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Built environment and urban cruise tourists' mobility

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Highlights

- Relationship between urban built environment and spatial behaviour is studied.
- Cruise passengers' mobility in a city is monitored using GPS tracking technologies.
- Space syntax and walkability measures are used to analyse cruise tourists' mobility.
- Few factors determine cruise passengers' spatial behaviour in the city.
- Key factors are visibility of tourist points of interest and economic activity.

Abstract

The article studies the relationship between the characteristics of the built environment and the spatial behaviour of cruise passengers in a city. For this purpose, the mobility of cruise passengers visiting the city of Tarragona (Catalonia) is monitored by means of GPS tracking technologies and analysed through the use of Geographic Information Systems. In order to identify what determines the spatial behaviour of cruise passengers, consideration has been given to diverse and multiple indicators related to the syntax of the urban space, the physical attributes of the urban space, the commercial activity and the visibility of tourist points of interest. Results show that the visibility of tourist points of interest and the type of economic activity found in the streets of Tarragona have more influence over the spatial behaviour of the cruise passengers than other factors related to the characteristics of the urban layout. The resulting information is particularly valuable for city management, since it provides a better knowledge of the characteristics of the areas that cruise tourists move through and spend more time in.

Keywords: Cruise tourism, tourist mobility, GPS, GIS, spatial analysis, space syntax, walkability

1. Introduction

As cruise tourism has experienced exponential growth, there has been a growing interest in developing related research, especially during the last fifteen years (Papathanassis & Beckmann, 2011). There is a significant volume of research on the role of cruise tourism in generating new and dynamic opportunities in port cities (Dwyer & Forsyth, 1996; Pratt & Blake, 2009). Analysing the determinants of cruise passenger expenditure at a given destination (Gargano & Grasso, 2016), and their satisfaction with the visit (Brida, Pulina, Riaño, & Zapata-Aguirre, 2012) have also emerged as hot research topics. However, the rapid expansion of cruise trips to some cities has resulted in greater criticism of this mode of tourism. In this regard, studies are emerging that measure the environmental impact of the cruise industry (Bonilla-Priego, Font, & Pacheco-Olivares, 2014), and which also home in on residents' perceptions of cruise tourism development (Jordan & Vogt, 2017). Furthermore, the study of the spatial-temporal behaviour of cruise passengers at destination is becoming more popular because it facilitates appropriate management of tourist mobility at destination, avoids congestion effects and boosts economic impact. The first approaches to cruise passenger mobility were developed through observational methods (Jaakson, 2004; Scherrer, Smith, & Dowling, 2011). Recently, tracking technologies, such as GPS devices, have enabled an accurate recording of the temporal and spatial behaviour of cruise passengers at destination (Ferrante, De Cantis, & Shoval, 2016). Additionally, there has been more research recently on the relationship between tourist pedestrian movement and the street network structure and characteristics of the urban environment (Edwards & Griffin, 2013; Hall & Ram, 2018; Huang, Wang, Yang, & Xu, 2018; Mansouri & Ujang, 2016) due to the natural correlation between the walkability of the built environment and the visitor's use of it (Anton Clavé, 2019).

In this context, this article aims to analyse the relationship between the characteristics of the built environment and the spatial behaviour of cruise tourists in the city. Consequently, the article analyses how cruise passengers move through the city. However, primarily the study detects and weighs up the effects of various groups of indicators that the literature pinpoints as significant for pedestrian mobility. Therefore, GPS devices are used to monitor the spatial behaviour of cruise passengers when they visit the city of Tarragona (Catalonia). Then, the data collected is integrated into a GIS in order to spatially relate to (1) the syntaxis of the urban space, (2) the physical attributes of the urban space, (3) the commercial activity in the urban space and (4) the visibility of tourist points of interest. Accordingly, regarding the research aim, two research questions have been proposed:

- Is there any correlation between the spatial-temporal behaviour of the cruise tourists through the city and the characteristics of the built environment?
- Which variables exercise a greater influence over the spatial-temporal behaviour of tourists?

The results from applying space syntax measures and other morphology and functional urban indicators initially reveal the most frequented spaces and the time spent in them. Secondly, and equally importantly, they inform on the characteristics of the areas that tourists move through and spend time in, which is particularly valuable for managing tourist cities.

Following this introduction, the paper presents a review of the relevant literature. Consequently, reference is made to two types of studies: those related to analysing cruise passenger mobility and those focusing on the use of space syntax and walkability indicators to analyse tourist mobility. After reviewing the literature, we present the territorial context where the research is conducted. Then, the data and methods are specified. Subsequently, the results are presented, and finally, the discussion and conclusions are presented.

2. Review of literature

2.1. Analysing cruise passenger mobility at destination with GPS data

The widespread availability of tracking technologies such as GPS, geolocated social media data, smart cards, Wi-Fi, Bluetooth and mobile phone traces (Shoval, Kwan, Reinau, & Harder, 2014) have allowed a fast proliferation of studies on tourist mobility over the last decade (Shoval & Ahas, 2016). The effectiveness and reliability of GPS tracking data (Shoval & Isaacson, 2007a) and the passive mobile positioning data (Eurostat, 2014) have boosted the possibilities of analysing spatial-temporal behaviours on multiple territorial scales and with a great diversity of research objectives. Data obtained by means of these tracking technologies has been used to detect visitor flow patterns (Baggio & Scaglione, 2018), regulate the carrying capacity of tourist points of interest to avoid overcrowding, develop new tourist attractions, improve allocation of accommodation and restaurant services to maximise exposure to visitor traffic (Edwards, Griffin, Hayllar, Dickson, & Schweinsberg, 2009), and reduce friction between tourists and the local population (Shoval & Isaacson, 2007b). They have also been used to identify seasonal demand patterns (Ahas, Aasa, Mark, Pae, & Kull, 2007) and to improve the management of destination marketing (Kuusik, Tiru, Ahas, & Varblane, 2011). Moreover, there is more and more literature that incorporates tourist emotions and experiences into the analysis of the spatial behaviour (Grinberger, Shoval, & McKercher, 2014; Kim & Fesenmaier, 2014), as it helps to understand subjective feelings conveyed by the tourists when they visit a destination. Nevertheless, as pointed out by Edwards et al. (2009), when it comes to analysing tourist mobility, there are only a few researches that consider the relationship between the tourist movements and the destination design and infrastructure .

GPS data has been used to analyse the mobility of tourists in zoos (Birenboim, Reinau, Shoval, & Harder, 2015), natural parks (Hallo et al., 2012), theme parks or confined attractions (Birenboim, Anton Clavé, Russo, & Shoval, 2013; Xiao-Ting & Bi-hu, 2012), small historic quarters (Shoval & Isaacson, 2007a) and large urban settings (McKercher, Shoval, Ng, & Birenboim, 2012). Despite this increased GPS usage, there are only three published studies based on an analysis of the cruise passenger behaviour at destination using this tool. First, there is the publication by Ferrante et al. (2016), which establishes a framework for collecting and analysing data on cruise passenger mobility. They propose using GPS to collect mobility data on cruise passengers and subsequently integrate this spatial information into traditional surveys, so as to formulate indicators for developing a detailed spatial analysis of mobility. They develop two case studies in the cities of Palermo (Italy) and Dubrovnik (Croatia) with 277 and 51 tracks, respectively. Second, there is the publication by De Cantis, Ferrante, Kahani & Shoval (2016) that develops a very similar spatial analysis with the same 277 tracks from the city of Palermo (Italy), at the same time as they perform a segmentation procedure which identifies different cruise passenger profiles based on their spatial behaviour and sociodemographic characteristics. Third, there is the study developed by Domènech, Gutiérrez & Anton Clavé (2019) with 154 tracks in the city of Tarragona (Spain) where they show that cruise tourists with different expenditure levels also have different mobility patterns. These types of studies are particularly useful for destination management organisations, public authorities and service enterprises (i.e. restaurants, accommodation or attractions) for two reasons. First, they provide knowledge on the most frequent routes taken by cruise tourists. And second, they distinguish multiple tourist profiles according to their spatial behaviour at destination. However, further knowledge is needed to determine the characteristics of the urban environment that attract tourists when they are visiting the destination, such as land uses, distribution of attractions, sight lines, among others (Edwards et al., 2009).

