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How young pedestrians perceive walkways: gender differences

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Abstract

Promotion of active mobility is a strategy to discourage motorized mobility and solve problems linked to environment protection. Particularly, walking could be considered as an alternative to short trips made by car in more densely inhabited areas. For promoting pedestrian mobility, the quality levels of pedestrian paths should be increased. At this regard, collecting pedestrians' perceptions about the path characteristics is fundamental. In this paper, perceptions are collected in terms of Stated Preferences (SP) by detecting the choices pedestrians would make in hypothetical scenarios characterized by certain service quality levels. More specifically, this work aims to analyze pedestrian preferences by highlighting gender differences through discrete choice modelling. An SP survey was addressed to a sample of 240 Italian university students, and mixed logit models were calibrated. The results highlight how women and men perceive differently some walkway characteristics

Keywords: pedestrian mobility; SP; young pedestrians' perception; quality of pedestrian path

1. Introduction

Due to global warming and air pollution problems, the issue of sustainability has become a fundamental topic. To contribute to the achievement of environmental sustainability, the challenge of the transport sector foresees the promotion of active mobility (walking and cycling) and the disincentive of motorized mobility. In particular, walking represents an alternative to short trips made by car in inhabited areas. For increasing pedestrian mobility, it would be opportune offering to pedestrians paths characterized by good quality levels. The analysis of the quality of pedestrian paths started from the concept of Pedestrian Level Of Service (P-LOS), which was derived by the antecedent concept of Level Of Service (LOS) (e.g. TRB, 2000). P-LOS originally considered aspects mainly linked to geometric characteristics, successively more qualitative aspects were introduced, regarding safety and comfort, and so on (e.g. Muraleetharan et al., 2005; Bian et al., 2009; Bivina and Parida, 2019). More recently, literature studied have been oriented to an evaluation of pedestrian path quality starting

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from the opinions of pedestrians with the objective of determining the factors mostly influencing pedestrians' satisfaction and identifying the factors to be improved for increasing quality and consequently pedestrian mobility (e.g. Lee et al., 2021; Vallejo-Borda et al., 2020). Pedestrians' opinions have been generally collected in terms of rates, but interesting results can be obtained by investigating user perceptions by adopting Stated Preferences (SP) surveys, which represent an efficient tool for collecting pedestrians' perceptions about the characteristics of a path and detecting the choices they would make in hypothetical scenarios.

The general objective of the proposed work is to investigate on gender differences. The need for such an investigation arises from the evidence that women reveal a different pattern in their interaction with space, time and safety (Souza et al., 2018). According to Pardo et. al. (2010), women's daily routines are different from men's (e.g. going to work, taking children to school, going to the supermarket, performing domestic duties). Some studies aiming at investigating of gender differences in perceptions have focused on the aspect linked to transportation safety, which is a critical factor in females' mobility choices (Carboni et al., 2021).

More specifically, our work aims to analyze pedestrian preferences for walkway collected in terms of SP data and through discrete choice modelling; particularly, mixed logit models have been calibrated. The rest of the paper is organized as follows. Section 2 provides a brief literature review concerning the use of SP for evaluating transport service quality. Section 3 describes the SP survey and the methodology based on the mixed logit models. Section 4 provides model results and a discussion of the main findings. Some final remarks are presented in the section of conclusions.

2. Literature review

The Stated-Preferences approach is a particular type of survey, where the interviewee is asked to choose the scenario they prefer most or to rank the scenarios according to their personal level of preference. Defining the attributes and the attributes levels to be used in an SP experiment is not an easy task, requiring several important decisions to be made by the analyst (Hensher et al., 2007).

The literature concerning the measure of transit service quality is rich of methodologies proposed for determining the factors mostly influencing the overall service quality and customer satisfaction (de Oña and de Oña, 2015). Some studies are based on data collected in terms of rates, while also SP data have been adopted for such objective. Several studies (e.g. Eboli and Mazzulla, 2008, 2010; dell'Olio et al., 2011; Hensher et al., 2003; Roman et al., 2014) have proposed SP experiments for calibrating discrete choice models aiming at identify the attributes mostly affecting the overall level of passenger satisfaction. Most recently, also in the field of air transport, SP experiments have been proposed for collecting data for analyzing service quality (e.g. Espino et al., 2008; Martin et al., 2011; Wen et al., 2014).

