The Use of Geo-Located Photos as a Source to Assess the Landscape Perception of Locals and Tourists − Case Studies: Two Public Open Spaces in Munich, Germany

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Abstract: Geo-located photos are part of the current big data communally spread out by photo-sharing platforms such as *Flickr*. The use of this dynamic and unstructured data as a source for landscape-related disciplines is the main problem addressed in this study. Through this, it was assessed the landscape perception of locals and tourists in two public open spaces in Munich: *Olympiapark* and *Königsplatz.*

In this exploratory work, a method based on the KDD *(Knowledge Discoveries in Databases)* process was used to harvest, transform, classify and interpret the data to make it reliable, valuable and usable. The data harvesting was done by using the *Flickr API* (*Application Programmers Interface*) and by transforming and classifying the locals and tourists through a semi-automatic process of filtering. After these initial steps, a series of three analyses were performed: statistical, spatial and content.

The results of these analyses showed that the geo-located photos as a source to assess the landscape perception proved to be useful and reliable, due to being able to obtain much data within a short period, and because results from the different analysis were consistent. At the same time, the methods and tools utilized to transform and analyze the data were significant in the process.

The landscape perception of locals and tourists of both case studies presented more similarities than differences and some characteristics of the space influenced this perception, making the extracted information valuable and usable for landscape-related disciplines.

Keywords: Landscape perception assessment, geo-located social media, spatial-analysis, content-analysis, data visualization, Flickr

1   Introduction

Nowadays people are generating more data than ever before. Most of the data is captured, shared and communally interpreted through the geo-located social media. This situation gives the opportunity to know more about users' opinions and perceptions about the places where they live or visit, transforming human beings into potential "sensors" who process and interpret what they feel and think, in addition, to localizing the information and spread it globally through internet. (CIUCARELLI et al. 2014).

Zook and Graham (2007) identified, "that traditional methods for registering users' perceptions and activities in cities, such as surveys and ethnographic reports are becoming inadequate to meet our contemporary society's need for information because they require a considerable amount of resources in terms of time and money and because they are often only tied to a specific and limited time (the period of investigation)" (CIUCARELLI et al. 2014,

6). Given this, new methods and technologies to capture, measure and visualize these perceptions have started to be implemented.

Based on the hypothesis that using geo-located photos from social media as a source, or as a way of crowdsourcing, is helpful to provide information for landscape-related disciplines; this study aims to investigate possible ways on how to capture, interpret and visualize data from the photo-sharing platform *Flikr* in this case.

A common meeting point for tourists and locals are public open spaces, where both groups get together, use the space and share much information online. For this reason, using this spatial typology as a case study for registering and analyzing users' perceptions, may offer useful information about these two groups of people.

By using software such as *ArcGIS* and a semi-automatic process of filtering to analyze and visualize the captured data, it was expected to recognize some perceptual and spatial patterns between the two selected groups in two different public open spaces: a modern/contemporary park, and a historic square. The chosen places in Munich were *Olympiapark* and *Königsplatz* respectively.

The first study case, *Olympiapark*, is a city-wide significant public open space in the north of Munich built at the end of the 60's beginnings of the 70's of the XX Century with an area of 160ha. This park integrates artificial elements, such as sports facilities, a tower and various kinds of recreational areas and natural elements, such as meadows, trees and water bodies.

The second study case is the *Königsplatz*, a historic square in the city center built at the beginning of the XIX century with an area of 4,6ha where there are three historic buildings: one main gate and two museums.

2   Methods

In this exploratory work, an adapted method based on the *KDD (Knowledge Discoveries in Databases)*, worked by (FAYYAD et al. 1996) was used as a leading guide in the process of harvesting, transforming, classifying and interpreting the data, as Fig. 1 shows. The data was harvested by using the *Flickr API (Application Programmers Interface)* during the years 2015 and 2016 and by transforming and classifying users into locals and tourists through a semi-automatic process of filtering.

The classification between tourists and locals from raw geo-social data has been mainly done by using two different methods in previous investigations.