2.2. Space Syntax and walkability of the urban space

Public spaces and walkable urban areas are fundamental for the urban tourism experience (Anton Clavé, 2019). In this regard, both quantitative and qualitative researches are emerging on the analysis of the walkability of urban tourism areas, and its effects on tourist spatial behaviour. The relationship between built environment and tourist mobility factors are being explored, at the same time as we are gaining further insight into current debates on tourism pressure in specific locations, and destination carrying capacity (Ram & Hall, 2018). In this context, walkability is being targeted as a potential tool for analysing and improving the quality of the urban space (Sharipov & Demirkol, 2018) and for upgrading the tourism experience (Kanellopoulou, 2018). Accordingly, it can be used by local and regional authorities, as well as by planners and urban designers dealing with urban complexity, especially in successful tourist cities with contradictions and conflicts generated by overtourism (Anton Clavé, 2019).

Linking walkability and the urban tourism experience, Gorrini and Bertini (2018) proposed usefulness, comfort, safety, attractiveness and legibility as a set of criteria for assessing the walkability level for tourists in urban areas. All these indicators are closely associated with the characteristics of the built environment, such as urban layout and design. However, little research has been undertaken on urban tourism and walkability including space syntax indicators. Although researches with space syntax approaches and studies on walkability consider different types of indicators, they share their common focus on analysing how urban space design influences pedestrian mobility. On the one hand, according to the space syntax theory, the structure of the urban network is the first key to generating mobility. This is also coherent with the theory of natural movement which pinpoints that, in general, attractors are distributed equally in areas that are more conductive to mobility, or these attractors multiply the mobility patterns established by the urban layout (Hillier, Perm, Hanson, Grajewski, & Xu, 1993).

On the other hand, researches about urban walkability indicate that walkable places often concentrate the main attractions and accommodation supply in cities and attract the highest number of visitors (Anton Clavé, 2019). This is because they form a fluid connection between different destinations within a reasonable expenditure of time and effort, and in a secure, pleasant and attractive context (Southworth, 2005). Different types of variables have been considered to analyse the walkability of the urban environment. Proximity and accessibility have been considered as critical factors for defining a walkable built environment (Lo, 2009), as well as other indicators such as the mix of land uses, street connectivity, aesthetics, density, form, pedestrian amenities, personal safety, recreational uses, public spaces, traffic measures, among others (Alfonzo, 2005; Buckley, Stangl, &

Guinn, 2016). Nevertheless, the availability and reliability of the data is a limitation when developing analytical methods (Anton Clavé, 2019).

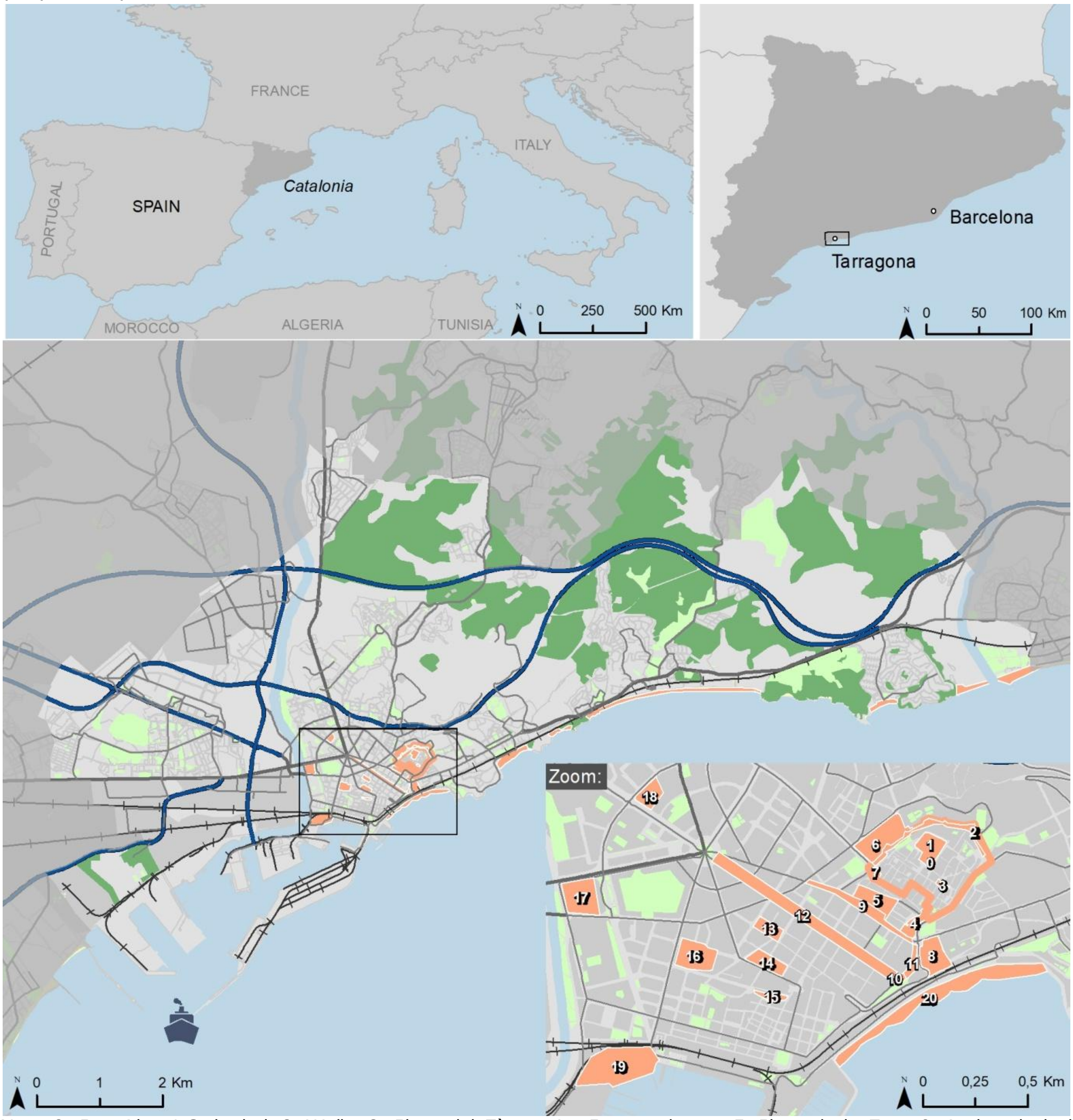
Our research is part of a large group of studies that use, among others, space syntax indicators to explain the movement of pedestrians in urban space (Koohsari, Owen, Cerin, Giles-Corti, & Sugiyama, 2016; Zhai, Korça Baran, & Wu, 2018). A state-of-the-art report on this group of studies can be consulted in Sharmin and Kamruzzaman (2017). From their study, it is clear that research applying space syntax techniques to analyse tourist mobility is scarce and very recent in time (Edwards & Griffin, 2013; Li, Xiao, Ye, Xu, & Law, 2016; Mansouri & Ujang, 2016; Wang, Li, Yu, He, & Zhen, 2018). Edwards and Griffin (2013) applied the space syntax approach to examine visitor spatial data collected in Sydney and Melbourne (Australia) by means of GPS devices. They stated that the relational properties of the street network are important for understanding tourist mobility, just as the location of the tourist points of interest in the street network. Li et al. (2016) applied a space syntax analysis to the street network of Gualangyu (China) and analysed its relationship with tourist spatial behaviour. They used cell phone locations (GPS and location based services) to track the mobility of the tourists, and their results pointed to a high positive association between the integration of the street network and the spatial behaviour of tourists. Wang et al. (2018) used space syntax and kernel density to study the evolution of the spatial structure and the functional properties of Shichahai historic and cultural conservatory area (Beijing). They demonstrated that the tourist-oriented functions tend to cluster in a highly accessible and easily identified street network, while the resident-oriented functions are generally in less advantaged topological spaces, separated from the tourist areas. Mansouri and Ujang (2016) used gate observation and space syntax analysis to demonstrate that pedestrian tourist movement in Kuala Lumpur city centre is highly and mainly influenced by land uses and elements of attraction, as opposed to the configurational attributes of the street network.