Literature studies investigating pedestrian perceptions adopting SP approach appears also in the field of pedestrians' environments; in these studies, actual or potential users are asked to rate or rank the attractiveness of existing or hypothetical scenarios (Kaparias et al, 2012; Lusk et al., 2018; Kelly et al., 2011; Kasraian et al., 2020). SP scenarios are typically presented in text format describing attributes and their levels, but sometimes by using photos or videos. Kaparias et al. (2012) investigates the importance of factors affecting the perceptions of pedestrians and drivers to shared space. Using two web-based

stated-preference surveys, they found that pedestrians feel most comfortable in shared space under conditions which ensure their presence is clear to other road users (low vehicular traffic, high pedestrian traffic, good lighting and pedestrian-only facilities). Lusk et al. (2018) proposed a visual preference survey where pedestrians and cyclists were asked to provide their preferences about whether trees should be planted and, if yes, the preferred locations on the sidewalk/cycle track they were using; photomontages of pictures were used. Kelly et al. (2011) proposed stated preference surveys to determine the importance of factors in the pedestrian environment; they found a number of pedestrian attributes considered important by pedestrians when walking, such as pavement cleanliness, safe crossing places, good connectivity and sense of security. Kasraian et al. (2020) proposed a work for evaluating pedestrians' perception of walkability through a stated preference survey using a dynamic 3D representation of various street designs in Toronto (Canada); they derived several interesting findings: the number and type of through lanes (car or transit) are the most critical influencers of street attractiveness to pedestrians; more trees and activities on the sidewalk are preferred.

However, few studies still apply SP method for analyzing pedestrian perceptions on walkways. This paper wants to provide a contribution to the literature of the studies proposing SP experiments for investigating pedestrian preferences, with a focus on preferences expressed by young pedestrians. 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.

3. Materials and method

3.1 Survey

A sample survey was conducted in November and December 2019 interviewing face-to-face 240 people along a pedestrian path (Figure 1) located inside the University Campus of Rende (Italy). The sample is totally composed of students (99%) under 25 years and it is spreads almost equally between males (51%) and females (49%). The path is used by students prevalently for reaching the study areas (about 96%), at least once a day by 87% of the sample.

The questionnaire was composed of more parts aiming at collecting information about socio-economic characteristics of the users, their perceptions in terms of rates about a series of characteristics of the path, and a final part proposing the SP experiment according to which interviewees had make a choice between two hypothetical scenarios characterized by different quality levels of some path characteristics. The selection of the attributes was made starting from a deeper analysis of the literature review and successively by conducting a preliminary survey, being pedestrian paths characterized by several attributes. Respondents were asked to express their perceptions about comfort attributes such as width and continuity of the pedestrian path, pavement, furniture, presence of trees, access to public transport, lighting, environment, cleanliness, presence of shops, disturbance due to the presence of other pedestrians, bicycles, and vehicular traffic (Bellizzi et al., 2019).

