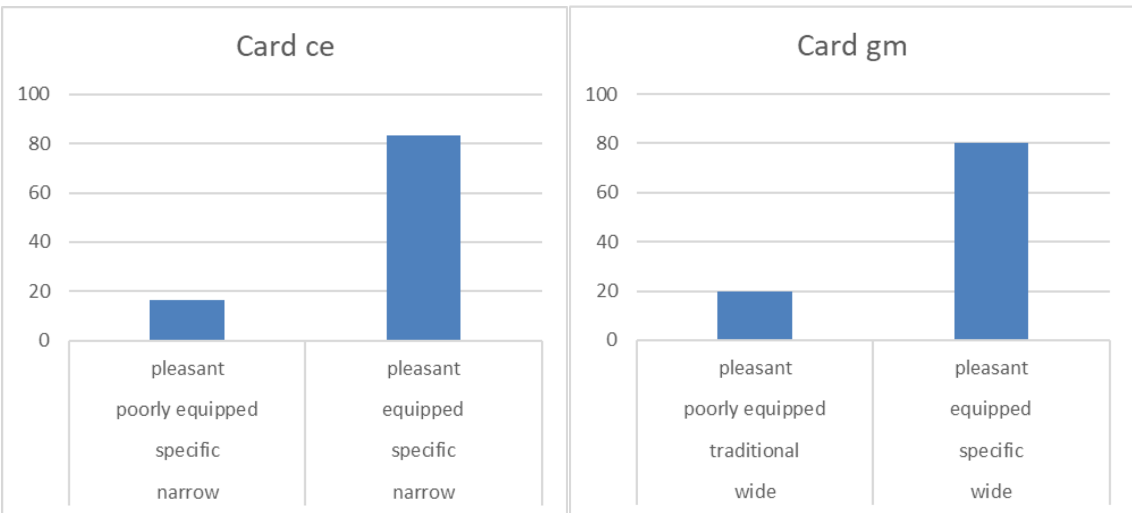


Fig. 6 – SP results: difference between poorly equipped and equipped path

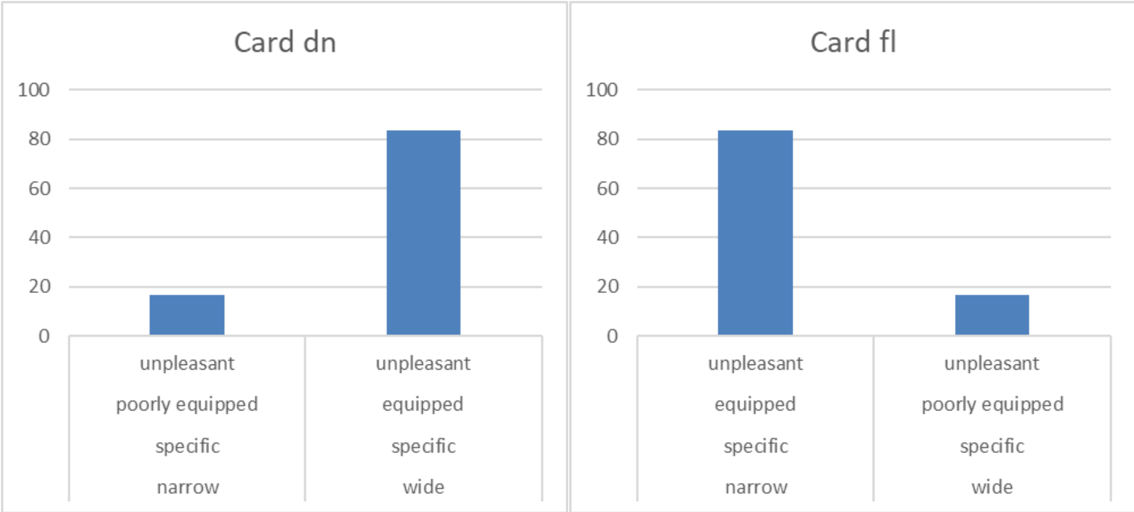


Fig. 7 – SP results: difference between poorly equipped and equipped paths in relation to other attributes