Therefore, in line with Mansouri and Ujang (2016), in addition to the space syntax measures, our analysis includes other variables related to the characteristics of the urban space that the literature underpins as essential for walkability conditions in cities. Hence, we have considered the presence of natural elements such as trees (Gobster, 1995), the absence of discernible slopes (Zhu & Lee, 2008) and car speed limits (Blečić, Cecchini, Congiu, Fancello, & Trunfio, 2015). In addition, as mixed land use and presence of commercial activity also condition the spatial behaviour of pedestrians (Foltête & Piombini, 2007), they have been included in this research. Finally, variables related to the visibility of places of interest (POI) have also been incorporated, since according to the experiential landscape theory, human behaviour can be altered by the perception of the spatial dimension (Thwaites & Simkins, 2007), together with other variables related to open views (Lindsey, Wilson, Yang, & Alexa, 2008) and the visibility of stretches of water (Gobster, 1995).

3. Case study

The city of Tarragona is located on the Mediterranean coast, 100 km south of Barcelona (Figure 1). The recreational and commercial centres of Tarragona, its historical tradition, archaeological heritage, and beaches, make the city an attractive tourist destination. The archaeological Roman ruins in Tarragona were certified as a UNESCO World Heritage Site designation in 2000. Furthermore, the city has received two more World Heritage designations: the cultural heritage of the human towers in 2010 and the Mediterranean diet in 2013. According to data from the Tourist Observatory of Catalonia, Tarragona attracts around a half million tourists every year in licensed accommodation. This converts to 2 million overnight stays per year, with family tourism being the most predominant.

Figure 1. Location of Tarragona (upper maps) and identification of places of tourist interest in the city (map below).



Note: 0: Part Alta; 1:Cathedral; 2: Walls; 3: Plaça del Fòrum; 4: Roman circus; 5: Plaça de la Font; 6: Archaeological promenade; 7: Portal del Roser; 8: Roman amphitheatre; 9: Rambla Vella; 10: Balcó del Mediterrani; 11: Passeig de les Palmeras; 12:Rambla Nova; 13:Mercat Central; 14: Fòrum de la Colònia; 15: Roman theatre; 16: Tarraco Arena; 17: Commercial Centre (Parc Central); 18: Commercial centre (el Corte Inglés); 19: Serrallo; 20: Beaches

Own elaboration

Tarragona has only emerged recently as a destination for cruise tourism. According to data provided by the Port Authority of Tarragona, the number of passengers grew rapidly in 2017, with an increase of 40,000 cruise passengers in relation to the previous year (Table 1). This growth is associated with the arrival in Tarragona of one of the world's most important cruise companies, Costa Crociere. The company has established the Port of Tarragona as a regular port of call, but it also has used it as a base port. In fact, in 2017, 72% of the cruise passengers were in transit, while 14% disembarked and another 14% embarked at Tarragona.

Table 1. Number of cruises and cruise passengers per year from 2013 to 2018

Year	Cruise passengers	Cruises
2013	1,394	3
2014	1,893	3
2015	11,600	11
2016	13,393	22
2017	51,390	37
2018	98,126	57

Own elaboration with data provided by the Port Authority of Tarragona.

The analysis of how the characteristics of the built environment influence cruise tourist mobility in a city such as Tarragona, has two explanation. First, Tarragona is a new site for cruise tourism, and therefore most of the cruise passengers are making their first visit to the city. Consequently, the urban structure and built environment are potentially the factors that influence cruise tourist decisions the most as they move through the city. Second, cruise tourism is a growing activity and lessons can be learned for the future, both from the perspective of managing the tourist experience and the urban space.

A couple of additional factors related to the urban layout of Tarragona should be considered, as they could condition cruise tourist mobility through the city. The most promoted area for tourism is the city centre, especially the Part Alta (upper town) where most of the monuments and world heritage sites are located. The long distance from the cruise terminal to the city's tourist venues means that the cruise passengers have to take a shuttle bus or a taxi to arrive at their destination. On the contrary, if tourists are in the city centre and want to go to the beaches, they have to overcome two physical barriers: the slope between the upper part and the promenades along the beaches and the railway, which, since its construction in the middle of 19th century, separates the main urban blocks from the Mediterranean Sea. Given these particular characteristics of the urban morphology of Tarragona, we have focused our study on the central part of the city (see zoom in Figure 1).

4. Data

Data collection was conducted in 2017 between 4 August and 27 October at the port of Tarragona. This period was chosen because of the diversity of cruise ships (in terms of number of ships and size) arriving in Tarragona in 2017. With the permission of the Port Authority of Tarragona, the field research team was located at a key position, just beyond the exit point from the cruise ship, within the time range of cruise passenger disembarkation. GPS loggers were distributed to in transit, self-organised cruise passengers according to a random sampling procedure. All the passengers who wanted to collaborate with the study were provided with a GPS QSTARZ BT-Q1000XT aimed at recording information on space-time behaviour during their visit. These devices collected tracking data from the received GPS signal at very accurate time intervals (15 seconds) and locations, with an error margin of about 5-10 meters. A sample of 161 independent cruise passengers was obtained. Seven of the 161 participants did not visit the city of Tarragona and were excluded from the analysis. Thus, the final sample size included 154 independent cruise passengers. Once the cruise passengers returned the device to the research team at the cruise ship, they were asked to complete a survey to gather information on their main demographic characteristics and their level of satisfaction with the visit.

5. Empirical approach

As can be seen in Table 2, different variables were calculated to fulfil the research objective and answer the two research questions. The GPS data was used to calculate the number of tourists who walked through each segment of the street network in the city of Tarragona, and the average time tourists spent in them. Besides, four additional types of indicators relating to the built environment were calculated according to the street segments.

First, the space syntax toolkit extension of the Quantum GIS software was used to compute, four space syntax indicators relating to attributes of the city's street network. Space syntax indicators can be calculated on different scales. A global scale analysis measures the average depth of a line or segment with respect to all other lines or segments in the whole area, while the local scale analysis makes this calculation within a certain radius (Li et al., 2016). In the present study, a local radius of 400 meters, that is, the distance of 5 minutes on foot, was established and indicators of connectivity, depth, choice and integration were computed. Connectivity measures the number of neighbouring street segments directly connected to one particular street segment (Dettlaff, 2014). Depth is defined as the smallest number of syntactic steps (in the topological sense) needed to reach one street segment from another. Choice refers to the frequency at which a street segment is crossed by the shortest topological route between another two arbitrarily chosen street segments within the defined radius. In other words, choice is used to measure the possibility of a segment being an access path to other street segments (Wang et al., 2018). Whereas, integration refers to the accessibility of a street segment or the potential for a segment to attract traffic (Bill Hillier & Hanson, 1984).