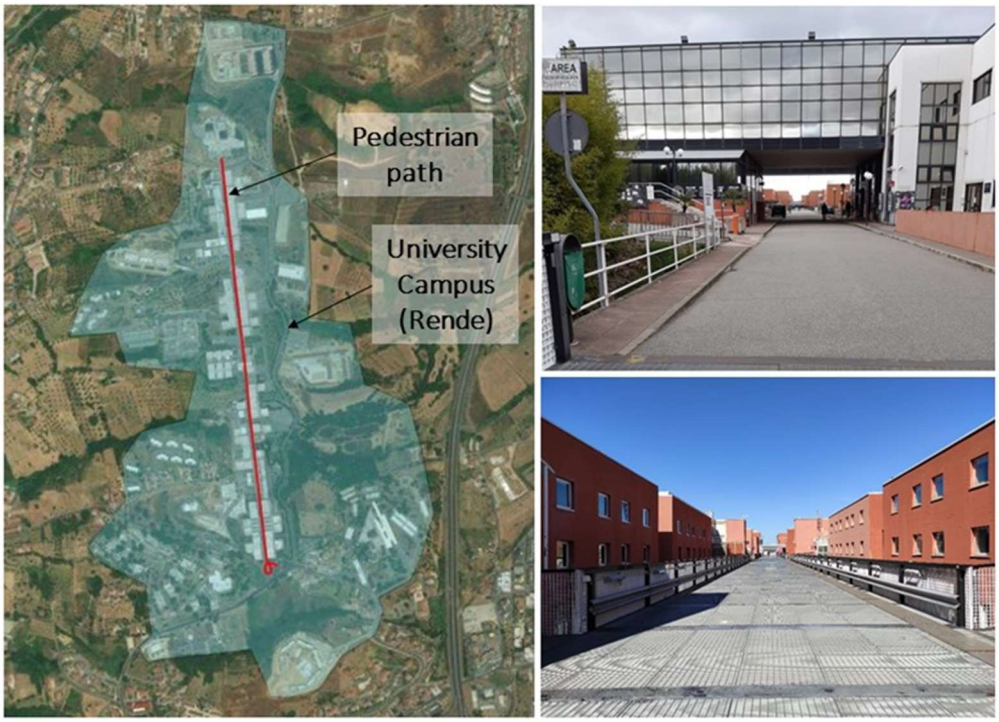


Figure 1: Location and current aspect of the pedestrian path.

The attributes identified for the SP experiment are following:

- 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 only two levels. As recognized by Hensher et al. (2007), reducing the number of levels within the design of an SP experiment involve a loss of information; however, such a reduction will dramatically reduce the design size.

Table 1: Attribute and levels in the SP experiment.

Attribute	*Level 1*	*Level 2*
Width	narrow path	wide path
	(pedestrians only)	*(interference with bicycles, scooters, hoverboards, authorized vehicles*
Pavement	traditional	specific for pedestrian paths
	(asphalt, concrete, dirt path)	*(colored asphalt, rubber, beaten and/or stabilized ground)*
Equipment	poorly equipped path	equipped path
	(lighting, waste baskets, benches)	*(lighting, waste baskets, benches and/or seats, beverage and food distributors, Wi-Fi and charging stations, protection from atmospheric agents)*
Environment	unpleasant	pleasant
	(dirt, untreated green spaces, dilapidated building facades, scarce presence of commercial activities)	*(clean, well-kept green spaces, decent building facades, presence of commercial activities)*

In order to facilitate the understanding of the attributes and consequently the choice of the users, images relating to the different levels of the attributes were included in the presentation of the experiment. This practice is particularly useful when attribute levels may be ambiguously interpreted, as in our experiment composed of qualitative attributes. Images in the SP surveys better capture the attention of the interviewee and provide a concrete idea of the attribute (Cherchi and Hensher, 2015; Sottile et al., 2013).

The attributes and the levels are summarized in table 1. Hypothetical scenarios were constructed by combining attribute levels. As an example, a scenario could be a wide path, with a traditional pavement, poorly equipped path, unpleasant environment. Having considered four attributes varying on two levels, the Full Factorial Plan consists of 16 scenarios (2^4). We decided to eliminate four scenarios that we considered as not compatible because characterized by traditional flooring (with poor quality pavement) and an equipped path. Therefore, twelve scenarios were included in the survey. Then, the scenarios were combined in pairs, obtaining 64 sets of choices, named "cards", each containing two scenarios. One block of 8 cards was proposed to each interviewee, who was asked to choose one of the two scenarios composing each card. Each pedestrian interviewed answered only one block, so for each block we collected the answers of 30 respondents. In figure 2 an example of card is reported.

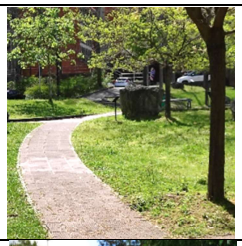
Which of these alternatives would you choose?	
☐ Scenario *d*	☐ Scenario *g*
Width **Narrow path** (pedestrians only) 	Width **Wide path** (interference with bicycles, scooters, hoverboards, authorized vehicles) 
Pavement **Specific for pedestrian paths** (coloured asphalt, rubber, beaten and/or stabilized 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) 

Figure 2: Example of card.

