

# **Comparing and Contrasting Place-Based Activity Patterns** Within & Between Montreal & Toronto

## BACKGROUND

We are creatures of habit. The times of day and days of the week that we visit certain places are patterned. For example, it could be assumed that we tend to visit restaurants in the evenings, coffee shops in the mornings, and bars on weekends. Each **point of interest** (POI) in a city (restaurant, bar, park, etc.) has its own temporal signature revealing the times of day and days of the week when it is most popular [4][3][5]. Little research has been done to investigate the variability of human activity within and between cities, but using geosocial data from Google Places and Foursquare, this can be studied through the temporal signatures of the places we visit.

Foursquare is a search and discovery app which displays personalized recommendations of places to visit in a user's area based on time of day and user history



Example of a temporal signature for one day, binned by hour, from [4]

## **OBJECTIVES**

Investigate the spatial and temporal variability in activities, proxied by the places we visit, within and between Toronto and Montreal

- . Are the temporal signatures of place types significantly different between the two cities? How different?
- 2. How does the popularity of place types change throughout the day and week on the neighborhood level within and between cities?
- 3. How does the popularity of place types within neighborhoods compare to the city overall?

## METHODOLOGY

Points of interest were collected for both Montreal and Toronto using the Google Places and Foursquare API's [1][2]. Foursquare provided points with a category, while Google provided points with 168 popularity values (one value for each hour of the week). Each set of 168 values was treated as a temporal signature. Each point was recategorized into 1 of 7 broader categories (below right). Data analysis was done in R studio [7], spatial analysis and maps were completed with GIS software [6]



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Category	P - value	Significant α = 0.05	Cosine similarity
Restaurant	0.0137*	Yes	0.984
Coffee Shop	0.4806	No	0.989
Art & Museum	0.3326	No	0.956
Nightlife	0.9405	No	0.969
Groceries	0.0644	No	0.994
Outdoor & Rec.	0.0621	No	0.991
Spiritual	0.0361*	Yes	0.931

Figure 2. Weekly temporal signatures for points of interest in all 7 categories. In both cities, Saturday and Sunday midday have highest popularity for art & museum, coffee shop, and grocery places. Nightlife is most popular Friday and Saturday early morning and late night. Outdoor and rec has highest popularity on Wednesday in Montreal and the weekend in Toronto. Restaurants have 2 popularity peaks, around midday and in the evening – they are most popular on Friday and Saturday. Spiritual places are most popular on Sundays.

Table 1. Results of the Wilcoxon rank sum test for each category. Only restaurants and spiritual places have significantly different temporal signatures between cities. Based on cosine similarity, the cities are most similar in grocery, and outdoor and rec places, and least similar in the spiritual category

## Tuesday vs Saturday



Figure 3. Maps showing how neighborhood popularity of 2 randomly selected place types changes between the week (Tuesday 9pm) and the weekend (Saturday 9pm) across both cities. For restaurants, popularity is notably higher on the weekend in both cities, and the highest popularity values are found in Toronto. For coffee shops, popularity gets slightly higher on the weekend. Increases in popularity are not uniform, rather they are variable across distinct areas.

Figure 4. Maps showing how similar the weekly popularity of place types within neighborhoods is to the overall city, demonstrating which neighborhoods are most **representative of Montreal and Toronto.** A = coffee shops, B = restaurants C = art & museum, D = groceries, E = spiritual, F = nightlife, G = outdoor & rec. Generally, Montreal has higher similarities in most neighborhoods for coffee shops, outdoor & rec, nightlife, and groceries. The neighborhood similarity for restaurant popularity is high and uniform across both cities. Art & museum and spiritual places are hard to evaluate due to a lack of data, but generally, in both cities, the downtown core is most representative for art & museum places, while spiritual has the lowest similarities across neighborhoods.





## **DISCUSSION & CONCLUSIONS**



- Weekly popularity of most place types is close to expected - weekends are usually most popular for activities
- Overall. Montreal are Toronto and surprisingly similar in terms of weekly activity, differing significantly in only 2 categories: restaurants and spiritual
- Montreal neighborhoods seem to have less internal diversity, with more areas being more representative of the overall city in terms of place type popularity

Limitations: for both cities, only the points falling within city neighborhood boundaries with both a Foursquare category and Google popular times data were used. Because of this subset, Toronto and Montreal data did not have equal amounts of points, Montreal points fell into 32 out of 34 neighborhoods, Toronto points fell into 139 out of 140, and not all categories were represented in every neighborhood.

## **FUTURE WORK**

The next step will be to run Geographically Weighted Regression to determine which place types contribute (and by what amount) to an increase in population for both cities. The results of this work can later be useful in applications using POI recommendation [8] and for urban planning, tourism, geo-analytics [4] and transport infrastructure.

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