Second, other indicators related to the physical characteristics of the urban space were also calculated. These were the street incline, the presence of vegetation taller over 2 meters and the maximum speed at which vehicles can circulate. Hypothetically, as the literature pinpoints, streets with a gentle incline (Zhu & Lee, 2008), greater shade generated by the vegetation (Foltête & Piombini, 2007; Gobster, 1995) and vehicles circulating at a lower speed (Blečić et al., 2015), can lead to a greater number of tourists walking along these streets.

Third, information was collected about the type of land uses in order to ascertain whether the presence of commercial activity is favourable for cruise tourist movement, as proved previously as a determinant of pedestrian mobility (Foltête & Piombini, 2007). In this sense, through fieldwork, trades located on the ground floor were mapped and classified as food, restaurants, fashion and souvenirs, banks and resident-oriented commerce.

Fourth, the proximity to elements or points of interest was considered. As the perception of the spatial dimension influences human spatial behaviour (Thwaites & Simkins, 2007), variables on the visibility of points of interest from the streets were defined. Places were classified into seven groups depending on their typology. The visibility of World Heritage Sites (WHS) was divided into three categories: (1) streets located in the Part Alta with visibility of WHS located in the same neighbourhood; (2) streets beyond the Part Alta with visibility of the Roman amphitheatre and Roman circus; and (3) streets with visibility of WHS located downtown. The other four place typologies are the streets integrated into (4) the Serrallo neighbourhood, (5) public and tourist spaces with visibility of the urban landscape, such as Rambla Nova, Rambla Vella and Plaça de la Font, (6) public spaces with visibility of the Mediterranean Sea, such as the Mediterranean Balcony and promenades along the beaches and (7) streets with visibility of the commercial centres and markets.

After calculating these indicators, descriptive statistics of the cruise tourists participating in the research were calculated, and a spatial analysis was performed. To answer the first research question, bivariate regression analyses were carried out to explore the relationships between the dependent variables (number of tourists and average time per street) and the various explanatory variables considered. To answer the second research question, five multivariate regressions have been applied for each dependent variable, including only those explanatory variables that were significant in the bivariate models: a first regression that includes the space syntax variables; a second that incorporates the two significant variables of the set of physical characteristics of the urban space; a third that includes the variables related to commercial activity; a fourth with the variables related to the visibility of tourist spaces; and a fifth with all the variables included in the precedent multivariate analysis. All the analyses were performed at the level of the 2,473 street network segments included in the central part of the city (see zoom in Figure 1). The modelling technique applied was an Ordinary Least Square regression. As the measuring units of the variables are different, the results are interpreted following the standardised coefficients. The standardised coefficients allow comparability between indicators, as they represent the relative importance of each variable in the regression equation.

Table 2. Main characteristics of the variables calculated

Type of variable	Name of variable	Description	Source
Cruise tourists' mobility	Tourists per segment	Number of tourists who walked through a given street network segment	Own elaboration by means of GPS data
	Average time per segment	Average time that tourists stay in a given street network segment	
Space Syntax indicators	Connectivity	Number of neighbouring segments directly connected to a segment.	Own elaboration with Space Syntax toolkit of QGIS
	Integration	Accessibility of a segment or the potential for a segment to attract traffic.	
	Choice	Frequency at which a segment is crossed by the shortest topological route between another two arbitrarily chosen segments within the defined radius.	
	Depth	Smallest number of syntactic steps (in the topological sense) needed to reach one segment from another	
Physical attributes	Slope	Street incline in percentage.	Calculated from the TEM of Catalonia[1]
	Vegetation > 2m.	Presence of vegetation taller over 2 meters.	Calculated from LIDAR of 2011[2]
	Maximum speed	Maximum speed cars can drive along streets	Own elaboration through field work
Commercial activity	Food	Supermarkets, bakeries and greengrocers	Own elaboration through field work
	Restaurants	Restaurants, bars, coffee shops	
	Fashion & souvenirs	Shoe stores, clothing stores, souvenir shops and similar	
	Banks		
	Resident-oriented commerce	Services, retail, administration, education and medical services	
Visibility of places of tourist interest (POI)	Visibility – WHS in Part Alta	Visibility of WHS from any street located in the Part Alta neighbourhood	Own elaboration through field work
	Visibility – WHS (Amphitheatre and Circus)	Visibility of the amphitheatre and the Roman circus from any street located beyond the Part Alta neighbourhood	
	Visibility – WHS in Downtown	Visibility of World Heritage Sites located downtown	
	Streets – Serrallo	Streets integrated into the Serrallo neighbourhood	
	Visibility – wide urban landscape	Public and tourist areas with great visibility of the urban landscape	
	Visibility – Mediterranean	Public and tourist areas with visibility of the Mediterranean Sea	
	Visibility – commercial centres	Streets surrounding the commercial centres and markets.	

Note: [1] Terrain Elevation Model: conformed by a regular grid of 1x1m., with a mean square error of 0.15m.. (http://www.icgc.cat/Administracio-i-empresa/Descarregues/Elevacions/Model-d-Elevacions-del-Terreny-d-1x1-m). [2] Light Detection and Ranging or Laser Imaging Detection and Ranging: minimum density of 0.5 m^2 (http://www.icgc.cat/Administracio-i-empresa/Descarregues/Elevacions/Dades-lidar).
Own elaboration

6. Descriptive statistics

6.1. Characteristics of the sample

As can be seen in Table 3, the cruise passengers who have participated in the study come mainly from European countries (88.3%), with Italy being the most represented nationality. More than two thirds of the participants were between 35 and 64 years old (69.5%). The majority came accompanied by relatives and children (40.9%) or their partner (40.9%). A total of 96.1% cruise tourists visited the city for the first time, and this makes for an interesting analysis of how the built environment is related to cruiser mobility in the city, i.e. how the urban area influences the way cruise tourists move through it. More than three quarters (76.6%) did not know anything about the city before visiting it. However, only 17.5% of the tourists looked for information about the area to visit when they arrived at the destination.

Table 3. Characteristics of the sample

Variable	Category	N	%	Variable	Category	N	%
Date	04/08/2017	11	7.1%	Origin	Italian	113	73.4%
	11/08/2017	15	9.7%		European	23	14.9%
	18/08/2017	15	9.7%		Others	18	11.7%
	25/08/2017	8	5.2%				
	01/09/2017	17	11.0%	Party structure	Friends	15	9.7%
	08/09/2017	15	9.7%		Family	9	5.8%
	22/09/2017	16	10.4%		Fam. with children	63	40.9%
	29/09/2017	16	10.4%		Alone	4	2.6%
	30/09/2017	9	5.8%		Partner	63	40.9%
	13/10/2017	18	11.7%	Repeater	1st visit	148	96.1%
	27/10/2017	14	9.1%		Repeater	6	3.9%
Gender	Women	72	46.8%	Previous knowledge of the city	Nothing	118	76.6%
	Men	82	53.2%		Something	36	23.4%
Age group	16 - 24	11	7.1%	Previous information about the city	No	127	82.5%
	25 - 34	16	10.4%		Yes	27	17.5%
	35 - 44	38	24.7%	Recommendation of the city	Maybe not	5	3.2%
	45 - 54	37	24.0%		Maybe yes	45	29.2%
	55 - 64	32	20.8%		Surely not	2	1.3%
	65 or more	20	13.0%		Surely yes	102	66.2%

Own elaboration

6.2. Areas within the city visited by cruise tourists

Table 4 presents the frequency of cruisers who visited the areas and points of interest, and the average time of their visit. The 154 cruise tourists spent an average time of over 5 hours in Tarragona. A total of 80% of the cruisers visited the Part Alta, the Rambla Nova, the Roman archaeological legacy and Rambla Vella. Less visited areas were commercial centres, beaches and the Tarraco Arena. The average time that cruisers spent in the areas and POIs varies substantially. Beaches, with an average of 2h. and 25min. are clearly the areas where they stayed the longest, followed by commercial centres, with an average of almost 1h. and 20min, and the Part Alta with an average time of 1h. and 5min.

