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URBAN AND ECONOMIC ACTIVITIES IN METROPOLITAN STRUCTURING AXES

THE CONTRIBUTION OF GOOGLE PLACES GEOLOCATED DATA[1]

ACTIVIDADES ECONÓMICAS Y URBANAS EN EJES ESTRUCTURANTES METROPOLITANOS
LA APORTACIÓN DE LOS DATOS GEOLOCALIZADOS DE GOOGLE PLACES

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Los ejes viarios metropolitanos son espacios de centralidad urbana y de oportunidad para promover una mejor conectividad entre las distintas partes del continuo urbano. En este sentido, la caracterización funcional de seis ejes representativos en Madrid, Barcelona, París, Londres, Nueva York y Ciudad de México permite obtener un diagnóstico actual sobre la densidad y diversidad de actividades económicas y urbanas, con el fin identificar aspectos clave sobre los que incidir para mejorar su estructura funcional y social. Para ello, se propone un método que adopta los datos geolocalizados de la red social Google Places como principal fuente de información. De la investigación se deducen importantes similitudes en el carácter funcional de los ejes, entre otras, la predominancia de las actividades relacionadas con los servicios y el comercio o la mayor diversidad de actividades económicas y urbanas en los espacios más centrales. Pero también se identifican diferencias, como son la especialización de determinadas actividades características en cada eje metropolitano o la diferencial relación entre la densidad de población y cantidad de actividades, tanto en términos de densidad como en cuantificación lineal. En definitiva, el método propuesto abre nuevas posibilidades para la planificación estratégica de actividades económicas y urbanas en ámbitos metropolitanos.

Palabras clave: metrópoli, ejes urbanos, actividades urbanas, redes sociales, Google Places.

Metropolitan road axes are spaces of urban centrality and opportunity to promote a greater connectivity between different parts of the urban continuum. In this sense, the functional characterization of six representative axes in Madrid, Barcelona, Paris, London, New York and Mexico City allows obtaining a current analysis of the density and diversity of economic and urban activities to identify key aspects over which to influence to improve their functional and social structure. For this, a method is proposed that adopts the geolocation data from Google Places social network as a main source of information. From the research, important similarities in the functional character of the axes are deduced, among other the predominance of activities related to services and shopping or the greater diversity of economic and urban activities in more central spaces. But differences are also identified, such as the specialization of certain activities characteristic in each metropolitan axis or the differential relationship between population density and the number of activities both in terms of density and linear quantification. All in all, the method proposed opens new possibilities for the strategic planning of economic and urban activities in metropolitan areas.

Keywords: metropolis, urban axes, urban activities, social networks, Google Places.

I. INTRODUCTION

Traditionally, in Europe and America, the trend of the big city to expand has been recognized with the term "metropolitan area of the city", which covers beyond the political and administrative limits of the city itself (Burgess, 1984, p. 50). Its rapid growth has transformed the urban landscape and brought with it, new dynamics and spatial and socioeconomic challenges that to date, continue being great unknowns, especially on there being a significant lack of standardized data (da Cruz, Oh & Choumar, 2020).

Indeed, facing the importance of the metropolitan scale and the acknowledged lack of sources and tools that allow its study and comparison with other metropolitan contexts (Van Susteren, 2005, p.11), the novelty of this research is located. This is an exploratory and comparative study, fundamentally methodological, whose goal is the functional characterization of six metropolitan axes starting from the economic and urban activity data sourced from the Google Places social network.

The relevance of analyzing metropolitan axes from a functional point of view consists of addressing one of the key matters in the sustainability of cities: the urban complexity (Agencia de Ecología Urbana de Barcelona, AEUB, 2015), that responds to a mixture of uses and their proximity, and which leads to other issues, like the sustainable use of resources and the vitality of urban spaces.

It starts from the hypothesis that the structuring axes that cross the urban continuum through its central area are aspects of urban centrality, that wander along the different fabrics and are physical, social and economic evidence of the evolution and spatial-temporal growth of the metropolis. And, as such, their analysis implies an opportunity to establish strategies that allow reassessing public policies, improving the management and development of these aspects and facing the challenges that metropolitization processes involve (da Cruz et al., 2020).

In this sense, recent studies have demonstrated the great potential of social networks to know the amount and diversity of the economic offer of the cities (Carpio-Pinedo & Gutiérrez, 2020) to resolutions that, through traditional data collection methods, like collecting data onsite, would be boundless. Although there are studies that specifically address functional analysis at a metropolitan scale (Yang & Marmolejo Duarte, 2019), the functional characterization of their axes from social networks constitutes a novelty that this research contributes.

II. PREVIOUS STUDIES

The metropolitan scale and its structuring axes as urban centrality

The difference between the city and the metropolis does not exclusively lie in the number of inhabitants or the surface they cover, but also in their functional and social organization (Park & Burgess, 1984, p.184). While the administrative and political boundaries of the city tend to be rigid, the metropolitan areas are dynamic settings insofar as their four dimensions: spatial, social, economic and environmental (da Cruz et al., 2020).

Despite there not being a consensus in terms of the spatial boundary of the metropolitan urban sprawl (Krätke, 2007), it is often argued that this covers from the downtown to the areas where daily journeys are made, the *commuting zone (*Burgess, 1984, p.51). That is to say, the commute affects the spatial boundary of the so-called "functional urban areas". This criterion allows maximizing the international comparability among metropolitan areas and overcoming the limitation of just using the administrative boundary (OECD, 2020). In this criterion, the structuring axes play a really relevant role as essential elements for mobility as they that spatially link the periphery-downtown-periphery, facilitating access from one end of the urban continuum to the other, while promoting the feeling of belonging of the residents of the periphery, who are also part of the urban vitality of the downtown (Park & Burgess, 1984, p. 184).

Although Burgess (1984, p. 51) illustrates urban centrality in the city's expansion process with a layout of concentric circles and where the central area – *The Loop* – groups the most economically powerful activities, this coexists with other aspects of centrality, *satellite loops*, or represented by streets, avenues, or crossroads of strategic routes for the mobility and functions of the city (Burgess, 1984, p.61). Indeed, the central sections of metropolitan axes tend to be characterized by their urban centrality condition, understood as the concentration, intensity and variety of urban activities, especially those related to political decision, innovation and research, diffusion and emission, exchange and meeting, ludic or recreational and of a symbolic nature (Terrazas, 2004, p. 263).

Although the urban sustainability seeks the balance between the critical mass of population, services and activity and the connectivity of the fabrics through continuous corridors of AEUB activity (AEUB, 2015, p. 131-133), the metropolitan axes that cross multiple administrative divisions are fields of opportunity. Concretely, because the spatial agglomeration of their elements takes place in a longitudinal sense which,

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paradoxically, is the least integrated form in itself but the most integrated towards the exterior and towards other systems of the region, given that each one of its constituent elements is directly adjoining the exterior space of the form; unlike the circular form, which is more internally integrated, but segregates the peripheral elements more (Hillier, 2007, p 266).

The functional analysis of metropolitan axes

The analysis of the functional nature of urban areas is of great interest for different reasons. These linear public spaces constitute the spatial unit of our experience in the city (Mehta, 2014), the setting of citizen meeting and the container of public life where social life takes place (Lynch, 1984, p. 407).