The first one, used by (GARCÍA-PALOMARES et al. 2015), determines whether the photographer is a local or a tourist based on the period of time when the photos were taken. If this period exceeded more than one month, then it is assumed that the photos were taken by a local. On the contrary, if the period was shorter than one month, the photos are attributed to a tourist. This research proved to be very consistent with the results, although not being hundred percent accurate, as the authors argued.

Some disadvantages are that, for example, tourists who visit the city for more than one month or two times in different months could be wrongly classified as locals, in the same way as a local that just takes one photo or uploads very few, could also be wrongly classified as a tourist. Nevertheless, regarding public open spaces, it is not very likely that a tourist will visit

the same place twice, bearing in mind that usually, tourists tend to see many places in a short period. At the same time, it is probable that a local may visit the public open space several times.

The second method is by getting the "*owner_location*" from the *Flickr API* of each user. This method was used by (VAN DER DRIFT 2015). However, there are also some disadvantages in this method. Firstly, to get this information, a very time-consuming search in *Flickr API* is required. Another disadvantage is that not all photographers have a location in their Flickr profile.

For this study, the first method was used and then the results were tested by selecting a random sample of users classified as tourists and locals through this method. This information was proved in a further step by searching the location of each user from the *Flickr API,* according to the second method.
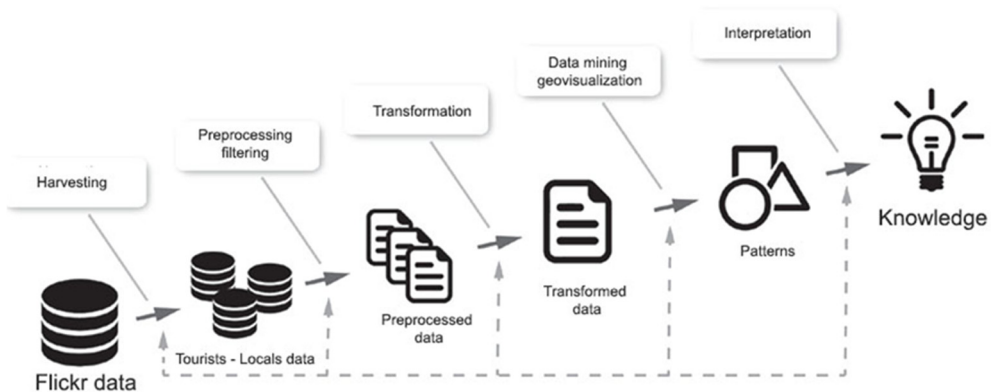

Fig. 1:   Knowledge Discovery in Databases (Graphic adapted from Van der Drift 2015, 3, and Fayyad 1996, 41)

After these initial steps, a series of three analyses were performed (see Fig. 2). First, the data gathered and classified by locals and tourists as mentioned was statistically analyzed. Second, as it was done by (GARCÍA-PALOMARES et al. 2015), through a spatial-analysis by using *ArcGIS* clustering methods, some "*hotspots*" and density maps of the location of the photos were identified. Additionally, with this information, it was possible, through the dates when the photos were taken, to detect temporal patterns within a year.

Lastly, a content-analysis was performed by using a random sample of the 10 % of the harvested photos from 2016 for both types of users and study cases. This analysis, as HALL & VALENTINE 2005, KOLBE & BURNETT 1991 mention, is an observational research method to systematically evaluate the symbolic content of different ways of communication (Cited by DONAIRE et al. 2014, 29).

In this phase, the photos were categorized according to their main natural and human-made features and the relationships between them. Several investigations have been studied the people's landscape preferences and investigations such as (YANG & KAPLAN 1990, YANG & BROWN 1992), (BUIJS et al. 2009) among others, have related these preferences to landscape styles and their elements.