Table 4. Frequency of cruise passengers who visited the spaces and points of tourist interest (POI) and average time of visit.

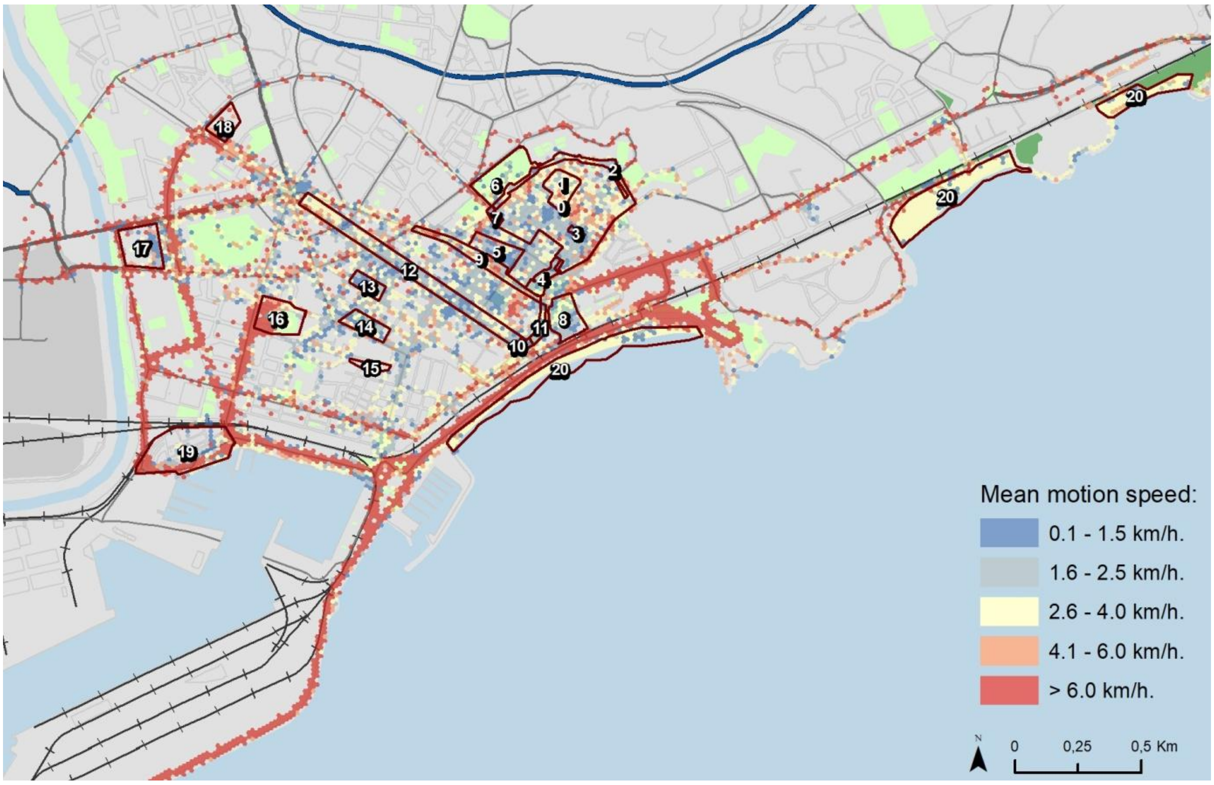
POI	Cruise passengers	%	Average time	Standard Deviation
Rambla Vella	131	85.07%	00h. 09' 22''	00h. 11’ 20’’
Wolrd Heritage Sites (WHO)	124	80.52%	00h. 21' 55''	00h. 29’ 11’’
Rambla Nova	132	85.70%	00h. 35'23''	00h. 29’ 21’’
Part Alta	125	81.17%	01h. 05' 35''	00h. 52’ 00’’
Balcó del Mediterrani	107	69,.8%	00h. 13' 59''	00h. 13’ 01’’
Plaça de la Font	89	57.80%	00h. 17' 59''	00h. 26’ 46’’
Serrallo	56	36.36%	00h. 09' 16''	00h. 27’ 02’’
Mercat Central	39	25.33%	00h. 18’01’’	00h. 24’ 16’’
Tarraco Arena	38	22.73%	00h. 02' 02''	00h. 00’ 42’’
Beaches	25	16.23%	02h. 25' 42''	01h. 47’ 28’’
Commercial centres	13	08.44%	01h. 19' 36''	01h. 25’ 33’’
Average visit	154	100.00%	05h. 16’ 54’’	02h. 06’ 17’’

Own elaboration

6.3. General cruise tourist mobility patterns

The aggregated GPS tracking data of the 154 cruisers who participated in our study are presented in Figure 2. It shows the average speed of movement of cruisers when they visit the city, by segmenting the speed according to the categories of pedestrian velocity proposed by Bauder (2015). It clearly showcases the routes used by cruisers to go from the cruise terminal to the city and return to the cruise ship, which are the cells in a darker red, and places where tourists move slowly, which are the cells in darker blue. These places where the cruisers spend longer periods of time are mainly concentrated in the Part Alta and along the Rambla Nova, and to a lesser extent in certain areas with beaches and shopping centres.

Figure 2. Average consumption speed of the urban space by cruise passengers in the city of Tarragona.



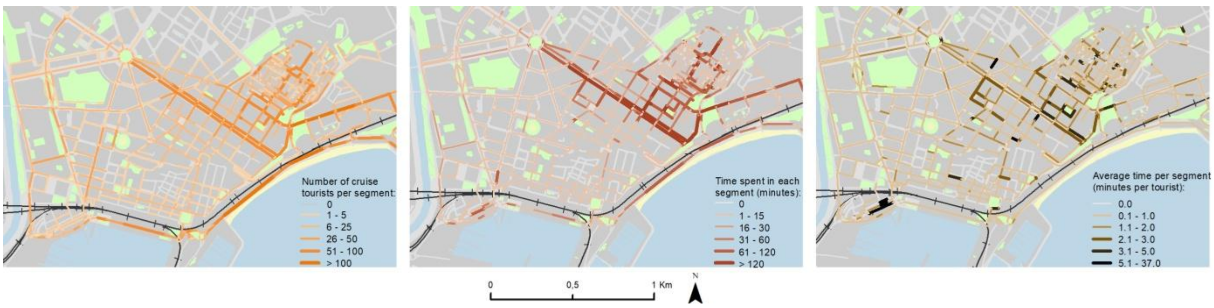
Note: 10 meter-sided hexagonal grid cell; 0-1,5km/h.: standing; 1.5-2.5km/h.: strolling; 2.5-4.0km/h.: walking slowly; 4.0-6.0km/h.: walking fast; >6.0 km/h.: running or using means of transport
Own elaboration

7. Results

7.1. Relationship between the characteristics of the built environment and the spatial behaviour of tourists in the city

Figure 3 shows the distribution of cruisers per street network segments in the centre of Tarragona, as well as the number of minutes they have spent in each segment and the corresponding average time. Both the frequency of cruisers per street segment and the average time have been used as dependent variables when applying subsequent statistical models.