Indeed, the amount and concentration – density – and the localization pattern – proximity – of the urban and economic uses and activities in these public spaces are determining factors in the level of pedestrian activity (Hillier, 1996, p. 51; Levy, 1998: p. 61), a matter that is also closely related with urban vitality and that, at the same time, is translated into public safety – self-surveillance – (J. Jacobs, 1961). In the same way, the collective image that is perceived of the environment is, to a good extent, the result of the social use and permanence in these linear spaces, a result of their physical characteristics and of the layout of the functions in the space (Gehl, 2011, p. 96; Lynch, 1960, p. 50).

Thus, the analysis of the patterns of urban and economic uses and activities present in urban axes is a recurrent approach among urban researchers to assess the functional nature of the environment and to value whether there is a good amount, mix or specialization or, on the contrary, if there are gaps of urban activity.

Traditional and current sources for functional characterization

Traditionally, the study of the functional nature of urban aspects has been based on an exhaustive collection, walking the streets, for the later preparation of maps (Gehl & Svarre, 2013; De Souza & Bustos, 2017; Mehta, 2014). These methods have disadvantages regarding the resources their implementation demands, time and cost, and because only the economic activities that are visible from the public space can be recorded. That is to say, those activities which are not marketed on public streets, like in the case of offices or businesses located on higher floors of buildings, which likewise contribute to the functional nature of the setting, can be unperceived in field studies.

It is for these reasons that, for more than a decade now, a good part of urban and geographic research has opted to use technology-based sources like social networks and web services that allow obtaining data in an automatic and massive way. The use of these social media has produced an important advance in the way of addressing urban and territorial research. This is alongside the frequent absence or obsolescence of statistical databases that jeopardize the diagnosis and, therefore, a suitable management of the current reality of the territory has derived into a considerable volume of scientific literature that adopts social networks as a primary source of information (Stock, 2018).

However, these sources are not free of challenges and limitations (Tasse & Hong, 2014). Among other aspects, the exhaustive task of previously checking the data to guarantee reliability and representativity of the sample and the restrictions and terms of service established by the platforms themselves, conditioning total or partial access to the information available within a concrete setting.

In any case, these sources are of interest for this research, because it has been shown that it is possible to obtain data on a metropolitan scale (Folch, Spielman & Manduca, 2018), and also, in general, these are very extended sources and, thus allow progressing in the same issue in different geographical contexts. For example, in recent research, the list of urban activities of Foursquare has been used for urban analysis in Asian (Vu, Li & Law , 2020), European (Carpio-Pinedo & Gutíerrez, 2020) and American (Ballatore & De Sabbata, 2020) contexts.

Concretely, this research focuses on Google Places, a social network associated to Google Maps that represents "Google's attempt to add and organize all the information available about any place in the world" (Barreneche, 2012). Considering the goal and scale of the research, the use of this social network implies important advantages over other traditional sources (Martí, Serrano-Estrada y Nolasco-Cirugeda, 2019).

1. It provides an updated list of the economic and urban activities contained in the building and not just those that have marketing facing the street.
2. The records are geo-positioned, a characteristic that facilitates the mapping and analysis of the information.
3. Places registered on the platform are classified by types of activity or tags, a quality which allows analyzing the type of urban activity in both an aggregated and disaggregated way.
4. Google Places, unlike other networks, is used at a global level (Sen, Quercia, Ruiz y Gummadi, 2016) facilitating both reproducibility of the methods and the comparison between different geographical aspects.

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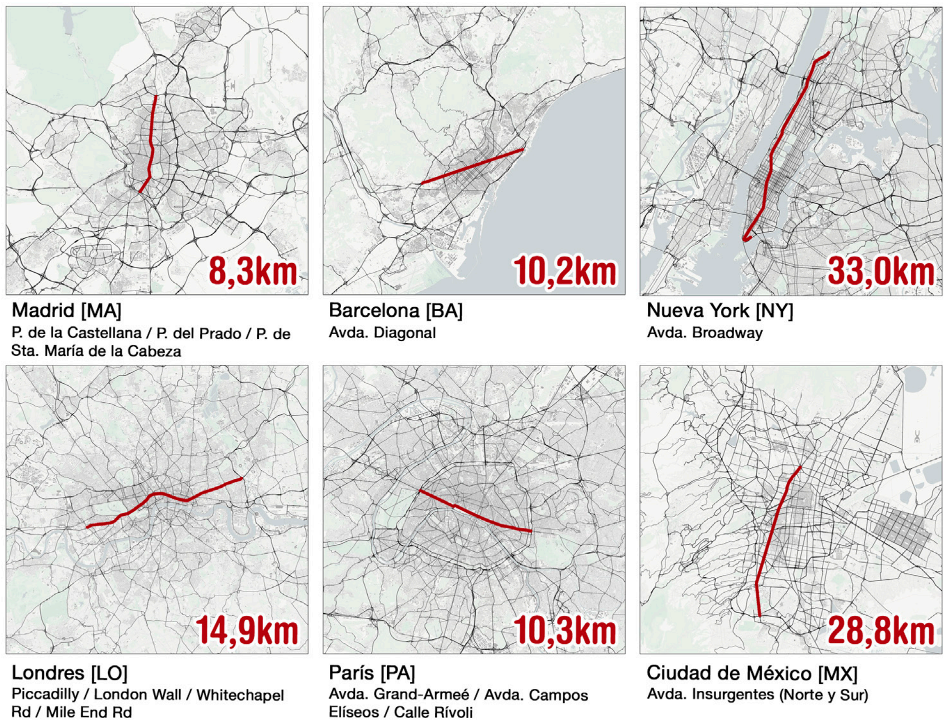

Figure 1. Length of the sections chosen. Source: Authors

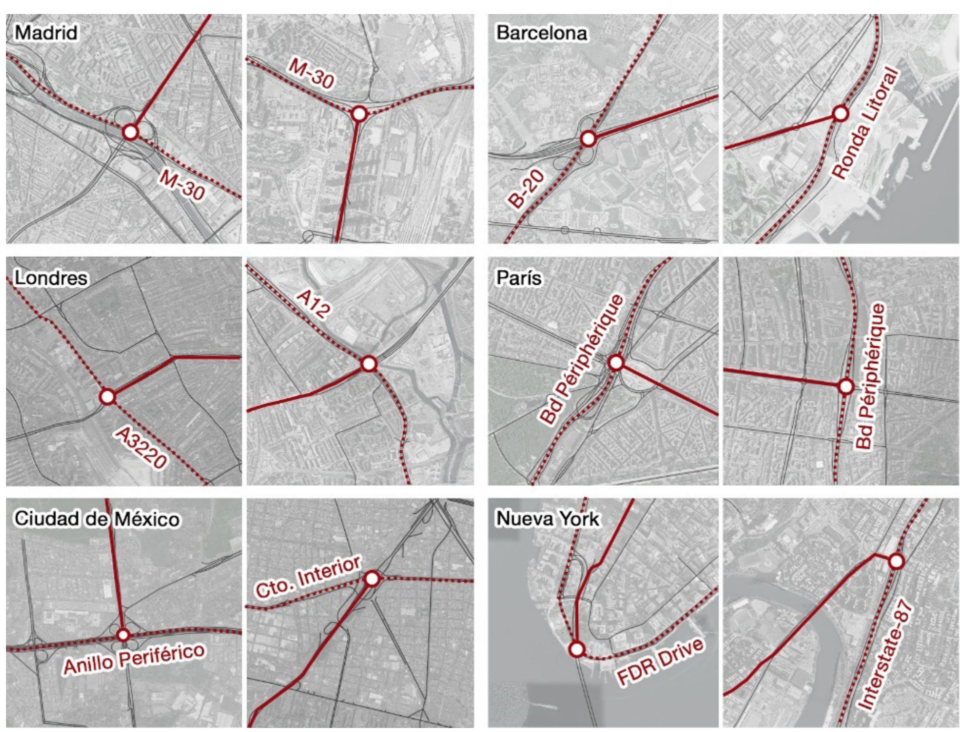

Figure 2. Road intersections that mark the sections. Source: Authors.