Similarly, an analysis of the different ways of focusing the photos was done to know the photographers' gaze. As (DONAIRE et al. 2014) also developed, the purpose of this analysis is to determine not only what people look at but also how do they look at it. Therefore, four categories, from the mentioned source, were taken: Space-scenery (Big long shot. Focus on the entire scene), Element in context (Long shot. Focus on an element with its context around), Element (Full shot. Element occupies the entire image), and Fragment (Close-up). After having the results, a two-sample t-test was done to validate them.
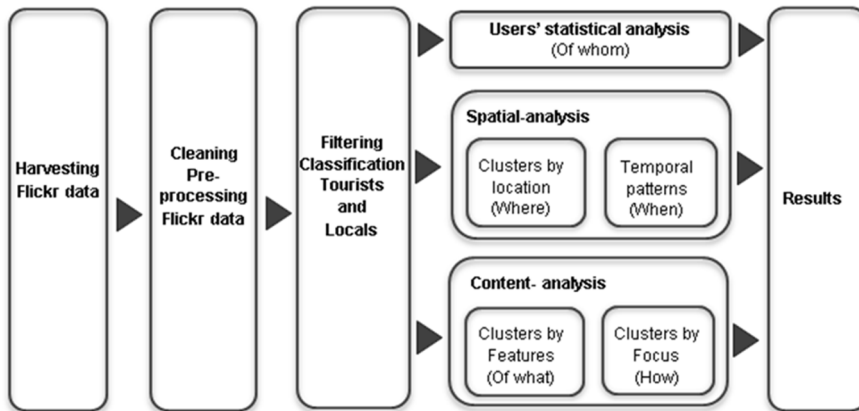

Fig. 2: Methodology and stages (Graphic adapted from Van der Drift 2015, 9 and own elaboration)

3   Results

The compiled results of the analyses mentioned above showed that there were some identifiable patterns, hotspots/coldspots and characteristics in the perception of locals and tourists when visiting the *Olympiapark* and the *Königsplatz*. It was detected that these features perceived by the users are related to the way people can access in the public open space, as well as how the place is related to its right urban context. Additionally, some landscape elements were preferred over others, as well as some combination of these elements over others.

Some of the primary outcomes from these three analyses revealed that:

- The photos taken by locals and tourists showed similar spatial patterns, although the ones coming from locals presented a higher spatial dispersion than the ones from tourists which were more concentrated in certain spots. In Figs. 3 and 4 the case of the *Olympiapark* can be seen, where the areas in red represent the highest concentration of photos, the orange and yellow areas represent an intermediate density and the green areas the lowest density respectively. Single dots throughout the place indicates different grades of dispersion.

- Most of the photos in *Olympiapark* were taken in the north part of the park, and a series of hotspots towards neighbor "attractors" such as the BMW pavilion and museum, were identified.

- The "coldspots" of the *Olympiapark* are located in the green area at the south side of the park. These places were far from the main entrances, the facilities, and the characteristic elements or the park.
- The "coldspots" of the *Königsplatz* were located in the green areas around the buildings and in the areas located far from the main street that crosses the square (See Fig. 5, 6).
- The most important features and attributes within the *Olympiapark*, both for locals and tourists, were the singular buildings and the combination of these with other elements such as water and vegetation (trees, lawn, among others), how can be seen in Fig. 7.
- Having different viewpoints and angles to see the public open spaces, changes the way people perceive them. This diversity of viewpoints can be observed in the *Olympiapark*, where photos from different heights and positions were taken, whereas in *Königsplatz* the photos focused more on the elements and details (See Figs. 8, 9).
- In *Königsplatz*, the most important features and attributes perceived by both locals and tourists were the buildings themselves. The photos did not show that people were interested in the spatial configuration of the entire open space, but the photos captured each building with an open space around and some details.
- The photos taken by the locals were more detailed than the ones taken by tourists. This level of detail can be probably justified by the fact that the locals may spend more time in these public spaces when compared to the tourists, who usually take photos more related to general views.
- It might be interpreted that, between Olympiapark and Königsplatz, both locals and tourists perceived more visually attractive the Olympiapark. The Königsplatz registered a low number of photos in comparison to the *Olympiapark*, although the square, mainly due to its historical value, is one of the most important places in Munich. Additionally, the location of the square, very near to the old town, does not appear to help to improve its popularity among visitors.