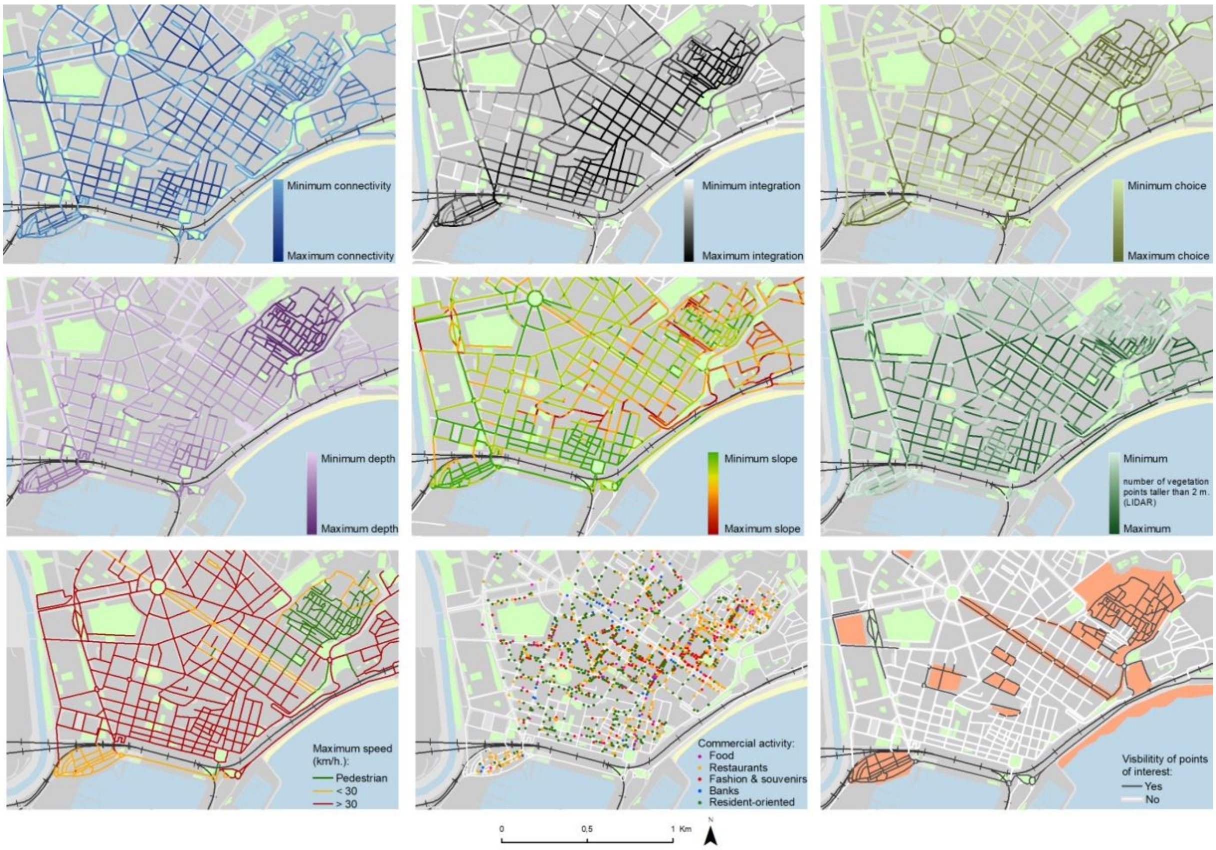
Figure 3. Number of cruise passengers per segment (left); Time spent in each segment (centre); Average time cruise tourists spent in each segment (right).



Own elaboration

Figure 4 shows the spatial values of the explanatory variables used in the statistical models designed. They correspond to space syntax indicators regarding attributes of the city street network configuration, other indicators regarding the characteristics of the urban space, and also to variables regarding the presence of commercial activity and the visibility of tourist spots.

Figure 4. Indicators per street segment related to the built environment in Tarragona



Own elaboration

Results of the bivariate regressions, shown in Table 5, indicate that the two dependent variables, the number of cruise passengers (1) and the average time per street segment (2), are significantly associated with most of the explanatory variables (at least 95.0 % ($p < 0.05$)). However, no association has been detected with the variable regarding the incline of the streets or the variables regarding the visibility of commercial centres and World Heritage Sites located downtown. The variable related to the visibility of the Amphitheatre and the Roman Circus is significantly correlated with tourist frequency, but not with the average time spent there.

More precisely, as for the explanatory variables regarding spatial syntax, the standardised coefficients show that both the dependent variables have a significantly positive association with connectivity, integration and depth. However, results associated with average time are less explicative. As for the set of variables regarding the physical attributes of the urban space, the presence of vegetation is also highly associated with greater cruise passenger frequency and the longer time spent in certain areas. Conversely, both dependent variables are negatively associated with the maximum speed at which vehicles can circulate through the road network. In this sense, the higher the maximum speed, the lower the cruise passenger frequency and average time.

Turning now to the set of explanatory variables relating to commercial activity, important positive associations have been identified between both dependent variables and the greater presence of food trades, restaurants, fashion and souvenir shops.

Regarding the results of the visibility variables for tourist areas, positive and statistically significant associations are highlighted between both dependent variables and the visibility of World Heritage Sites located in the Part Alta neighbourhood, the visibility of a wide urban landscape and the visibility of the Mediterranean Sea. The visibility of the Serrallo neighbourhood is associated negatively with tourist frequency, while it is associated positively with the average time. The visibility of the WHS located beyond the Part Alta neighbourhood (Roman amphitheatre and Roman Circus) has a high impact on tourist frequency, but it is not associated with the average time. Lastly, no association has been identified between the dependent variables and the streets with visibility of WHS located downtown and the streets with visibility of the commercial centres.

Table 5. Bivariate regression analysis

	(1)				**(2)**			
Explicative variables	**Coef. (B)**	**Std. Dev.**	**Std. B**	**R^2**	**Coef. (B)**	**Std. Dev.**	**Std. B**	**R^2**
Connectivity	2.069***	0.223	0.184	0.034	0.131***	0.018	0.147	0.020
Integration	0.167***	0.009	0.364	0.132	0.007***	0.001	0.189	0.036
Choice	0.002***	0.000	0.393	0.155	0.000***	0.000	0.087	0.008
Depth	0.009***	0.001	0.334	0.111	0.000***	0.000	0.131	0.017
Slope	-0.007	0.060	-0.002	0.000	-0.002	0.005	-0.007	0.000
Vegetation > 2m	0.012***	0.001	0.248	0.061	0.001***	0.000	0.143	0.021
Maximum speed	-0.135***	0.014	-0.191	0.036	-0.003**	0.001	-0.054	0.003
Food	7.467***	0.786	0.188	0.035	0.472***	0.063	0.150	0.022
Restaurant	6.512***	0.505	0.251	0.063	0.545***	0.040	0.265	0.070
Fashion and souvenirs	5.742***	0.453	0.247	0.061	0.266***	0.037	0.145	0.021
Banks	13.147***	1.443	0.180	0.032	0.346**	0.116	0.060	0.004
Resident-oriented business	1.737***	0.230	0.150	0.022	0.103***	0.018	0.112	0.013
Visibility – WHS in Part Alta	15.670***	1.354	0.227	0.051	0.362***	0.110	0.066	0.004
Visibility – WHS (Amphitheatre and Circus)	24.354***	2.160	0.221	0.049	0.285	0.175	0.033	0.001
Visibility – WHS in Downtown	-3.373	2.874	-0.024	0.001	0.228	0.227	0.020	0.000
Streets – Serrallo	-5.180***	1.314	-0.079	0.006	0.451***	0.104	0.087	0.008
Visibility – wide urban landscape	30.387***	1.265	0.435	0.189	0.564***	0.111	0.102	0.010
Visibility – Mediterranean	47.774***	5.845	0.162	0.026	1.436**	0.468	0.062	0.004
Visibility – commercial centres	1.135	2.465	0.009	0.000	0.220	0.195	0.023	0.001

Note: (1) Dependent variable: Number of tourists per segment; (2) Dependent variable: average time (in minutes) per tourist and per segment. Robust standard errors: * 90.0%; ** 95.0%; *** 99.9%

7.2. Identifying the main indicators for tourist spatial behaviour

To answer the second research question (about the impact from the different variables), the explanatory variables detected as significant in the bivariate regression models have been included in multivariate regression analysis performed according to types of variables (Table 6), and for all the variables (Table 7). The specifications that take the number of cruise passengers per segment (1) as a dependent variable have a higher coefficient of determination, R2, than the specifications taking the average time (2) as a dependent variable.