3.2 Mixed logit model

A mixed logit model was calibrated for deriving the importance of each attribute in the pedestrians' evaluation and for evaluating the gender differences eventually identified.

The mixed logit models are based on the hypothesis that the decision maker is able to rank the different alternatives by an order of preference represented by a utility function. Since part of the utility is unobserved, these models are also known as random utility models, and can be used to take into account the heterogeneity of the variables that describe a phenomenon. Individual heterogeneity can be introduced in the parameters associated with the covariates entering the observable part of the utility or in the variance of the errors.

We chose this kind of model because it seems to fit well with the major aim of the research, which is the identification of heterogeneity as regard gender in perceiving and evaluating the quality of a pedestrian path.

The model was elaborated through R software (https://www.r-project.org/), using the *mlogit* package (Croissant, 2020). The four attributes ("Width", "Pavement", "Equipment" and "Environment") and the gender variable were included as independent variables, while the choice made by pedestrians was considered as dependent variable.

4. Results and discussion

The model results are reported in table 2. All the variables included in the model are statistical significant. "Environment" has the greatest impact on the choice alternative, followed by "Pavement". "Width" and "Equipment" are considered as less important. Similar results are confirmed by other studies in the literature (e.g., Sarkar, 2003; Tavalera-Garcia and Soria-Lara, 2015; Motamed and Bitaraf, 2016; Bivina and Parida, 2019; Vallejo-Borda et al., 2020). These scholars found that the environment surrounding the pedestrian path, the equipment, the width and the pavement of the pedestrian paths are all relevant aspects in the evaluation of quality.

For analyzing gender differences, the interaction between the four variables "Width", "Pavement", "Equipment" and "Environment" and the variable "Gender" was evaluated. The results show that correlation between "Width" and "Gender" and between "Pavement" and "Gender" are statistically significant. This means that women and men give a different importance to width and pavement when choosing a pedestrian path. More specifically, it seems that for women these two variable are more important than for men.

Regarding the presence of equipment along the path and the surrounding environment, no significant differences in the assessment between women and men emerged.

The obtained results offer interesting considerations. First of all, from the application of the model it emerged that width, pavement, the presence of equipment such as benches and other furnishings, and surrounding environment are all important aspects for young pedestrians. The pleasantness of the surrounding environment was found to be the element that most of all influences the choice of a pedestrian path. Generally, pedestrians prefer to walk in a pleasant and clean environment, with well-kept green spaces, decent building facades, presence of commercial activities. The pavement also plays an important role in defining comfort of a pedestrian path, most likely for safety reasons (protection from the risk of accidents along the path). Less important, but still relevant, are the equipment along the path and the width.

Table 2. Model results.

Variables	*Estimates*	*Std. Error*	*z-value*	*Pr(>|z|)*	
Width	2.682221	0.029928	89.6224	< 2.2e-16	***
Pavement	7.463391	0.048928	152.5372	< 2.2e-16	***
Equipment	1.650266	0.053497	30.8476	< 2.2e-16	***
Environment	9.724871	0.038793	250.6861	< 2.2e-16	***
Gender	6.655346	0.043351	153.5231	< 2.2e-16	***
Width-Width	-0.127040	0.138951	-0.9143	0.36057	
Width-Pavement	-2.437775	0.173243	-14.0714	< 2.2e-16	***
Pavement-Pavement	-1.299931	0.176125	-7.3807	1.574e-13	***
Width-Equipment	0.485337	0.222894	2.1774	0.02945	*
Pavement-Equipment	-0.966855	0.217394	-4.4475	8.688e-06	***
Equipment-Equipment	-0.708990	0.142135	-4.9881	6.097e-07	***
Width-Environment	0.884393	0.175330	5.0442	4.555e-07	***
Pavement-Environment	0.096392	0.153577	0.6276	0.53024	
Equipment-Environment	0.116554	0.188350	0.6188	0.53604	
Environment-Environment	-0.478289	0.220701	-2.1671	0.03022	*
Width-Gender	1.480867	0.171153	8.6523	< 2.2e-16	***
Pavement-Gender	1.188498	0.188508	6.3048	2.886e-10	***
Equipment-Gender	-0.379285	0.214315	-1.7698	0.07677	
Environment-Gender	0.305762	0.246288	1.2415	0.21443	
Gender-Gender	0.528732	0.039007	13.5550	< 2.2e-16	***