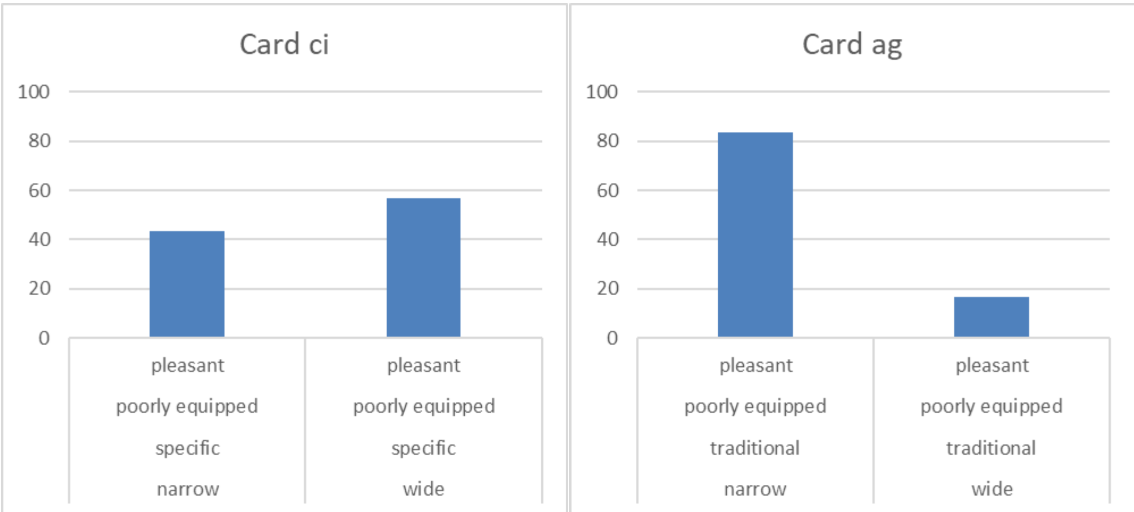


Fig. 8 – SP results: difference between narrow and wide path

Looking at the results related to the cards, where also other attributes vary, the width attribute seems to be the least relevant and the choice of scenario seems to be guided by the other variables.

From this preliminary statistical analysis, the environment where the walkway is located seems to be the most important aspect of evaluation for pedestrians.

3.2 Multinomial Logit model

A Multinomial Logit model (MNL) was calibrated for deriving the importance of each attribute in the pedestrians' evaluation. The four attributes (width, pavement, equipment and environment) were included in the model elaborated through NLogit software (Greene, 2016).

The results are reported in Table 2. The coefficients have the correct sign. Only the variable “width” is not statistically significant. The other three variables have a high statistical significance.

Variable	Standard coefficient		Error	z	Prob. |z|<Z*	Confidence interval	
Width	0.02365		0.07200	0.33	0.7425	-0.11747	0.16477
Pavement	0.60991	***	0.09706	6.28	0.000	0.41967	0.80015
Equipment	0.49662	***	0.09064	5.48	0.000	0.31897	0.67428
Environment	1.93261	***	0.09334	20.71	0.000	1.74968	2.11554
***, **, * ==> Significance at 1%, 5%, 10% level							

Table 2 – MNL output

The results of the model seem to confirm what was observed in the statistical analysis of the data. “Environment” is the variable with the highest coefficient. This means that, in this study, the environment of the walkway is the most important attribute for the pedestrians. “Pavement” and “equipment” variables are also relevant but the coefficients are lower.
In particular, the coefficient of “pavement” is higher than that of “equipment”. Even this result goes to confirm what observed analyzing the data. The variable “width” is not significant. This means that in this study the width of the path is not an important element in the pedestrians’ evaluation.

4. DISCUSSION AND CONCLUSIONS

The proposed analysis provides important points for discussion. “Environment” is the variable that most strongly affects the scenario selection in the set of choices. Among the variables included in the model, the environment can be considered as the most important aspect for pedestrians. This result is also amply confirmed by other studies in the literature (Motamed and Bitaraf, 2016; Vallejo-Borda et al., 2020b). In particular, “environment” is one of the most relevant attribute especially when its definition includes also the concept of security (Bivina and Parida, 2019).

The results also show that type of pavement has less importance than environment, but it still relevant in the evaluation of quality. In the literature, the pavement as structural element is poorly treated. Many studies consider the condition of the pavement in general as variable (Asadi-Shekari et al., 2013; Moura et al., 2017; Banerjee et al., 2018).

The variables that refer to the equipment along the walkway are often present in studies on the quality of pedestrian paths. As reported by Sarkar (2003), the presence of good furniture improves pedestrian comfort.

In the present study, the variable “width” does not result statistically significant. This means that having a more or less wide path does not influence the pedestrian’s evaluation. In other studies, instead, width is a significant variable (Kim et al. 2011; Talavera-Garcia and Soria-Lara, 2016). Streets with more lanes and streets where automobiles and bicycles are mixed have higher pedestrian numbers than pedestrian-only streets (Sung et al., 2015).

Regarding the methodology, the SP experiment seems to be suitable for simulating the pedestrians’ expectations on walkways. Considering hypothetical scenarios, respondents are faced with an unknown situation, so that their answers are not influenced by habit and knowledge of the path. In addition, the choice of including images representative of the different levels of the variables contributed to reducing any errors in understanding the question.

Ultimately, the results give indications regarding territorial and transport policies to be pursued in future years for increasing pedestrian mobility. Environment where the pedestrian path is inserted is the aspect needing more attention. It is clear that pedestrians prefer to walk in a pleasant and clean environment, with well-kept green spaces, decent building facades, presence of commercial activities. The objective has to avoid the production of an unpleasant environment, characterized by dirt, untreated green spaces, dilapidated building facades, lack of commercial activities.

The analysis provided satisfactory results, and in future studies it will be possible to continue to increase the proposed methodology. Other aspects could be included in the survey. As an example, an attribute relating to the presence of trees along the walkway could be inserted among the physical characteristics of the path. In fact, it was observed that pedestrians like to walk along tree-lined paths because the trees offer protection from the sun’s rays and heat.

Another potential important aspect could be the presence of restaurant and bar activities.

Other studies, in fact, have shown that the presence of these activities makes the walkway more pleasant for the pedestrian.

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