Table 6. Multivariate regression analysis according to types of variables.

	(1)				**(2)**			
Explanatory variables	**Coef. (B)**	**Std. Dev.**	**Std. B**		**Coef. (B)**	**Std. Dev.**	**Std. B**	
Connectivity	0.504*	0.282	0.045		0.049**	0.024	0.054	
Integration	0.064***	0.015	0.140		0.005***	0.001	0.139	
Choice	0.001***	0.000	0.257		0.000	0.000	-0.031	
Depth	0.002***	0.001	0.087	Overall model R^2 = 0.189 Sig. = 0.019	0.000**	0.000	0.055	Overall model R^2 = 0.039 Sig. = 0.251
Vegetation > 2m.	0.015***	0.001	0.296		0.001***	0,000	0.160	
Maximum speed	-0.176***	0.014	-0.249	Overall model R^2 = 0.121 Sig. = 0.000	-0.005***	0.001	-0.085	Overall model R^2 = 0.027 Sig. = 0.000
Food	2.755**	0.878	0.069		0.168**	0.071	0.053	
Restaurants	4.874***	0.566	0.188		0.509***	0.046	0.248	
Fashion & souvenirs	4.512***	0.500	0.194		0.156***	0.040	0.085	
Banks	9.916***	1.444	0.136		0.090	0.117	0.016	
Resident-oriented business	-1.085**	0.282	-0.094	Overall model R^2 = 0.119 Sig. = 0.000	-0.061**	0.023	-0.067	Overall model R^2 = 0.080 Sig. = 0.000
Visibility – WHS in Part Alta	17.998***	1.141	0.260		0.442***	0.109	0.081	
Visibility – WHS (Amphitheatre and Circus)	24.581***	1.813	0.223		0.330*	0.173	0.038	
Streets – Serrallo	-1.689	1.083	-0.026		0.524***	0.103	0101	
Visibility – wide urban landscape	31.203***	1.153	0.447		0.624***	0.110	0.113	
Visibility – Mediterranean	50.815***	4.844	0.173	Overall model R^2 = 0.333 Sig. = 0.000	1.532***	0.462	0.066	Overall model R^2 = 0.031 Sig. = 0.000

Note: (1) Dependent variable: Number of tourists per segment; (2) Dependent variable: average time (in minutes) per tourist and per segment. Robust standard errors: * 90.0%; ** 95.0%; *** 99.9%

In relation to the regression of the space syntax indicators (Table 6), it is observed that choice and integration are the variables that influence tourist frequency the most (1). Only integration provides an important explanatory value of the average time that cruisers spend in certain areas of the city (2).

With regards to the regressions that include the two variables related to other characteristics of the urban space, it is observed that both the presence of vegetation over 2m and the maximum speed at which the vehicles can circulate are significant, at 99.9 % (p <0.01), with the association being positive in the first case and negative in the second. The incidence of both variables on the frequency of cruise passengers (1) is higher than their influence on the average time (2).

As for the regressions that incorporate explanatory variables related to economic activity, all the variables corresponding to tourist-focused commercial activities have a positive and significant association, at least at 95.0% (p <0.05), with the variable related to restaurants being the one with higher incidence. The presence of banks indicates the central position of urban spaces. Therefore, as the tourists walk through the most central spaces, this is a significant indicator for explaining cruiser frequency in the streets of Tarragona. It is also important to highlight that the resident-orientated activities have a negative association with the dependent variables. Therefore, the greater the presence of local-oriented business in the streets, the lower the average time and number of cruise passengers.

Finally, in relation to the regressions with the variables relating to the visibility of tourist areas, we have detected a high incidence of the visibility of wide urban landscapes, with significant associations at 99.9% (p<0.01) in both models. This means that tourist frequency and the average time per street is higher in those public and tourist areas with more visibility of wide urban landscapes. The visibility of WHS located in the Part Alta neighbourhood, the visibility of the Roman amphitheatre and the Roman circus, and the visibility of the Mediterranean Sea also have an important impact on the dependent variables.

Results of the joint multivariate regression analysis are set out in Table 7. The coefficient of determination for the first specification is much greater than the coefficient for the second model. This means that the independent variables considered are more explicative of cruise tourist frequency per street segment, than the average time they are in each segment. As the measuring units of the variables are different, it is important to observe the standardised coefficients in order to guarantee comparability. These coefficients reveal the relative importance of each variable within the regression equation.

In the first model, where tourist frequency per street is the dependent variable, it is observed that most of the variables are statistically significant. The variables with greater incidence on the higher cruise tourist frequency in certain spaces of the city, are the visibility of wide urban landscapes, the visibility of WHS located in the Part Alta, the visibility of the Amphitheatre and the Roman Circus, the presence of vegetation over 2m, the visibility of the Mediterranean Sea and the number of commercial activities focusing on fashion and souvenirs. Among the space syntax indicators, choice and depth are statistically and positively associated with the dependent variable. It is related to the fact that pedestrians tend to choose the visually shortest route out of the competitive routes in the street network (Bill Hillier, Yang, & Turner, 2012; Lerman, Rofè, & Omer, 2014), especially when they do not know the layout of the built environment through which they are moving, as is the case of cruise tourists visiting Tarragona. In contrast, we have detected a statistically significant negative association with the dependent variable in relation to the presence of resident-oriented businesses.

Table 7. Joint multivariate regression analysis

	(1)				(2)			
Explanatory variables	**Coef. (B)**	**Std. Dev.**	**Std. B**	**Overall model**	**Coef. (B)**	**Std. Dev.**	**Std. B**	**Overall model**
Connectivity	-0.257	0.246	-0.023	R^2=0.512	0.028	0.026	0.031	R^2=0.117
Integration	0.003	0.013	0.007	Sig.=0.000	0.002	0.001	0.049	Sig.=0.000
Choice	0.002***	0.000	0.272		-0.000	0.000	-0.008	
Depth	0.001**	0.001	0.049		0.000	0.000	0.038	
Vegetation > 2m.	0.008***	0.001	0.152		0.000**	0.000	0.050	
Maximum speed	-0.013	0.014	-0.018		-0.001	0.002	-0.022	
Food	2.198***	0.656	0.055		0.159**	0.070	0.051	
Restaurants	2.442***	0.438	0.094		0.430***	0.047	0.210	
Fashion & souvenirs	3.501***	0.379	0.151		0.137***	0.040	0.075	
Banks	6.288***	1.092	0.086		0.042	0.116	0.007	
Resident-oriented business	-0.580**	0.218	-0.050		-0.057**	0.023	-0.062	
Visibility – WHS in Part Alta	12.835***	1.081	0.186		0.378***	0.115	0.069	
Visibility – WHS (Amphitheatre and Circus)	21.179***	1.606	0.192		0.381**	0.171	0.044	
Streets – Serrallo	-0.734	1.606	-0.011		0.484***	0.104	0.093	
Visibility – wide urban landscape	25.108***	0.974	0.359		0.244**	0.114	0.044	
Visibility – Mediterranean	51.094***	4.189	0.174		1.564***	0.446	0.067	

Note: (1) Dependent variable: Number of tourists per segment; (2) Dependent variable: average time (in minutes) per tourist and per segment. Robust standard errors: * 90.0%; ** 95.0%; *** 99.9%

With regard to the second model, where the average time that tourists spend in certain areas of the city is the dependent variable, the variables with the greatest impact are the presence of restaurants, the number of fashion and souvenirs shops, the visibility of WHS in the Part Alta, the visibility of the Mediterranean Sea, the visibility of the Serrallo neighbourhood. Furthermore, contrary to the first specification, in the second model none of the space syntax variables are significantly associated with the average time tourists spend per street segment.