In both case studies, locals took more photos per user than tourists. One possible reason for this could be the time-availability and the better understanding that locals have of these places. Nevertheless, there were many more tourists than locals, within a range of approximately 73 % to 82 % of tourists and 26 % to 18 % of locals in both years, and therefore, there were more photos from tourists than from locals, as Table 1 indicates. These numbers showed that in general more data is shared online when users take on the role of a tourist.

Table 1: Results in numbers. Own elaboration.

Public open space-year	Olympiapark-2015	Olympiapark-2016	Time trend	Königsplatz-2015	Königsplatz-2016	Time trend
% Locals (users)	17,8	22,4	▲	19,8	26,6	▲
% Tourists (users)	82,2	77,6	▼	80,2	73,4	▼
% Locals (photos)	35,3	32,7	▽	29,7	33,0	△
% Tourists (photos)	64,7	67,3	△	70,3	67,0	▽
Average Photos/Locals	18,4	15,0	▽	8,7	4,8	▽
Average Photos/Tourists	7,3	8,9	△	5,1	3,5	▽

"Attractor" zone

Hard zone

Water zone

Green *"soft"* zone

Border zone

Figs. 3, 4: Results of the spatial-analysis of *Olympiapark*'s case. Density of photos 2016 (Above: Tourists: Below: Locals). Own elaboration (ArcGIS).
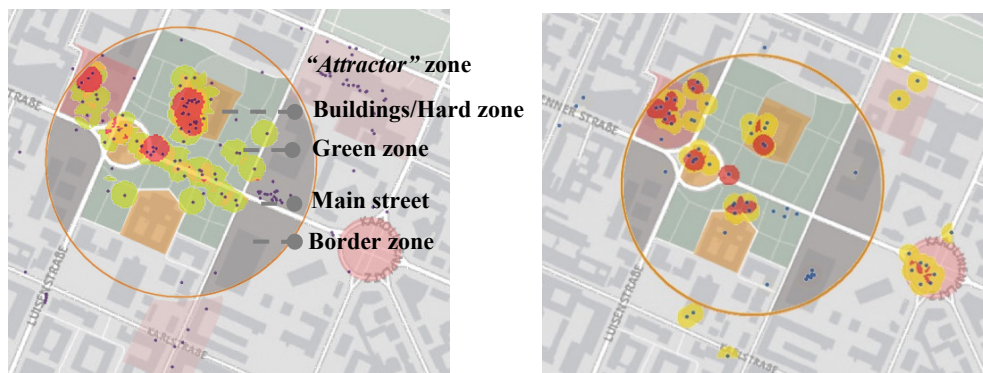
Figs. 5, 6: Results of the spatial-analysis of *Königsplatz'* case. Density of photos 2016 (Left: Tourists: Right: Locals). Own elaboration (ArcGIS).
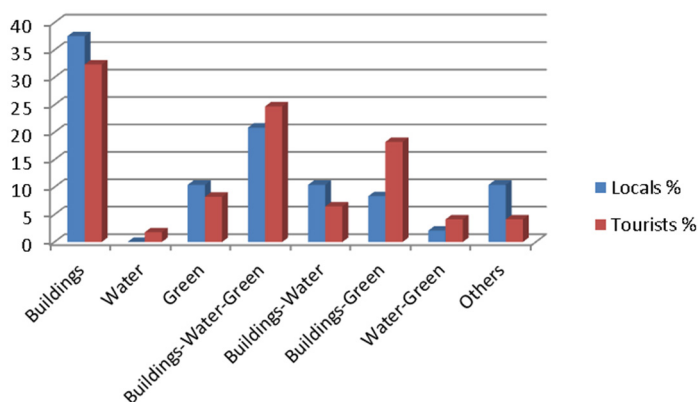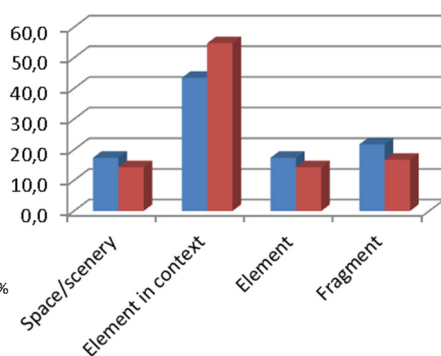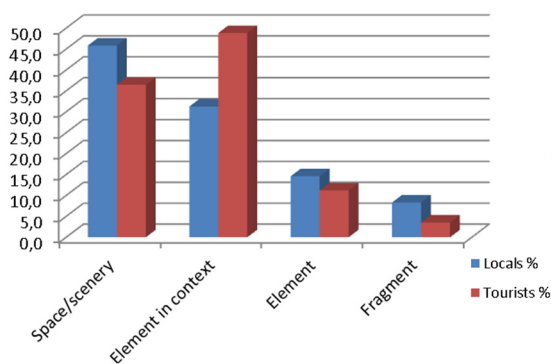