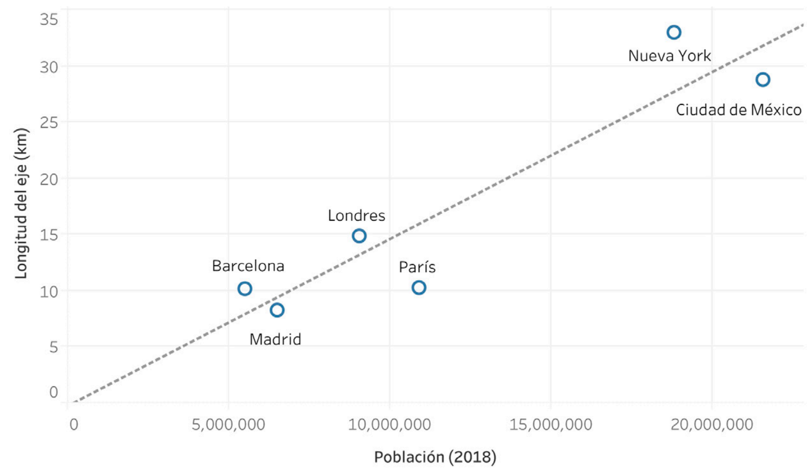

Figure 3. Relation between metropolitan population and length of the axes.Source: Authors

III. CASE STUDIES

For the analysis and comparison of the functional nature of metropolitan urban axes in different geographical contexts, six case studies are adopted: four European, the most representative for the population in Europe, South – Spain, North - UK, and West – France (United Nations, 2018) and two American, including the most populated metropolitan area of the entire continent, Mexico City, and the most representative of North America, New York, which leads, alongside London, the financial centers' ranking at a global level (Morris, Mainelli y Wardle,2015).

These are six metropolis that respond to diverse casuistries regarding their management and socioeconomic context. Thus, in the European context, although the four cases represent European hubs for the economy of knowledge (Krätke, 2007), in the case of Madrid and Barcelona, leaders of the Spanish urban system, the management of the metropolitan areas is still developing, unlike France and the United Kingdom, examples of best practices and confirmable success regarding the implementation of metropolitan scale planning instruments (Hildenbrand, 2017).

Spatial boundary of the study area

A structuring axis of great relevance is identified regarding its hierarchy in the metropolitan network of each case study and then, a representative section is chosen, whose extension is defined in Figure 1.

The selection of the sections is based on their importance in the urban structure, connecting periphery-downtown-periphery, and their length is limited by the intersection with ring-roads, or by the intersection with other first order metropolitan axes, as is shown in Figure 2.

Once the length of the sections is defined, these are connected to metropolitan population density, checking that there is a positive high correlation between the two variables (Figure 3).

Regarding the spatial marking of the sections in their transversal direction, three disciplinary criteria could be considered, adopted by students of the public space and, concretely, those focused on the analysis of urban activity on road links and linear spaces: the façade face (Cullen, 1961; Jacobs, 1995; Jacobs, 1961), the social field of vision, which refers to the maximum distance where it is possible to see and perceive a person or urban activity – 100 m approximately – (Gehl, 2011), and the use in ground floors of buildings alongside the urban space (Mehta, 2019). The first two, (Figure 4, right), allow analyzing the urban image and how this affects the human activities that occur in the space, while, with the third criterion it is possible to understand a relationship between the uses, in uses in the ground floors of the buildings with the socialization of the urban space, (Figure 4, left).

Thus, this research conceptually follows the third disciplinary criterion, but incorporates the two nuances: first, as has been mentioned above, the Google Places

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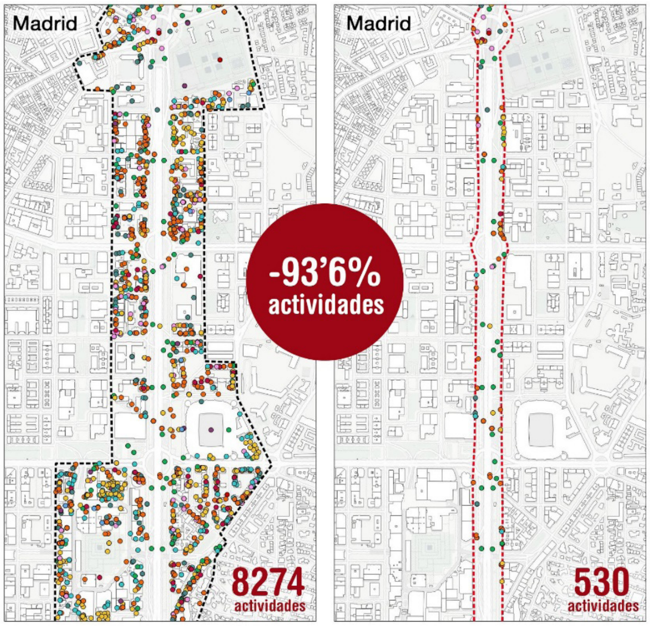

Figure 4. Comparison between the number of urban activities of Google Places included within the spatial limits of the area of study – left – and those exclusively within the route of the axes – right. Source: Authors.