Significance: 0 '***'; 0.001 '**'; 0.01 '*'

Taking gender differences into account, the results showed that width and pavement of the pedestrian path have different significance for young women and men. The next step will be to determine how the perception of women and men of these aspects differs in order to plan improvement interventions aimed at satisfying both groups of users.

5. Conclusions

This paper proposed a mixed logit model calibrated on the basis of data collected through SP experiments for investigating pedestrian preferences. The specific objective of the model was to discover differences of perceptions between females and males. The elaboration starts from the data collected by means of an SP survey addressed to a sample of 240 young pedestrians, prevalently students, about a walkway located in the University Campus of Rende (Italy). After a deep study of the literature review and on the basis of the preliminary results of a survey previously conducted, 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. We proposed SP experiments supported by photos representing the characteristics of the alternative pedestrian environments, in order to facilitate the respondents in making their choices. The results showed that young pedestrians give importance especially to the environment close to the path, and highlighted how women and men perceive differently some characteristics of the

walkway. The outcomes also provide useful suggestions to make walkways increasingly attractive and to encourage women and men towards active mobility.

A limit of this study concerns the number of variables considered in the SP experiment and included in the model. Other aspects could be included in the analysis, in order to better identified specific users group. As an example, in addition to gender differences, also the difference between habitual user and non-habitual user could be included in the model. At the same time, it could also be interesting to study the differences due to gender differences and age in the perception of the aspects that characterize a pedestrian path. Research perspectives expect to explore other differences in perceptions in different walkways environments.

References

Bellizzi, M.G., Eboli, L., Forciniti, C. (2019) "Segregation vs interaction in the walkways: An analysis of pedestrians' perceptions", *Research in Transportation Business and Management* 33, 100410.

Bian, Y., Ma, J., Rong, J., Wang, W., Lu, J. (2009) "Pedestrians' level of service at signalized intersections in China", *Transportation Research Record* 2114, 83–89.

Bivina, G.R., Parida, M. (2019) "Modelling perceived pedestrian level of service of sidewalks: A structural equation approach", *Transport* 34 (3), pp. 339–350.

Carboni, A., Pirra, M., Costa, M., Kalakou S. (2021) "Gender perceptions of active mobility: Insights from three European cities", *European Transport\Trasporti Europei* 85, Paper 9.

Cherchi, E., Hensher, D.A. (2015) "Workshop synthesis: Stated preference surveys and experimental design, an audit of the journey so far and future research perspectives", *Transportation Research Procedia* 11, pp.154–164.

Croissant, Y. (2020) "Estimation of Random Utility Models in R: The mlogit Package", *Journal of Statistical Software* 95 (11), pp.1–41.

de Oña, J., de Oña, R. (2015) "Quality of service in public transport based on customer satisfaction surveys: a review and assessment of methodological approaches", *Transportation Science* 49 (3), pp. 605–622.

dell'Olio, L., Ibeas, A., Cecín, P. (2011) "The quality of service desired by public transport users", *Transport Policy* 18, pp. 217–227.

Eboli, L., Mazzulla, G. (2008) "A Stated Preference Experiment for Measuring Service Quality in Public Transport", *Transportation Planning and Technology* 31 (5), pp. 509-523.

Eboli, L., Mazzulla, G. (2010) "How to capture the passengers' point of view on a transit service through rating and choice options", *Transport Review* 30 (4), pp. 435-450.

Espino, R., Martín, J.C., Román, C. (2008) Analyzing the effect of preference heterogeneity on willingness to pay for improving service quality in an airline choice context", *Transportation Research Part E: Logistic and Transportation Review* 44, pp. 593–606.