Fig. 7:
Results of the content-analysis of *Olympiapark* (Main categories found). Own elaboration.

Figs. 8, 9: Results of the content-analysis (Different focuses) of *Olympiapark*, (left) and *Königsplatz* (right). Own elaboration.

4   Conclusions

The use of geo-located photos from social media as a source to assess the landscape perception of locals and tourists in two public open spaces in Munich, in this case from photo-sharing platform *Flickr*, demonstrated to be useful and reliable. Mainly because it was easy to get much data within a short period, and because results from the different analysis were consistent, this would hardly be possible when obtaining this information just on site and by using traditional methods. However, it was identified that the reliability and validity of this data depend not only on the source itself but also on the methods and tools that are implemented to filter, analyze and transform this data.

A combined spatial and content analysis proved to be more accurate than doing just only one of them. The main reason is that sometimes the location of a photo is not very precise or could even be entirely wrong. Knowing the content of a photo might help to avoid these type of errors; in the same way, the location of a photo does not always indicate that its content fits with the exact place, since the target of the photo and the GPS coordinates of the camera may not be the same. That is why the combination of both analyses can be used to complement and verify the information obtained.

The results of these analyses showed that the geo-located photos as a source and the methods and tools used to process, transform and interpret them proved to be valuable and usable for assessing the landscape perception. Through this, it was possible to know information such as:

- The most visited parts of both public open spaces, the hotspots/coldspots, the most and least attractive "aesthetically" and "visually" spots.
- The images that people (users) attach and relate to the places.
- The time trends and temporal patterns during a year.
- The architectural/landscape elements that people like and prefer as well as, the relationships between these elements.
- The photographer's gaze (Level of detail in the photos).

5   Discussion and Recommendations

The results and conclusion of this study allow landscape-related disciplines such as planning, design, monitoring, and others, not only to get valuable information of a particular place but also to analyze and take decisions on it. At the same time, it recognizes that people's online shared perceptions and experiences as part of more inclusive and participatory decision-making processes for future interventions, both in public open spaces and in a broader urban, landscape context. However, some shortcomings were also identified in this study, such as the lack of information found from local users as well as the need of more automatization through different software for managing such amounts of data and proving more their reliability.

It might be challenging to do this landscape perception assessment in a non-touristic place, or where not so many photos were taken. Nevertheless, it can be said, that the absence of photos, for example, in a square or any urban space could indicate that perhaps the place is

not so visited, that there are security problems, or it is not attractive enough to visitors. Nowadays, with the use of smartphones and photo-sharing platforms, there is a low probability of not being able to find photos of a particular place online.

It was also noticed the need to complement these outcomes with some other sources and methods, for example, extracting the comments of people from the photos, which could be very useful to know the users' opinions. Another example might be to combine the data from different social media to get more information and probably more demographic profiles according to the type of social network used.

In the same way, it would be worthwhile to combine this source of data retrieved from social media, with data from the site by performing, for instance, a behavioral mapping. Both methods have different scopes and purposes and, being present physically in the place when analyzing, it can provide more information, mainly when this is coming from locals.

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