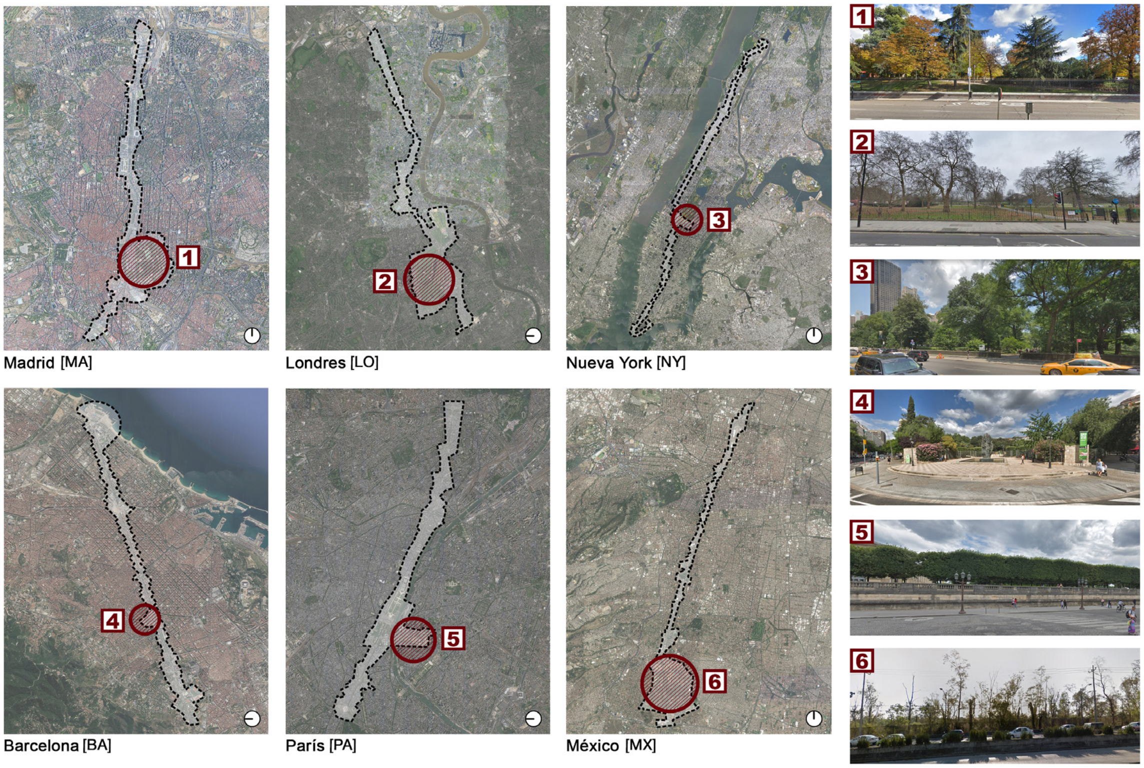

Figure 5. Spatial delimitation of the case studies. Source: Authors.

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database includes all the economic activities contained in the building and not just those located on the ground floors; and, second, that each one of these activities is represented by a point, which can be geopositioned on the façade line or in any other location within the lot, or even, of the block, reason why it is deemed suitable to include the whole block alongside the route of the axes. In the cases where these blocks are occupied by open and public spaces, like parks or urban squares, the edified blocks alongside these spaces are likewise considered.

As for the number of activities recorded that are within the chosen setting, in Figure 4 it is seen that the criterion adopted allows obtaining 93% more data than if the façade line had been considered as a spatial limit. In fact, activities are included that, although they do not directly affect the axis, influence in its functional dimension, on being located near to road intersections that transversally cross the axis. The spatial delimitation of the six case studies considering the described criterion, is seen in Figure 5.

IV. SOURCES AND METHOD

The geolocated data of Google Places were obtained through the SMUA– *Social Media Urban Analyzer* – IT application (Marti et al., 2019), during May 2018. This is a list of places of interest and economic activities with specific qualities like: the name of the place, the type of economic activity or tag (Google Developers, 2019), the physical address and the geographic coordinates.

Next, the extracted data were checked and validated. The verification included the manual revision and the discarding of duplicated data where the information about the name of the place, the coordinates and the physical address matched; and the validation focused on the screening of 128 tags or types of activity associated to the different places. In addition, it was checked that the types of place listed corresponded exclusively to economic and urban activities, discarding other types of tags.

Once screened, the data were grouped with the goal of summarizing the information and aiding its analysis. For this, the taxonomy of places from the Foursquare social network (Foursquare Inc., 2018) is adopted, as unlike other social networks, it has a structure that is well defined in ten main categories for the rating of places of interest and establishments (Keßler y McKenzie, 2019): Arts and Entertainment; Education, Schools and Universities; Food; Health and Sport; Nightlife spots; Outdoor; Professional, Government and other places; Services; Shopping; Travel and Transport (Figure 6). Once categorized, the data were displayed on a map with the QGIS Geographic Information System, and after this, two types of analysis were carried out.

The first analysis allows getting to know the total amount and types of urban and economic activity by axis starting from three metrics: the density of activities, which is also contrasted with the population density, estimated based on metropolitan density, the average number of activities per 100 linear meters of axis, threshold distance at which it is possible to appreciate the presence of a person (Gehl, 2011) and, the representativity of each one of the categories in each one of the study settings.
Although the central fabrics are characterized on having higher densities than the periphery ones, a mean is set with the central metropolitan density (OECD, 2020) aiming at using a standard criterion for all the cases that allow their comparison. The metrics adopted offer a numerical global view about the amount of legal activity and sensorial information available at a human scale.

The second analysis consists in identifying spatial patterns of concentration and diversity of activities on the axes. The data are represented by category on the map and, in line with the work Sen, Quercia, Ruiz y Gummadi (2016) that also uses the data of Google Places to study diverse metropolitan settings, an orthogonal mesh is traced aligned to the cardinal axis that cover the entire areas. The size of the cell is 200 x 200 meters, the same as the reference mesh that the Ecological Urbanism Certification (AEUBAEUB, 2015) sets out to measure the different urban sustainability indicators, among which is the Urban Complexity. Finally, the number of different categories present in each cell is calculated to characterize the diversity of activities.

V. RESULTS

From the data verification of Google Places and the validation of the 128 types of activity or tags, only 87 types are kept, which refer exclusively to economic and urban activities. These are classified in the ten categories of Foursquare, as can be seen in Figure 6.

Regarding the analysis of the data recorded and in respect to the characteristics of the axes and the population of each one of the metropolitan areas, a series of correlations are established through the combination of the diverse variables (Table 1 and Figure 5).