Results of the joint multivariate regressions highlight that urban configuration and design are important generators of cruise tourist mobility (Hillier et al., 1993), but not highly determinant of the time the users decide to spend in each street segment. Therefore, this research pinpointed that the presence of attractors such as commercial activity, restaurants and points of interest is key to understanding where cruise tourists prefer to spend more time during their visit. Therefore, results underpin that cruise tourist behaviour is shaped by their perception of the spatial dimension (Thwaites & Simkins, 2007) and by the presence of mixed land use and commercial activity (Foltête & Piombini, 2007; Mansouri & Ujang, 2016) that give them multiple possibilities to engage in specific activities.

8. Discussion and conclusion

This article has demonstrated that the configurational attributes of the street network are useful for understanding cruise tourist spatial behaviour in Tarragona. However, results also revealed that indicators referring to the visibility of tourist places and the type of economic activity are more consistent and have higher incidence. Those results are in line with previous research that confirms the importance of the relational attributes of the urban form, but pinpoint the presence of attractors as a greater explanation of pedestrian spatial behaviour (Foltête & Piombini, 2007; Mansouri & Ujang, 2016).

Furthermore, the study has shown that when the space syntax indicators are used to explain cruise tourist spatial behaviour at a destination, it is important to consider not only the number of cruise tourists who walk along the streets, but also the average time that they spend in them. Therefore, after performing the multivariate regression analysis we have seen that, regarding the space syntax indicators, choice is the variable with the highest effect on tourist frequency in certain areas in the city. Indeed, the literature identifies choice or option as the space syntax measure that has stronger and more consistent correlation with pedestrian movement, than other conventional syntactic measures (Bill Hillier et al., 2012). This is because pedestrians are more likely to choose the visually shortest route out of the competitive routes in a network (Lerman et al., 2014).

In contrast, when the average time that the cruise passengers stay in the streets of Tarragona has been taken as the dependent variable of the multivariate regression, results showed integration as the space syntax indicator with the highest impact. Integrated streets are accessible and attractive to pedestrians for natural movement (Sharmin & Kamruzzaman, 2017). In fact, Li et al. (2016) demonstrated that in the historic town of Gualangyu (China), the street network integration is highly and positively correlated with tourist pedestrian movement. Nevertheless, the relation between integration and the cruise passengers staying longer in certain streets of the city can be a result of the multiplier effect of local attractors (Mansouri & Ujang, 2016), such as commercial activity and places of interest. These findings are consistent with results obtained by Mansouri and Ujang (2016), that pointed to urban activities and land uses as very important factors explaining tourist spatial behaviour. Precisely, the results show a greater consistency of the indicators related to commercial activity and visibility of tourist attractions. On the one hand, the higher presence of restaurants, souvenir and fashion shops per street segment has been associated with a higher frequency of tourists, but also with a greater average time. In contrast, a negative association has been identified between the presence of economic activities oriented towards the local people and the tourist inflow.

On the other hand, variables related to the visibility of tourist attractions also affect the tourist frequency and the average time per street. Results show that those streets with a visibility of wide urban landscapes, visibility of the Mediterranean Sea and proximity to World Heritage Sites in the Part Alta and nearby are positively associated with the presence of cruise tourists. However, there are tourist areas with reasonably good walkways that interest few cruise passengers, such as the streets with visibility of World Heritage Sites located in the downtown area and the streets with visibility of the Serrallo neighbourhood. This may be related to the distance that separates the central part of

Tarragona from downtown where these tourist places are located. In this regard, more efforts should be made by the local authorities to integrate attractions into the network and foster a higher level of mixed land use between attractions so as to obtain more compactness and connectivity between attractions (Jacobs, 1961).

In accordance with the results obtained for the indicators related to other physical characteristics of the urban space, the more vegetation over 2 meters there is along the streets, the higher the number of tourists and the average time that they spend in them. Therefore, the presence of shade is an aspect that tourists take into account when visiting the city, as it makes the spaces more walkable (Foltête & Piombini, 2007). The maximum speed at which the vehicles can drive is also a determinant of cruise passenger frequency along the streets (Blecic, Cecchini, & Trunfio, 2015). Hence, it has also to be considered by the public authorities with regards to city planning, to ensure safety in public areas.

Last, but not least, this article highlights the importance of considering the average time that the tourists spend in different places in the city, when discussing the influence of the built environment design over tourist spatial behaviour in cities. In fact, the main constraint of cruise tourist mobility in the city is their time, as they are in the city for a limited number of hours.

This study has proven the utility of analysing characteristics of the built environment in order to understand mobility decisions of cruise visitors in a city. It is an exploratory study by nature and, certainly, since the validity of the model has been established, it can be further enhanced using larger samples. This will also allow defining segmented patterns according to the characteristics of visitors. Otherwise, characteristics such as the length of street segments and the width of the pedestrian space should be considered in future studies, as they could be important explanatory variables regarding cruise tourist mobility. Moreover, authors may suggest that if the method is replicated in other cities and those cities have the arrivals cruise port close to the visitors attraction area, it would be worthwhile analysing the significance of the distance from the port to the city, and the different paths that visitors can follow to plan their tour. In this study, this variable has not been considered because all the cruise tourists have to take public transport services due to the long distance from the port to the urban centre.

Thus, although methodological limitations can be identified, the results from this research are particularly valuable since they provide better knowledge of the characteristics of the urban areas that cruise tourists prefer to move through and spend more of their time. In this regard, it can also give valuable insight into public administrations that have to consider urban planning and design as key factors for both the tourist experience in the location and their satisfaction, and the prosperity of the people who live in there. Along these lines, as the continuous growth of tourism is a challenging situation for destination management organisations and local and regional authorities, because pressure on public and urban spaces is increasing considerably, the empirical evidence provided can be particularly useful for mitigating problems caused by cruise passenger mobility in certain places in the city, through better design and management of the built environment.

In this vein, future research should analyse in greater depth the time component of tourist spatial behaviour, in order to detect to what extent the functionality of the built environment is altered by their presence, and how this is affecting other users in the urban system. Hence, different issues have to be analysed from a time-geography perspective, such as the variability of processes of interaction between locals and tourists in specific spaces during the day, the week or according to seasons of the year; the potential effects of agglomeration caused by cruise tourism for a few hours, both intense and massive, over the carrying capacity of the different streets; the relationship between the sequence of activities developed by tourists in relation to the availability of services, attractions and points of interest; or changes to the built environment in particular places as a consequence of the increasing number of visitors.

Linked to this last example, it is important to mention that destination management organisations have to ensure that neither the attractiveness nor the meaning of public spaces are lost. Furthermore, the subjective perception of the urban landscape by both locals and tourists also has to be an issue of consideration, because an important part of the human spatio-temporal behaviour is due to the subjective feelings about the environment they are moving through. Therefore, complementary analysis contrasting the mobility of locals and tourists should be done to measure to what extent the particular perception of each one group influences their spatial behaviour. It would contribute significantly to the debate on how a liveable and socially, economically and environmentally sustainable urban space has to be configured.

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