Hensher, D.A., Rose, J.M., Greene, W.H. (2007) *Applied choice analysis. A primer*. Cambridge University Press.

Hensher, D.A., Stopher, P., Bullock, P. (2003) "Service quality - developing a service quality index in the provision of commercial bus contracts", *Transportation Research Part A* 37 (6), pp. 499-517.

Kaparias, I., Bell, M.G.H., Miri, A., Chan, C., Mount, B. (2012) "Analysing the perceptions of pedestrians and drivers to shared space", *Transportation Research Part F: Traffic Psychology and Behaviour* 15 (3), pp. 297–310.

Kasraian, D., Adhikari, S., Kossowsky, D., Luubert, M., Hall, B.G., Hawkins, J., Habib, K.N., Roorda, M.J. (2020) "Evaluating pedestrian perceptions of street design with a 3D stated preference survey", *Environment and Planning B: Urban Analytics and City Science* 0(0), pp. 1–19.

Kelly, C.E., Tight, M.R., Hodgson, F.C., Page, M.W. (2011) "A comparison of three methods for assessing the walkability of the pedestrian environment", *Journal of Transport Geography* 19 (6), pp. 1500–1508.

Lee, S., Han M., Rhee, K., Bae, B. (2021) "Identification of Factors Affecting Pedestrian Satisfaction toward Land Use and Street Type", *Sustainability* 13,10725.

Lusk, A.C., Da Silva Filho, D.F., Dobbert, L. (2018) "Pedestrian and cyclist preferences for tree locations by sidewalks and cycle tracks and associated benefits: Worldwide implications from a study in Boston, MA", *Cities* 106, 102111.

Martín, J.C., Román, C., Espino, R. (2011) "Evaluating frequent flyer programs from the air passengers' perspective", *Journal of Air Transport Management* 17, pp. 364–368.

Motamed, B., Bitaraf, A. (2016) "An Empirical Assessment of the Walking Environment in a Megacity: Case Study of Valiasr street, Tehran", *International Journal of Architectural Research* 10, pp. 76–99.

Muraleetharan, T., Adachi, T., Hagiwara, T., Kagaya S. (2005) "Method to determine pedestrian level-of-service for crosswalks at urban intersections", *Journal of the Eastern Asia Society for Transportation Studies* 6, pp. 127–136.

Pardo, M., Echavarren, J. M. (2010) "Transportation, Mobility, and Women in Cities of Developed Countries", *Social and Economic Development - Vol III*. Public University of Navarre, Spain.

Román, C., Martín, J.C., Espino, R. (2014) "Using stated preferences to analyse the service quality of public transport", *International Journal of Sustainable Transportation* 8, pp. 28–46.

Sarkar, S. (2003) "Qualitative Evaluation of Comfort Needs in Urban Walkways in Major Activity Centers", *Transportation Quarterly* 7, pp. 39–59.

Sottile, E., Cherchi, E., Meloni, I. (2015) "Measuring soft measures within a stated preference survey: the effect of pollution and traffic stress on mode choice", *Transportation Research Procedia* 11, pp. 434 – 451.

Souza, A.C.S., Bittencourt, L., Taco, P.W.G. (2018) "Women's perspective in pedestrian mobility planning: the case of Brasìlia", *Transportation Research Procedia* 33, pp. 131-138.

Talavera-Garcia, R., Soria-Lara, J.A. (2015) "Q-PLOS, developing an alternative walking index. A method based on urban design quality", *Cities* 45, pp. 7–17.

TRB (2000) *Highway capacity manual*. Washington, DC: Transportation Research Board.

Vallejo-Borda, J.A., Cantillo, V., Rodriguez-Valencia, A. (2020) "A perception-based cognitive map of the pedestrian perceived quality of service on urban sidewalks", *Transportation Research Part F* 73, pp. 107–118.

Wen, C.H., Chen, T.N., Fu, C. (2014) "A factor-analytic generalized nested logit model for determining market position of airlines", *Transportation Research Part A: Policy and Practice* 62, pp. 71–80.