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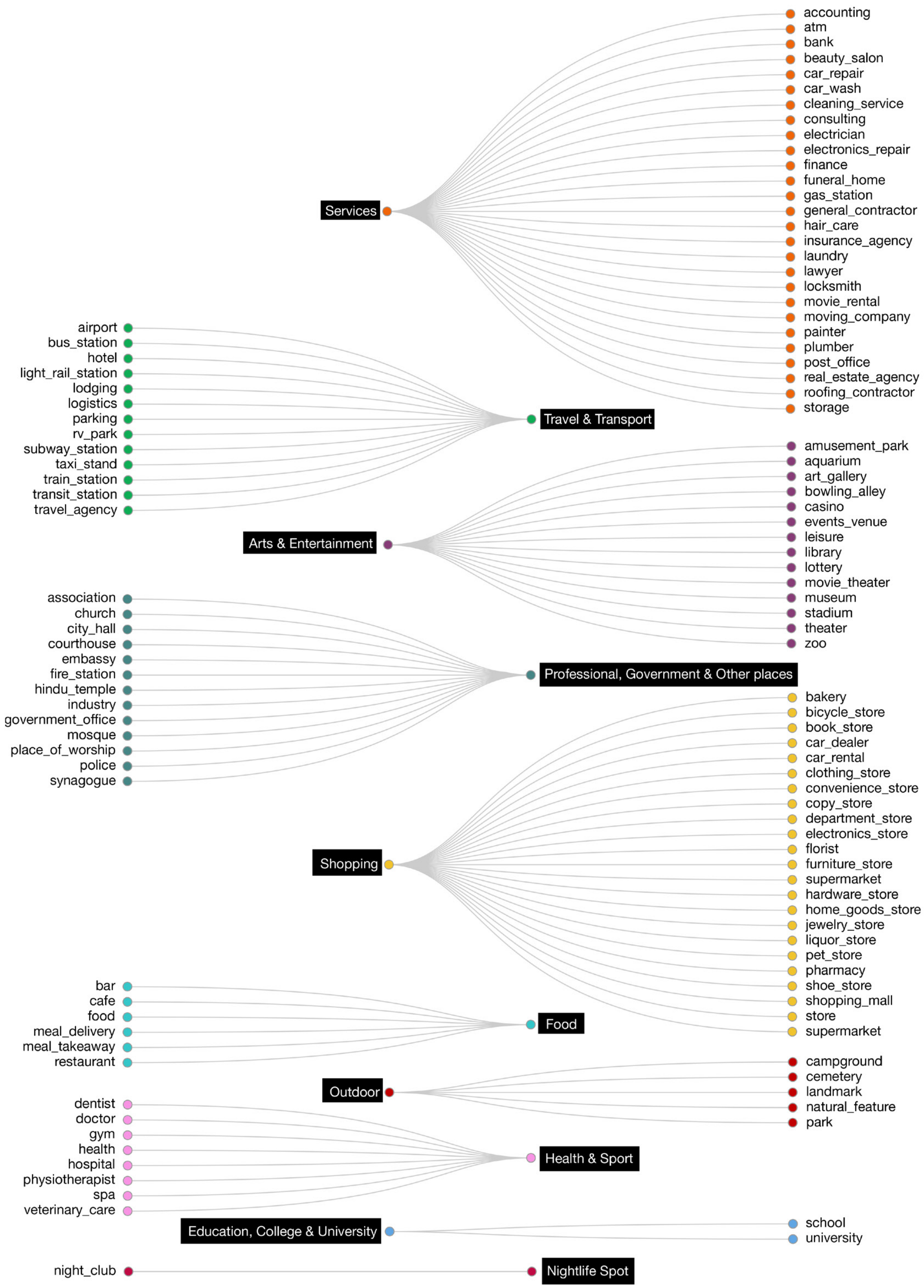

Figure 6. Grouping of Google Places' tags in the Foursquare categories. Source: Authors.

Metropolitan Area	Length of the axis (km)	Axis surface (km2)	Metropolitan population (2018) (UN, 2018)	Population density of the metropolitan central area (inhab/km2) (2018) (OECD, 2020)	Activities recorded in Google Places	Activity density (act/km2)	Activities by each linear 100 m
Mexico City [MX]	28.8	14.1	21,581,000	5237	11,915	845	41
New York [NY]	33.0	8.6	18,819,000	1445	23,600	2744	72
London [LO]	14.9	11.6	9,046,000	3486	14,023	1209	94
Paris [PA]	10.3	6.7	10,901,000	4999	15,164	2263	147
Madrid [MA]	8.3	7.2	6,497,000	3828	9,413	1307	114
Barcelona [BA]	10.2	5.9	5,494,000	6661	7,916	1342	78

Table 1. Data recorded by metropolitan axis. Source: Authors.

The first finding of interest is that, with the six sections being very active, according to what the density of activities recorded indicates, three groups are recognizable: the NY and PA axes, with the highest concentration of activity; followed by LO, MA and BA, with medium densities; and MX with a significantly lower density of activities. As for the presence of activities by each 100m, the PA axis leads the list along with MA, next, the LO, BA and NY axes have similar amounts and, finally, MX is the axis with the lowest presence of activities. In this sense, the European cases stand out over the American ones, with a higher amount of activities every 100 m. This would lead to other considerations and morphological type debates, which are outside the goal of the research.

Relating the population density and that of activities in the scatter graph of Figure 7, a negative correlation between these two parameters can be seen: the lower the population density is, the density of activities in the axis increases. Thus, those cities with the highest population densities, like MX, have the lowest activities density, while the case with the lowest population density, NY, has the highest number of activities. However, the relationship between population density and the number of activities by each 100 meters increases linearly, Figure 8, contrary to the terms of density, from which it can be deduced that the population density affects the proliferation of activities along the route of the axis, but not so much its population density in areas alongside it. And the relationship between population density and activities, Figure 9, corroborates that, for similar activity densities, like BA, LO or MA, the number of activities every 100 meters is very uneven, which is why the density in a longitudinal sense is not related with the density of the blocks adjoining the route of the axis. In any case, NY stands out as the most singular case, due to its lower population density and higher activities density which, nevertheless, are not reflected in the linear quantification.

Regarding the type of activities, the Services category standards out in the six areas of study (Table 2 and Figure 10) as it exceeds 30% of the total activities in five of the six cases. Likewise, the Shopping category, even more important than the Services category in MX, is the second most represented one in MA, BA, LO and PA, with more than 20% of the total activity. In NY, the category Health and Sport is the second most relevant activity, barely represented in the rest. The Food category is significant in MX and LO, exceeding 18% of the total activities, unlike the case of NY with 7%.

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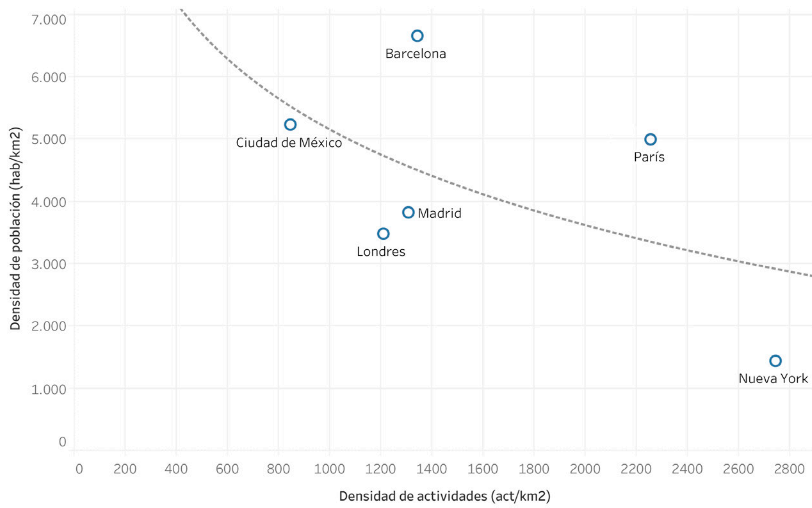

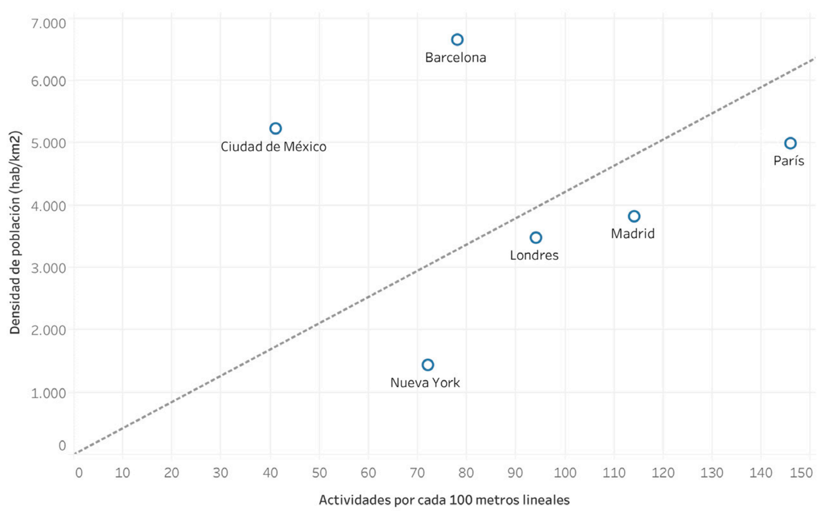

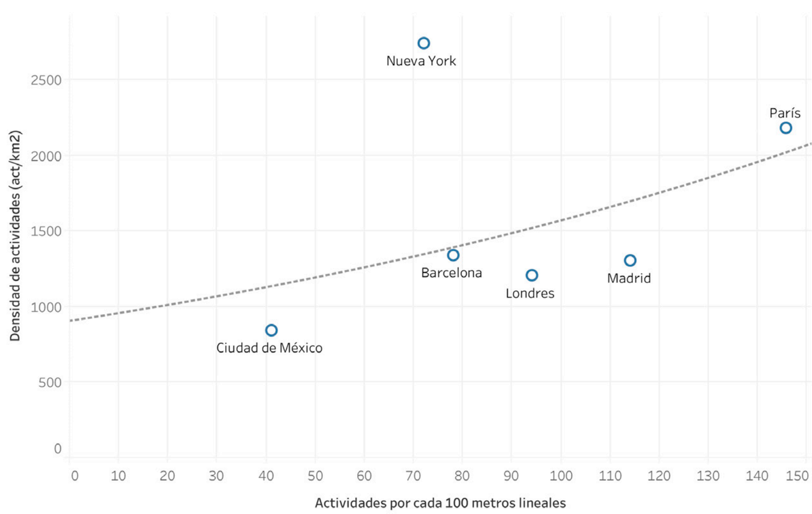

Figure 7. Relationship between activities density and population density. Source: Authors.
Figure 8. Relationship between activities every 100 linear meters and population density.Source: Authors.
Figure 9. Relationship between activities every 100 linear meters and activities density. Source: Authors.

	Madrid [MA]		Barcelona [BA]		Londres [LO]		París [PA]		Nueva York [NY]		México [MX]	
Artes y Entretenimiento (Arts & Entertainment)	173	1,8%	86	1,1%	320	2,3%	377	2,5%	427	1,8%	133	1,1%
Educación, Colegios y Universidades (Education, College & University)	148	1,6%	138	1,7%	252	1,8%	214	1,4%	459	1,9%	502	4,2%
Establecimientos de Restauración (Food)	1152	12,2%	942	11,9%	2588	18,5%	1920	12,7%	1643	7,0%	2227	18,7%
Salud y Deporte (Health & Sport)	673	7,1%	542	6,8%	579	4,1%	1307	8,6%	6303	26,7%	1436	12,1%
Ocio nocturno (Nightlife Spot)	342	3,6%	290	3,7%	83	0,6%	599	4,0%	340	1,4%	50	0,4%
Aire Libre y Recreación (Outdoors & Recreation)	26	0,3%	48	0,6%	85	0,6%	47	0,3%	95	0,4%	44	0,4%
Profesional, Gobierno y Otros Lugares (Professional, Government & Other places)	315	3,3%	84	1,1%	312	2,2%	314	2,1%	264	1,1%	210	1,8%
Servicios (Services)	3608	38,3%	2881	36,4%	5456	38,9%	4961	32,7%	8667	36,7%	2968	24,9%
Comercio (Shopping)	2248	23,9%	2207	27,9%	2990	21,3%	4158	27,4%	4267	18,1%	3422	28,7%
Turismo y Transporte (Travel & Transport)	728	7,7%	698	8,8%	1358	9,7%	1267	8,4%	1135	4,8%	923	7,7%
TOTAL	9413	100%	7916	100%	14023	100%	15164	100%	23600	100%	11915	100%

Table 2. Data of Google Place recorded by area and category. Source: Authors.

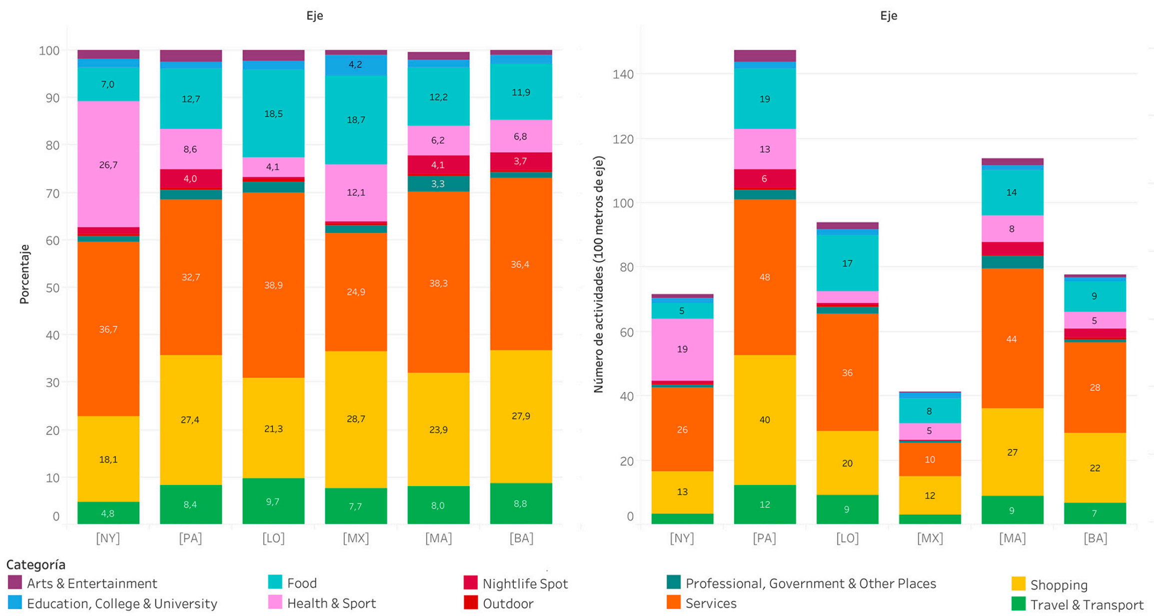

Figure 10. Frequency of the types of activity (left) and number of activities per 100 linear meters (right). Source: Authors.

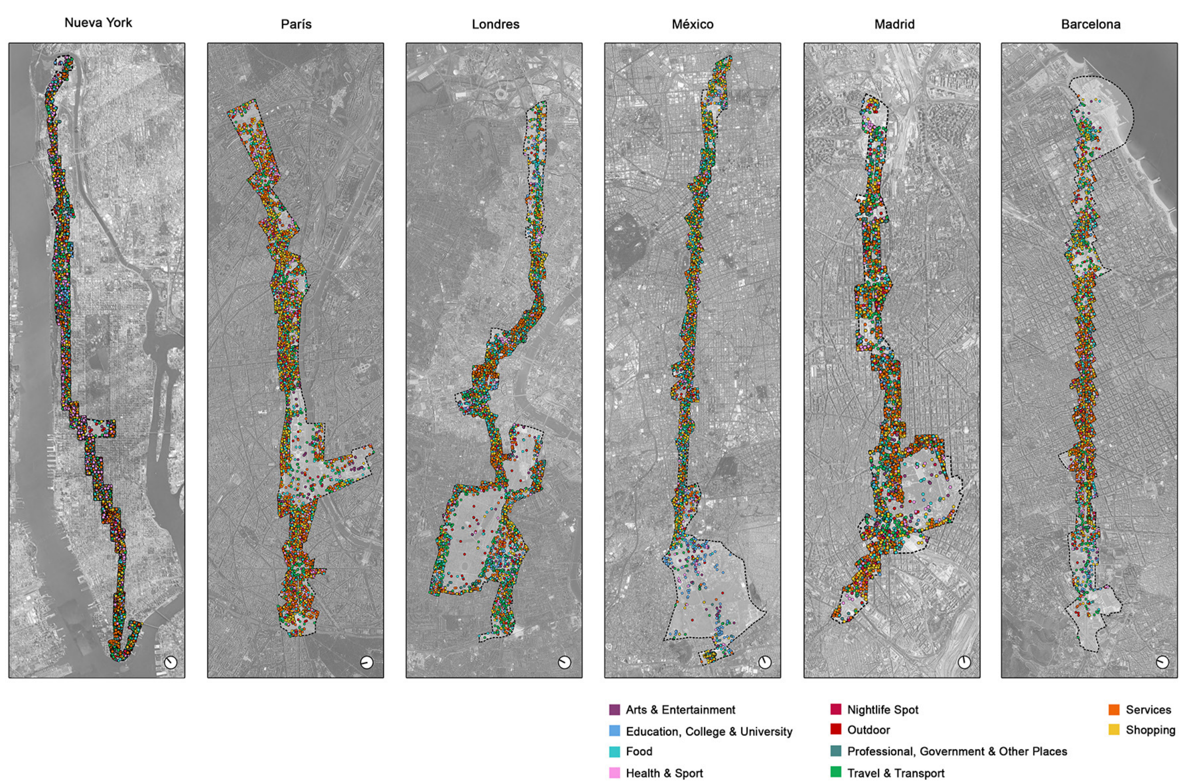

Figure 11. Distribution of urban activities. Source: Authors

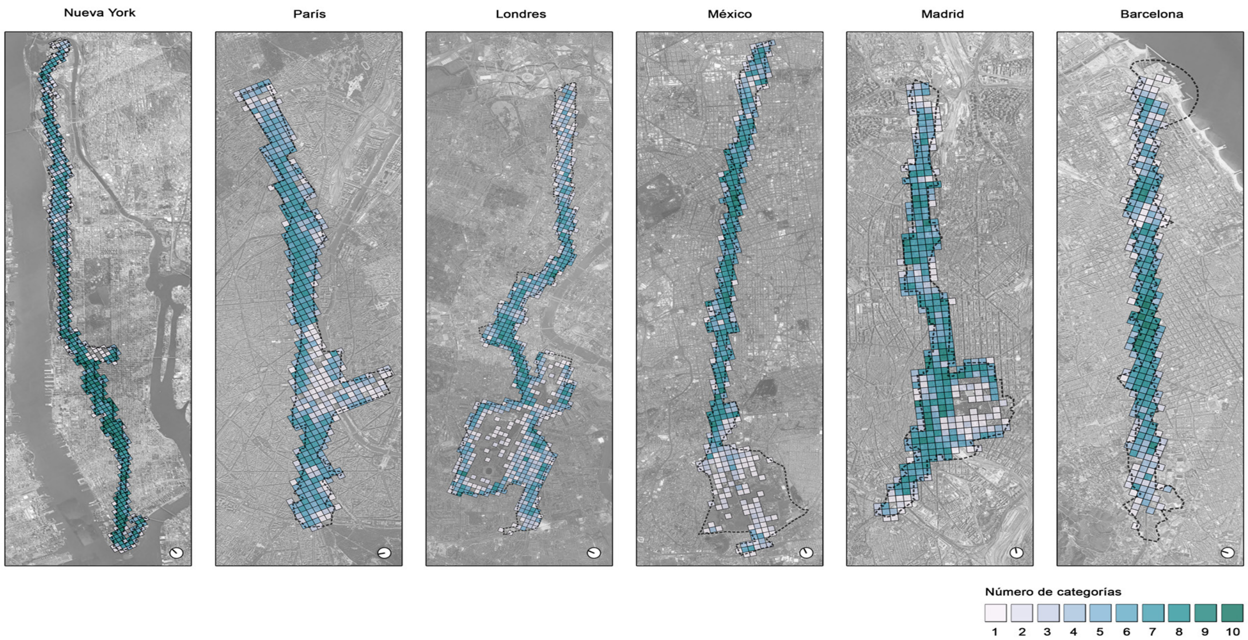

Figure 12. Number of different categories by 200 x 200 m cell surface area. Source: Authors.

Regarding the category of Travel and Transport, present in similar amounts in all the axes, it represents spaces linked to public transportation and shows the great connectivity and the structuring role of the analyzed areas, Figure 10, left.

Regarding the spatial distribution of the activities (Figure 11) with the exception of some very limited areas, where activity gaps are seen, in general the axes have similar patterns, with a higher concentration of urban activity in central zones and a tendency towards the spreading of activity at the extremes. This is logically by reasons of centrality, since these axes connect central and compact areas with more peripheral and spread out areas and, therefore, with higher and lower concentration of activity, respectively. NY is an exception since it maintains a homogenous concentration of urban activity in practically the entire axis, with the extreme south, Lower Manhattan standing out, where the city's financial center is located.

This aforementioned trend is confirmed with the analysis of activity diversity (Figure 12). The central areas have a higher diversity than the extremes, with the exception of NY which has a high diversity along the whole axis.

The PA and LO axes are the least diverse, with cells that gather between 4 and 6 activities on average. It also stands out on how the diversity drops considerably around the large parks.

Finally, areas with a certain specialization have been detected, whose main activity rarely accepts another type of use, for example, the case of the financial areas in LO or the university campuses of MX and BA (Figure 13).

VI. DISCUSSION

Among the most important challenges that the metropolitan areas present is guaranteeing the sustainability of the built environment in all its dimensions through the design of governance strategies that respond, both to a timely and current diagnosis, and to the needs of the citizens.

Attending the urban complexity and the distribution of uses in the territory, starting from evaluating the density and diversity of economic and urban activities at a metropolitan scale, directly affects the public space

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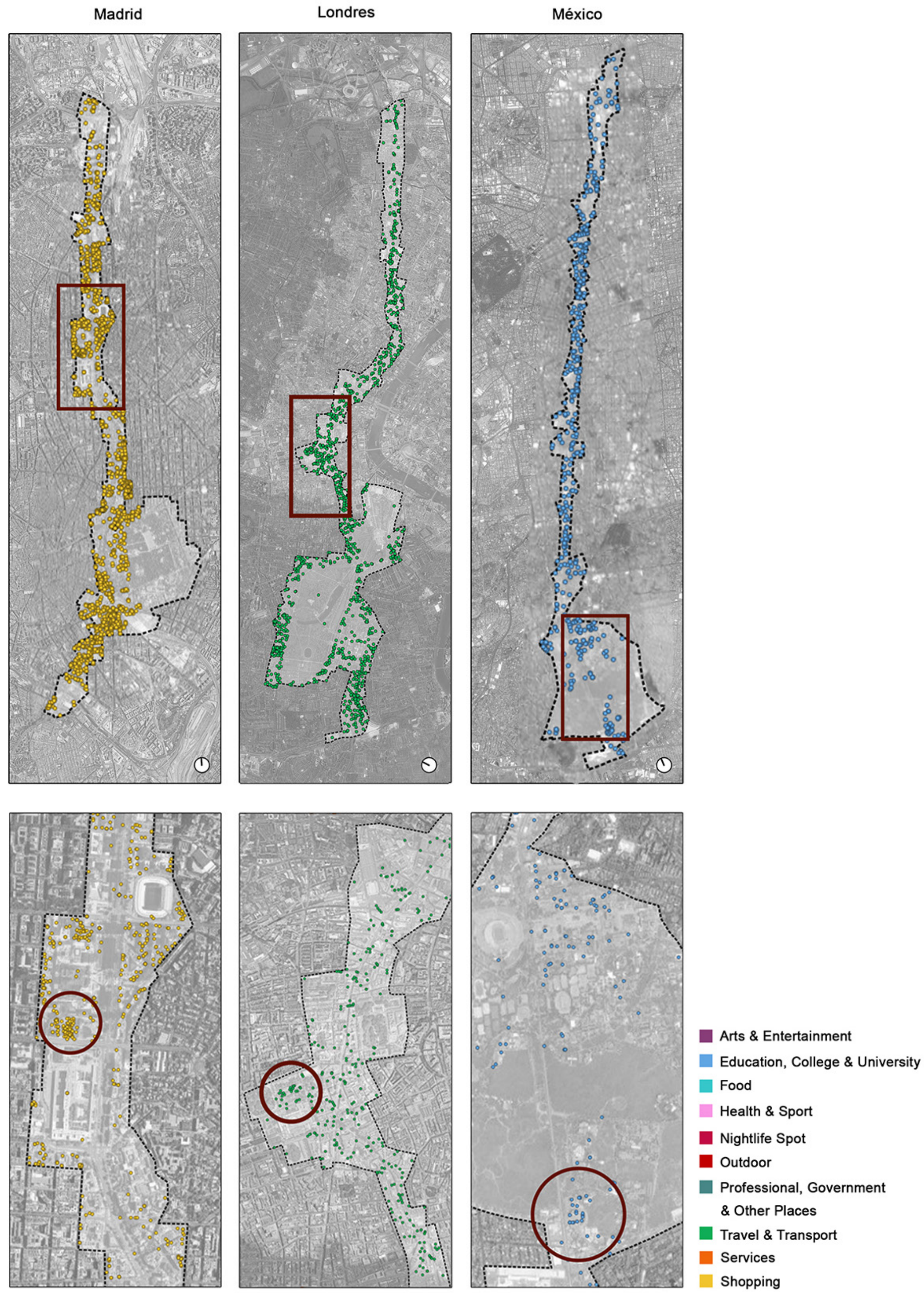

Figure 13. Visualization of data by categories. Source: Authors.

social use at a human scale (AEUBAEUB, 2015, p.133). However, obtaining updated data for this type of detailed diagnoses implies an important challenge (da Cruz et al., 2020). This study faces this difficulty, using data from the Google Places social network and proposes a general grouping of urban activities in ten categories. Nevertheless, it could all consider a second level of grouping by tag or type of activity by cell, allowing a greater granularity for specialization diagnoses and/or lack of establishments and services of a given sector. Likewise, research that addresses matters related with the perception and urban vitality would be benefitted from this type of detailed analysis. For example, it has been shown that, although there is a good mixture of activity in the case of the MX axes, it is necessary to reevaluate the amount and proximity of these, considering the population density to guarantee a correct distribution and balance that promotes the self-containment and functional self-sufficiency of the area (AEUBAEUB, 2015, p.229). Moreover, it is this axis out of the six analyzed, where commercial and food activities dominate, activities that provide a good amount of information and sensorial stimuli to the passersby through their "soft facades" (Gehl & Svarre, 2013, p.77), unlike the NY axis, where the Health and Sport category is greater than the number of commercial establishments. Another consideration that emerges from and is related to the use of the public space would be crime prevention through urban design – CPTED – *Crime Prevention Through Environmental Design* – and self-surveillance by guaranteeing the passing through and recurrent stay of people in the urban space (Newman, 1972). For example, in the MX axis, the supply of activities related to nightlife and arts and entertainment are negligible in comparison with the case of PA.

Other matters related to land uses and its morphology with the urban activities they hold are also shown. In this sense, a large scale urban green space is identified in all the cases alongside the axis, around which the diversity of activities tends to drop. Likewise, although predictable, since in the European and American city, the form and role are interrelated matters (Hillier, 1996, 0.43), the results show a clear relationship between the predominant type of activities of an area and its morphology, being able to confirm that certain categories of economic activities have spread in areas whose physical structure and makeup allow it. For example, in central urban fabrics a greater presence of activities related with restaurants or shops close to the ground floor and professional services on higher floors is identified, while in the periphery areas, large facilities like universities, hospitals or shopping centers are located, like the university campus of UNAM in Mexico or La Paz Hospital in Madrid.

VII. CONCLUSIONS

The metropolitan axes, especially those that cross the urban center, represent spaces of opportunity as urban activity corridors that connect and structure the diverse sections that flow along their route. For the analysis and comparison of these metropolitan axes, just as for any study that intends on addressing the metropolitan scale, it is essential to not sidestep the lack or non-existence of databases, standardized and updated on the same recording date. In this sense, one of the more relevant contributions of this research is the methodological approach that uses the geolocated data of Google Places to functionally characterize six metropolitan axes: New York, Paris, London, Mexico City, Madrid and Barcelona. The comparison between these great structuring axes has allowed identifying similarities and differences regarding the density, diversity and patterns of localization, concentration and specialization of the economic activity.

As for the density of activities, a certain concentration is seen in the central sections and, in general, a spread in the peripheral areas. In respect to the diversity of activities, there is an important mix and complementarity of uses, even in areas whose functional imaginary is traditionally tied to very specific uses, like shopping on Rue Rivoli in Paris or entertainment on Brooklyn Avenue in New York. The European cases stand out in this aspect, benefitting from a greater mix of uses.

In general, the results ratify the hypothesis that the chosen sections are urban centrality areas since they include, to a greater or lesser extent, administrative activities, of innovation and research, of diffusion and emission, of exchange and meeting, ludic and symbolic (Terrazas, 2004, p. 253). Furthermore, the method has allowed confirming very particular matters, like, for example, that in the MX axis, with lower density of activities compared to the population density, there is a greater number of innovation and research activities, activities dense in knowledge (AEUBAEUB, 2015, p. 229), while the PA axis, which heads the list in density of activities for every 100 linear meters, it does not include records in this category.

All of the above demonstrate the potential of the Google Places social network as a source of global

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information for urban studies at a metropolitan scale, and the pertinence of running diagnostics about the offer and distribution of economic and urban activities that allow designing strategies seeking a better planning and management of the metropolis.

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